CAVES AUSTRALIA

The Journal of the Australian Speleological Federation Inc.

Cave Animal of the Year
Junee Dye Tracing Extravaganza
When it Happens...

No. 218 • DECEMBER 2021

Regrettably, the next ASF conference in Ceduna will be postponed again to April 2023. New dates will be announced soon.

This decision has been made by the conference committee and the ASF executive in light of the ongoing uncertainty regarding covid, travel restrictions, vaccinations, boosters etc.

The activities, field trips and social aspects of the conference are a highlight for many and we want to make sure everyone who wants to attend can get there in person.

There are some things to look forward to, though...

There will be a series of exciting online talks and workshops to be held in early 2022 – more details to come.

The conference has been issued permits to access caves on the South Australian Nullarbor. The field trips in 2023 will be a rare opportunity to visit caves that have not been accessible for many years.

Early bird registration has been extended to January 2023

We will contact those who have already registered to discuss whether you'd like a refund or to roll over your registration to 2023.

Have a question?
Contact event organisers at registration@asfconference2022.com

COMING EVENTS

COVID-19 is still disrupting international travel and events. Many events are now providing virtual attendance options. Information on UIS-sanctioned events can be viewed at http://tinyurl.com/y7rgb8ah

Don't forget that 2021 is the International Year of Caves and Karst. You can find more information about what's going on and what you can do to help the cause at http://iyck2021.org/

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ASF

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President's Report

THIS YEAR has been an up and down again — just when the country was able to go caving again mid-year, it was back into lockdown for many.

Now I'm pleased to say things are definitely looking up and interstate caving trips might even be possible soon… fingers crossed.Like many of us, I have had very few trips underground this year, and recently I have been reflecting on what I miss the most.

And there are of course many things to miss — the total uniqueness of the underground world, the way the day to day stresses disappear when you put on your caving suit, the first lungful of cool cave air, how cave dust makes the craziest hair styles, the slightly unpleasant but nostalgic smell of caving gloves, the reverberating skitter of a misplaced rock, and all the physically and mental challenges that teach us how to become better cavers. But the one thing I miss the most is spending time with a wonderful and eccentric bunch of cavers.

There are things that just can't be experienced without other people — when teamwork is required to pull something off and how we have to look out for each other when it's most needed.

In some ways we are more genuine when out of our comfort zones which makes us able to bond more easily though shared risk and adventure.

We've all been on trips where those small gestures of a knee up or pack pass have been offered at just the right moment, when someone else's jelly snakes are the only thing that'll get you up the last pitch or when an epic trip goes from miserable to the makings of a good story with a shared smile when you emerge from the entrance.

There's also seeing the way nervousness turns to excitement in a beginner, celebrating birthdays at the bottom of caves with only slightly squashed cake and the satisfaction in taking the last survey leg before heading out.

BRIAN EVANS

There are the side stories too: the hilarious conversation topics that only occur on a long car journey, discovering your friends' tastes in music are irrevocably different and a shared take-away on the way home when you're tired and hungry and chips and chocolate milk are the best dinner ever.

The people are definitely what make caving trips so enjoyable.

So I hope wherever you are, you can enjoy some time outdoors this holiday season with friends and family, and maybe a trip that will be the making of a good story…

— Sarah Gilbert

Junee-Florentine (JF) Dye Tracing Extravaganza

Stephen Fordyce
VSA/STC

THE Southern Tasmanian Caverneers (STC) are in the midst of a very large and complex dye tracing exercise in the Junee-Florentine (JF) karst region in Tasmania.

I guess you'd say I'm spearheading the effort. Despite being within easy reach of a day trip from Hobart, the area contains one of the largest hydrologically connected cave systems in Australia, and contains almost all of the ten deepest caves in the country. The caving is cold, hard and frequently miserable, but as a result, the potential for new discoveries is excellent.

A good deal of historical dye tracing work has already been completed, establishing key flow paths between many significant caves, however most of these used mechanical (dyed spores and nets) or chemical (dye and charcoal detectors) methods. Some years ago, Petr Smejkal had some success with electronic detectors he'd built, and some years later I took up the torch with the support of TFM Engineering Australia. More than 200 days of Melbourne lockdown turned out to be an excellent opportunity for research and development, and a family of prototype devices was officially released into the wild in the summer of 2019-20.

Historically, a 'more, the merrier' approach to dye releasing was taken; however, in the long and arduous process of gaining a formal research permit from Tasmania Parks and Wildlife, this was obviously not cool. Turning pristine Tasmanian rivers green is to be avoided at all costs. Even pictures of green rivers on social media are best avoided.

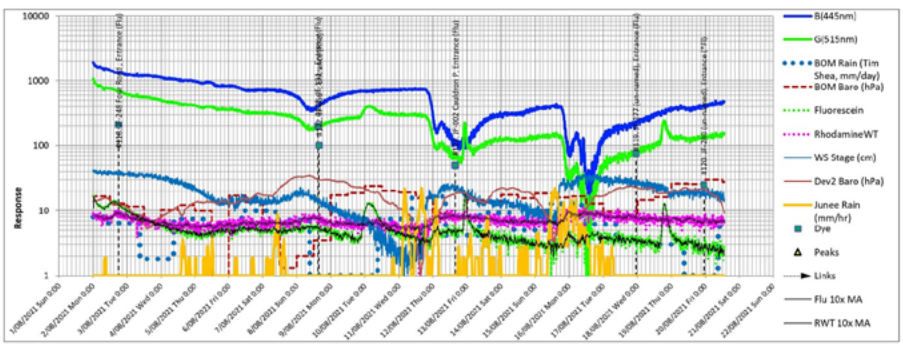
Fortunately, the detectors are extremely sensitive to fluorescent tracing dyes including fluorescein and rhodamine WT, so with some due diligence we can keep resurgences well below visual thresholds. The Tasmanian EPA were also kind enough to provide us with guidelines on dye levels in drinking water and for the environment, and the dyes used are obviously chosen for their lack of environmental impact.

STEPHEN FORDYCE

Pax releases a carefully calculated amount of fluorescein in Sesame

The detectors are, to be honest, pretty awesome, beyond even my optimistic expectations, with a detection threshold in the order of 10 parts per trillion or better. In summer conditions (approx. 1000 L/s), a release of 10 g of fluorescein powder at Growling Swallet is easily detectable at the Junee River resurgence, some 10 km away as the crow flies. A recent dye trace saw 20 g (100 mL solution) of Rhodamine WT detectable in winter flood conditions (approx. 3000 L/s). Historically, kilograms of dye were used for this trace. As a rule, we aim for dye levels to be visually undetectable at Junee (there is a 5 km gap between the last Niggly detector and the Junee resurgence).

As the detectors take a reading every 10 minutes, they provide information on flow time, dilution and peak shape, as well as temperature and water level, opening the door to a whole series of detailed analysis of water flow and cave characteristics. It has been interesting to see how the peaks differ with the different types of inflow — for example, a dye release into a small tributary at the extents of the catchment in summer took ten days to travel to Junee and made a dye peak three days wide. A repeat trace in winter had two days travel time and a six-hour-wide peak. A winter dye release in Owl Pot showed two distinct peaks on reaching Niggly, indicating that multiple flow paths were in play. Of course, the most useful thing about this is that a detector can record many dye peaks across a single deployment. A dye peak may also go past



Example detector results

STEPHEN FORDYCE

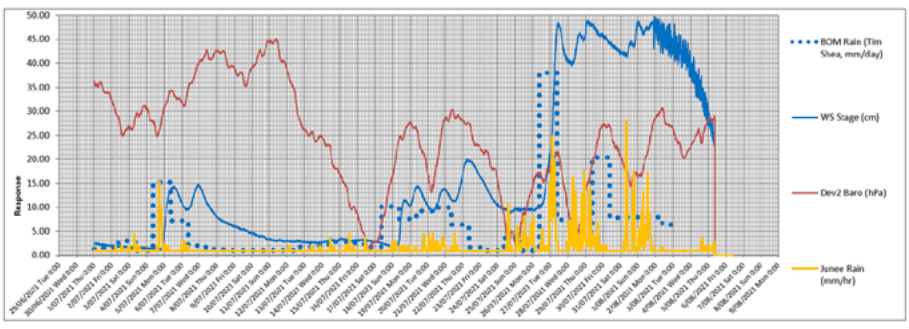
Nice clean devices — but not for long

multiple detectors — as many as eight with the current deployment —allowing detailed study of how it changes with distance and cave characteristics.

Electronic detectors already exist; however, they are prohibitively expensive, such that most dye traces use only a single detector. Those that I have developed are cheaper, so many can be deployed at once, to create a comprehensive net for a series of dye releases. In fact, where previous studies traced only key inflows, we have managed to trace almost every swallet and sink known in the area. The family of devices includes dye detectors, stage loggers, weather stations, and automatic dye releasers. The last are particularly useful for keeping dye releases several days apart to prevent interference. A single day of setup and another of collection can achieve as many dye releases as you have devices for. The weather stations are useful at cave entrances for recording rainfall to correlate with water level data and in caves for normalising water depth readings. We know from flood marks that some areas of Niggly flood to 20+ m and Growling Swallet to 35+ m. As they record atmospheric pressure, draught can be extrapolated and studied (an anemometer version is in the works too).

