CAVES AUSTRALIA

The Journal of the Australian Speleological Federation

Craybacks • Windjana Exploration
Christmas Island • Mexico Expedition

No. 208 • JUNE 2019

CAVES AUSTRALIA

Caves Australia is the Journal of the Australian Speleological Federation and is published quarterly.

Editor:
Alan Jackson
Email: alan.jackson@lmrs.com.au

Production and Advertising Manager:
Alan Jackson
Email: alan.jackson@lmrs.com.au

Proofreading:
Susan White
Greg Middleton
Ian Curtis

ASF: asf.caves.info@gmail.com
For all ASF publications:
asf.caves.sales@gmail.com
Editorial contributions are welcome!
For contributor guidelines, contact the Production Manager.

Advertising
Contact the Production Manager for commercial, caving community and classified rates. Rates range from $5 to $400 for full page mono back cover. Discounts apply for placements of 4 adverts and an up-front payment.

Issue Dates
March, June, September and December

Magazine Subscription
Caves Australia is included within ASF membership fees. Subscription to the magazine is also available to non-ASF members at $40.00 including postage within Australia for one year (four quarterly issues).

Change of address
Notify us immediately of any address changes to ensure delivery of your *Caves Australia.*

Layout and Production by
FB Design, Hobart, Tasmania

Caves Australia

No. 208 June 2019
Australian Speleological Federation
PO Box 388 • Broadway • NSW 2007 • www.caves.org.au
ABN 15 169 919 964
ISSN 1449-2601 • Registered Publication NBQ0005116

Contents

Craybacks and Lobsters 3
Subaerial Stromatolitic Stalagmites in Australian Caves
Garry K. Smith

Windjana Gorge Exploration, Kimberley WA 7
Alan Pryke

eDNA Sampling Expedition to Christmas Island, 2018 13
Brett Wiltshire

Beyond the Sump Expedition 2018 17
Return to the Cueva de la Peña Colorada
Andreas Klocker with input from Adam Haydock, Alejandra Mendoza, Chris Jewell, Gilly Elor, Matt Vinzant, Teddy Garlock and Zeb Lilly

New club for Central Queensland 26
Dwayne Kersey, Kerrod Hamilton and John Kersey

Chester Shaw 26
A friend of caves and cavers at Mole Creek
Cathie Plowman

Coming Events 27

Editorial 27

STOP PRESS: Tasmania's Niggly Cave and Growling Swallet joined 27
Alan Jackson

Cover: Coral Maze Cave East, Windjana WA. Photo by Alan Pryke.

ASF Executive

President	John Cugley
Senior Vice-President	Graham Pilkington
Vice-President	Roderick Smith
Vice-President	Janine McKinnon
Vice-President	Grace Matts
General Secretary	Sarah Gilbert
Executive Secretary	Philip Maynard
Membership Secretary	Colin Tyrrell
Treasurer	Robert Kershaw

WANTED
ARTICLES FOR *CAVES AUSTRALIA!*

Whether caving, cave diving or generally just caving, *Caves Australia* readers are interested in YOUR story. It is only with YOUR contribution that we can produce a quality magazine for all to enjoy. For writing and style guidelines, contact the Editor or Production Manager.

Craybacks and Lobsters

Subaerial Stromatolitic Stalagmites in Australian Caves

Garry K. Smith
NHVSS

STALAGMITES which resemble the shape of a 'crayback' or 'lobster' have a distinctive hump ridge shape, with a characteristic layered or stepped profile, described by 'Argus' (1898) as similar to a crustacean's segments.

They are only found in partial daylight and twilight zones of caves where there is air movement, a steady supply of dripping cave water and the presence of photosynthetic cyanobacteria.

Examples can be found in NSW at Nettle Cave (Jenolan), Victoria Arch (Wombeyan) and Arch Cave (Abercrombie) (Cox 1984). Other examples have been reported in Daylight Cave (Yessabah, NSW) (Vaughn-Taylor 1991) and on the other side of Australia in 6KNI80 cave (Ning Bings, East Kimberly, WA) (B. Kershaw pers. comm.).

The nickname or colloquial term used to describe these features often becomes confusing as different terms are used at each of the three main cave areas in NSW where they are found. Terms used in historic and scientific literature include 'crayback', 'lobster', 'lobsterback' and 'crayfish-like'.

Argus' 1898 description of these uniquely-shaped stalagmites at Jenolan Caves appears to be the first instance where they are likened to a crustacean's back.

He writes, 'Other stalagmites take the form of immense lobsters…' The presence of 'craybacks' at Wombeyan was first recorded in the book *Wombeyan Caves* (James *et al.* 1982, p. 130). The study by Cox *et al.* (1989a) identified 28 similar stalagmites of various sizes in Nettle Cave, Jenolan and notes the presence of examples at Wombeyan and Abercrombie. Osborne (1991) described 'craybacks' as being abundant in the Abercrombie Arch, with the best examples located in the Hall of Terpsichore. It appeared that the more people looked, the more were being found.

However, compared to the majority of other speleothems found in caves, crayfish-like stalagmites are not common as they require specific conditions to exist. This is because the photosynthetic cyanobacteria creating them are only able to grow and flourish where there is a balance between microbial activity, sunlight, wind and rate of cave drip water (Barlow 2017). Mulec *et al.* (2007) states that, 'At present just a few examples are known where growth of speleothems is linked with biolithogenic activity of certain organisms.'

GARRY K SMITH

Sonia Taylor-Smith with crayback in Victoria Arch, Wombeyan NSW

These odd-shaped speleothems are the result of photosynthetic cyanobacteria (sometimes loosely referred to as blue-green algae) growing on the surface and between the layers of calcite crystals. In simplistic terms, they use the carbon from the hydrogen carbonate in the cave drip water and release oxygen to the atmosphere.

By reducing the carbon dioxide content of the cave drip water (particularly within the sticky mucilage layers covering their surface), the bacteria cause preferential deposition of calcium carbonate ($CaCO_3$) around their structure. In addition, any aeolian sedimentary particles landing on the damp surface are trapped and cemented

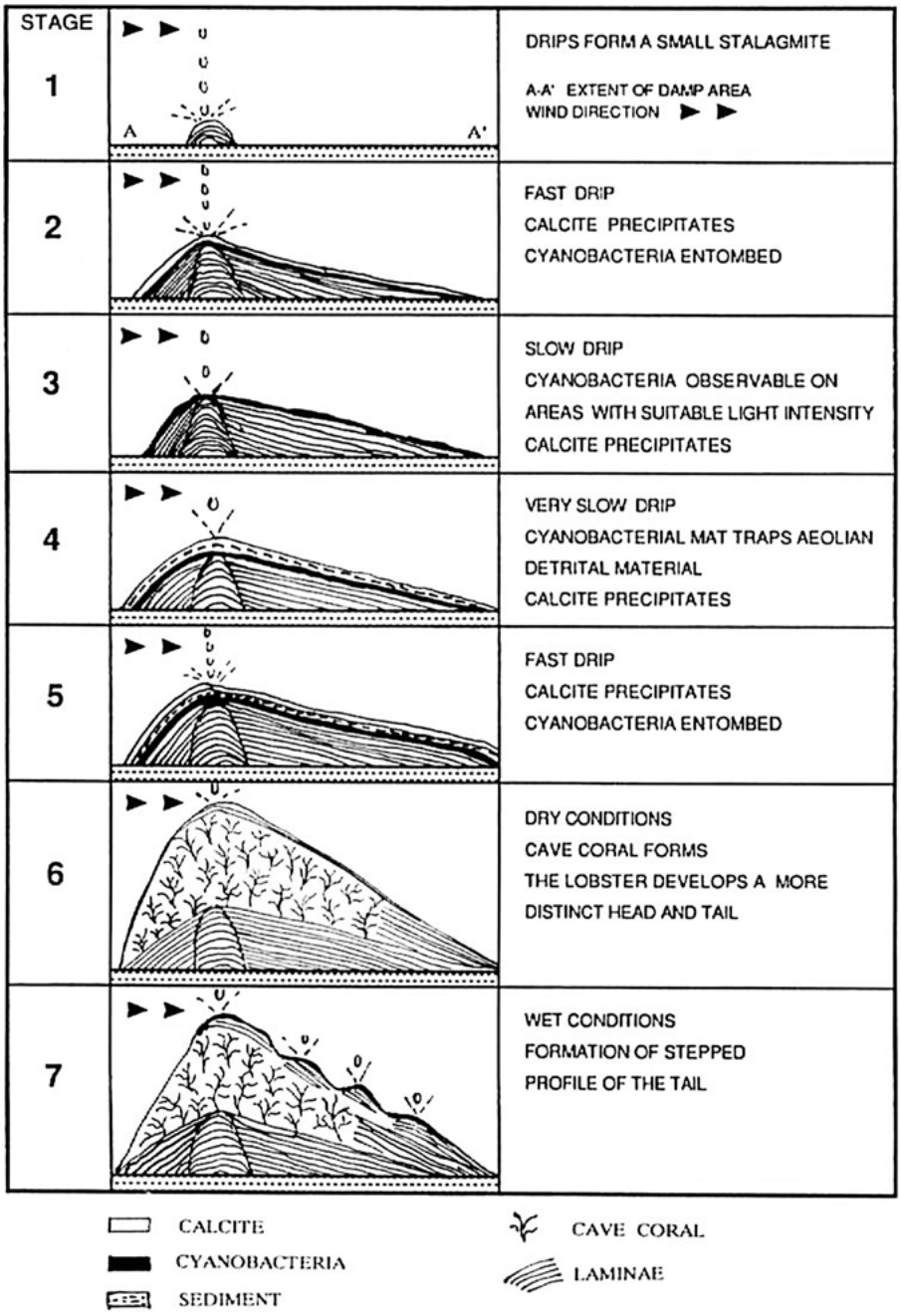


Figure 1: Proposed model for the formation of a crayfish-like stalagmite after Cox et al. *(1989a)*

together along with the precipitated $CaCO_3$.

Over time the photosynthetic bacterial colonies grow layer upon layer of calcium carbonate along with trapped aeolian sediment, while constantly reoccupying the uppermost layer to create large calcareous structures. 'They can be regarded as stromatolites within currently accepted definitions of the term' (Cox *et al.* 1989b).

ORIENTATION AND SHAPE

These distinctively shaped 'crayfish-like' stalagmites are found almost exclusively in the entrance areas of caves, where some direct or filtered daylight can penetrate, and where there is a reasonably constant supply of drip water and relatively high humidity. The airflow past the stalagmite also has a bearing on the relative shape of the stalagmite as constant breezes blow back and forth through large cave arches, causing the drip line to move along a linear axis.

This wet patch of the drip line on the cave floor is referred to as a 'footprint' and is the beginning of a crayback's creation (Osborne 1991). Cox *et al.* (1989a) provides an excellent theoretical diagram of a crayback's growth (Figure 1).

Thus, the orientation of the crayback's elongated shape usually aligns with the airflow direction through an arch. The distance the cave drip water falls and the strength of the prevailing breezes have a great influence over the length and orientation of the resulting crayback. The ratio of a crayback's length to width is a function of the distance in which the solution drips fall. The further drops fall, the more they splash to create a broader stalagmite (Gams 1981).

Cox *et al.* (1989a) determined from their study of Jenolan and Wombeyan craybacks that they are all elongated, having their long axes greater than their height. However, recent inspection of some examples at Abercrombie revealed that there are some exceptions to the physical ratio noted by Cox *et al.* (1989a).

Most have one end larger than the other, the larger end being referred to as the head and a tapering end called the tail. Cox *et al.* (1989a) found there was no relationship between direction of the most intense light (presumably the region of maximum calcite deposition) and the head orientation of the crayback.

The three main locations of craybacks in NSW, Jenolan, Wombeyan and Abercrombie are in arch or tunnel caves at the bottom of deeply incised valleys. Pockets of temperate rainforest in the bottom of the surrounding valleys help to maintain a higher humidity in the prevailing breezes which blow back and forth with changes in surface meteorological conditions.

LINKING SPELEOTHEMS TO STROMATOLITES.

You may recall the article published in *Caves Australia* 203 (Smith 2018) which provided an overview of the photosynthetic bacteria being among the earliest lifeforms on earth, which created stromatolites and thrombolites. The majority of these grew while immersed in shallow saline to hypersaline waters and, depending on location, may have been subject to brief periods out of water.

There are other examples in fresh alkaline water, such as those in the Blue Lake and at least eight sinkhole (cenote) lakes around Mount Gambier SA (Thurgate 1996). However, the photosynthetic bacteria causing the creation of craybacks in caves are only under a thin film of water and may have extended periods when they are completely dry. Cox *et al.* (1989a) states 'they are the only known stromatolites which have formed without even periodic submersion.'

But who was the first to determine that crayfish-like stalagmites in Australian caves were actually stromatolitic structures? James *et al.* (1982) identified that the unusual speleothems in Victoria Arch at Wombeyan were classed as stromatolites. Cox *et al.* (1989a), determined that the stalagmites found in Nettle Cave, Jenolan must be considered as 'stromatolites', because they fit the classification described by Aitken (1967). Aitken's description refers

GARRY K SMITH

Garry K Smith with a crayback in Arch Cave, Abercrombie NSW

to stromatolites being structures created by an organic film directly trapping or agglutinating sedimentary material or indirectly precipitating calcium carbonate as a result of the life processes of microbiota.

The quandary over a more scientific name for the 'crayback', 'lobster' and 'crayfish-like' stalagmites was finally resolved in the paper by Cox *et al.* (1989b), where they are referred to as 'Subaerial stromatolitic stalagmites.' Needless to say the debate over which nickname or colloquial terminology should be used has continued at various cave sites with the inevitable reference back to historic literature. It is proposed here that the term 'crayback' could be used as a generic nickname, instead of the other terms, which liken the 'Subaerial stromatolitic stalagmites' to a shape similar to a segmented crustacean's back.

STRUCTURE AND SCIENTIFIC VALUE

Physical analysis of sectioned crayback samples from Jenolan and Abercrombie revealed their structure to consist of alternating coralloid and laminated layers and incorporated detrital grains. Their composition was found to be primarily calcite (Cox *et al.* 1989a and Osborne 1991).

Seasonal conditions cause layering of the crayback structure, 'with solid or coralline layers deposited in wet seasons and allochthonous layers of dust, grains and animal matter deposited in dry seasons' (Cox *et al.* 1989b).