OXANA REPINA

Reconfiguring a dye dispenser in the field

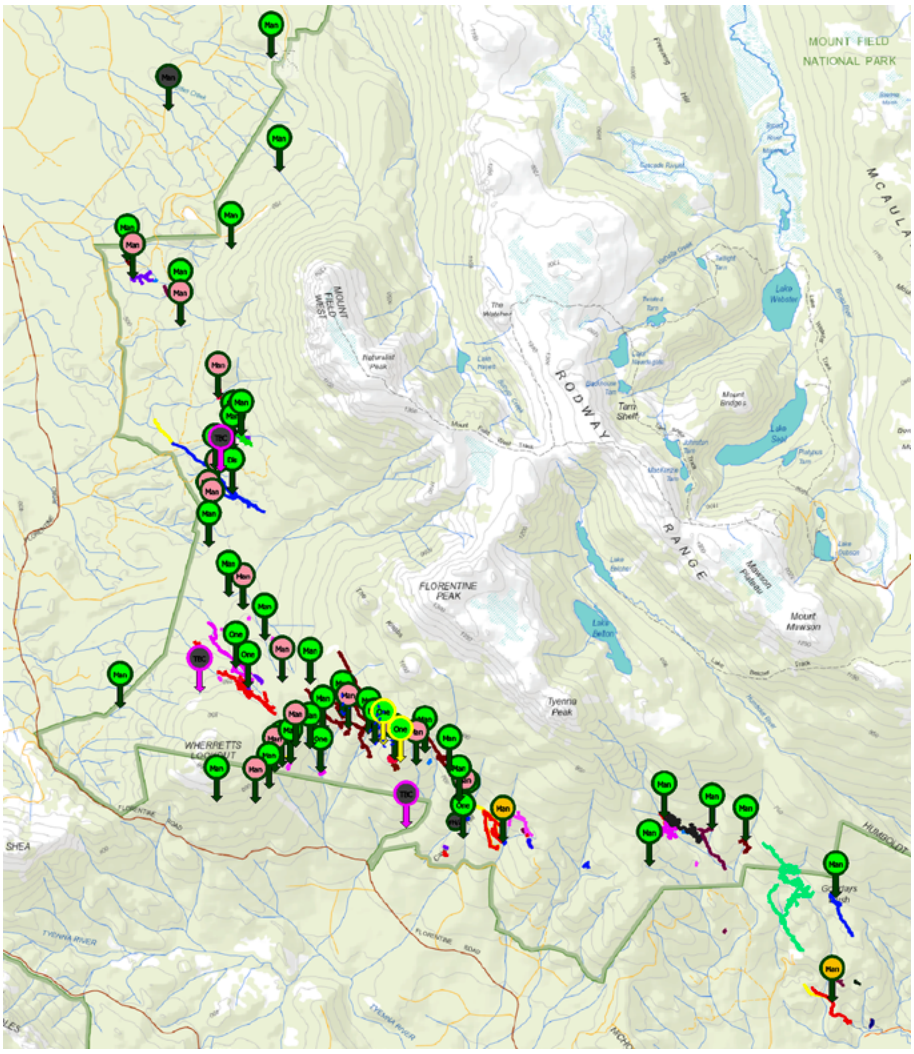


Junee River (at carpark) stage and weather data for 1st July to 9th August

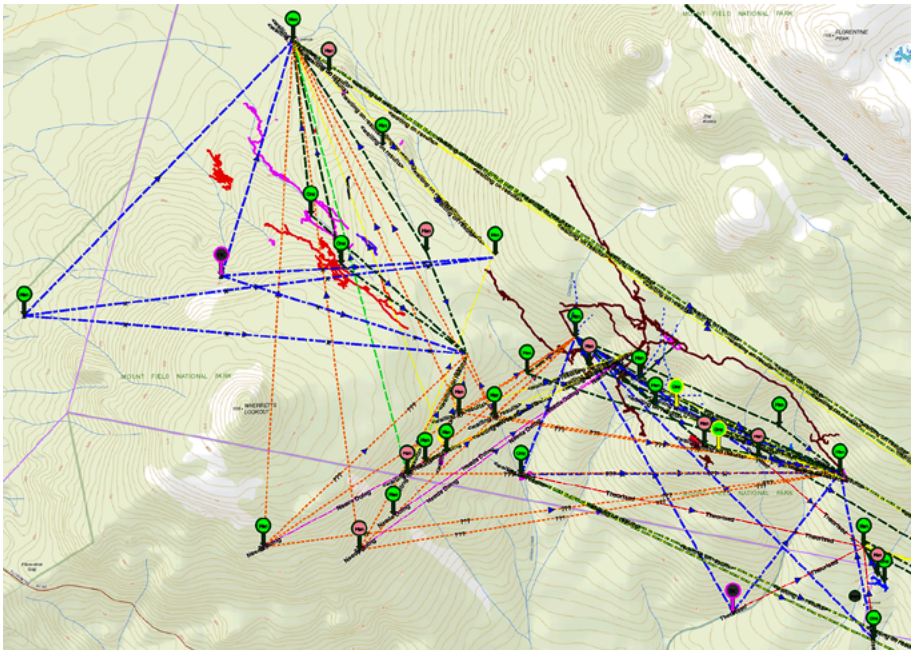
In case you're not impressed yet, I had better rattle off the current population: five detectors and three weather stations in Niggly Cave; two detectors and two stage loggers in Growling Swallet; four detectors and a weather station in Porcupine Pot; two detectors, two weather stations and a phone for results reporting at Junee Cave. Plus a detector in Lawrence River Rising and a few expended dye release devices up near Tachycardia. I haven't misplaced one yet, but it is a serious possibility. Most of these were placed in May 2021, with a few back in January and February 2021 (the longest verified deployment to date is about six months). They were configured to stop high power detection on 1st September 2021, and revert to water level only logging on 1st January 2022. There should then be enough battery power left to continue logging until the end of 2022 in the event of another global pandemic…

In a spectacular club-wide effort, we have done 129 dye releases since December 2020. This is all the more ridiculous when you consider that to avoid interference, generally only one lot of each dye can be released each day. Big thanks to everyone who has put up with my beggings to make a small or large detour or a dedicated trip. Results are updated in the shared QGIS project as I get to it. I hope you will agree it's been worth it. I dare say the dataset will be analysed in various ways for decades to come. Please contact me if you have interest, ideas or a spare research assistant.

A subject for another article is the use of QGIS to display cave data. The learning curve for this is steep, but lockdown weekends were a good opportunity to wean myself off Google Earth and into this much more powerful program, otherwise known as the free and open-source version of ArcGIS. All the JF cave data in the STC archive has been translated and configured to show up in QGIS, which can even be used on our Android phones in the field. LiDAR/topo/satellite background, cave locations using a



Dye releases to 25th August (green outline is completed, magenta - yet to be done, yellow — TBC by device)



Some delicious, automatically generated graphical carnage in QGIS

spreadsheet master, survey overlays, roads, cave routes, points of interest, surface walking breadcrumbs, etc. It is still a work in progress, but at some point soon I will make a sample package ready to share and be populated for other areas, so watch that space or feel free to hassle me.

But I digress… the point of all that was that the increasingly huge dye tracing dataset is also integrated to allow geographic visualisation of the myriad devices, traces and context in the grand scheme of things. Device deployments, dye releases and links between the two are recorded in spreadsheet registers, which generate CSV files for selection and display in QGIS.

The current state of play has all the planned dye releases completed, although extra data points are always useful, and a nervous wait until everything can be retrieved and the data extracted in summer and with open borders. I've been having a bit of a break from full-on detector work to catch up on life this lockdown, so while I've been keeping the ball rolling, things like commercial rollout/sales, another batch and what on earth to actually do with the huge dataset have been on the backburner.

If you have a potential dye tracing project, and/or would be interested in buying some kit, please feel free to let me know. There isn't much in the way of spare devices at the moment, but there should be a few kicking around once the current batch is retrieved.

DAN MKITCHELL

Oxana and Nina prepping Oneshot dye release devices

When sh!t happens…

Brian Evans
ISS

WE ALL KNOW... we all quote… that caving is a very safe activity. We say that it's far more dangerous travelling to the cave than being in it.

We endlessly explain that we are not death-wishers or brave superheroes. That caving is not as dangerous as soccer, or netball, or cycling.

All this is true, I think, although I've not recently compared the numbers.

But we know that sh!t does happen, and we know that the consequences of an accident, or medical incident in a cave are likely to be complex and slower to deal with — that's part of the reason that we have so few incidents — we do, for the most part, take care!

Those cavers around the country who train for cave rescue know this, and that's why we got into it — knowing that if someone has an incident, a caver is going to be more effective at getting them treated, and out.

But we also know, that if we're not already there, it's going to take many hours to get cave rescuers to the incident — many hours that the casualty would be better off not waiting, if they could avoid it.

So who does this leave as best placed to help a caving casualty? Their mates: those in the party, or on the trip. Those who have been on remote expeditions probably already know this very clearly — but those caving in settled areas should, too.

Risk management is clearly a trip leader's role, but it's also important for other cavers on the trip, as is thinking about how to help a member out, in the event of an incident.

Obviously, there are going to be occasions when the casualty must NOT be moved, or can NOT be moved by the party s/he's with. Self-rescue will NOT always be an option.

I'm not asking you to not call your caver rescuers. Nor am I saying don't call emergency services. Far from it.

I am saying that you should be evaluating whether your own team can respond effectively to the problem, because you're there, and more expert rescuers will be hours away.

So here are a few things that I think all cavers should be developing in their skill sets, that might make a BIG difference to the outcome.

FOR ANY INCIDENT:

Initial assessment

Look and Plan first!

Danger — there's absolutely no point in placing yourself at high risk as well. You have to evaluate whether the risk of your getting mashed as well will help the casualty.

So, take five:

1. What happened? Is someone hurt? Is someone not responding?
2. Is there a safe way for you to get to them? Or to get them to you?
3. Observe. If it's a medical incident, the cave is just as likely to be as safe as it was before, but a rockfall? Is there a way to avoid dislodging more? Anchor failure: how can you gain access?
4. Communicate with others: devise a plan together. Two minds are definitely better than one.
5. Review. Keep looking for changes of information that might need a revised plan. Keep talking with other members of the team.

Assess: What injuries do they have? Can they be moved to a place where they are safer?

Deal with life-threatening injuries — bleeding, breathing; and get them to a place that is not making them worse — not hanging, or in water or wind; and then you can consider options. Maybe your team can brace and support the casualty's body?

Once you've got to the casualty and managed any immediate first aid, now it's time to really plan. Discuss with the team, and casualty if possible: How urgent? What needs to be done? In what order of priority? Who can do it? Do others need looking after?

- Will moving the casualty make them worse? Will leaving them exactly here make them worse? Hypothermia is often a problem waiting to happen in caves.
- Is help from outside required urgently? Remember emergency services will be many hours away in most caving situations. Have you got other cavers nearby who could help?
- Can the casualty move her/himself? Can your team assist the casualty in moving? There are mental benefits in allowing the casualty to be a bit independent — do the benefits outweigh the further damage they may do? Even if it's just to move them closer to emergency services coming in? What equipment and skills do you have to do this?

Of course, sometimes, the casualty cannot be moved, or the team will not be able to get her/him moving through the cave and sending someone for help is the only solution. Perhaps those sent for help can bring stuff in to help keep the casualty and whoever stays with them safer and maybe even comfortable?

Even in a cave, a tent will make the casualty much warmer. Mats and sleeping bags are obvious. Stove, food? In most circumstances, don't worry about 'Nil by mouth'; the casualty will be needing energy just to keep warm and alive, even if they are in a stretcher. Anaesthetists can cope with vomiting on the table better than the casualty can cope with starving during the wait and rescue.

Does the casualty need a stretcher? Do they need bits splinted? What do you have that you can adapt to splint and protect the casualty?

At the entrance, do you have tent poles, car seat covers, bags, packs, tarps, gaffer tape, raincoats, cardboard, mats, foam? What else could you use? FUSSI have been giving themselves rescue practice exercises where they challenge themselves to build splints or a stretcher for a specified set of injuries with what they have with them for the weekend — that seems like a sensible challenge to try…

Do you need extra rigging gear? Is there stuff at the entrance? In camp? How long would it take to return with gear? Are there ropes and rigging elsewhere in the cave that you can use?

Extra gear: water, food, warmth, knife, tape
It's always tempting in a long, hard cave, to have as little as possible, and rely on being active to keep warm, however, if sh!t happens, you'll want some extra. In hot, northern, caves, that might be water. In cooler climes, it'd be an aluminised rescue bag and some food.

Knife: do you carry one? In rope work situations it could save your life, or someone else's. Even when there's no ropes involved, a knife can help with splinting and bandaging.

Leaving extra gear at the entrance may be helpful. Perhaps a caver going out to get extra stuff is quick enough? You'll need to think that through with respect to walk times, and speed in moving through the cave.

Extra rope available in case of emergency is very useful, especially on trips that include dependent cavers, who have fewer skills to draw on.

SAR CONTACT

Do your trips have a check in (SAR) contact?

Do all members, and the SAR contact, understand the same rules of what will happen, and when?

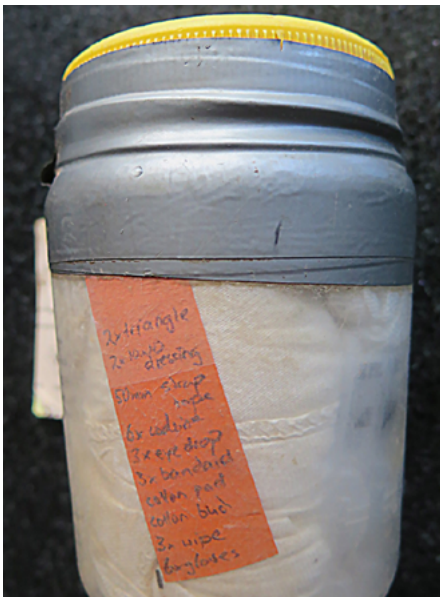
I've caved with some clubs that have a very clear check-in system. A time is agreed.

If the SAR contact has not received the check in at the time, they call people to initiate a search immediately. Other clubs have no real system: there might be a contact nominated, who knows where the party was intending to go, but may not act if no-one checks in… There are many variations in between!

The important part is that contact and cavers understand their system, although I suspect that a system that initiates immediate search response, but with a late check-in time (perhaps even next morning) is the easiest to understand.

- Does your club have a system? Do all leaders and cavers understand it?
- Does the SAR contact have a plan, and the appropriate phone numbers (and back-ups) to put it into place? Do they have cave maps and entrance location information?
- Can the SAR contact point rescuers to someone who knows the cave? A cave map? Rescue information? People or gear?

FIRST AID TRAINING AND WHAT TO HAVE ON HAND



BRIAN EVANS

Figure 1

To be blunt, skills are more useful than gear. Get training. If you can, get on a CareFlight trauma course, or, even better, a wilderness first aid course.

Encourage as many of your caving buddies as possible to do the same. At least a basic course is better than none.

For gear, it depends on the trip: intro trip, or normal club trip with dependent cavers along? You should be carrying a bit. I carry:

2x triangular bandages
Nitrile gloves
50 mm roller bandage
Isopropyl alcohol wipes
10x10 non-adherent dressings
A big cotton wool pad
50 mm rigid strapping tape
Some cotton buds
Painkillers
A few band-aids
Some saline ampoules
Some duct tape

There's room for improvement — and certainly argument. My thought is that this is stuff that will make an immediate difference in a major incident, or stop a small incident getting much worse — not something for treating the minor injuries. The band-aids should not really be there — steri-strips would be more useful. Likewise, I'm not sure how useful the painkillers really are.

I package these in a plastic peanut butter jar, with duct tape to ensure it seals — see figure 1. It's a bit more bulky and awkward to pack than I'd like, but it really is waterproof.

Carried separately is the rescue blanket, knife, a few matches and another roller bandage for snakebite, if that's a risk.