Uranium-thorium dating by mass spectrometry of a piece of cyanobacterially covered stalagmite from Nettle Cave, Jenolan, indicated that the sample was over 20,000 years old. Cox *et al.* (1989b) estimated some of the larger structures to be at least 100,000 years old. Further study of oxygen and carbon isotope data from speleothem layers and trapped organic materials could provide additional past climatic information. Due to their morphology and composition, craybacks represent a well-preserved, consistent paleoclimatic record, as they have not been exposed to intense weathering like stromatolites outside the cave environment.

CYANOBACTERIA

The bacteria creating craybacks belong to the phylum — the principal taxonomic category — of cyanobacteria also known as cyanophyta, which obtain their energy through photosynthesis and are the only photosynthetic prokaryotes able to produce oxygen. The name cyanobacteria comes from the cyan colour of the bacteria (Greek: κυανός).

'Cyanobacteria (popularly called blue-green algae) are not true algae but prokaryotes (allies of the bacteria). They do, however, carry out photosynthesis in exactly the same way as true (eukaryotic) algae' (Cox *et al.* 1989a).

Cycles of cyanobacterial activity and calcite deposition were observed on crayback stalagmites in Nettle Cave, Jenolan, by Cox *et al.* (1989a, b). Below permanent drips in dry periods, the cyanobacterial colonies were active and a deep blue-green colour. Dust and detrital material whipped up by the dry breezes were observed collecting on the colonies.

The craybacks then turned white when drip rates increased during periods of heavy and prolonged rainfall. The increased deposition of calcite partly buries the active cyanobacterial layer which is contributing to the increased calcite precipitation rate. When the drip rate slowed during drier periods, the cyanobacteria continued to divide and break through the calcite crystals to recolonise the surface of the stalagmites in a matter of weeks. Within five months the surface of the crayback stalagmites returned to a bright bluish-green.

However, in extended dry periods the surface of the stalagmites may become dry, causing the photosynthetic bacteria to become dormant, loosing most of their dark green colour and becoming pale green or grey-black.

In an in-depth study by Vardeh *et al.* (2018), comparing Jenolan and Wombeyan

GARRY K SMITH

Crayback in Nettle Cave, Jenolan NSW

GARRY K SMITH

Subaerial stromatolite stalagmite section close-up (sample at Jenolan)

craybacks, they identified 'significant differences between the microbial communities of speleothem biofilms …' within different caves, '… and between actively accreting and inactive and weathered structures.' There was dominance shifting from Chroococcales to Actinomycetales and highly desiccation-resistant and oligotrophic Rubrobacterales with decreasing water availability.

Taxonomic analysis of the surface bacteria on craybacks showed that cyanobacteria are indicators of active speleothems only, while actinobacteria are mainly indicators of inactive structures and bare rock and soil (Vardeh *et al.* 2018).

Cox (1984), when comparing scrapings of common wall algae — cyanobacterium from the entrance chambers of Spanish and Papua New Guinea caves (Cox *et al.* 1981) — and scrapings from a Jenolan 'lobster', stated: 'If … this is the alga responsible for the formation of the Lobsters, we have the interesting situation of a fairly common cave-wall alga forming rather uncommon structures — presumably when stringent environmental conditions are met.'

For further reading about other types of subaerial stromatolites, it is worth looking at *Subaerial freshwater phosphatic stromatolites in Deer Cave, Sarawak — A unique geobiological cave formation* (Lundberg and McFarlane 2011).

ACKNOWLEDGEMENT

Thank you to Dr Julia James for helpful comments regarding terminology used in historic literature.

REFERENCES

Aitken, J. D. 1967 Classification and environmental significance of cryptalgal limestones and dolomites with illustrations from the Cambrian and Ordovician of South Western Alberta. *Journal of Sedimentary Research,* 37: 1163-1178.

'Argus' 1898 *The Jenolan Caves and the Blue Mountains,* Cumberland-Argus Newspapers; Parramatta 60 pp.

Barlow E.V. 2017 Conveying the importance of stromatolites to self-guided tourists in Nettle Cave, Jenolan, NSW. *Proceedings, 17th International Congress of Speleology*, Penrith NSW pp. 129-133.

Cox, G., Benson, D. & Dwarte, D.M. 1981 Ultrastructure of a cave-wall cyanophyte - Gloeocapsa NS4. Arch. Microbiol., 130: 165-174.

Cox, G. 1984 Phototropic stalagmites at Jenolan Caves, NSW. *Helictite,* 22(2): 54-56.

Cox, G., James, J.M., Osborne R.A.L. & Leggett, K.E.A. 1989a Stromatolitic crayfish-like stalagmites. *Proceedings of the University of Bristol Spelæological Society*, 18(4): 339-358.

Cox, G., James, J.M., Leggett, K.E.A. & Osborne, R.A.L. 1989b Cyanobacterially deposited speleothems: Subaerial stromatolites. *Geomicrobiol. Journal*, 7(4): 245-252.

Dyson, J., Ellis, R. & James, J.M. (eds) 1982 *Wombeyan Caves*, Sydney Speleological Society Occasional Paper No. 8

Gams, I. 1981 Contribution to morphometrics of stalagmites. *Proceedings, VIII International Congress of Speleology, Bowling Green,* pp. 276-277.

James, J. M., Jennings J. N. & Dyson H. J. 1982 Mineral decoration and weathering of the caves [in] Dyson, J., Ellis, R. & James, J. M. (eds), Wombeyan Caves. Sydney Speleological Society Occasional Paper No. 8. pp. 121-136.

Lundberg, J. & McFarlane, D. 2011 Subaerial freshwater phosphatic stromatolites in Deer Cave, Sarawak – A unique geobiological cave formation. *Geomorphology,* 128: 57-72.

Mulec, J., Kosi, G. & Vrhovšek, D. 2007 Algae promote growth of stalagmites and stalactites in karst caves (Škocjanske Jame, Slovenia). *Carbonates Evaporites,* 22(1) Article 6.

Osborne, R.A.L. 1991 A geological review of Abercrombie Caves, *Helictite,* 29(1): 8-18.

Smith, G.K., 2018 Karsting light on stromatolites and thrombolites. *Caves Australia,* 203: 11-13.

Thurgate, M.E. 1996, The stromatolites of the cenote lakes of the Lower South East of South Australia. *Helictite*, 34(1): 17-25.

Vaughn-Taylor, K. 1991 What happened at Yessabah. *Proceedings, 18th Biennial Conference of the Australian Speleological Federation,* Margaret River W.A. pp. 108-113.

Vardeh, D.P., Woodhouse, J.N. & Neilan, B.A. 2018 Microbial diversity of speleothems in two southeast Australian limestone cave arches. *Journal of Cave and Karst Science*, 8(3): 121-132.

Windjana Gorge Exploration, Kimberley WA

Alan Pryke
SUSS

ALAN PRYKE

Windjana: Coral Maze North

DURING the July 2015 Windjana Gorge expedition (Pryke 2016), a major cave, KN73, Coral Maze was entered and as no known survey existed, the group set about systematically mapping the complex cave.

The cave had previously been entered on the 2014 expedition by Megan and Alan Pryke, who found it by following a dry surface creek to the streamsink, a large cavernous entrance. As no cave tag was found, brief exploration led to the prospect of mapping. Large easy passages led off everywhere. To get some idea of the extent of the cave, a very rough DistoX centreline survey revealed the need for a thorough survey.

The 2015 expedition quickly discovered the high cliff entrance and KN73 tag and surveying began. Two survey teams were formed, one heading west (Mark Sefton and Tina Willmore) and the other east (Megan and Alan Pryke). It soon became apparent that the cave was more complex than realised, as the name suggests, with junction after junction.

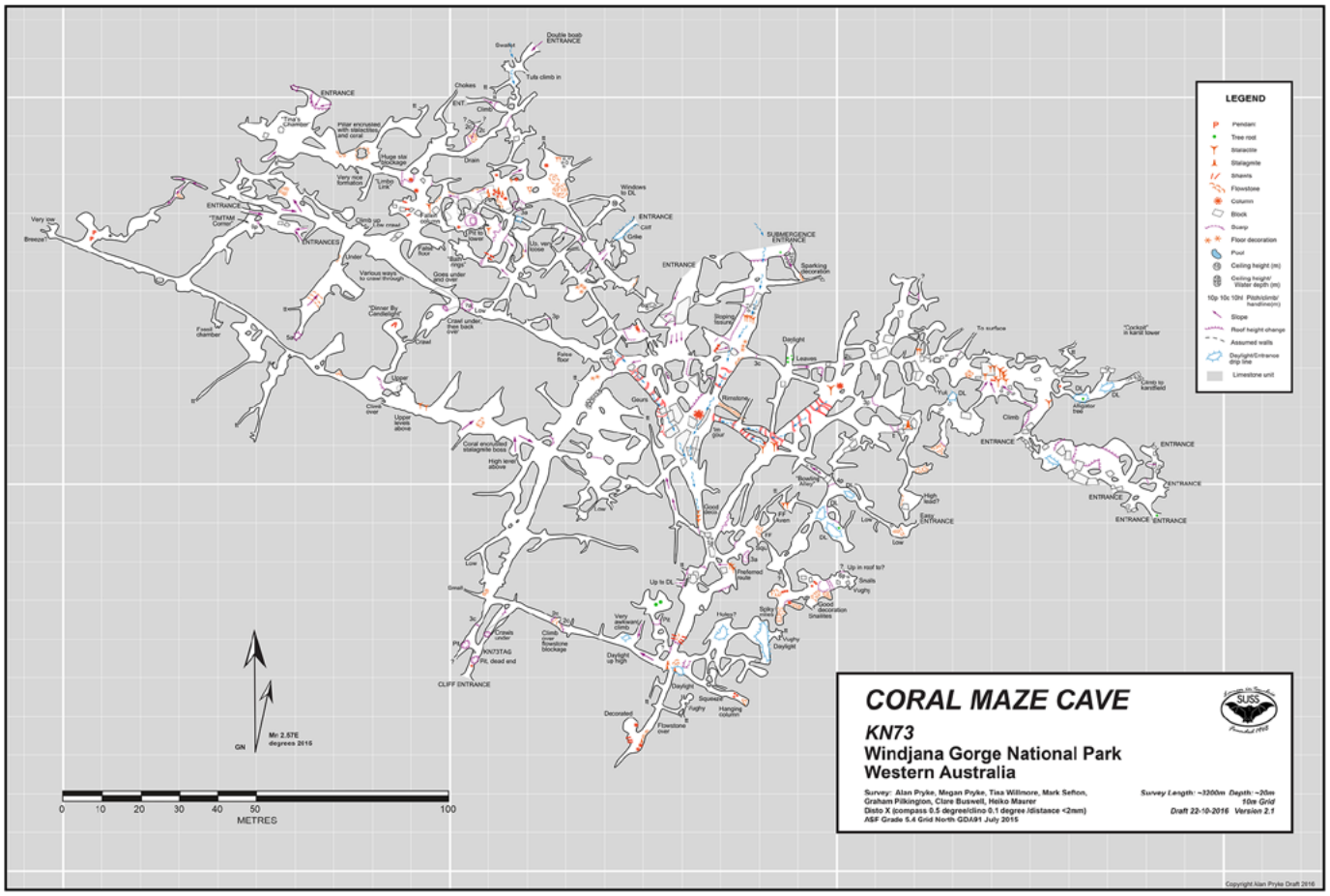
The cave collects wet season rain from the plateau and channels it towards the cliff line. Passages within the cave are generally large and horizontal, with a slight gradient towards the cliff. Large gours are common along the stream passages. As the passages approach the cliff, the nature of the cave changes, with many small passages carrying the flow into cracks in the floor. The only exit large enough to traverse is an abandoned upper level, opening up high in the cliff line.

There is no obvious single resurgence, instead many stains from cracks high on the reef limestone wall. In fact, the whole cave sits near the top of the 60 m limestone wall, suggesting some sort of aquiclude blocking vertical development.

Various parts of the cave were named, including TIMTAM Corner, which Mark translated as 'Tick Infestation Makes Tina Absolutely Miserable.'

The cave survey remained unfinished in 2015, and the 2016 expedition continued the mapping to the northwest and east. The eastern side of the cave opened out into a

***Note:** Clicking on the maps in this article will take you to a larger PDF version on the ASF website*



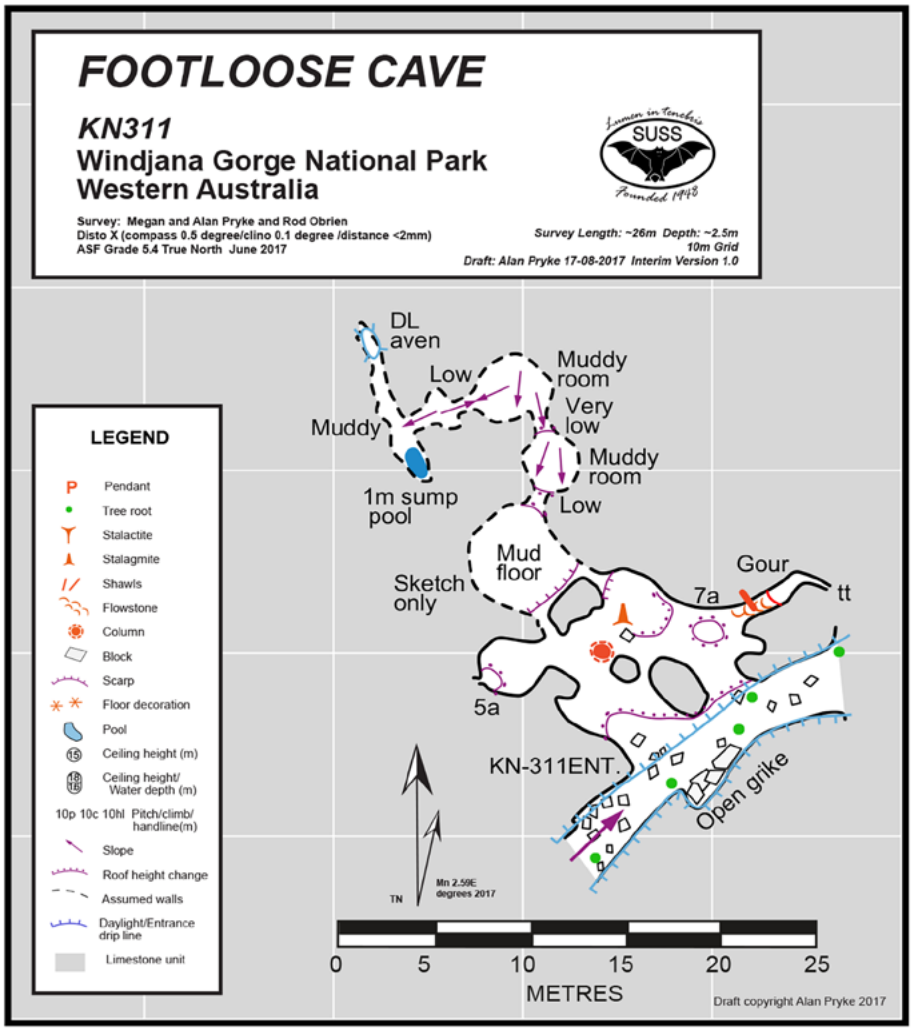
vegetated valley on the plateau, and does not seem to continue, maybe due to the aquiclude, despite the entire plateau being limestone. Rugged limestone towers dominate the landscape to the east.

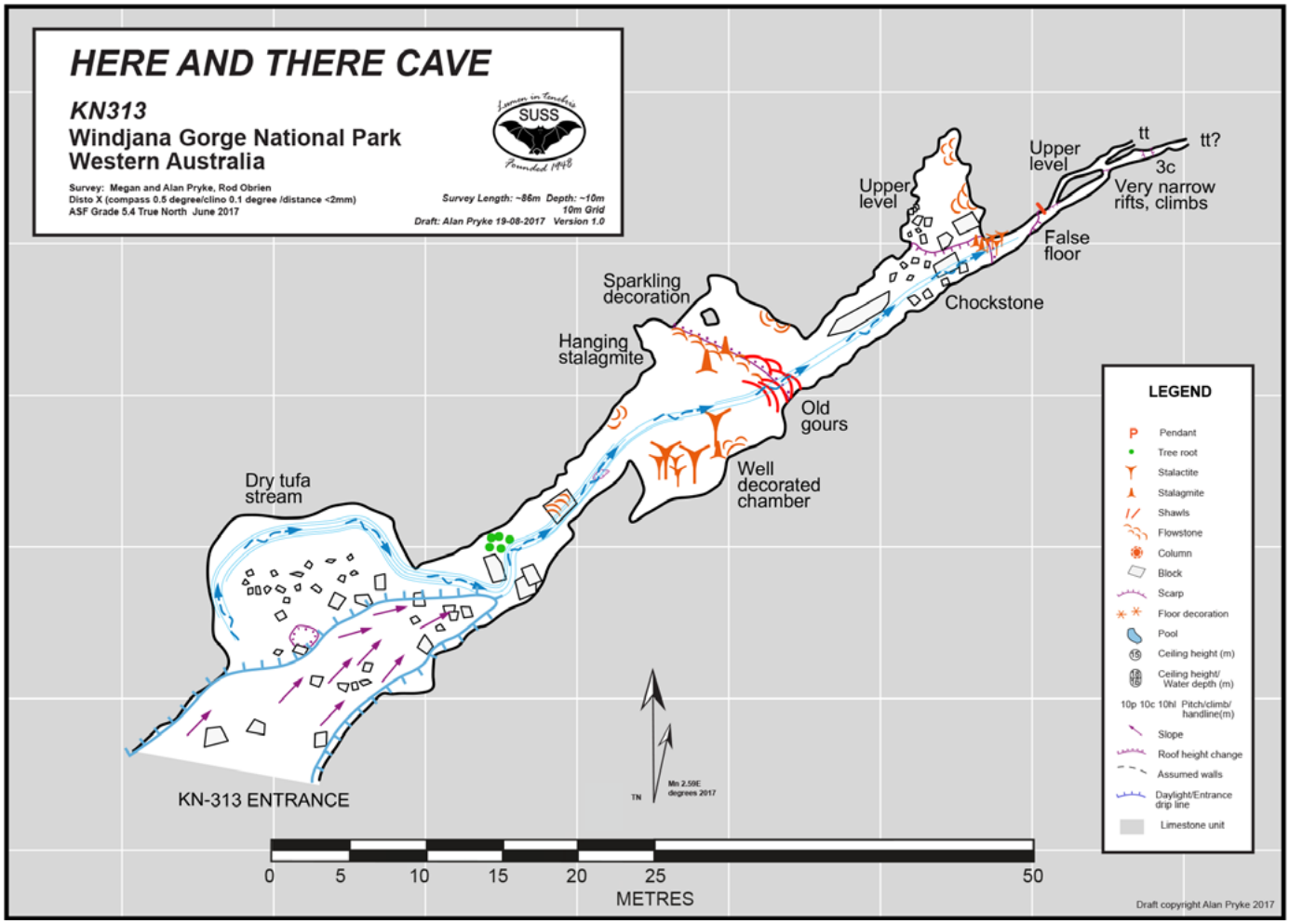
By the end of the 2016 expedition most leads in the cave had been explored and mapped. The complex passages could reveal more cave, as did Fanackapan Cave (Pryke 2016).

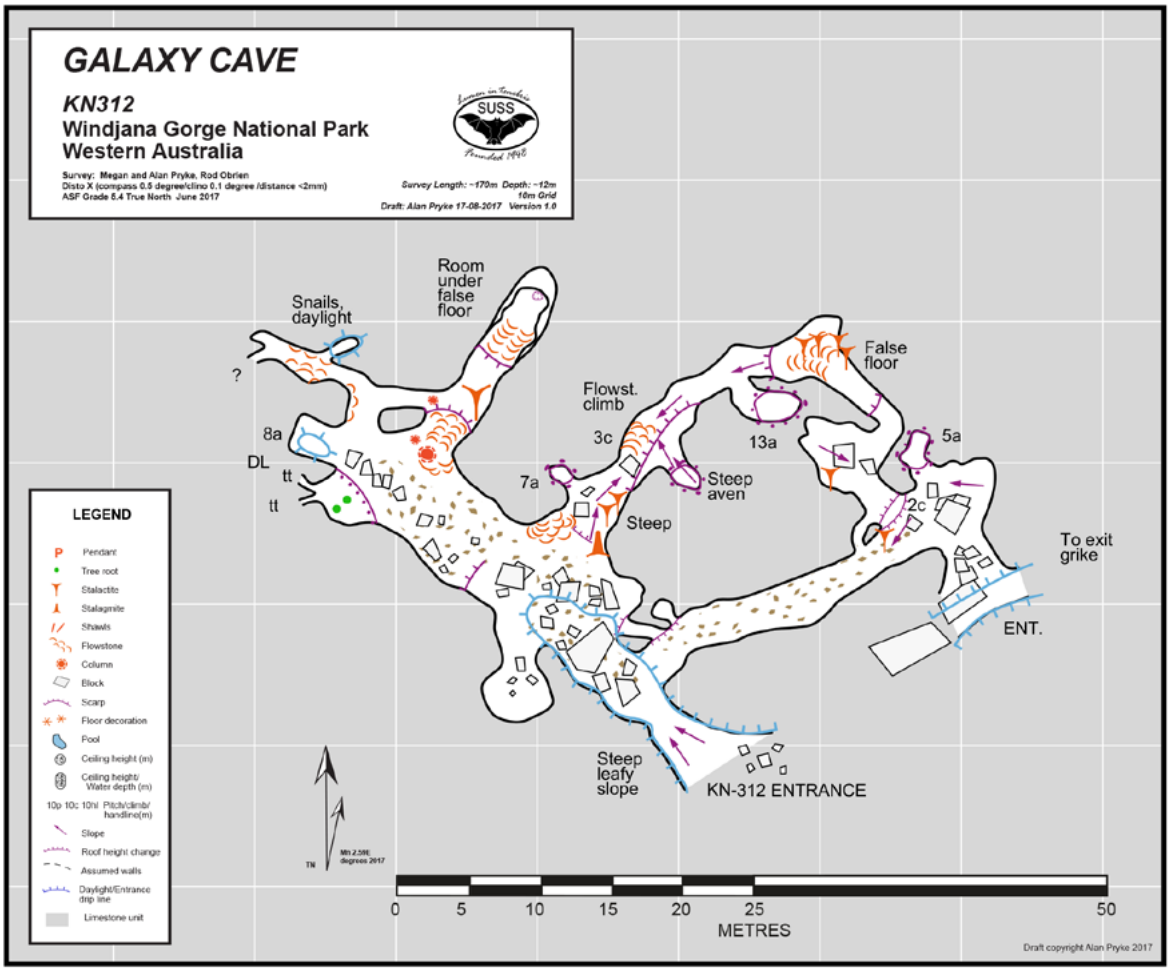
The 2017 expedition committed a lot of time to surface exploration of the limestone plateau. Extension of Fanackapan Cave continued, with the discovery of a small stream in the southeast of the cave, ending in a sump. Rod OBrien naturally thought about diving it, despite its rather small size, and its remoteness.

A new pass from the plateau was forged by Rod, which gave access to a series of smaller caves. Mark and Graham set to work mapping two small but attractive caves near the top of the pass — Anemone and Break Down caves. The latter included a spectacular series of high gours.

Meanwhile, Rod, Alan and Megan traversed a grike and discovered Footloose Cave, following the alphabetical naming scheme (Pryke 2014), a small, damp cave with several low muddy circular chambers. The survey ceased when the more substantial Galaxy Cave was discovered nearby by Alan, a large promising entrance which lead to a large dead end chamber. They then




HERE AND THERE CAVE
KN313
Windjana Gorge National Park
Western Australia
Survey: Megan and Alan Pryke, Rod Obrien
Disto X (compass 0.5 degree/clino 0.1 degree /distance <2mm)
ASF Grade 5.4 True North June 2017
Survey Length: ~86m Depth: ~10m
10m Grid
Draft: Alan Pryke 19-08-2017 Version 1.0
Upper level
tt
tt?
Upper level
3c
Very narrow rifts, climbs
False floor
Chockstone
Sparkling decoration
Hanging stalagmite
Old gours
Well decorated chamber
Dry tufa stream
KN-313 ENTRANCE
LEGEND
Pendant
Tree root
Stalactite
Stalagmite
Shawls
Flowstone
Column
Block
Scarp
Floor decoration
Pool
Ceiling height (m)
Ceiling height/ Water depth (m)
10p 10c 10hl Pitch/climb/ handline(m)
Slope
Roof height change
Assumed walls
Daylight/Entrance drip line
Limestone unit
0 5 10 15 20 25 50
METRES
Draft copyright Alan Pryke 2017


GALAXY CAVE
KN312
Windjana Gorge National Park
Western Australia
Survey: Megan and Alan Pryke, Rod Obrien
Disto X (compass 0.5 degree/clino 0.1 degree /distance <2mm)
ASF Grade 5.4 True North June 2017
Survey Length: ~170m Depth: ~12m
10m Grid
Draft: Alan Pryke 17-08-2017 Version 1.0
Room under false floor
Snails, daylight
?
8a
DL
tt
tt
Flowst. climb
3c
7a
Steep aven
Steep
13a
False floor
5a
2c
To exit grike
ENT.
Steep leafy slope
KN-312 ENTRANCE
LEGEND
Pendant
Tree root
Stalactite
Stalagmite
Shawls
Flowstone
Column
Block
Scarp
Floor decoration
Pool
Ceiling height (m)
Ceiling height/ Water depth (m)
10p 10c 10hl Pitch/climb/ handline(m)
Slope
Roof height change
Assumed walls
Daylight/Entrance drip line
Limestone unit
0 5 10 15 20 25 50
METRES
Draft copyright Alan Pryke 2017

traversed the plateau, discovering some vertical pits and Here and There Cave, a large, dry streamsink leading to a decorated chamber, followed by small cracks.

Peter and Alan explored west of Coral Maze through high karst towers with short cave sections which they nicknamed The Playground as its easy-going clear flat floors and mazy thoroughfares made 'hide and seek' inevitable. They discovered Intersection Cave in the maze, which consisted of low crawly flat floored drains. Some survey work was done, but not completed.

To avoid the heat whilst traversing the plateau, the group sheltered in a series of shaded alcoves. Some limestone rifts were explored nearby with Megan discovering a deep grike.

However, Alan discovered a good entrance opposite and two survey teams began mapping Joinery Cave, named as many entrances were found independently, and its connection with the alcoves mentioned earlier. A second survey day here finished the mapping.

On the final day of the 2017 trip, the deep grike found by Megan was explored, which revealed a large cave passage with high flowstone walls. Cursory exploration revealed limited continuation and it was named Left Right Out Cave. One more cave entrance was looked at by the team, a crumbly pitch into a dirt floored chamber left unexplored, but named Krumble Cave.

Four years of expeditions have revealed many fantastic caves in the impressive, forbidding landscape, with the promise of more to come in the future.

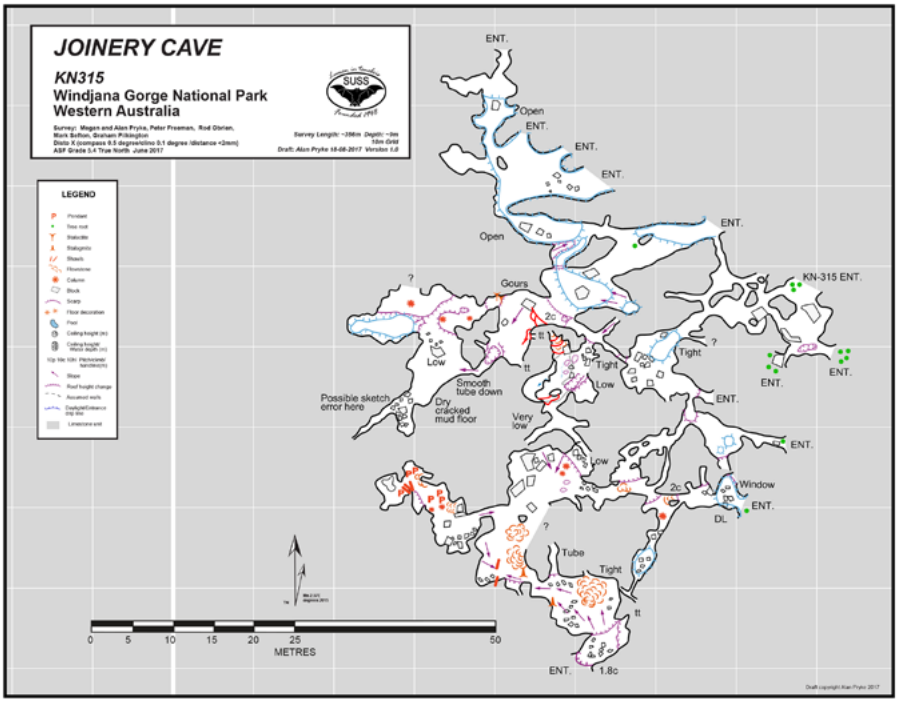
The group would like to thank WA Parks and Wildlife Senior Operations Manager Dave Woods and the Broome Parks office for issuing the necessary permit, the traditional owners — the Bunuba people — and all the staff on the ground at Windjana, including Henry Corpus, Erin and senior ranger Rod O'Donnell.