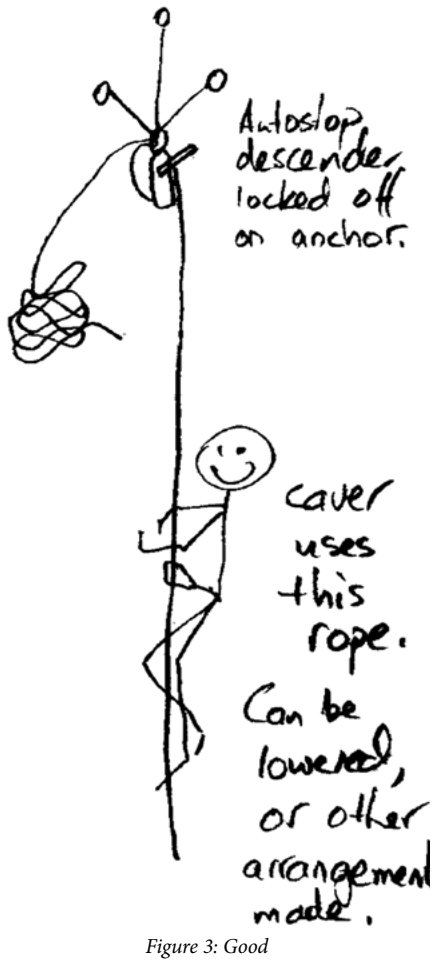
For tough trips with all independent cavers (where I'm usually the weakest link!) the kit is much smaller: rescue blanket, knife, matches, roller bandage.

CAVES INVOLVING ROPE WORK

Rigging for rescue

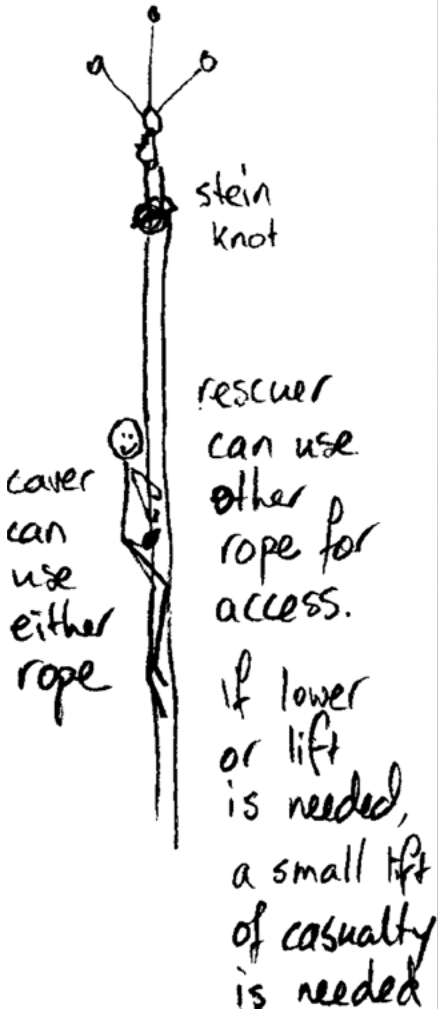
BRIAN EVANS

Figure 2: Best



BRIAN EVANS

Figure 3: Good



BRIAN EVANS

Figure 4: Still OK

OK, this concept might be new to many, but it's simple, usually easy to have the gear, and can make an extremely quick difference in saving a life. I don't use this for all my caving. I do use it when I'm with dependent cavers, or pull-through trips when I'm using a double rope anyway.

We all know about the dangers of harness hang syndrome. Do we all know that it CAN happen in minutes?

If we rig descents through a descender, a casualty having issues on the rope can be lowered through the descender from the top, even if they are unconscious. If we rig with a Munter (Italian) — see figures 2 and 3 — hitch, and lock it off, we don't need extra gear.

If we descend on single ropes, but rig a doubled rope through a Stein knot, another rope is loose and ready for someone to descend to help, and with a little equipment and fiddling, a descender can be fitted — see figures 4 and 5 — the weight taken with a tiny lift and the Stein knot removed so the casualty can be lowered or lifted by a counter balance.

Even if you don't have enough rope to rig two, at least make it easy to introduce more rope and lower. Use a separate rope for the rigging and the hang, and have an ascender available to take the weight, and allow re-rigging with extra rope. Of course, this is not practicable in all situations, but should be a consideration, especially when with dependent cavers, or where a problem is probable. Consider bad air or very tight abseils.

Does everyone have all of their SRT gear on and ready when doing ropework? Ascenders there, ready to be clipped to rope, even on a pull-through trip? We should!

Practice beforehand! At club vertical sessions, do the problem challenge: invent a problem for the group, and see what ways it can be solved, with the gear that you'd have with you.

When the problem involves someone hanging on a rope, always rig for rescue so that casualty and rescuer can be lowered if all goes wrong! Best is a seriously over-the-top option — suitable for when you are very concerned about a pitch, e.g. abseiling into probable bad air.

Pick Offs

Phew! Scary! A caver might let their hair, clothes, gloves or body bits get into abseil devices A person might also need a pick off after being hit by something, or falling.

You may have as little as four minutes to get a person trapped in a harness off the rope, or horizontal.

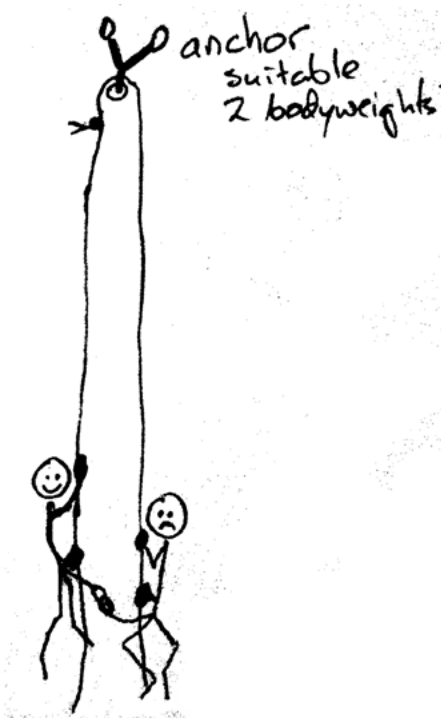
Encourage anyone caught on a rope to keep moving, especially their legs. Use their foot loop to stand up and move. Tie a loop in the rope below and stand in that. Can they tie a prusik with a sling, or use their pack?

The technique you choose is not important. What's important is that you practise it, often, with the gear you'll have, and that your caving companions will have. You should be confident that you can do it reliably within five minutes. There are some links below — practice and discuss amongst your club. Always rig practice sessions with the ability to lower the rope with both casualty and rescuer on it (rig for rescue) — it is possible to jam yourself in an endless loop that neither of you can escape.

Assisted Prusik

So you have a tired team member? Or somewhat damaged, but conscious and capable? Assisted prusik is simple, fast and able to be used in many situations.

You do need a single pitch (at a time) and no re-belays. Simply tie another rope on so that you have a doubled rope from bottom to top and back again, and clip that doubled rope through a pulley, or even a karabiner: a pair of opposing crabs or a big steel one



BRIAN EVANS

Figure 5: Assisted Prusik

works better. Put the casualty in their ascenders on the rope on one side of the pulley. Put the rescuer in her/his ascenders on the other. Both clip to each other with a sling or cow's tails. As the rescuer ascends, they go twice as far, but only lift the difference in weights + friction. At the top, both need to clip on and take weight before either can remove their ascenders.

EXTRA GEAR

I carry a few extra screwgates, a small pulley and my pack has a sling and an extra snaplink. Sometimes I have a couple of short prusik loops, too. I've recently changed to one 2 m long 4 mm prusik cord, having watched such being used very effectively.

There's always much discussion about this. Choose what you know how to use and have practiced with. There's always a braking 'biner on my descender, too, in case I have to take a double load.

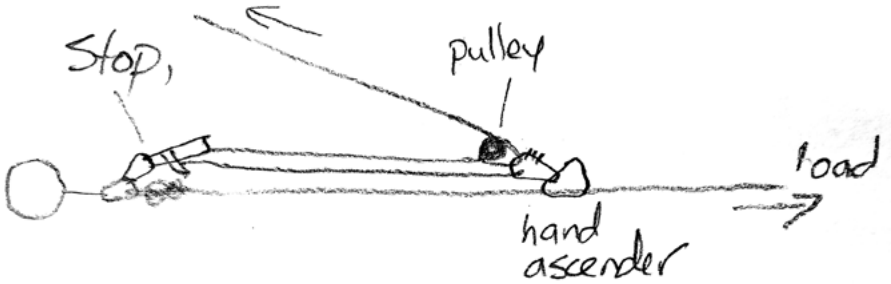
I don't care that I'm carrying a few 100 g of gear that I should not need: I'm also carrying 10 kg or so that I don't really need! I've used that extra gear almost every time I go out as leader, or with less experienced cavers.

A SIMPLE Z HAUL

So easy, and, apart from extra rope, you have the gear on your harness already. You'll get a bit better than 2:1 effectively if you use one pulley and a Stop for progress capture. Nearly 3:1 if you use two pulleys with a prusik as progress capture.

If you can use a counterbalance to move them, that's physically much easier, but sometimes a 3:1 can be applied in a differ-

The problem: You've anchored your rope to a sling and now there's a problem on the tight rope.



BRIAN EVANS

Figure 6: The solution: Some extra rope. Maybe the tail? Ascender, autostop, pulley and a couple of krabs… This is a "bolt-on 3:1" Have what you want to replace it with ready before you take the tension off. Then take in and hold the load while you install a system to lower.

ent direction, or in a place where you can't get bodyweight to do the work for you.

ESCAPING THE BELAY

Simple. Never build a belay that you have to escape from. Attach your belay device of choice to the anchor. Attach yourself to the anchor.

If you didn't do this, you'll need to Z haul the loaded rope up and re-belay it without you in the system. Possible, but much more time-consuming. Your buddy-in-trouble will not thank you for that delay.

COMMS

Look, we all reckon we know what's going on, and have loud voices, so there's no real need to communicate.

True, until something unusual happens. Suddenly, the team doesn't follow, or there's a new plan but we don't understand it.

A few of the cheapest, lowest powered handheld radios scattered in your group will make a big difference when the usual rules don't apply, and a self-rescue needs to be initiated, especially in a noisy environment.

Agree on a channel. Turn them on. Do a radio check to see you are all working.

UHF is probably not worthwhile for most caves, but noisy pull-through trips, canyons and single entrance pitch caves are sensible.

They're also good for travelling on the surface to and from the cave.

For those who don't know: UHF radios will work well in line of sight underground, so from pitch top to bottom is usually fine. Often you can get a bit more range.

I reckon inability to communicate has caused more chaos than anything else on trips I've been on — when something happens and the plan needs to change, but some of the party cannot understand why, what or how...

CAVES THAT DON'T USUALLY REQUIRE ROPE WORK

Carrying a rope and some bits

We've all been taught to have 5, or 10 m of tape around our waist when horizontal caving. And do we always remember? Useful to help someone, but extra useful if someone falls down something, or needs to be dragged through something, or even for bandaging. Include a karabiner, and make sure the rest of the team has the same, and a great deal can be done if one of you has an incident.

RIGGING A BELAY

So what if it's not usually needed? It might be useful for today's party, today.

You have tapes, and a krab, use them. A Munter/Italian hitch does work OK with

BRIAN EVANS

Figure 7: A Munter works OK on tube tape of 25 mm or thereabouts. It's probably not good for the tape. If you potentially have a freehanging, heavy buddy, use a SuperMunter knot. (Look it up)

BRIAN EVANS

Figure 8: If you're stuck with seat belt tape, the 'twisted knot' approach with one turn like this, or two full turns, is probably better.

tube tape — see figure 7. The old 'twisted knot' method of running the tape through the krab three times might be more suitable for 50 mm rigid (seat-belt) tape — see figure 8.

You might not have an anchor. If not, consider a 'meat anchor' but take care — first, that the person you select as body belay is secure and cannot be accidentally pulled down; second, that they know what they are doing; and third, that there are others around to help — the belayer cannot escape from a meat anchor role if the climber falls.

RIGGING A TIGHT SAFETY LINE

You may not have the gear or skills to rig a tyrolean (tight line suitable to safely carry an immobile casualty across difficult terrain), but can you rig a tightish line that a mobile casualty can use for support and assistance as they climb?

I know a group who were able to help a friend who kept falling down after a medical incident, by using the lines they'd rigged to carry equipment into the cave. They were not prepared to carry the casualty on the lines, but could rig them so that he would not fall over when he stumbled.

A TARP TO SLIDE THE CASUALTY

No stretcher? While I'd argue that a stretcher should be in camp for expeditions, I agree, you're not likely to have one available for every caving trip.

However, even an inert casualty can be dragged and slid through difficult terrain with some mats and something with low friction — a tarp? Yes, the tarp is not likely to come out of it well, but this will be a small price to pay.