PERSONNEL

2014: Megan and Alan Pryke (SUSS)
2015: Megan and Alan Pryke, Tina Willmore (SUSS), Mark Sefton (CEGSA)
2016: Megan and Alan Pryke (SUSS), Mark Sefton, Graham Pilkington (CEGSA), Heiko Maurer, Claire Buswell (FUSSI)
2017: Megan and Alan Pryke, Rod OBrien (SUSS), Mark Sefton, Graham Pilkington (CEGSA), Rod OBrien, Peter Freeman (VSA)

REFERENCES

Pryke, A. 2014 Windjana 2014. *Caves Australia* 199: 5-7
Pryke, A. 2016 Windjana 2015. *Caves Australia* 202: 17-19



ALAN PRYKE

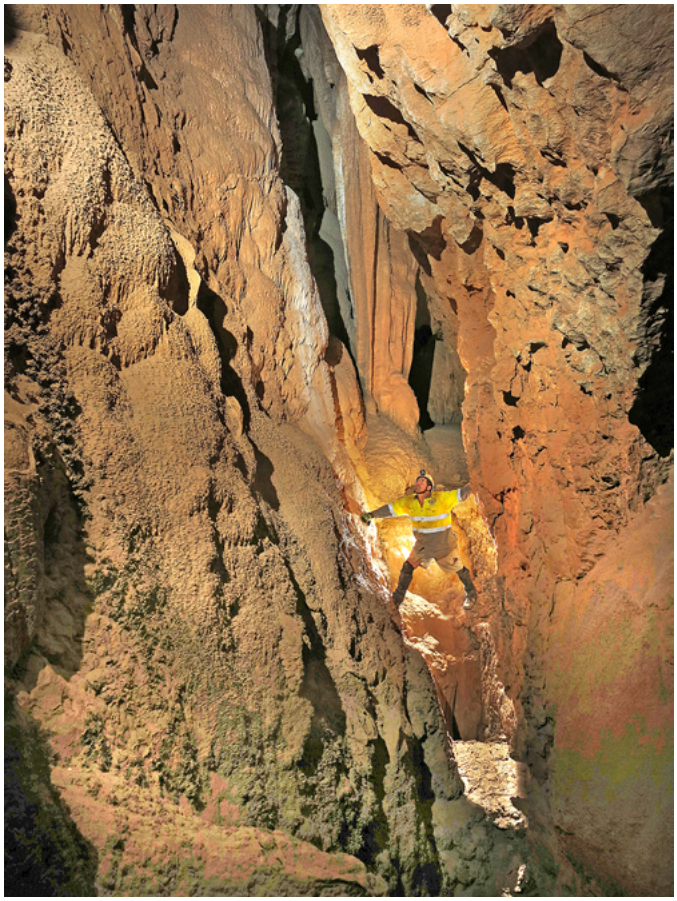
Gour in Coral Maze Cave

ALAN PRYKE

Windjana: The Wall

ALAN PRYKE

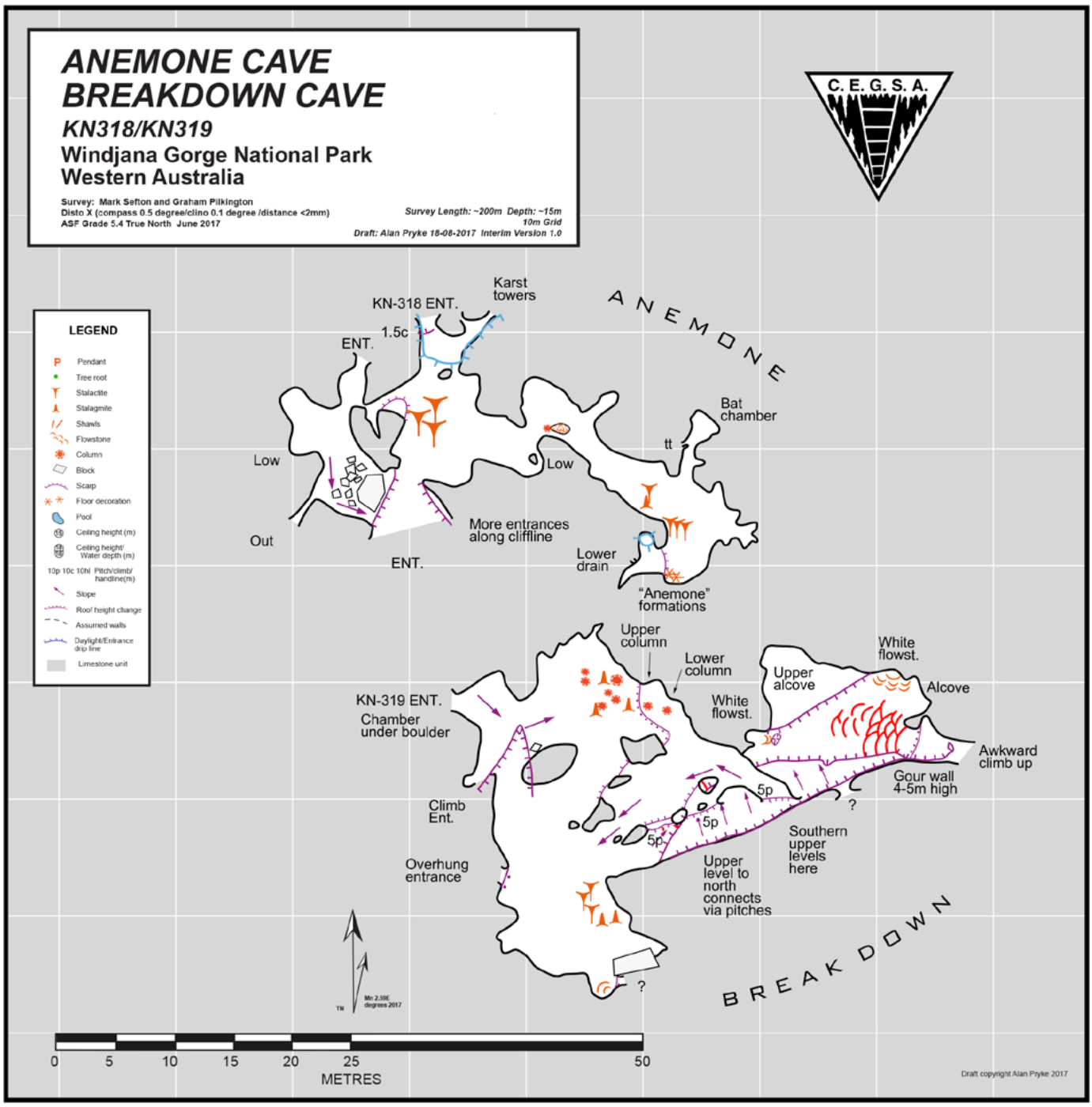
Breakdown Cave



ALAN PRYKE

L Cave 8

Windjana Gorge Exploration, Kimberley WA



eDNA Sampling Expedition to Christmas Island, 2018

Brett Wiltshire
WASG

WEIDI KOH

Drone panorama of Dolly Beach, Christmas Island

IN 2018 WASG assisted with the sampling of subterranean waters on Christmas Island for a PhD thesis involving analysis of environmental DNA.

Christmas Island is usually known by the public from the media for the immigration detention centre or the spectacular annual red crab migration but it also has some great caves and is an interesting place to visit.

The first WASG expedition was in 1987, during which 53 caves or features were recorded (Webb 1987). By the time of our visit, 140 numbered caves or features had been recorded and this expedition added eight entries, three being caves, two rock shelters and three dolines.

Our group stayed at The Pink House, a research centre run by Parks Australia. The Pink House has reptile breeding enclosures and was also being used by other researchers studying flying foxes and rats at the time of our visit.

The main source of evening entertainment was watching the local robber crab (*Birgus latro*) community; about thirty of these large creatures live around the Pink House and stage little battles with each other in the afternoons and cluster around the doors at dinnertime.

The robber crabs are also a significant feature of the caves and we found them in most caves and often far into the dark zone. These large creatures can even cling upside down on the cave roof and it is daunting to see claws that can shred coconuts right next to a tight squeeze that must be passed.

When meeting a robber crab in a tight space, a slow and confident crawl forwards will make them back away slowly. Getting too close to a robber crab results in a rapid swat with a hind leg. Luckily, they never seem to use their claws on people.

They do advance if one lies still for too long though (such as when deciding 'Will I fit through there?') and the exploration of one cave was halted because of this.

Our main challenge was to find caves with water and resist the urge to swim or explore further before the sampling work was done to prevent cross-contamination of DNA between caves.

ROD AND SUE HAMILTON

Robber crab warning sign

The water samples were carried out of the caves and filtered each day to extract the traces of DNA shed by organisms for later analysis back in Perth. Unfortunately, not every cave goes down to water, so we did some exploration to locate new caves and springs.

One of the easiest caves to find on the island is CI-001 The Grotto, which is signposted from the road. CI-001 is a beautiful clear blue pool of water under a karstic overhang.

It is a mixture of fresh water from a stream and seawater from a small blowhole entrance to the ocean at water level. The blowhole sends thunderous bursts of spray over the water pool at unexpected times, as the ocean is not visible from the pool.

We also searched in areas that had been used for phosphate mining in the past. The historic mining areas appear to be areas of tower karst with shallow excavations in every low-lying area.

The regrowth is a low, thick covering of grass and fishtail ferns that cover many little ground depressions that look like they could all be cave entrances from a distance, but we had no success in these areas.

The expedition had better luck search-

DANNY WILKINSON

Large chamber decoration

WEIDI KOH

Christmas Island coastline

ing some of the steep valleys leading into the ocean. A few caves and rock shelters were found in these.

Fortunately, the island has many springs and sampling these helped to make up for time spent exploring caves that did not reach water level.

The best-known cave on the island is CI-003 Daniel Roux Cave. Faded signs at the entry indicate the cave is closed to public access but there is no barrier to entry and the main parts of the upper section of the cave can be seen online on Australian Geographic's YouTube video https://www.youtube.com/watch?v=f6bF7aDES8Q

About 200 rungs of permanent steel ladder leads visitors down to a scenic swimming passage at the bottom of the cave. Apart from the odd stalactite spray painted pink (presumably done for navigation purposes?) the cave seems to be in surprisingly good condition — the deeper parts at least.

Some of the more accessible caves contain a surprising amount of infrastructure. CI-002 Runaway Cave, apparently named as it was used to hide from the Japanese invasion in World War II (Meek 2001), has power cable and water pipe running though the cave and an improvised shower.

Others, such as CI-005 Jedda Cave and CI-011 Grants Well have entrances that have been developed for the island's water supply.

The most significant 'new' cave of the trip was described to us by the Parks staff. In dense, swampy, mosquito-ridden jungle in the middle of the island there is a recent collapse exposing a deep solution pipe with mud and tree roots creating a

WEIDI KOH

Sea cave entrance

DANNY WILKINSON

CI-003 Daniel Roux cave upper section swiftlet guano pile

ROD AND SUE HAMILTON

Robber crab meeting

ROD HAMILTON

Curious robber crab in CI-010 Freshwater Cave

2 m wide hole above a 36 m deep vertical pipe.

The entrance had been amusingly signposted 'Free WiFi' on our arrival but the bottom of the pitch had not been reached. We entered the muddy pipe very cautiously, as a recent visit to a nearby cave had been stopped because of bad air.

Surprisingly, this was not the case with the new cave and 250 m+ of gloriously muddy streamway was mapped (CI-141 Wifi Cave).

The cave contains some interesting fossilised corals but the main highlight is the mud stalagmites. Mud and drips of water oozing through rock at the upstream extent of the cave create towers of the same shape and dimensions as clusters of stalagmites. All photographic equipment was inoperable by this point so these features remain unrecorded.

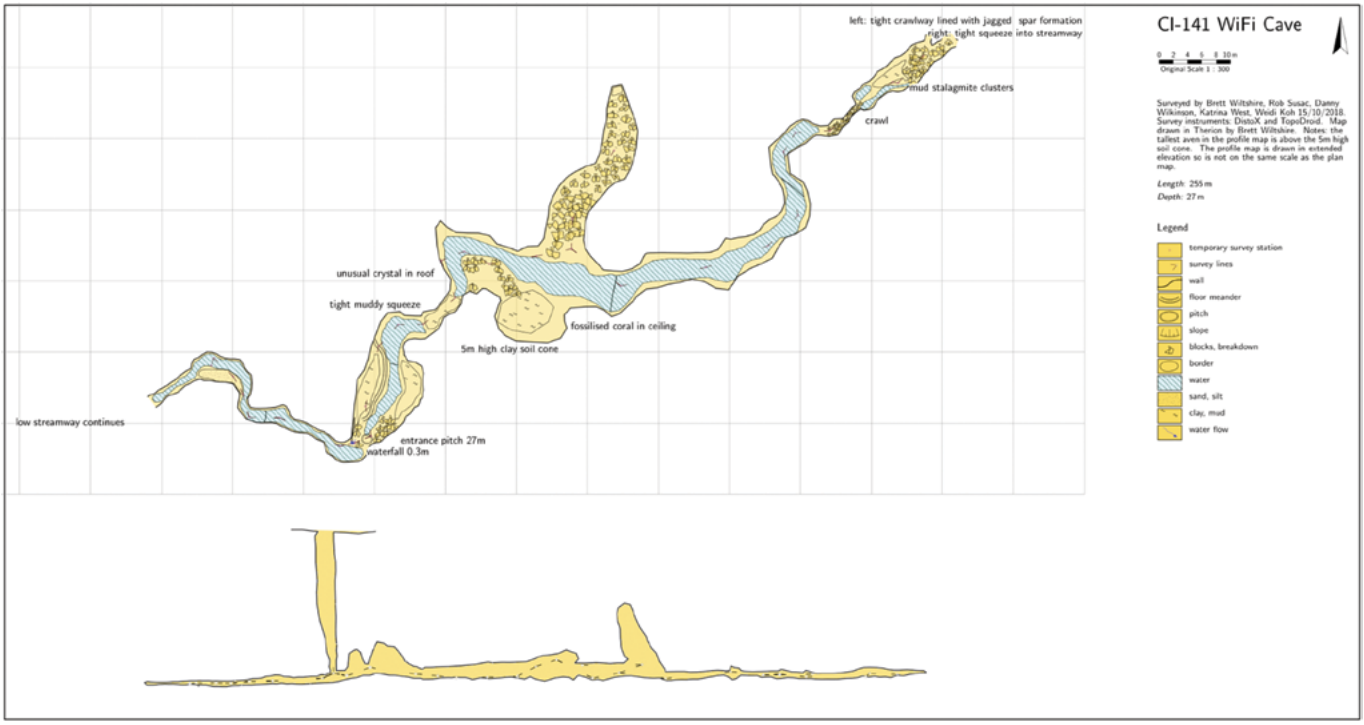
Most of the known caves are sea level entrances and contain little mud; there are many passages with great expanses of warm, crystal clear water and great calcite formations.

While the sea cave entrances are often geographically close to a road, we encountered some setbacks in trying to reach these by land, as they are separated by jungle and thickets of spiky Pandanus that overhang vertical cliffs.

The cliffs are made of very fragile eroded limestone and are undercut by the sea below. An SRT attempt would likely involve about 10 m of carpet for rope protection and being prepared to swim in a harness upon reaching the sea. There are some very photogenic sandy beaches but the majority of the coastline is cliff and reaching the sea caves is far easier by boat.

DANNY WILKINSON

Expansive phreatic tidal chamber in CI-020



Finding a boat operator willing to fit a caving trip into their schedule also had its difficulties.

For our visit to CI-020 Full Frontal Cave, we were given ten minutes to swim to the cliff line from the boat and confirm that we were happy to be left for the afternoon. We were told if we were not out by the agreed time, the boat would not wait and the coastguard would be called.

The CI-020 entrance is narrow and jagged and the swell makes disturbing growling noises as it pushes and pulls one through. Once inside, much of the cave is a pleasant swim through quite a large passage.

A dive line set deep into calcite formation leads the way through the cave to a rusty shovel abandoned at a muddy dig at the farthest point. Our exit from the cave was more difficult because of the rising tide and swell (we were sure to be on time, though).

It was comforting to see that parts of CI-020 do not submerge with the tide but other tidal caves we visited during the expedition ad extensive areas of maze-like passages that do apparently tidally submerge. While these were some of the most entertaining caves we visited, risk assessment of the forecast tide and swell is worth taking seriously.

ACKNOWLEDGMENTS

Thanks to PhD candidate Katrina West for applying for the necessary permits and for assistance from Curtin University, Parks Australia and the exploration efforts of expedition members Rob Susac, Weidi Koh, Danny Wilkinson, Rod and Sue Hamilton, John Clarke, Ross and Jay Anderson and Anne Wood.

REFERENCES

Webb. R. 1987 President's Report. *The Western Caver,* 27: 4

Meek, P. D. 2001 The History of Christmas Island and the Management of its Karst Features. *Helictite,* 37(2): 31-36

Beyond the Sump Expedition 2018

Return to the Cueva de la Peña Colorada

Andreas Klocker with input from Adam Haydock, Alejandra Mendoza, Chris Jewell, Gilly Elor, Matt Vinzant, Teddy Garlock and Zeb Lilly

BACKGROUND

Sistema Huautla, located in the Mexican state of Oaxaca, is one of the world's most spectacular deep caves.

It is currently 1560 m deep and about 85 km long. It has over 20 entrances, all of which collect large amounts of rainwater during the wet season. The most downstream part of this cave system is a huge sump — a sump being a fully submerged part of the cave which can only be explored with dive gear — known as Sump 9 or 'The Mother of all Sumps' that had been discovered on an expedition led by Bill Stone in 1994 (Stone and am Ende 1995; Stone *et al.* 2002).

It was only in 2013 that cavers returned to Sump 9 on a British expedition organised by Chris Jewell. On that trip Jason Mallinson and Chris Jewell pushed Sump 9 to a depth of 81 m at 440 m penetration, with the underwater tunnel barrelling off to greater depths (Jewell 2013).

One of the great mysteries of Sistema Huautla is its connection to the active resurgence in the Santo Domingo canyon some 10 km away. This resurgence has been confirmed by dye trace and has been the subject of several expeditions, each of which has increased the known length of the cave and reduced the gap from the end of the line in Sistema Huautla's Sump 9.

In 2001, Brits Jason Mallinson and Rick Stanton explored and surveyed the underwater resurgence for just over one kilometre to an air bell where a passage was seen heading off 10 m above water level, but the upstream continuation of the underwater river remained a mystery (Shade and Stone 2002).

In 2016, Andreas Klocker and Zeb Lilly started Beyond the Sump Expeditions with the goal of continuing Bill Stone's efforts to connect Sistema Huautla with its resurgence. In both 2016 and 2017, the main goal of the expedition was to continue exploration in the Huautla Resurgence, and find the way on from where Jason Mallinson got to in 2001.

While both these expeditions significantly increased the length of this cave, finding some of the most spectacular cave passages in this region, due to the complex nature of this cave the main way on, following the underwater continuation towards Sistema Huautla remained elusive (Klocker 2017, 2018). As a consequence, the objectives for the 2018 expedition focused on the Cueva de la Peña Colorada, which is hypothesised to be the overflow resurgence to Sistema Huautla and hence could provide a short cut connecting into Sistema Huautla between the known upstream system and its resurgence.

THE 1984 PEÑA COLORADA EXPEDITION

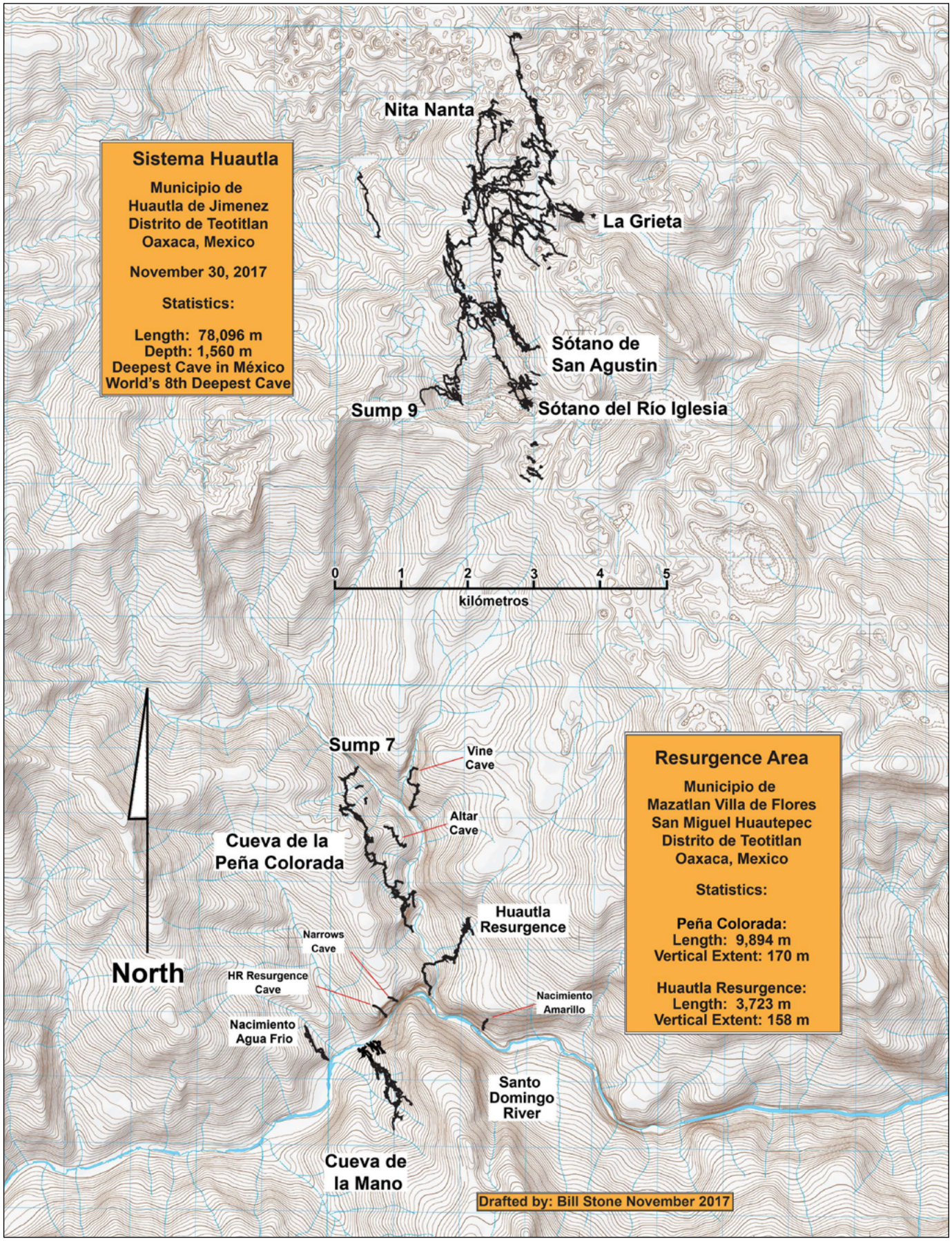
Thirty-four years ago, in 1984, a team of cave explorers led by Dr. Bill Stone of the US Deep Caving Team explored a remote resurgence cave in the Mexican state of Oaxaca, known as the Cueva de la Peña Colorada (Stone 1984). Over three months, the team successfully explored roughly 5 km into the mountain, requiring them to tackle several sumps and establish the first ever subterranean camps beyond sumps, requiring the team to transport all camping gear through these sumps, until they were finally stopped by Sump 7.

Sump 7 started just beyond Camp 2 at the bottom of a 55 m vertical drop, with no place at water level where the cave explorers could put on their dive gear. Hence, they had to descend this vertical drop with dive gear attached to them.

Nevertheless, after an epic effort to get into the sump, the team finally managed several exploration dives. The sump quickly reached a depth of over 50 m, but due to the divers using air rather than gas mixes including helium which is commonly used for modern day deep diving, and due to the amount of tanks necessary to dive at such depths on open circuit, these cave explorers quickly hit their logistical limits and were forced to return.

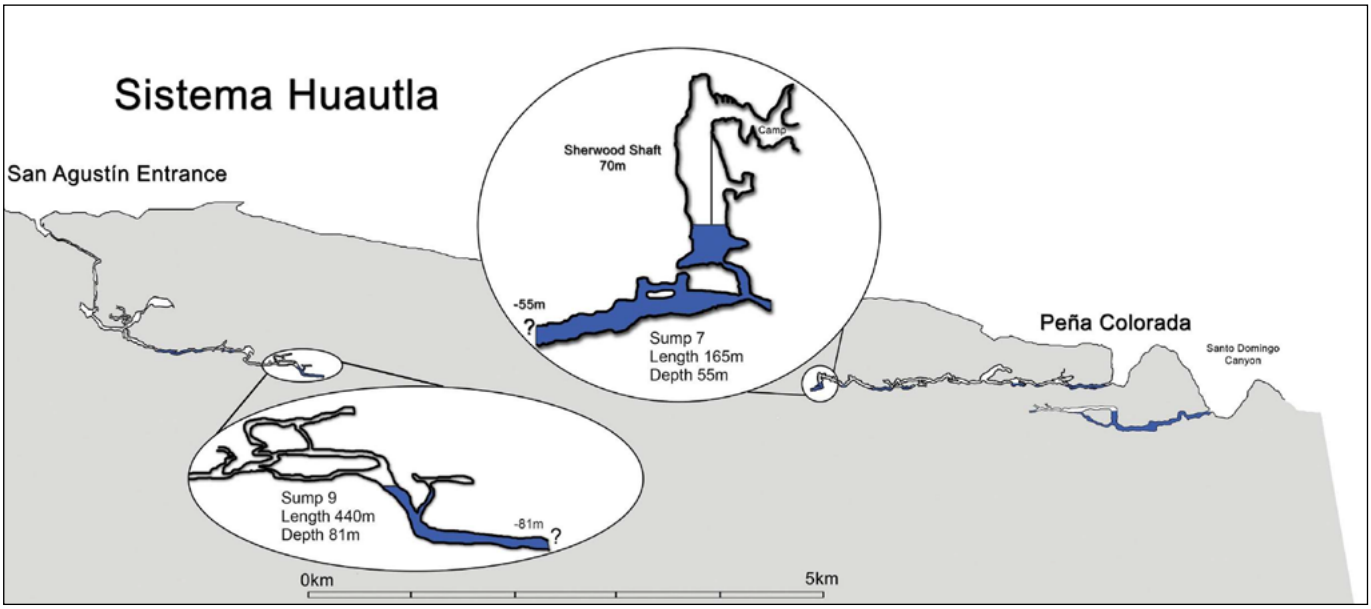
The divers reported a large passage continuing north underwater, leading them to believe that this cave might connect to Sistema Huautla. Since then the hypothesis had been that the Cueva de la Peña Colorada is an overflow resurgence to Sistema Huautla which is only active during the wet season. Nevertheless, this hypothesis had

Beyond the Sump Expedition 2018: Return to the Cueva de la Peña Colorada



never been proven using dye tracing. The hope for 2018 was that, after not finding the way on underwater in the Huautla Resurgence in 2016 and 2017, the Cueva de la Peña Colorada might be a short cut into the elusive underground river between Sistema Huautla and its resurgence.

The 1984 expedition was an immense logistical challenge. Two hundred Mazatecs were hired, along with 65 burros to transport the eight tonnes of provisions, camping, caving, and diving gear down into the Peña Colorada canyon. Using the team's supply of 72 light-weight composite dive tanks, two divers finally reached Sump



A schematic showing the main underwater leads which are thought to connect Sistem Huautla with its resurgence. The left inset shows Sistema Huautla reduced to the quickest way to reach Sump 9 from the surface via the Fools Day extension in San Agustin. The right inset shows both Sump 7 in the Cueva de la Peña Colorado and the Huautla Resurgence.

7 with only five tanks, since all other tanks were needed to get everyone through the first six sumps to Camp 2, the second subterranean camp located just above Sump 7.

It was clear to Bill Stone that new technology was needed to overcome these logistical challenges to explore further, and it was after this trip that he started to develop the now famous CIS-Lunar rebreather. Rebreathers are complex pieces of dive kit (at that time only available to the military) which recycle only the oxygen metabolised by the diver and extract the CO_2. They are thus much more efficient than the open circuit dive gear used on the 1984 expedition.