Consider also the homemade stretcher

concept. I put the FUSSI link below.

REMOTE CAVE EXPEDITIONS

You know you need to be self-contained for most things — that includes self-rescue!

It will be days before anyone else can realistically help you with a cave incident. The local emergency services are not likely to have well-developed cave rescue skills!

Members on expeditions should learn rescue skills, and first aid, and take with them the things that they consider they could use if an incident occurred, balanced against the expense and difficulty of getting extra gear to the location.

Here are some things that I'd consider; your team may come up with different things.

- Stretcher
- Enough first aid stuff for major trauma, and several days.
- Ropes
- SRT gear
- Krabs, pulleys
- Drill
- Satellite comms
- Deobstruction tools
- Removable anchors

You can borrow a stretcher, satphone and/or AED from the ASF or various clubs.

WHAT CAN WE DO ABOUT THIS?

Know more! Practice more. On nearly all of our trips, nothing will go wrong — cavers are pretty careful adventurers. However, practising how you can solve a problem will make a big difference to what you can do for your partner, when sh!t does happen. Have a look at the further reading below.

FURTHER READING

Vertical, Al Warild esp. Chap 9: - Disaster
https://www.cavediggers.com/files/vertical/9disastr.pdf

Al's chapter on Disaster covers plenty of ways to make a difference when something goes wrong.

Life on A Line, Dave Merchant
https://www.speleo.no/redning/Life%20on%20a%20line%20part1.pdf

Dave Merchant's book is a thorough treatment of 'cavalry'-based cave rescue that considers both British and American approaches but does have relevance to small teams of cavers supporting each other.

ASF Safety Guidelines
https://www.caves.org.au/administration/codes-and-standards

Our own organisation includes description of a lot of good practices.

SPAR resources from the US NSS
https://tinyurl.com/jebk9e48

The American National Speleological Society has put together an impressive reference and course on Small Party Assisted Rescue. The book below is one, but this web page offers some useful tools.

SPAR US book ~ A$150
https://tinyurl.com/ye9yy443

The book for the SPAR course. I've seen extracts — it looks good.

Cave Rescue Techniques, Italian CNSAS
https://tinyurl.com/d636xxsb

This is in English, and well describes the lightweight European school of rescue thinking which is appropriate to self-rescue in caving teams.

US Cave Rescue Commission
https://ncrc.info/

Like our ACRC pages.

Self Rescue, Dane Evans
https://goneepic.com/self-rescue

For climbers. Has more detail than this article, and has a strong bias toward solving your own problems on climbing routes, not calling for help just because you have the technology. Worth a look for cavers.

Specific techniques

Pick-offs:
https://www.cavediggers.com/files/vertical/9disastr.pdf
Rig for rescue:
https://www.ropelab.com.au/rig-for-rescue/
Stein knot
https://tinyurl.com/4t7454xd
Improvised stretchers
https://fussi.caves.org.au/newsletters/FUSSI_22_2_10.pdf
Harness Hang Syndrome:
https://en.wikipedia.org/wiki/Suspension_trauma

CAVE RESCUE TRAINING

All cave rescue groups around the country invite new people to be involved and learn the skills.

Join them on a course. You'll learn very useful skills for your own caving, and also may be available to assist when a team is needed.

PRACTICE

These skills certainly need regular practice. Organise a session or a training weekend, for your club or expedition group, to challenge yourselves with the sorts of incidents you can imagine. Perhaps use a cliff, rather than a cave - sometimes it's easier for a group to see and contribute, but caves do present challenges that ordinary cliffs do not.

Find some like-minded people to enthuse and practice with.

Always rig for rescue in these sessions - you're going to be asking people to try new stuff! There does need to be a safe way to get people to the horizontal again.

WHAT IDIOT WROTE THIS?

I'm certainly not the expert on how best these things are done — I'd argue that being expert is NOT the essential thing — we can certainly learn from them, and we have plenty in the caving community — but what will really make a difference for your mate whos in trouble is what each of us can actually DO when sh!t happens. It's the responsibility of all of us to learn, practice and think about these issues.

Let's all promote practising these skills, and thinking and writing about this aspect of caving.

Bloody hell, I've made enough mistakes and needed help in 60 years of outdoor leadership. I'll keep making them.... and trying to learn from them.

So far, I've not had a major injury, or worse, on my trips, but I have needed outside help. Sometimes, I should have handled things differently.

I include a thank you to all of those people who have taught me almost all of the things I've discussed above — you have all made me a better caver.

...and an extra note to three of them who edited this and tried to make it better. In fact, they did make it better, but I own all of the bits that they couldn't improve.

This article is intended to prompt discussion and thought amongst cavers, not to be definitive or even detailed. I think some more articles like this that describe specific techniques in some detail would help. Who is up for creating them?

AUSTRALIAN CAVE ANIMAL OF THE YEAR 2022

Ghost bat

Macroderma gigas

It's time to bat for bats!

Emerging from forests and caves to feed in the darkness, bats pollinate our crops and feed on insects that could, if left unchecked, become plague species. But 'out of sight and out of mind', people are often oblivious to bats. With declining populations and a range of threats, bats need humans actively on their side.

A resident of tropical areas in northern Australia, the endangered ghost bat is the only carnivorous bat in Australia. Its large eyes, huge ears (twice the length of the head!) and nose-leaf all assist its keen hunting skills to find prey, which includes small birds, mice, insects and snakes.

Cave Animal of the Year celebrates our little-known cave animals and the importance of caves as their homes. Join with us and learn more at:
www.caveanimaloftheyear.org.au
hello@caveanimaloftheyear.org.au

We gratefully acknowledge support from the Australian Speleological Federation's Karst Conservation Fund.

BRUCE THOMSON

Announcing the Australian Cave Animal of the Year 2022

The Ghost bat *(Macroderma gigas)*

Cathie Plowman
NC

BATS. They can be loved or loathed, revered or detested. Thankfully bats have many friends in cavers, but in the wider community there is often an abhorrence towards these creatures of the dark that many people know little about.

COVID-19 has added to perceptions that bats are dirty and bad. Not so readily discussed is the constant alteration of the natural world and our relationships with wild animals so that animal diseases can cross over to humans.

GETTING TO KNOW OUR 2022 AUSTRALIAN CAVE ANIMAL

Different authors give alternate reasons for the name 'ghost bat'. Some say it's for the pale colour of the wing membrane and pale skin, while others link the name to the near white to pale grey colour of the fur.

Ghost bats are endemic to Australia and were once widespread over northern Australia including the arid lands. Today they are confined to three separate regions that are all north of the Tropic of Capricorn, all either near the coast or within about 400 kilometres of it.

A prominent feature of ghost bats is their large nose-leaf. Like most other bats, ghost bats use echolocation to navigate, and the ultrasonic waves of echolocation are generated in the larynx. The nose-leaf of the ghost bat is part of the complex system of directing and receiving echolocation to detect prey.

2022 CAVE ANIMAL PROMOTIONAL MATERIALS

We've produced our attractive and popular items of poster, bookmark, sticker and tea/coffee mug. The poster, bookmark and sticker are all free of charge.

Postage and packing fees are minimal. Donations are appreciated.

Mugs are $10.00 each plus postage.

Spread the word about ghost bats by displaying a poster in a public area such as libraries, outdoor shops, Scout halls, notice boards, schools and anywhere where we can increase public awareness about cave animals, and in 2022 the ghost bat.

The poster is not intended for private homes and offices. But if you can display one in a public area you can collect it back at the end of the year and have your own copy. Win win!

Stickers and bookmarks are readily available to distribute and increase the love for cave animals.

To order your 2022 Cave Animal of the Year products please email: hello@caveanimaloftheyear.org.au

To learn more about ghost bats:
www.caveanimaloftheyear.org.au

Thanks to the ASF Karst Conservation Fund for ongoing support of the Australian Cave Animal of the Year program.

BRUCE THOMSON

JF-389 Porcupine Pot

Diving 'The Ken Murrey River'

Stephen Fordyce
VSA/STC

This article originally appeared in *SpeleoSpiel* 444: 42-48 (May-June 2021)

PARTY

Keith Chatterton, Stephen Fordyce, Gabriel Kinzler, David Myles, Ciara Smart, Petr Smejkal

SUMMARY AND PREAMBLE

Spoilers: A utopia of new rigging. 420 m of new JF master cave (The 'Ken Murrey River'). A lovely dry bypass.

Apart from the JF-36 Growling Swallet/JF-237 Niggly Cave system and the JF-008 Junee Cave resurgence, JF-389 Porcupine Pot is the only section of accessible Junee-Florentine master cave — 1.5 km of large-scale streamway passage which carries water from many small feeders. It's upstream of Niggly, with a gap of about 1 km between their extents (and the Living Fossils section of Growling Swallet is punching right for the middle of this gap). The Porcupine downstream extent ends in somewhat inconclusive rockfall, while the upstream extent ends in a rather remote sump which had been known for decades but only dived in recent times.

It had been 2.5 years since the December 2018 dive in Porcupine (Fordyce 2018) — a sordid affair with 300 m of new underwater cave but no survey. The intervening years saw everyone distracted by breakthroughs in Niggly and caving politics. Both having been (mostly) resolved in late 2020, Porcupine could now be visited again, and the black mark on my surveying record could be expunged.

TRACK CLEARING AND RIGGING

Back in April 2021, Gabriel and I couldn't bring ourselves to actually go underground after a punishing day finishing off new discovery JF-703 Jimmys Window (report and map still on the list), and ended up spending hours clearing the track anyway. Alas, the gouge in the door of my Falcon attests to our failure to cut all logs back far enough.

Keith, Dave and I had a shakedown and played with new rigging on the first day of our two week May 2021 JF trip. Delicious new Bluewater 9.5 mm rope (we had 2 m to spare off a 200 m roll), new concrete screws/SS hangers/SS maillons are installed throughout, mostly using the old concrete screw holes. I covered the cost of most of this gear (SS hangers and maillions from Niggly were re-used) but while it's in Porcupine it should be considered club gear. I'm hoping to get reimbursed by a grant I've applied for, in which case it will become club gear in perpetuity.

So please take the opportunity to visit this significant and interesting cave!

A few changes and simplifications were made, including converting many rebelays to redirects and a new route down a final pitch rather than around the awkward traverse. I was quite proud of the new rig, but the grumblings from the Sherpa team (and my broken toe) suggest that the rigging is likely to evolve over the next little while, so we'll do detailed notes once it's settled.

The old rigging was completely removed by others. It was in surprisingly good condition considering some of the concrete screws had been there since 2016!

PUSH DAY

Saturday 8 May was the day, and a hardy team of six met up at our AirBnB in Maydena to faff with gear and packing - we got away at a suboptimal but not totally unreasonable time.

As usual, I was not one to waste an opportunity and we split into pairs to enact

GABRIEL KINZLER

The closest thing I could find to a group photo

STEPHEN FORDYCE

The dive gear made for six reasonably acceptable bags

dye missions on the way. Petr and Dave headed into the cave straight away, to go through the miraculous bypass and place a dye detector as far downstream as they could get without getting really wet.

Ciara and I went to set up a dye dispenser at JF-414 Jolly Roger, and Gabriel and Keith went to set up a dispenser at JF-388 (these are the big swallet dolines flanking the Porcupine entrance).

The dispensers were programmed to drip slowly for 6 hrs and allow us to do a visual dye trace, and another slug release in a few days once things had settled. Cross pollination of mainlanders and Tasmanians was also achieved. Nobody complained of hayfever, so that was good.

Dye missions achieved, we met up with impeccable timing at the bottom of the rockpile (damn, my plans are awesome) and proceeded. The Horrible Crawl (75 m wriggling on your belly in the stream) lived up to its name but the team remained undaunted and we popped into the master streamway.

There was no sign of dye from the dispensers, but we put out a detector to catch water from the various inlets (and the main stream from JF-35 Gormenghast) feeding the Horrible Crawl.

We also put a detector in the master cave streamway upstream from the junction, and a weather station to record atmospheric pressure up the bank opposite the HC. The fourth and last detector was eventually installed near Trump Rock and the upstream sump. It was interesting to note that flood marks from the intervening years were no more than 1.5-2 m (contrasted with the 20 m+ floods we know happened in Niggly over this time). Interesting indeed.

With Petr and I veterans of the three (four?) previous dive attempts, route finding was easy, despite the intervening years. Improbable wet squeezes, rib-cracker rocks, stoopy wades and precarious rockpiles were remembered with fondness and enjoyed by all. The newcomers were impressed with the proportions and significance of this section of master cave.