Nevertheless, Bill Stone never returned to the Peña Colorada, and, until 2018, 34 years later, no other team stood up to the immense challenge of exploring this remote sump. Now, in 2018, the plan was to return to Sump 7 and continue exploration towards Sistema Huautla.

ASSEMBLING THE TEAM

One of the big challenges of cave exploration in a cave such as the Cueva de la Peña Colorada is to put together a team with the right skill set to push a remote sump, such as Sump 7. In particular, for such a cave, a large team of support divers was necessary to put a very small team of exploration divers into the final sump. This team would need to be made up of:

1) Support divers who have extensive experience in both dry caving and cave diving. They had to be able to deal with techniques used to ascend and descend ropes on vertical drops in dry parts of the cave, have plenty of endurance to keep hauling gear down a 700 m deep canyon, 5 km into a cave, on trips which would sometimes would last more than a week underground — definitely a very rare species of cave explorer. The need for a large team of support divers with cave diving experience is unique to this particular cave, since not many caves have passages beyond sumps as extensive as the Cueva de la Peña Colorada and many other caves can make use of a large team of dry cavers to help support the dive team.

2) Push divers, who in addition to the requirements of the support divers, are capable of doing long and deep exploration dives. Survey data shows that Sump 7 in the Cueva de la Peña Colorada and Sump 9 in Sistema Huautla are at the same vertical level within survey errors, pointing towards the possibility of Sump 7 being very long and deep.

3) People who can support the team on the surface, with both local politics, the relationship with locals,and translating.

Luckily, the full crew of the 2017 expedition to the Huautla Resurgence returned in 2018, meaning several people on the trip with previous experience of caving in this region could add to the trip. In addition, a large group of cavers from the UK and Ireland came along, most of whom are part of the UK's Cave Diving Group (CDG) and have extensive experience in working beyond sumps. From the other side of the Atlantic, several cave divers from Florida joined; they were very experienced in diving Florida's long, deep springs, but quite new to dry caving techniques. This team was topped off by several strong cavers from Canada and Poland. As in previous years, this expedition could not have happened with the help of Alejandra Mendoza, who dealt with local politics and the locals for us, assisted by Alma, a schoolteacher in Huautla, and Fernando Hernandez, a Mexican doing his PhD in the US.

The members of the team included: Adam Haydock (USA), Adam Walker (CAN), Alejandra Mendoza (MEX), Andreas Klocker (AUS/AUT), Andrew Atkinson (UK), Charlie Roberson (USA), Chris Jewell (UK), Connor Roe (UK), Dane Motty (USA), Dave Watts (UK), Fernando Hernandez (MEX), Gareth Davies (UK), Gilly Elor (ISR/USA), Jim Warny (IRE), Josh Brackley (UK), Matt Jenkinson (UK), Katie Graham (CAN), Kyle Moschell (USA), Laura Trowbridge (UK), Matt Vinzant (USA), Maxwell Fisher (UK), Michael Waterworth (UK), Mirek Kopertowski (POL), Teddy Garlock (USA), Tomasz Kochanowicz (POL), and Zeb Lilly (USA).

DIVE GEAR

From old trip reports of the 1984 expedition and several conversations Zeb and Andreas had with Bill Stone, it was clear that just organising all the gear needed for a serious dive attempt in Sump 7 would be an epic challenge. During the 1984 expedition the reason for the team to retreat was that they hit the logistical limits of the dive gear available at the time, and to be successful, this expedition needed to overcome the challenges which stopped the 1984 expedition.

The biggest change to the dive gear from 1984 was the use of rebreathers, which would allow for long and deep exploration dives without the need for an unrealistically large amount of diving cylinders. These rebreathers needed to be lightweight and easy to repair with few tools far into the cave. While some of the support divers used open-circuit dive gear, most divers on

ADAM HAYDOCK

Some of the team relaxing at Camp 1

this trip used small side-mounted or chest-mounted rebreathers, either some of the cutting-edge rebreathers produced by the company KISS Rebreathers, or home-built units such as are common with the CDG in the UK. All of these had in common that they were manual rebreathers, making them much easier to repair in remote situations since they do not rely on complex electronics.

Similar to the 1984 expedition, composite tanks were used which are very lightweight, but on the downside need much weight to sink when diving. The big advantage of these tanks was that only the tanks needed to come out of the cave to refill while the lead weights could stay in the cave.

And while the tanks used to get to Sump 7 were all filled with air or Nitrox, the tanks used in Sump 7 were filled with Trimix, i.e. gas mixes including helium, for divers to be able to maintain a clear head when diving at 50 m depth and beyond.

To facilitate gearing up for Sump 7 and to avoid having to climb up a 55 m vertical drop above the sump after a big dive, a platform was used, similar to the portaledges climbers use to sleep on big walls. In case Sump 7 turned out to be very long and/or deep, lithium-powered scooters and a decompression habitat were kept in the field house, ready to go into the cave.

TRAVEL

The trip started when Zeb, who lives in Virginia, after months of preparing gear at his place, finally started the drive in his long wheelbase Ford F350 full of gear towards Florida. At a similar time Andreas left his home in Hobart, Australia, to fly into Jacksonville where Zeb picked him up from the airport.

In Florida they met up with Matt Vinzant, a highly experienced Florida cave diver who was going to join the expedition as exploration diver, and Gilly Elor, one of the support divers. Over a few days they did several practice dives in Florida's amazing springs and prepared over 70 4-litre Nalgene bottles with cave food to be used in the two underground camps for the large expedition team on the way to Sump 7.

Two days after leaving Florida, Andreas, Zeb and Gilly arrived at the Mexican border, a bit later than planned due to a minor mechanical hiccup when the fuel pump of the van, the second expedition vehicle (known as the 'Soccer Mum Special'), failed.

At the border they met Alejandra 'Alex' Mendoza who helped with the border formalities, since none of the others spoke fluent Spanish. After the border crossing the next stop was Monterrey where Zeb and Gilly flew back to the US to work in their day jobs for a few more weeks before joining the expedition while Alex, Alexander Buess (a German cave diver living in Mexico) and Andreas continued driving the two vehicles south.After a couple hours out of Monterrey the head gasket of the van suddenly decided that it needed replacement. After a stressful evening finding a towtruck, a mechanic, and the next morning a rental car big enough to carry all the dive gear we had in the van, the team was finally on the road again.

Annoyingly, though, Zeb would now have to pick up the van on his trip down south. Nevertheless, after two days of driving, the team finally made it to Huautla.

But the car trouble was not over and upon entering Huautla in the F350 one of the intercooler hoses popped off and a brake line developed a leak. While Andreas could reattach the hose with Zeb's instructions, the brake line needed to be ordered by the local mechanic, which left the team without a functioning vehicle since the rental car had to return with Alex Buess the next day. Luckily, Alma could organise an empty classroom in Huautla where the gear could be stored until the vehicle issues were sorted.

LOCAL POLITICS

by Alejandra Mendoza

The first time Andreas and Alex arrived at Loma Grande, the agent of the village, Rafael Carrera, agreed with the expedition. He would allow the divers to explore the Peña Colorada and offered them a place to stay in his house, with the only condition being to get written permission from the municipal president of Mazatlán Villa de Flores, Misael Martínez.

Misael Martínez is a young man with an open mind, a quality hard to find in small Mexican villages. President Misael agreed with the expedition as well, but he needed a reunion to communicate it to the other members of the cabinet. Unfortunately, many of them did not agree with the project and on purpose caused a delay in the writing of the permission.

A spontaneous trip to Oaxaca City, about 7 hours away, was made to hurry the president. He had to call Mazatlán to demand the realisation of the document for Andreas and Alex to receive it as soon as possible. But secretary Celso Vaquero and education alderman Artemio de la Cruz disobeyed Misael and never produced the paperwork.

When the first group of divers arrived, the team had not received the document. Alex had to return to Mexico City, leaving the team alone, but luckily one day after the group of divers arrived Misael sent the permission and the divers started to carry all the equipment into the cave.

Around two weeks later, a group of native people arrived at Rafael's house with sticks and machetes, arguing that the foreigners were there to kidnap their children, to take possession of their land and steal the gold inside the cave. Alex had to return to Loma Grande to try to fix this tension between the locals and the team, but these issues turned bigger and bigger.

Furthermore, some misunderstandings between the locals over their heritage in Loma Grande, with the locals believing that white people are very rich and would give Rafael lots of money, making these locals very jealous. They started a coup leading to a new agent taking over, who took the agency and acted like authority in some official events that took place. Rafael's family ended up being isolated from the rest of the town.

As president, Misael must travel to Oaxaca City once or twice a week, in addition to the visits to the agencies conforming the municipality, so each time the team went to Mazatlán, the president was not there, and the secretary was very disagreeable with Rafael, blaming him for all the things gone wrong. It was a communication issue with

people in the town, because he never did a reunion to inform others about the foreigners' plans. As natives were very introverted, they never joined activities in town and nobody attended the local meetings, which is why Rafael decided not to hold any meetings.

Secretary Celso promised to go to Loma Grande to calm down the people, but he never arrived. As Alex had to return to Mexico City again, Fernando, who was there doing hydrological studies, could stay longer to try to get an agreement between locals and foreigners, but that did not happen and the locals gave the foreigners just a couple of days to get out with all their equipment. Since Fernando moved to Huautla leaving the team without a native Spanish speaker, the atmosphere in the team turned delicate and stressful.

Finally, after a couple of days, President Misael arrived at Loma Grande with all the authorities and a lot of police. He talked with the people and ordered them to leave the divers alone so they could finish their exploration.

SETTING UP THE CAVE

After a fortnight of time spent driving and dealing with politics, the first large group of cavers, mainly Brits at this stage, arrived in Huautla via bus from Mexico City.

Since the written permission to access the cave was a bit late, a day was spent in Huautla shopping and fixing the rear window of the truck, which did not survive the long trip through Mexico.

The next day, with the permission in hand, the team moved into the accommodation in Loma Grande, unloaded all the gear from the trucks and stored it in the very limited space available to us in one small building.

Soon after, they were ready to start moving large amounts of gear towards Sump 7.

ADAM HAYDOCK

Andreas Klocker sorting gear at Sump 1

To access the cave, it was first necessary to descend 700 vertical metres down the Peña Colorada canyon with all of the gear, transport the gear 5 km into the cave through five sumps (Sump 1 could be bypassed via the canyon entrance to the Peña Colorada found by Bill Stone) to Camp 2, just above Sump 7. The hike from the field house in Loma Grande took about two hours once the trail became familiar, and for about two thirds of the descent down the canyon it was possible to use horses owned by locals to carry most of the load.

This canyon trip, steep and with extreme heat, was probably one of the main challenges for most expedition members. On top of that, it was known from previous expeditioners that the canyon is home to many poisonous snakes, in particular the aggressive and deadly pit viper and so most hiking was done during daytime.

It was time to get gear into the cave and through the sumps. Both Connor Roe and Andreas started relining the sumps for the others to follow. Luckily, Sump 2 was very short — just too long to dive it holding your breath — and then it was necessary to carry all the gear over a huge pile of large boulders before reaching Sump 3.

DAVE WATTS

Dry tubes loaded for the trip down the canyon

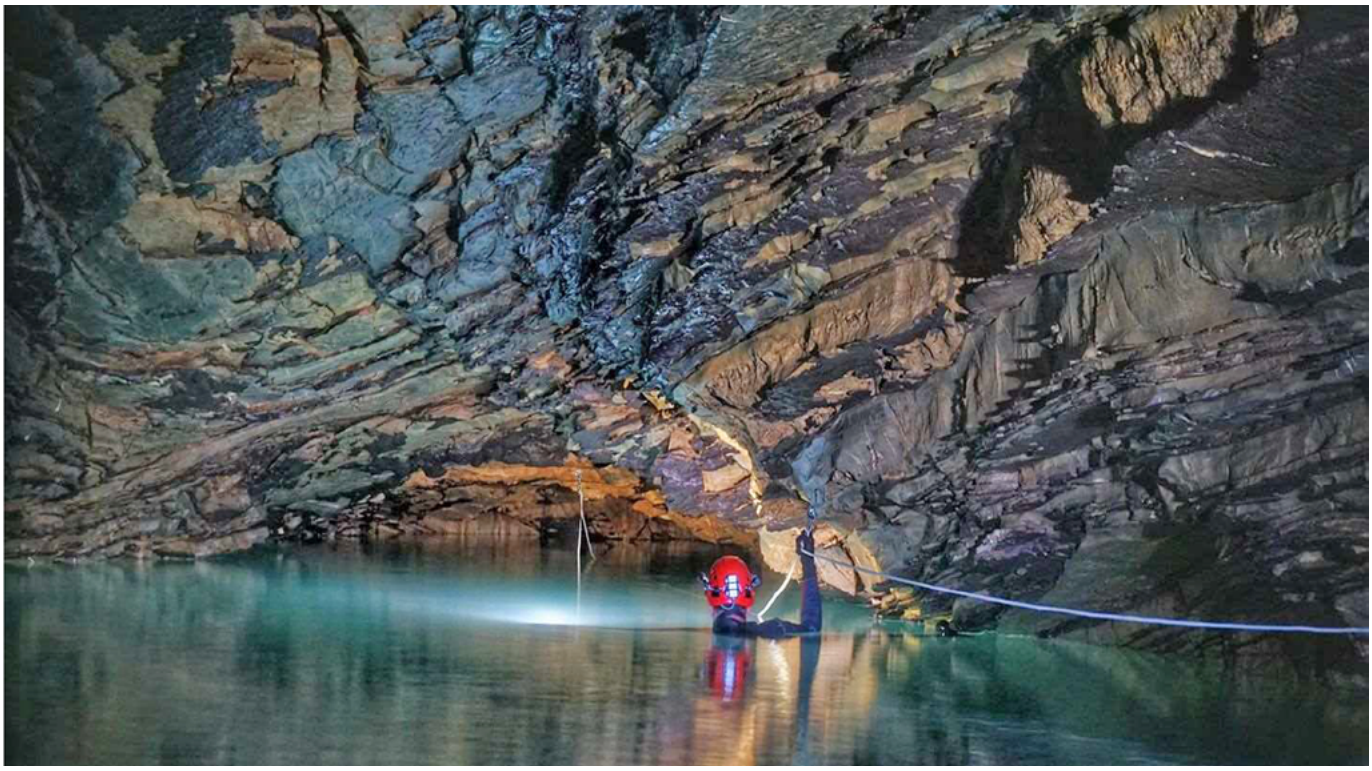
While the cave map showed that this sump should be relatively straightforward, with visibility quite a lot worse than anticipated from old reports, two dives were needed to reline this sump. The next day Chris and Connor returned and managed to find the way on. On the far side of the sump they had to climb about 15 m up a steep climb and rig a rope so that the team following could safely get up this vertical drop, hauling large amounts of gear.