Trump Rock (a large and belligerent orange thing which sits alone and out of place in a large room) and a cache of old gear was reached. We had brought all our own stuff except weights, but figured we probably should use the 2.5-year-old gas canister first…

Everyone pitched in to get me dressed and help me get to the water, saw me off (about 3:30 pm) and headed back to look at the pretties and work on a lead Petr had in mind. They found a bypass to some of the worst of the squeezes between the two rockpile sections! We went back that way, but I'm not sure I could find it again…

GABRIEL KINZLER

Porcupine veterans, Steve and Petr, discussing the finer points of caving light design

THE DIVE

Arrrgh! I screamed in terror as the friendly but unexpected 2 m bull ray disappeared back into the murky darkness from whence it came. This was not supposed to be in the cave. Neither was the fisherman who tentatively hooked me, the puffer fish, rusty junk or giant mutant starfish with spikes. I was also overdressed and overheating in the autumn warmth of northern Port Phillip Bay. This was my dress rehearsal night dive, a few days before heading to Tassie — as I often do, I ran through a simulated push dive including line laying, surveying, GoPro'ing and generally practising all the mental and physical skills I might need. The cave would be much more pleasant.

I had optimistically underestimated the effort required to get the gear between Trump Rock and the sump proper (we'd previously always done it with two people). It's low and shallow enough to be really painful, and I recommend asking the Sherpas to help as much as possible — using a low/dry bypass up to the left, it's possible to get quite close to the sump, while the diver can float on their belly through a low semi-submerged section. I recommend not kitting up properly until the actual sump.

After ~30 m of easy floating past the point where Sherpas would have to get properly wet, a 2 m section of awkwardness is required between pools — it's cobbled streambed, too low to crawl and bloody annoying. I recommend kit off, especially on the way out. The sump pool is extensive but also low, the roof is perhaps 0.5 m high.

Once in the sump pool proper (it's an upstream sump, so you don't have to worry about thrashing about and silt going where you want to see) the hard work is over. The sump is a joy, typically at least 1 m in any dimension, and often 2 m or more. I had been a bit concerned about the state of the

KEITH CHATTERTON

The obligatory 'Goodbye' pic

260 m of unsurveyed line laid by Andreas and me last time, but it was in great condition and better laid than I remember doing. The only thing I had to do was pull it out of siltbanks on occasion.

The visibility was great — maybe 5 m — and the GoPro footage was quite decent (I will keep this in my personal archive in case anyone ever needs it). Water levels in the master cave that day seemed pretty normal, and flow on the dive was not appreciable, although while surveying out I did notice a silt cloud tended to catch up with me when I stopped.

The underwater passage is almost entirely free of rockfall or breakdown, with clearly defined walls (usually vertical, sometimes pinching out horizontally) and often a ceiling too high to easily see (although I did check for airbells).

The rock sticking out of the walls and sometimes on the floor is brittle and breaks easily — fairly typical of other JF dives I've done. Mostly, the floors are mud/silt, with dolerite cobbles noted primarily on the floor of airbells (interesting?). There were plenty of Anaspides.

I hooned along the existing line, although I was a bit dismayed at the amount of gas I had used on surfacing in the airbell previously named 'The Room of Correct Terminology' (RoCT for short, and the anatomically correct result of a conversation had last dive).

Last time while diving in a wetsuit I had used about 1000 L to get here, but with the added drag of a drysuit and many bulky undergarments this time around, I had used 1400 L.

Compressibility of gas (you get less bang for buck at the high pressures the tanks were filled to) was probably also a factor.

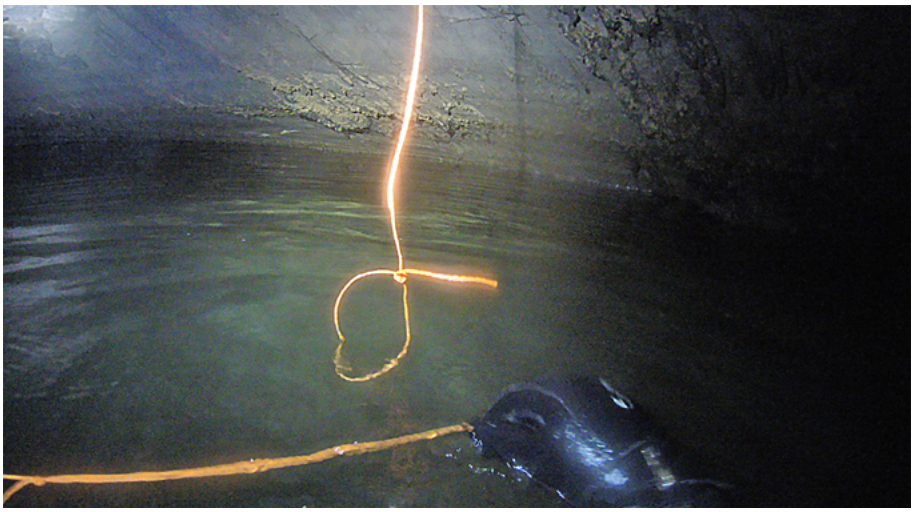
STEPHEN FORDYCE

Making a decent tie-off on this rock (it subsequently disintegrated)

INTO THE UNKNOWN

Another complication which had loomed was my buoyancy. The carbon fibre tanks and the double layer of undergarments made me quite floaty, and I'd put what I thought had been a ridiculous amount of weight on to compensate at the start of the dive.

However, by this point in the dive, I could tell that I didn't have much reserve 'sinkiness' left and as I used the gas in the tanks (about 2 kg in each tank) I would get lighter as the dive progressed. There was a long way to go before this became a survival



STEPHEN FORDYCE

I'd left a loop at the end of the old line waiting and ready

risk, but it was something best dealt with sooner rather than later. There was also the matter of how uncomfortable bulk surveying would be while struggling to stay off the ceiling (my dress rehearsal dive was awful for this).

I had been looking for good rocks and finding none, but fortunately the RoCT floor had plenty of dolerite cobbles — I filled my drysuit pockets as if they were gold (the density of gold would make it excellent for dive weights).

I still had a chunk of gas left before having to turn for home, so I attached Ken Murrey's reel and headed out. Ken was a friend of mine and a fellow caver and sump diver who passed away recently and this seemed like a good way to honour him. I also decided to name the whole upstream sump section the 'Ken Murrey River' in his memory just to make sure honour was fully satisfied.

The character of this new sump was similar to previous, but it was very straight and consistent, arrowing down to a deep point (15 m) and then a sharp right and up again in similar fashion, surfacing after 93 m total length. Still no restrictions or anything other than easy going — this was exploration cave diving at its finest.

Where the RoCT was more of an airbell, with barely a place to get out of the water, this new dry chamber (named 'The Undressing Room') was bigger, with a nice dry shelf 40 cm above water level big enough to stand up, and a bit more length to it. Neither air chamber had any sign of dry leads (although both had dolerite cobbles). I would discover an annoying shallow bit requiring annoying crawling/wriggling to progress into the next pool and some straws on the ceiling — significant for consistently ending about 50 cm above water level. They were also clean. It would seem like these indicate the maximum long-term flood level here.

UNDRESS FOR SUCCESS

I didn't have much gas left before I would have to turn for home, but enough to check out the next sump and see what it was doing. However the rocks in my pockets weren't being very effective (hard to beat the density of lead for negative buoyancy) and I wanted to deal with the floatiness issue a bit better before going any further.

Having taken tanks off to scope out the dry chamber, I took stock of things. A lot of rocks were going to be needed — my pockets were full and I didn't have a bag to put any in.

I could flood the case containing the DistoX… that was set aside for later.

I still had 350 m or so of orange guideline which floats a bit, but leaving that would be poor form.

Aha! I was wearing two sets of undergarments and had been if anything slightly too warm from the various exertions and breaks out of the water. Carefully taking off the top half of my drysuit, I removed my second jumper and bundled it into a ball, tying it up with a spare spool of guideline. It hurt to do, but I submerged it and squished the air out of it. This made an excellent difference and I had a more comfortable amount of negative buoyancy — great success!

GABRIEL KINZLER

There was no shortage of guideline

Leaving spare reels and unnecessary junk clipped to the guideline since I wouldn't have gas for more than a quick checkout, I negotiated a short/shallow/dry section with tanks and fins off and then re-kitted.

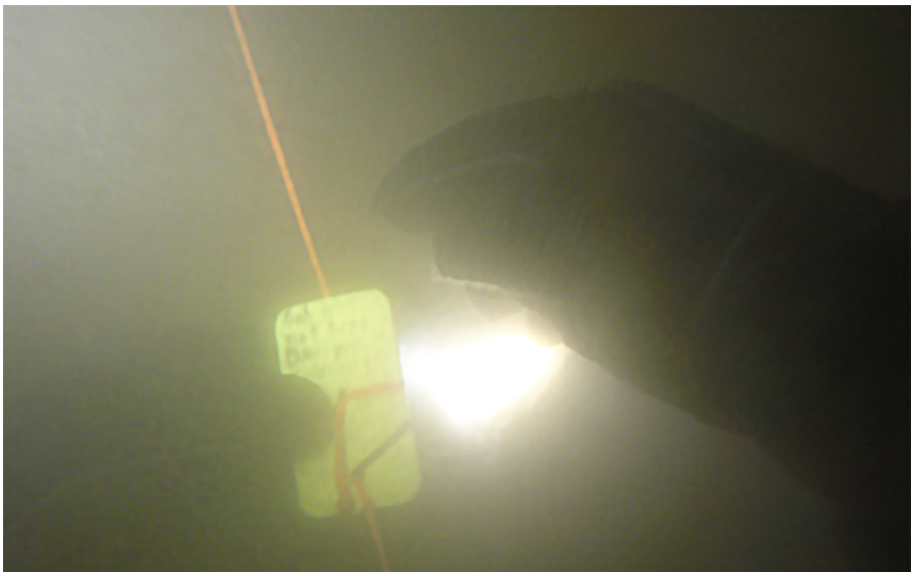
The third sump headed down a slope and I reached the first proper restriction for the whole day — a classic JF gravel slope on angle of repose meeting a roof step, about 5 m wide and with obvious bigger passage the other side. It didn't seem steep enough to give way and bury you, but was loose enough to give pause for thought. Aha, this is the sort of thing I had wanted to have a quick look for.

The gravel was loose and shifting it to get through in the centre would be possible, but take a bit of time. Fortunately I thought to check out the entirety of the restriction before starting on that, because at the far left (looking upstream) of the restriction it was big enough to get through in reasonable comfort, although as a precaution against gravel slides I went in feet-first. I got the line sitting as best I could, but future divers be warned if it's going to break anywhere (or get pulled into a line trap), it will be here.

HOMEWARD BOUND

Once through, the cave opened up again and I knew this was the time to turn around. I tied off the guideline beyond the gravel slope, attached a commemorative marker the Sherpa team had written messages on and cast a wistful look into the gloom as I began to survey out. I left it at a depth of 12 m barrelling off in 2 m x 2 m passage. It turned out that this point is 420 m of fairly linear cave from the end of the dry survey, following largely the same line as the rest of the master cave.

The trip out was reasonably uneventful. Stress levels peak at the far end of the push, where you are furthest from home and have the least amount of reserve gas. At this point you should have in reserve at least the amount of gas needed to get home if one cylinder fails. But by halfway back, this reserve is twice as much as you need to get home, and that's very reassuring. Some of this spare reserve can also be used if extra time is needed for surveying or line fixing, but I came out with plenty left — I think the slight current helped. Surveying out was pretty straightforward (the water



STEPHEN FORDYCE

What does the commemorative marker say? You'll have to go there to find out.

was pretty clear) and despite my lack of the second jumper, temperatures were tolerable. Towing the ball of jumper behind me in the water was easy, but on the occasions when it had to come out of water, the sodden thing weighed a ton!

Surfacing in the home sump pool (about 6:30 pm) and recording the last survey leg was nice, but the unanticipated epic effort of awkwardly de-kitting and getting gear back to Trump Rock was a rude and painful shock.

I'd been away for some three hours and the Sherpa team were settling into hibernation after a successful excursion to the pretties and finding a nice bypass of some of the painful bits.