Chris, Connor and several others then continued on with the plan to establish Camp 1. Unfortunately they were stopped by surprisingly high water levels, which turned the Grand Lagoon — which in 1984 was a swim with sufficient air space — into a short dive. Since it was late in the day, they decided to create a temporary camp before the lagoon.

On the next trip Welshman Gareth Davies, Brit Andrew Atkinson, Connor and Andreas entered the cave and pushed through the Grand Lagoon to establish Camp 1 on its other side. The day after establishing Camp 1 everyone helped carry Andreas' dive gear, including his rebreather, to Sump 4 where he then started to reline Sumps 4 and 5, which were separated by a short lake. Surprisingly, on this dive he found enough remnant pieces of dive line from the 1984 expedition which acted as breadcrumbs to find his way through this complex sump in one go.

After relining, Andrew and Andreas continued through Sumps 4 and 5, shuttling large amounts of gear with the goal of establishing Camp 2. This turned out to be a very long day, and since Andrew and Andreas became increasingly tired they tried to find a temporary camp spot on the way to Camp 2.

But the cave passage to Camp 2 was either wet, had loud waterfalls close by or was unsuitable for a camp in some other



MICHAEL WATERWORTH

The Grand Lagoon

way. They pushed on and finally established Camp 2 very close to Sump 7, where they put up several hammocks since there was no flat ground to sleep on.

In the meantime, the others spent several days hauling gear from Sump 3 to Camp 1 and over the long stretch from Camp 1 to Sump 4.

THE PUSH

After Andrew and Andreas exited the cave it still took almost a week for enough gear to arrive at Sump 7, including the platforms used to gear up for the dive. Now, 34 years after the initial exploration, it was finally time to put the first two divers, Chris and Connor, into Sump 7.

Chris describes the first dives in Sump 7:

'It is hard to describe the feeling of finally diving a sump you've dreamt about for years. Excitement mixes with nervousness and you know it has taken a lot of effort to get to this point – now you need to not mess it up!

'With Connor laying the line, I followed him across to the far wall of the spacious shaft. With visibility around 5 m it should have been easy to navigate but the scale of the underwater cave still meant our lights often failed to reach the walls. After picking our way through a boulder choke we descended to 33 m and entered a large horizontal passage which matched the description of the previous explorers.

'Following this passage steadily down we noted several alternative passages but instinctively we headed deeper along the largest tunnel. At the lip of a small pot, we peered down into the depths before descending to a rock and gravel floor at 51.5 m depth. A little further ahead, however, the large passage stopped abruptly in a pile of well-consolidated boulders jammed against each other.

'We couldn't believe it — the cave couldn't end like this; surely we had missed something. Retracing our steps while decompressing, we scoured the walls for the missing way on but nothing could be found except the previously noted side passages which we decided to leave for the next day'.

This was bad news for the expedition. The long hoped-for connection between the Cueva de la Peña Colorada and Sistema Huautla suddenly fell to pieces. Nevertheless, a week later Zeb and Andreas planned to head back to Sump 7 to give it another go. Maybe Chris and Connor had just missed the way on.

Supported by Katie Graham and Max Fisher, Andreas and Zeb finally headed back into the cave a few days later. After spending a night at Camp 1, they reached Sump 4 where they were surprised by much higher and still rising water levels, with Andreas' rebreather, placed on the last trip about 5 m above the sump, now floating in the sump pool. After rescuing the rebreather they headed back to Camp 1 and on the following day decided to go back to the surface to assess the situation.

A few days later Andreas and Mirek entered the cave to meet Tomasz at Sump 3 and then spend a night at Camp 1 before continuing to Camp 2. The day after, Zeb, Gilly and Charlie entered and followed the first team into the cave. Due to the limited number of hammocks in Camp 2, only Zeb continued to Camp 2 a day later to join Andreas for further exploration dives in Sump 7. As the time for Jim Warney from Ireland and Adam Haydock to return home came, they both left Loma Grande to spend a night in Huautla.

'Jim and I were having beers in Huautla and as we watched the rain start to downpour. I mentioned to Jim that rainfall occurs more at this elevation and it should stop soon, but as we continued to walk through town and talk with some of the cavers from the nearby Cheve expedition led by Bill Stone, the rain kept up coming down and streams of water ran down the sloped streets of Huautla.

'I mentioned to Jim that this was not good. There is a lot of water coming down and these streets are cascading with water. All these towns and hills shed this water into the caves beneath us and Sistema Huautla is a major drainage for the watershed. I became a bit concerned but I didn't imagine it would later cause a huge problem, as it did later on.'

While Jim and Adam were observing the downpour on the surface, Zeb, Andreas and several of our support crew were busy getting ready for another go at Sump 7 to try to find a way around the collapsed pile of boulders which stopped Chris and Connor on their attempt to explore this sump. At this time there was no way to communicate between the surface and those deep in the cave and thus we had no idea about the change in the weather.

After the several days it took Zeb and Andreas to get them and their gear to Sump 7, we were finally at the point where we did final preparations on our KISS Sidewinder rebreathers before sliding off the platform into the sump. The visibility above the restriction, which stretches between ~20-30 metres depth, was less than 2 m, but luckily it improved to ~7 m below. We followed Chris and Connor's line and tried to find a way on from there, but sadly without success.

After a 1.5 hour surface interval on the platform, Andreas decided to give it one more try, this time solo since Zeb had some issues with his gear. He checked out everything which looked like it could be a way on, surveyed the deepest part of the cave which Chris and Connor could not do on their dive due to a lack of time and finally checked one more remaining lead which just reconnected in the passage we already knew. Sadly though, Sump 7 was a dead end.

THE FLOOD

By this time, eight days after leaving the surface, Mirek Kopertowski and Andreas were seriously overdue for some sunshine and a cold beer. There were six people still in the cave. Dane Motty, Gilly, and Mirek were shuttling gear through Sump 3, and Matt and Zeb were assisting them at the vertical drop over Sump 3.

Andreas was lugging gear in an area known as the Grand Lagoon deep inside the system when the silence was suddenly broken by a deafening noise as if giant water turbines had suddenly been turned on. The only explanation for the noise was that an unexpected downpour was rapidly filling the cave system we had been exploring. Andreas quickly ran to the others where Zeb was just coming up a rope hanging down the vertical drop above the sump, who immediately told him that the water level in Sump 3 had just come up by almost a metre. Putting those two bits of information together, both the thundering noise at the Grand Lagoon and the fast-rising water in Sump 3, it was clear to Andreas that they were in big trouble.

Andreas' face must have looked worried and Zeb, who has probably spent more time with Andreas in very remote cave passages than anyone else, realised immediately that this was serious. Andreas decided to make a dash to safety, all six of us still in the cave, further into the cave to an area known as the Whacking Great Chamber, a cathedral-like space nearly a hundred metres high. If we could get there we would be safe from drowning, but the water was rising fast and in the narrow passage leading to the chamber was at its worst just 10 cm from the rock ceiling. Luckily Zeb decided to put a dive line through this low part of the cave, which would facilitate our escape later.

While we were safe from drowning in the Whacking Great Chamber, we were also a kilometre from the exit, with flooded parts of the cave separating us from both Camp 1 and the dive gear which was above Sump 3. Gilly Elor describes the time spent in-between the two flooded passages that trapped the team in the cave for 69 hours.

'We knew that in the Great Whacking Chamber we were safe from drowning, but as the water level continued to rise we began to speculate as to how long it will take to drop... or would it even drop? Could the high water level be the more normal state of the Cueva de la Peña Colorada? What if it rained again?

'This isn't a cold cave, so we knew that even though all we had were wetsuits and Matt's space blanket, hypothermia was a negligible risk. However, the only food we had was four granola bars between the six of us. The only action we could take once trapped was to lie still in the dark, conserving energy and headlamp batteries while attempting to keep warm and hope that the water level would drop, which we knew was our only way out.

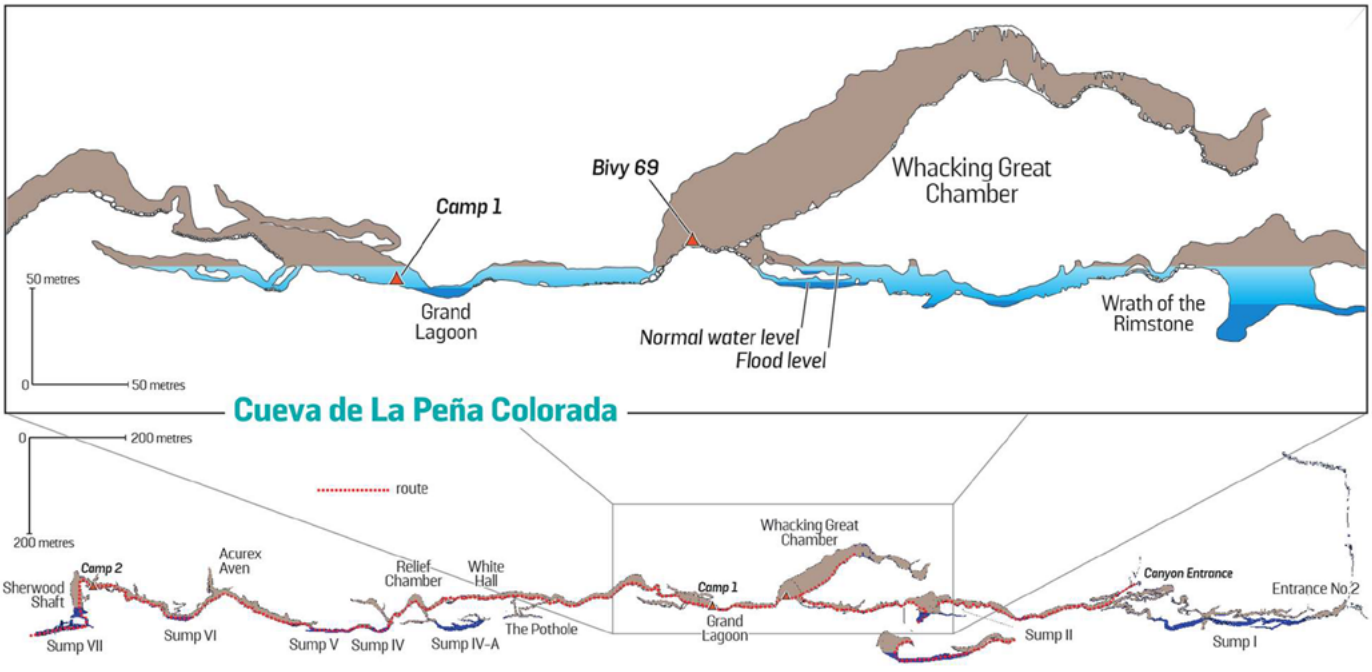
'That first night, as the water level continued to rise, nobody talked. What would we have talked about? Our outside lives. I think we were all contemplating the possibility that we may not get out. Eventually the water level began to slowly drop. We continued to huddle in the dark, listening to the sound of the gurgling water and coming up with theories justifying why every noise was a good sign.

'As time passed we also grew weaker from lack of food. After 48 hrs we split two out of the four bars six ways. I think the trick in this situation is not to think or fantasise about the food you can't have'.

In the meantime Teddy Garlock, one of the support divers from New York State, had arrived in Loma Grande. At this time nobody on the surface knew exactly what was going on in the cave.

Teddy recalls:

'The trip through Sump 2 was easy and I was soon on the far side carrying two composite cylinders and large amounts of gear to resupply the six cavers currently living in the cave. The passage between Sump 2 and Sump 3 requires a lot of scrambling through breakdown piles in some impres-



A schematic showing the extent of the flood

DIVE MAGAZINE

ADAM HAYDOCK

Whacking Great Chamber

sive cave. When I arrived I was a little taken aback by all of the Nalgenes floating in the sump pool. Then I heard the unmistakable sound of a solenoid firing and saw Tomasz's rebreather floating amongst the debris. Shit! Big problem.

'My immediate concern was related to the dive guideline — missing somewhere in the flooded sump pool. My first attempt at finding the line involved wading in the shallow end with a mask and a light, hoping it was close. I soon added both of my tanks, tied in the only safety spool I had and began a lost-line search. My 25 m of line was quickly exhausted as I swept from side to side, finding dive gear strewn across the bottom but no guideline. Using a second reel which I found in the submerged gear, I finally found the guideline and tied in.

'After recovering all of the floating and most of the submerged gear, I filled a dry tube with Nalgenes to resupply the others and set off alone into Sump 3. During the 15-minute traverse I noticed some mild narcosis which was notable since the passage was supposed to be ~20 m deep. After a while I arrived at the primary tie-off on the far side of Sump 3 which, much to my disappointment, was also under a significant amount of water. Having used all the spools I carried or could find, I was faced with an easy decision: surface and hope the tie-off had been placed in an area that would still have air space above it (and risk losing the line) or turn around and head all the way back out. I made the obvious choice and turned back, leaving a dry tube with food and batteries tied off on the line.

'After waiting two days I returned to Sump 3 and noted the water had receded a good 8 m. I made the dive alone and extended the guideline on the far side, surfacing in a huge air chamber with six headlamps staring back at me. Mirek was the first one I spoke with and he gave me a brief synopsis of their experience: 'Three days we've been stuck in an air chamber, no food and only one space blanket. We're getting out right now'. With that Mirek disappeared into Sump 3 and began making his escape.'

THE AFTERMATH OF THE FLOOD

by Matt Vinzant

The team of six spent 69 hours trapped in the Whacking Great Chamber and were beat down. In that time Matt, Dane and Zeb all suffered from intestinal issues.

The dive out of Sump 3 and the subsequent hike back to the field house was physically gruelling. The time had taken its toll on our bodies. Dane was suffering from exhaustion and dehydration, Andreas developed a fungal infection on his feet from wearing wet boots for days and Mirek could only drink one beer. The next day was a rest day and everyone agreed to spend it above ground, to enjoy the sun and spend time in Huautla eating real food and calling home. There were no more cave camps after the flood; every day a team would make the round-trip hike to the cave to continue to derig.

Morale was low after Sump 7 did not go, along with the flood and mild medical maladies. The flood had isolated us from Camp 1 and much gear remained at camp and beyond. Five days after escaping the cave Zeb, Gilly, Teddy and Matt returned to conduct a recovery mission for all of the gear remaining beyond Sump 3. Zeb and Matt, assisted by Teddy and Gilly, carried their KISS rebreathers over the Whacking Great Chamber where they found the formerly dry passage leading to camp still full of water.