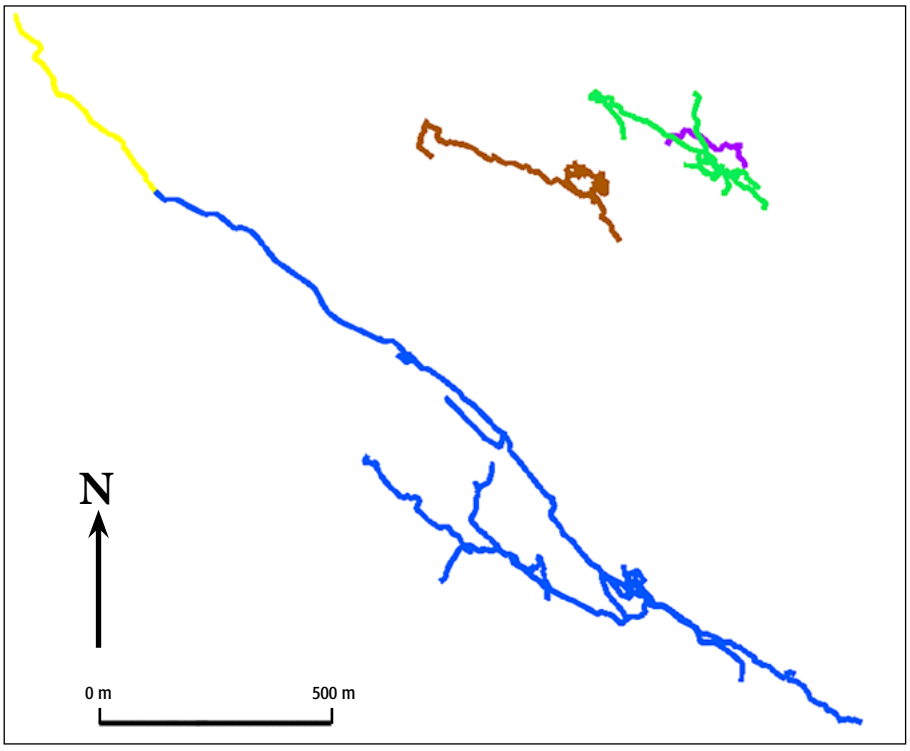
Still, I was well before callout time and we were all in good spirits after the successes of the day, and there were hot drinks and only occasional whinging as we slowly faffed our way towards packing and departure.

The soaked undergarment jumper was not appreciated by whoever had grabbed the undergarment bag thinking it would be a light option!

TAKING ONE FOR THE TEAM

We left the old kit at Trump Rock with an intention to collect it when retrieving/swapping the detector (I did record a stocktake video).

Since then, the old dive wing and fins have been removed. The intention is for the only things left there to be lots of weights,



New state of play – Porcupine in blue with dive shown in yellow. Tassy Pot, Owl Pot and Three Falls Cave also shown

but that will be confirmed later. Spirits remained high as we headed out, only briefly dampened when a falling rock broke my little toe at the base of the pitches (very lucky it didn't hit anything more important - see separate incident report). Fortunately it would seem little toes are unimportant for caving and my next two weeks were more or less unimpeded.

We arrived back at the cars sometime after midnight after about 14 hours underground, and my attempts at an inspirational speech were quickly quashed — the cretins were admirably nonchalant about the discovery of several hundred metres of JF master cave.

Offers to collect the dye dispensers were admirable but unnecessary — these still had programs to run now that the detectors were in place.

Nobody had noticed any coloured water, perhaps I had been overly conservative with the amounts, or estimated the transit times wrongly. Stupidly, I'd forgotten to arm the team with coloured lights, giving us a much better chance of spotting the fluorescent dye.

Keith and I happened to be recovering after our return through the Horrible Crawl when the detector there went off and we saw Fluorescein there from JF-388. Buggered if we could find where it came in with our white lights, though, unfortunately. Oh well, that's an easy one to repeat.

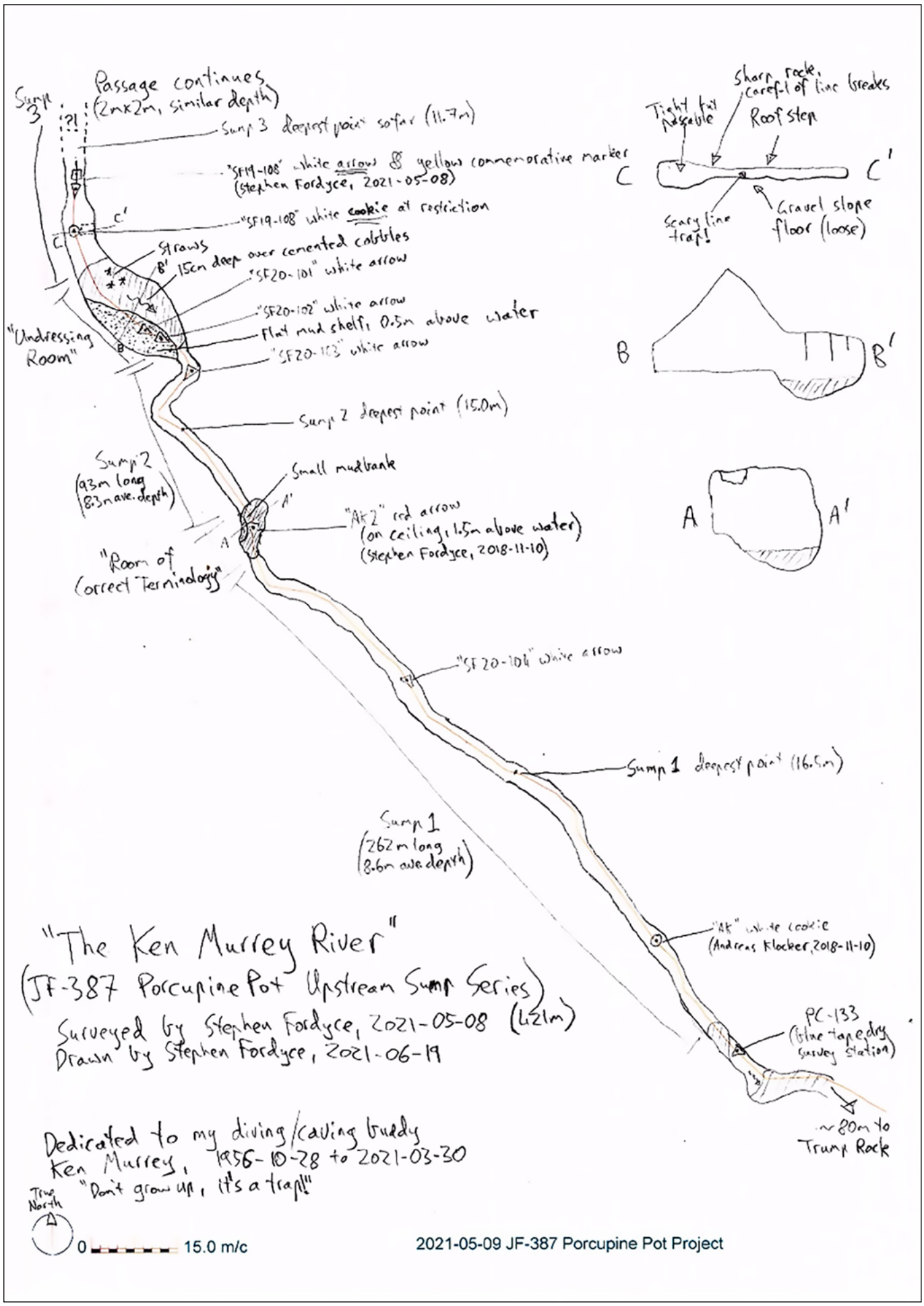
THE FUTURE

It was great to get back into Porcupine, especially carrying off a pretty audacious plan with near perfect success — awesome work by the whole team, who even all seemed to enjoy themselves. The detectors will be left in there over winter to record water levels, and many of the dye traces targeting them have already been done (but please, help with releasing dye desperately needed if we are going to get every single inlet).

There are more things to be done in Porcupine in the next little while, like push the downstream rockpile and perhaps attempt what should be a very short dive to connect to JF-35 Gormenghast.

The upstream sump is going on the backburner until dye tracing results are in, and options for finding a way in from the other end are re-checked and exhausted. Even then, pushing further would be a much larger logistical undertaking requiring a whole lot of Sherpa (and diver) enthusiasm.

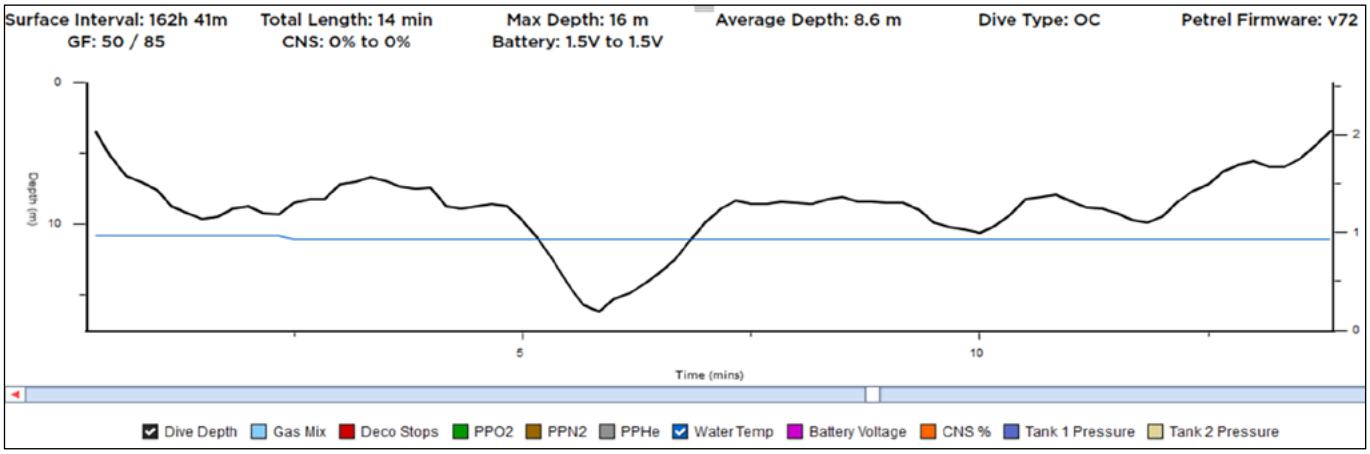
One day, perhaps I'll be that diver, perhaps not. In that case, I hope I'm still around to meet that diver, and I hope this report is useful to you. Good luck, have fun, and don't die.



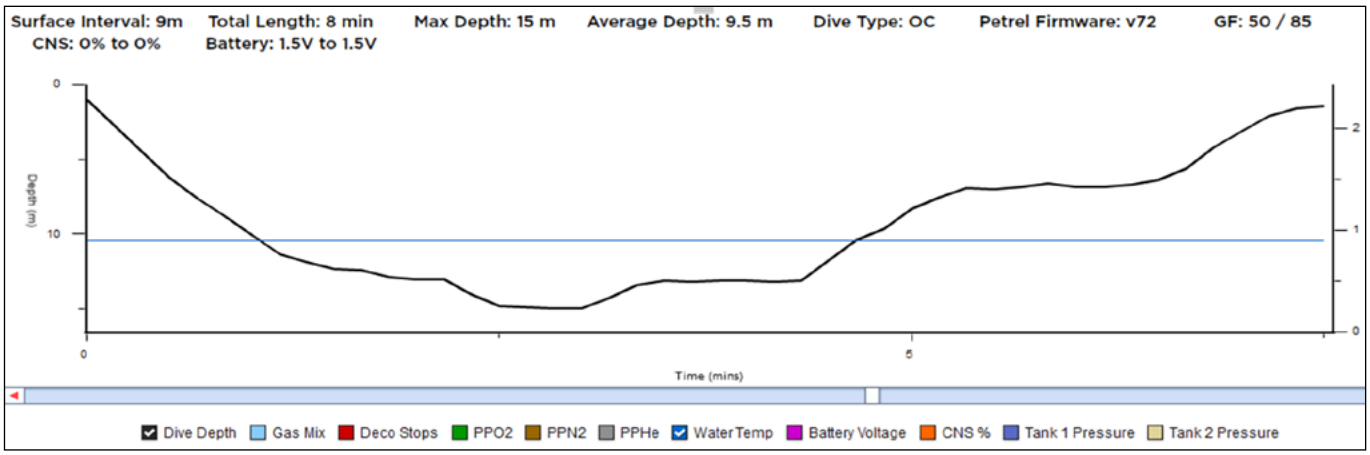
STEPHEN FORDYCE

Sketch of The Ken Murrey River

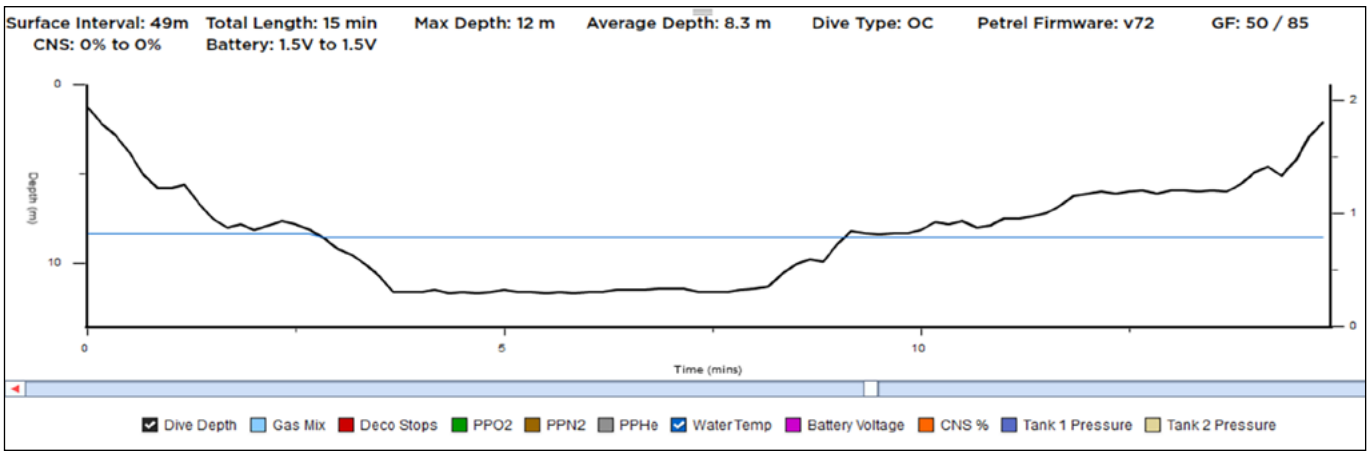
JF-389 Porcupine Pot: Diving 'The Ken Murrey River'



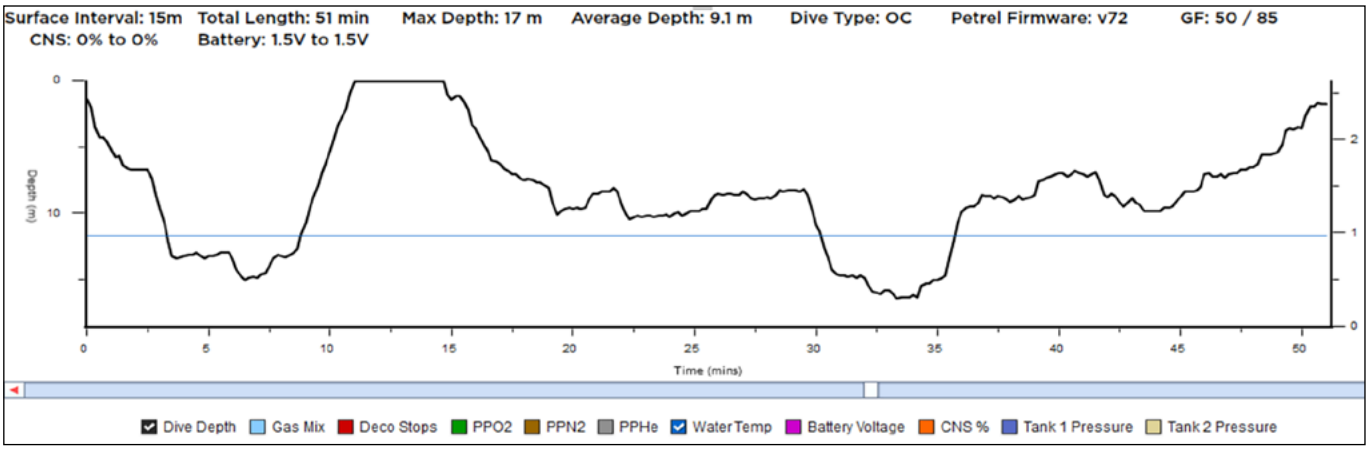
Dive profile #1 (Sump 1): start 15:44



Dive profile #2 (Sump 2): start 16:06



Dive profile #3 (Sump 3 out and back): start 17:02



Dive profile #4 (return through sump 1 & 2): start 17:32

Incident Report

Stephen Fordyce

This report was sent to the STC executive and also relevant ASF people.
Where: JF-387 Porcupine Pot (Junee-Florentine, Tasmania).
Who: A six-person team from STC
What: A long dive-support trip
When: Saturday 8/5/21

DETAILS

I was at the bottom of the lowest pitch, contemplating getting on the first rope (standing next to it). There were four people above me on a series of pitches and the rope was free, so while I should have stood further away until committing to it, I could also have been there legitimately.

Without any noise or warning, a rock about the size of a small dinner plate impacted my foot and the rock I was standing on (Keith Chatterton saw this) — enough to give the smell of impacted rock, and to break (and spectacularly bruise) my little toe through a gumboot, explorer sock and neoprene sock.

I'm rather glad it hit something relatively unimportant, and the break was pretty textbook. Much swearing was required at the time, but getting out wasn't a big deal, and two days later I didn't feel anything.

It's unclear where the rock came from, but it could have been unwittingly knocked off by any of those above, even the top of the big pitch (i.e. the start of the rope) likely has an alternative way down.

We did note a few loose rocks near the top of the long pitch (i.e. the start of the rope), so some better tidying would be a good investment for the future. The cave has had a moderate amount of traffic by Tassie standards.

It's a good reminder to be careful, especially when heavy bags and weariness at the end of a long trip are involved.

Postscript: I went into the Royal Hobart Hospital emergency department (nothing else was open) and got it checked out on the Sunday. They confirmed it was fractured, strapped it up and said to wear stiff shoes ('Gumboots? Perfect.'). It didn't stop me doing anything for the rest of the trip. I must admit I was perversely chuffed — it's my first broken bone.

REFERENCE

Fordyce, S. 2018 JF-387 Porcupine Pot. *Speleo Spiel,* 429: 9-10

DIVE GEAR USED:

- Drysuit, with two pairs explorer socks, polypro thermals, two-piece Fourth Element Arctic (top removed, would omit both next time), 1-piece Fourth Element Halo3D
- Nomad XT sidemount wing/harness, fins
- 2x 9 L carbon fibre tanks (with 4x 1.2 kg weights on each)
- 7x 1.2 kg weights on belt (NOT ENOUGH!), 4x 1.2 kg weights per CF tank. Beware of the trap of assuming 1.2 kg weights are close enough to 1.5kg weights.
- Breathing gas: Nitrox 32 (to reduce risk of The Bends)
- Line: all is orange 3 mm polypropylene floating cable-hauling line, knotted at 3 m intervals. There are frequent arrows and a few cookies marking it.

GAS USAGE:

Gas pressures:
Start: 295 bar/290 bar
At Room of Correct Terminology:
280 bar/200 bar
At Undressing Room: 220 bar/210 bar
(Turn pressure: 200 bar/200 bar)
Back at Undressing Room: 200 bar/170 bar
Home: 130 bar/50 bar

LITRES OF GAS USED:

Sump 1 transit (in): 945 L
Sump 2 transit (in): 450 L
Sump 3 (total): 540 L
Return through sumps 1 & 2: 1710 L

DISTANCES (FROM SURVEY DATA):

Sump 1: 262 m long
Sump 2: 93 m long
Sump 3: 40 m penetration
(See dive profiles for maximum and average depths)

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TO MEMBERS receiving the printed copy of *Caves Australia:*

In line with a motion passed at the Council meeting of January 2021 that:

'From January 2022 printing and postage of *Caves Australia* to be provided on a cost recovery basis, paid for by the member receiving the printed copy.'

The cost for each issue of a 24-page print issue will be $10, which covers printing and postage. Issues with more than 24 pages will be at a higher cost.

The Treasurer will invoice each recipient via email after each edition is posted to the member's email address in the Membership Database.

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Comparison of calthemite and speleothem straw stalactites,

and environmental conditions influencing straw diameter

Garry K. Smith
NHVSS

ABSTRACT: This study investigates environmental conditions that influence the morphology of calthemite straws and draws comparisons with speleothem straws. Calthemite straws are typically deposited beneath buildings, bridges and other concrete structures from hyperalkaline solution (pH>9), in contrast to speleothem straws that are deposited by near-neutral to mildly alkaline solutions (pH 7.5-8.5). On average, calthemite straws tend to have a smaller outside diameter range of 3.7 to 5.4 mm compared to speleothem 4.5 to 6.45 mm. Comparisons of straw mass per unit length revealed that on average calthemite straws were 40 per cent the mass of speleothem straws of equivalent outside diameter. The calthemite straws had a much thinner wall thickness and were more fragile to handle. Their fast longitudinal growth (up to 2 mm/day) and thin wall thickness appears to be due to the rapid reaction of atmospheric CO_2 with Ca^{2+} in solution at the drip surface. This results in deposition of $CaCO_3$ around the straw tip, with little CO_2 diffusing up the solution canal, thereby lengthening the calthemite straw with limited $CaCO_3$ deposition in the solution canal. Solutions from slower drips have a higher saturation and deposit more $CaCO_3$ per kilogram of solution (e.g. as a stalactite and/or stalagmite), than solutions from straws with faster drip rates. As drip rates and calcium ion saturation of drip solution vary greatly beneath a structure over time and location, the analysis of drip solution is not a reliable method to determine concrete's degradation rate.

THIS study stems back to a moment of pondering the mystery of straw stalactites growing on the concrete ceiling of an Aldi supermarket undercover carpark.

From this evolved a lengthy investigation in 2014-15 and then a later study between 2016-18 (Smith 2016, 2021).

These secondary deposits called calthemites, are derived from concrete, lime, mortar or another calcareous material outside the cave environment, and can grow hundreds of times faster than in limestone caves.

Calthemites grow on or under man-made structures and mimic the shapes and forms of speleothems, such as stalactites, stalagmites, flowstone etc (Fig. 1).

Most cave straw speleothems form when carbon dioxide (CO_2) is degassed from near neutral pH to mildly alkaline solutions (pH 7.5-8.5) whereas most concrete-derived calthemite straws are created when CO_2 is sequestered (absorbed) into hyperalkaline solutions at pH > 9.

Typically, the solution dripping from calthemite straws is highly alkaline at pH 13, and can burn skin or damage a car's paint, so don't park your car beneath these drip points.

For more information about the chemistry involved in creating calthemite straws and their growth rates versus drip rates, refer to Smith (2016, 2018).

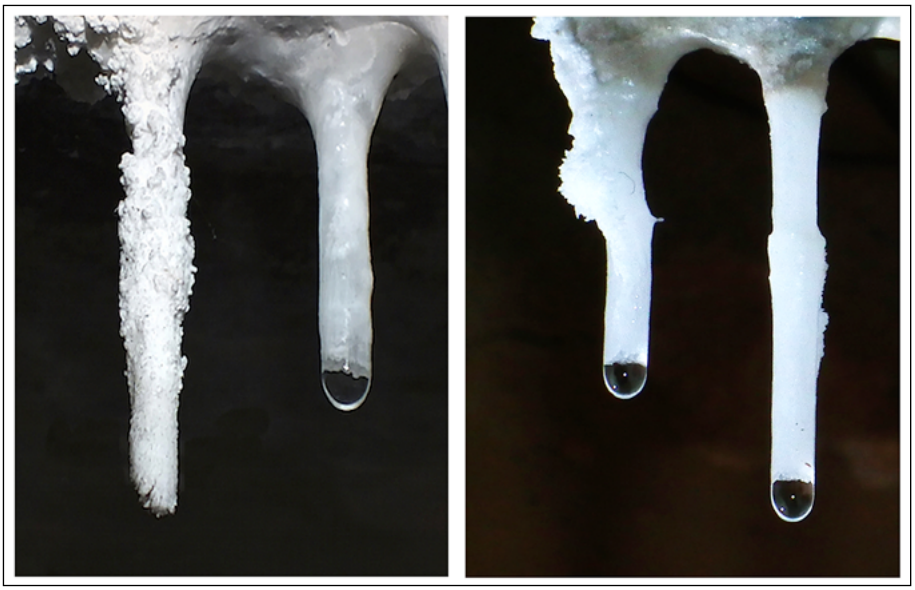

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Figure 1: Calthemite straws on the left, are similar to speleothem straws on the right. Both are composed of calcium carbonate and are approximately the same diameter, but the linear masses are significantly different.

It has been suggested by Dixon *et al.* (2018) that the formation of calthemites is a natural process that did not occur prior to human modification of the Earth's surface during the Anthropocene.

There were many unanswered questions that resulted from the earlier study published in *Cave and Karst Science,* Vol. 43, No. 1 (Smith 2016).

These include:

- What is the physical difference between calthemite and speleothem straws?
- What causes straws to grow at different diameters?
- Can the analysis of drip solution be used as a method to determine concrete's degradation rate?
- Does the solution surface-tension or drip-rate influence a straw's outside diameter?
- Does a straw's outside diameter influence a solution drop's mass?

The latest study answered these ques-

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Figure 2: Typical cross-sections of calthemite straws. These have a thinner wall, are more fragile and have a less dense crystal structure than do speleothem straws. The image scale divisions are in mm.