Visibility was poor. Matt led the way running the guideline along the ceiling. There was an air bell halfway before the passage submerged again where the Grand Lagoon once was. We named these two surprise sumps Sump 3a and 3b.

More than thirty 4-litre Nalgenes, six sleeping pads, sleeping bags, stoves and personal kit were abandoned in camp. Zeb and Matt made it to Camp 1, which was still 3 m under water a week after the flood. Expecting to surface in a pool full of camp debris and Nalgenes, they found nothing. Sand had moved, the water had risen and fallen and the gear disappeared with the water. 'It's all gone, flushed away, I suppose,' Zeb remarked.

Matt and Zeb continued to Sump 4 where cylinders and regulators remained. They noticed high watermarks and shifted sandbars.

The flood had overtopped the Relief Chamber at the top of Sump 4. They de-rigged the cave and recovered all of the equipment they could locate.

The next three days was spent ferrying gear through Sump 3 to Dive Base, and Dive Base before Sump 2 to the Horse Drop, which was the lowest point in the canyon the horses could get to. Thousands of kilograms of gear was returned to the field house, inventoried and loaded into the truck and van for the long drive back to the USA.

PHOTO DOCUMENTATION

by Adam Haydock

Photographing the Cueva de la Peña Colorada was a unique experience as the equipment required layers of protection from rough transport and the amphibious component provided challenges that continued to develop as the trip unfolded. Cave photography can become quite a task-oriented process and when delicate equipment is involved, one error or a faulty part can render cameras and light sources useless.

One of the more specialised challenges was to fit all the bulbs and equipment into a device that could keep everything dry. I was able to fit all of the sensitive electronic equipment into a dry tube designed for a dive scooter.

This provided a bit of streamlining while travelling through submerged passage. Furthermore, in order to make the tube neutrally buoyant, I had to strap an additional 20 lbs of weight and clip the tube onto the back of my sidemount.

Another challenge was to keep the bulbs from breaking due to the pressure or impacts that they might have encountered along the way. Thankfully, half the bulbs survived to make the photo of the Whacking Great Chamber a possibility. The other challenges were the typical battery and setup strategies that are encountered with cave photography, which was a non-issue.

I was glad to capture the cave from the main entrance back to Sump 4 as well as the surface of Loma Grande. It would have been good to get back to Sump 7 but thankfully photos were taken back there and video was made of the exploration dives beyond Sump 7.

Thank you to Katie Graham, Jim Warny, Connor Roe, Gareth Davies and Max Fisher for assisting with the photography and dealing with the exposed climbs in the Whacking Great Chamber.

JOSH BRATCHLEY

The divers'platforms at Sump 7

FUTURE PLANS

Since it is now believed that the Cueva de la Peña Colorada acts as an overflow to the canyon above, rather than as overflow to Sistema Huautla, to achieve the goal of connecting Sistema Huautla with its resurgence it will be necessary to either keep pushing the Huautla Resurgence where several leads remain, and find the continuation of the active streamway, or push Sump 9 which would involve a 100+ m dive in a very deep cave. While exploration in the Huautla Resurgence can be done with a relatively small team of 6-8 people, the exploration of Sump 9 would require a very long expedition with 40-60 dry cavers to support a handful of exploration divers in Sump 9.

In 2019, to allow for a bit of a change after several years pushing Sistema Huautla, the team will explore nearby resurgences, believed to drain the caves of a large karst plateau known as the Cerro Rabon. These systems could be up to 1500 m deep, but their resurgences have hardly been explored. Depending on local politics in Oaxaca, the objective the year after, in 2020, would be to organise a large expedition to continue the exploration of Sump 9. It will be epic.

SUPPORT

This expedition would not have been possible without the valiant effort from the expedition team and the local community of Loma Grande and Mazatlán Villa de Flores. We also want to thank our supporters: KISS Rebreathers, Xdeep, Shearwater Research, Hennessy Hammocks, Nalgene, Light Monkey, Submerge Scooters, Otter Drysuits, Highline Ropes, Scurion, Apeks, OC Lugo, TFM Engineering Australia, DKG Drysuits, Transglobe Expedition Trust, the United States Deep Caving Team, Subsalve USA, Wilderness Lectures, Canmore Cave Tours, The Ghar Parau Foundation, Australian Geographic Society, National Speleological Society and all of our other generous donors that helped to make this expedition happen.

For more information have a look at our web page, https://www.beyondthesump.org , and for regular updates on our future expeditions follow us on https://www.facebook.com/CaveDive/.

REFERENCES

Jewell, C. 2013 Dive Reports, San Agustín 2013 Expedition. *AMCS Bulletin,* 25: 33-37.

Klocker, A. 2017 The Huautla Resurgence Project 2016 Expedition. *AMCS Activities Newsletter,* 40: 37-44

Klocker, A. 2018 The Return to the Huautla Resurgence. *AMCS Activities Newsletter,* 41: 91-95

Shade, B. & Stone, B. 2002 2001 InnerSpace Odyssey Expedition. *AMCS Activities Newsletter* 25: 53-71

Stone, B., 1984 Peña Colorada. *AMCS Activities Newsletter* 14:46-55. http://www.mexicancaves.org/nl/14.pdf

Stone, B. and am Ende, B. 1995 The 1994 San Agustín Expedition. *AMCS Activities Newsletter* 21:44-64. http://www.mexicancaves.org/nl/21.pdf

Stone, B., am Ende, B., Paulsen, M. 2002 *Beyond the Deep: The deadly descent into the world's most treacherous cave,* Grand Central Publishing.

New club for Central Queensland

Dwayne Kersey, Kerrod Hamilton and John Kersey

YOU ARE invited to a public meeting regarding the potential formation of a caving club in the Central Queensland region.

The meeting will be held at 5 pm, Saturday 27th July 2019 at The Caves Community Hall, 4 Buch Square, The Caves QLD 4702

Fifty-two years ago on 27th July 1967 a public meeting was held to discuss the formation of a formal group of persons with a common interest in speleology or caving.

As a result of this meeting the Central Queensland Speleological Society was formed and was instrumental in the protection of the caves, flora and fauna on Mount Etna while increasing the scientific understanding of these rare and special natural wonders.

Since this was achieved the old club has ceased to operate. However the adventure and science of the caves lives on and another generation, as well as those still of active mind and young of heart, continue to find fulfilment in the activity of speleology.

This leaves a void for those with an interest who can meet locally with like-minded people to further grow their knowledge and skills while providing an opportunity to pass this knowledge on to other people.

Through discussions with other people and organisations there appears to be significant interest in the establishment of a formal group or club with a common speleological theme. Invitations have been sent out to interested parties including:

- Local, State and Federal political representatives
- Queensland National Parks & Wildlife
- Rockhampton Search and Rescue
- Australian Speleological Federation
- Scouts Queensland
- Local media
- Past and present cavers

Discussion may include:

- Presentation of any communications from parties who could not attend
- Open floor for discussion
- Potential structures for the clubs
- Club considerations: financial, equipment, membership, affiliations

We hope you will be able to attend the meeting. Please feel free to bring anyone else who may be interested along with you. Please confirm by contacting Dwayne Kersey on 0419 647 186 or email dwayne.kersey@saiglobal.com. If you are unable to attend you may submit a letter to be read out at the meeting or if you would like a record of the meeting, please advise us.

Chester Shaw

A friend of caves and cavers at Mole Creek

Cathie Plowman
NC

ASF MEMBERS who caved at Mole Creek in the 1980s and 1990s would have met this polite, quietly-spoken, unassuming and ever-helpful gentleman.

Chester was a cave guide and ranger for many years, having worked at Marakoopa Cave and King Solomons Cave from when they were administered as part of the Tourist Department.

He was an exceptional host to all and especially to cavers and scientists with whom he delighted in sharing the caves. To accommodate cavers he was fastidious with the timely processing of permit requests and ensuring that cave keys were reliably available.

A highly respected member of the Australasian Cave and Karst Management Association, Chester worked hard to implement best-practice management in the modern show cave environment.

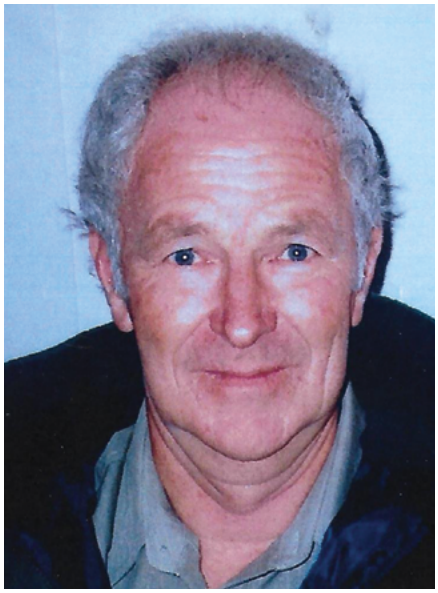
He loved the caves and was always patient and unflustered to cave visitors, guiding large tour parties and back-to-back tours for days at a time in the busy periods, with far less support and resources than in the current era.

Through his membership of Northern Caverneers, Chester was an ASF member for over 20 years.

Living in retirement at Mole Creek with his wife Kay, Chester was always keen to bump into cavers and hear what they were up to and news of other caving areas.

The Mole Creek Caves lost a great friend with his passing in March this year.

Our heartfelt condolences to Chester's wife Kay at this sad time.



KAY SHAW

COMING EVENTS

This list covers events of interest to anyone seriously interested in caves and karst. The list is just that: if you want further information the contact details for each event are included. The relevant websites and details of other international and regional events may be listed on the UIS/IUS website www.uis-speleo.org/ or on the ASF website http://www.caves.org.au. For international events, the Chair of International Commission (Tim Moulds) timothy.moulds@yahoo.com.au may have extra information. A similar calendar is published in *ESpeleo.* This calendar is for known events in 2019. This calendar comes to us courtesy of George Veni, President of the IUS.

July-November 2019

1-5 July
Symposium on Caves, Karst, and Subterranean Environments: Cuba, Havana, Cuba, http://www.cubambiente.com/

1-5 July
Symposium: Challenges for Subterranean Landscape Conservation in the World's Karst Regions, 10th World Congress of the International Association of Landscape Ecologists, Milan, Italy, http://www.iale2019.unimib.it

9-12 August
National Speleological Congress of Switzerland, Interlaken, Switzerland, https://sinterlaken.ch/en/

11-17 August
4th Summer School on Speleothem Science, Cluj-Napoca, Romania, https://www.speleothemschool.com/

15-18 August
German Annual Speleo Meeting, Nesselwang, Bavaria, Germany, www.vdhk.de

7-10 September
TransKarst 2019: The 3rd Asian Trans-Disciplinary Conference, Bohol, Philippines, http://www.transkarst2019.com/

11-13 September
ArmConference 2019: Caves as Natural and Cultural Monuments, Yerevan, Armenia, http://armconference2019.com/

18-22 September
25th International Cave Bear Symposium, Paklenica National Park, Croatia, nadja.kavcik@univie.ac.at

22-25 September
Geological Society of America Convention, Phoenix, Arizona, USA, http://www.geosociety.org/GSA/Events/Annual_Meeting/GSA/Events/gsa2019.aspx

23-26 September
13th EuroSpeleo Forum, Sofia, Bulgaria, https://esf2019.speleo-bg.org

23-27 September
46th IAH Congress 'Groundwater Management and Governance Coping with Water Scarcity' Topic 7: Karst Hydrogeology, Malaga, Spain, http://www.iah2019.org/topics-and-sessions/

7-11 October
National Cave and Karst Management Symposium, Bristol, Virginia, USA, http://nckms.org/2019-symposium

15-17 November
13th European Cave Rescue Meeting, Istanbul, Turkey, https://caverescue.eu/13th-european-cave-rescue-meeting/

2020 and beyond

20-24 April 2020
16th Multidisciplinary Conference on the Engineering and Environmental Impacts of Karst, San Juan, Puerto Rico, www.sinkholeconference.com

29 August-5 September 2020
19th International Symposium on Vulcanospeleology, Catania, Italy, http://www.19isvetna.com/

23-29 July 2021
18th International Congress of Speleology, Lyon, France, http://uis2021.speleos.fr/

A very useful international calendar is posted on the Speleogenesis Network website at www.speleogenesis.info/directory/calendar/
Many of the meetings listed above are on it but new ones are posted regularly.

EDITORIAL

WE'RE bucking tradition and putting this stuff on the latter pages of the issue in order to solve some layout technicalities.

Don't bother complaining; it should be back to normal for future issues.After last issue's focus on the conference we're back to exploration with a healthy dose of science. The two can even be combined by those of us who are particularly talented.

Indeed, they are often best combined, the latter getting exploration projects over the line for karst managers and cave permit issuers. Embrace your inner cave nerd (or support a nearby one) and you might get to go somewhere cool AND learn something at the same time.

If you don't write about it and send it to *CA* for publication then it doesn't count. ***— Alan Jackson***

STOP PRESS

Tasmania's Niggly Cave and Growling Swallet joined

Alan Jackson
STC

EFFORTS to join Growling Swallet and Niggly Cave in Tasmania's Junee-Florentine karst were rewarded on 23rd May 2019 with a team of cavers from Southern Tasmanian Caverneers finally making the long-theorised connection.

The connection was made by diver Stephen Fordyce after a ~230 m dive in the lower levels of Niggly Cave during which he located the end of his line from his previous dive from the Growling Swallet side some four years ago.

The connection extends the Australian cave depth record to ~395 m and creates a Growling Swallet-Niggly Cave system in excess of 18 km long and with five known entrances.

The four day trip was a great success in other areas too, with over 1 km of new dry passages explored and a diving breakthrough in the direction of the known hydrological connection with Porcupine Pot (some 3 km away).

With leads abounding, both wet and dry, the system is only going to get bigger and possibly deeper. Watch this space.

MAX LUMENS!

NEW El Speleo range: 2400 - 1600 Lumens!!
HUGE battery packs: 10200mAh - 6800mAh

El Speleo Lunatic

El Speleo Terra

CT Stark Helmet

CAVING PACKS

World famous tried and tested!

35L Caving Pack

15L Small Caving Pack

55L Large Caving Pack

GEAR UP

All the gear you need for your next adventure!

Petzl Omni Triact Lock Carabiner

Speleo Caving Harness

Caving Waist Belt

ASPIRING
Quality caving gear since 1981

FREE SHIPPING

for orders over $120

www.aspiringsafety.com.au