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Figure 3: Typical cross sections of speleothem straws. Compare these with Figure 2. These straws have thicker walls and a denser crystal structure, making them less fragile than calthemite straws.

tions and revealed some surprising physical differences between calthemite straws and speleothem straws.

On average calthemite straws had thinner wall thickness and a less-dense calcium carbonate structure than speleothem straws of equivalent external diameter (Figs. 2 & 3).

Calthemite straws tend to have a smaller external diameter range of 3.7 to 5.4 mm compared to speleothem straws (4.5 to 6.45 mm_ (Fig. 4). Calthemite straws are on average just 40 per cent of the mass per unit length of speleothem straws of equivalent external diameter (Fig. 4).

It appears that the chemistry and slower deposition rate of calcium carbonate from mildly alkaline solution (low Ca^{2+} saturation) associated with limestone cave (speleothem) straws, creates a denser structure than does the hyperalkaline solution creating calthemite straws.

The large disparity in straw mass per mm between calthemite and speleothem straws appears to be due to the difference in the $CaCO_3$ deposition process.

When $CaCO_3$ deposition occurs on a straw speleothem CO_2 diffuses out of the solution-drop; thus, the diffusion of the gas from the drop occurs slowly and more evenly throughout the drop.

This causes $CaCO_3$ to be deposited along the inner wall of the straw's solution canal as well as at the straw tip. This is well explained by the speleothem straw growth pattern image by Paul *et al.* (2013) (Fig. 5), and the structure of calthemite straws studied by Broughton *et al.* (2020).

With the creation of calthemite straws the rapid reaction of atmospheric CO_2 with the Ca^{2+} in solution at the drop surface results in deposition of $CaCO_3$ around the tip of the straw's rim. Hardly any CO_2 has a chance to diffuse evenly through the solution-drop, so that almost no deposition occurs farther inside the straw's solution canal. Therefore, calthemite straws lengthen quickly, with hardly any $CaCO_3$ deposition in the solution canal.

Various studies have documented speleothem straw growth rates of between 0.2 and 2 mm per year; however, Smith (2016) recorded calthemite straw grow up to 2 mm per day when the drip rate is 11 minutes between drops.

When the drip rate exceeds one drop per 11 minutes the deposition rate (length gain) is reduced. Smith (2021) suggests that changes in solution residence time within concrete, expressed by the drip rate, have a great influence on both the uptake of calcium ions in solution and on the amount of calcium carbonate ($CaCO_3$) deposited subsequently at the straw tip and/or as a stalagmite.

Hence, during periods of fast flow the concentration of Ca^{2+} in solution is less than when there is a slower solution flow rate.

The time a drop remains at the tip of a calthemite straw affects the ability of solution to take up carbon dioxide from the atmosphere and deposit $CaCO_3$. However, saturation of the fluid also plays a significant role.

The concentration of calcium ions carried by solutions is influenced by the solution pH, flow rate, length of seepage path and the time taken to travel through the concrete's micro-cracks and pores, and the availability of Ca^{2+} along the seepage path.

The mass of a drop of solution falling from a calthemite straw of known diameter is directly proportional to the end diameter

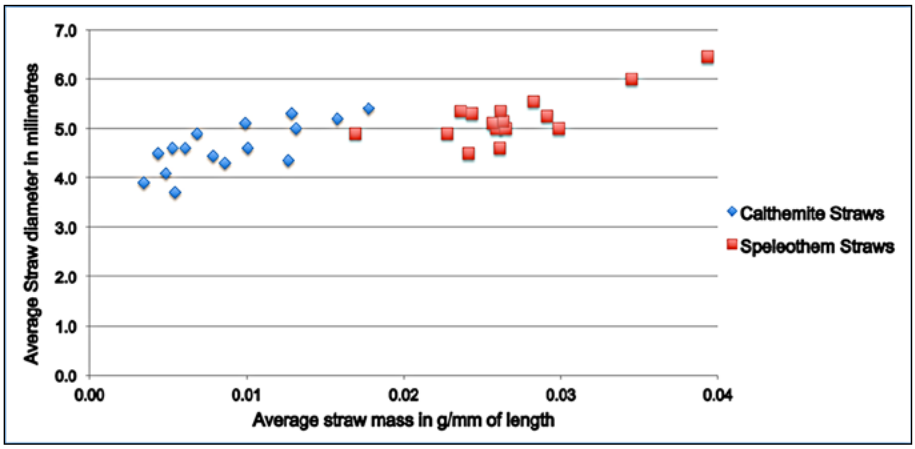

Figure 4: Relationship between average straw diameter and mass per unit length

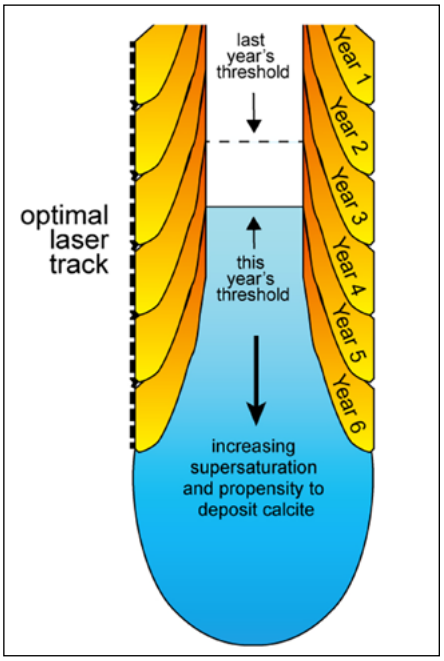

Figure 5: Speleothem straw growth pattern. Image by Paul et al. (2013). As the drip hangs from the tip, a combination of greater CO_2 degassing and lower nucleation energies occurs at the drip/straw-tip interface, producing wider layers at the edge of the straw.

of the straw from which it falls. Hence, the larger the straw's diameter, the greater the drop mass (Figs. 6 & 7).

The drop mass could not be predicted accurately without knowing the solution surface tension at the precise time.

However, many variables, such as temperature and impurities, can influence surface tension and, in turn, the drop mass. Provided that the possibility of a drop falling prematurely because of vibration, air movement or other factors is eliminated, a drop mass could be calculated approximately using the formula $mg = \pi d\gamma$ if the straw diameter (d) and the solution surface tension (γ) are known.

There appears to be sufficient variation in drip surface tension to have a small influence over the maximum external diameter range of calthemite compared to speleothem straws.

Calthemite solution drip rate appears to influence the resulting calthemite straw external diameter and the drip rate may well influence a speleothem straw's diameter. As Curl (1972) suggested, a speleothem straw's diameter at the tip is governed by the diameter and mass of the solution-drop that can be supported by the surface tension.

Equilibrium is reached when a straw's external sides becomes parallel. A straw's diameter 'should converge, with growth, in an exponential manner' to reach an equilibrium diameter.

However, a straw's diameter seems to be influenced by additional factors. In the case of calthemite straws, the solution drip rate

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Figure 6: A solution drop breaking free from a calthemite straw.

appears to exert a large influence over the external diameter of straws and can cause the diameter to increase or decrease in an attempt to maintain equilibrium with the drip solution parameters (Fig. 8).

An extra-fast drip rate does not instantaneously create a smaller-diameter straw, or vice versa for a slow drip rate. A straw changes diameter gradually as it grows in length. Calthemite straw growth rates (Smith, 2016) have shown that it can take a matter of days or weeks to change diameter significantly because of a change in drip rate. Due to its significantly slower growth rate a speleothem straw might take many months or years to change diameter,

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Figure 8: Variations in calthemite straw diameter, due to changes in solution surface tension, influenced by solution saturation of $Ca(OH)_2$ and usually associated with changes in solution supply (drip rate).

provided that the altered drip rate stays constant over a period substantial enough to have an effect. Because of the slower growth rate of a speleothem straw, there is more chance that fluctuation in drip rate may be averaged out and the straw external diameter remains reasonably constant.

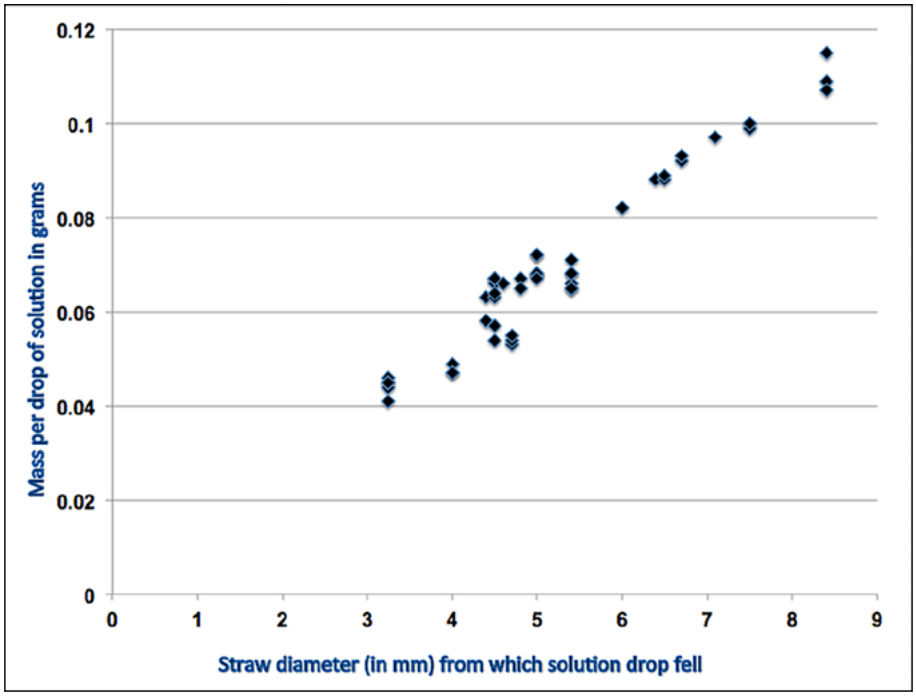

Figure 7: Graph comparing the mass of calthemite solution-drops (grams), to the outside diameter (mm) of the stalactite straws from which they fell. The solution mass included Ca2+ and any other dissolved minerals.

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Figure 9: Calthemite Straw and Stalagmite growing beneath a concrete structure.

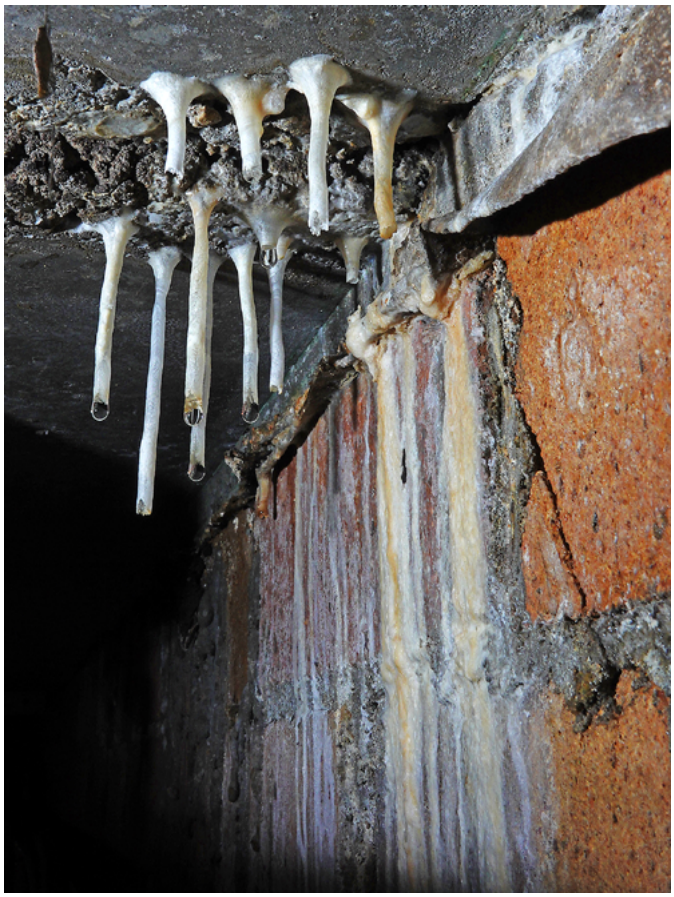

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Figure 10: Calthemite Straws and flowstone growing beneath a concrete structure.

Sampling and analysis of solution drip rate from straws and the Ca^{2+} ions leached from concrete (precipitated as $CaCO_3$) showed that a slower drip rate had a higher solution saturation.

However, the deviation of results from a straight line indicates that other factors, such as details of the solution seepage path, the residence time within the path and the availability of Ca^{2+} along the path, have an influence over the calthemite solution saturation.

Hence, analysis of drip solution alone is not a reliable method of determining a concrete's degradation rate.

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