

ANDYSEZ 49
THE GREEN SICKNESS
- LA MALADIE VERTE or LAMPENFLORA
PART 2

- Andy Spate

Andy Spate (centre) et al in Gunns
Plains Cave – ACKMA AGM Weekend



I had intended that this ANDYSEZ would sum up the *lampenflora* discussion. However, the pressure of other work (and the infinitely greater pressure exerted by one K. Henderson...) has meant that I have been unable to complete the dissertation – so there will be a Part 3. This ANDYSEZ continues in the vein of Part 1 in that it largely consists of various recipes and approaches from Australia, New Zealand and the United States.

Part 3 in the next issue of the Journal will provide further discussion and some recommendations.

I have gently edited the various contributions – hoping that their authors don't mind too much - and that I have interpreted what they are saying correctly. Remember that these came to me as pretty informal emails and that I had sought amplification from some of my collaborators so some of the contributions below arise from one, two or three emails.

Dave Williams writes from New Zealand:

"I am pleased to pass on my experience and thoughts on *lampenflora*. I do not have too much to do with the caves at Waitomo these days apart from being on the board of the Museum of Caves but I was cleaning *lampenflora* there about 12 months ago.

"They still use calcium hypochlorite which is very effective providing it is done regularly (at least yearly) and a deeply ingrained *lampenflora* community has not been allowed to develop, more about this later. Calcium hypochlorite was chosen because it is effective, cheap and seems to be safe.

"The chemical if used at adequate strength breaks down into compounds that are supposed to be found within caves but it does have chloramine fumes which are very unpleasant to the human nose. These

fumes are very foreign to a cave and the last smell that people should experience in a cave. I believe that the atmosphere of a cave including its smell is an important aspect of a visitor experience and I always regretted destroying this part of peoples visit when we cleaned away the *lampenflora*. In the Glowworm Cave we cleaned in mid-winter when the air currents moving through the cave were strong and the fumes would not be noticeable after 24 hours, in Aranui Cave dissipation would take around 72 hours.

"Calcium hypochlorite did not have any observable effects on cave biota. It has been used in the Glowworm and Aranui Caves now for nearly 30 years, the glowworms and wetas have not been affected although there are now more glowworms because the catchment has been improved. I have noticed though that the rats and the wetas do vacate the caves for a few weeks after *lampenflora* cleaning. There are still plenty of other invertebrates in the caves.

"Despite the effectiveness of calcium hypochlorite these odours are a significant problem and I think there are better ways to manage *lampenflora*. There are now other chemicals that should be scientifically tested, I have tried a few including some of the commercial algacides and some work as well as calcium hypochlorite... some work better on the ingrained *lampenflora* but they take a little longer. It would be good to see some research on these. I also tried hydrogen peroxide which acts like calcium hypochlorite in that it releases free oxygen which causes the plant cell walls to rupture. It was not as effective as calcium hypochlorite but this could also be evaluated. I was not willing to increase the concentration because it can be dangerous.

"On most surfaces *lampenflora* is easily cleaned if done from the beginning and done regularly however on some surfaces it becomes ingrained and very difficult to clean once it is well established. These surfaces are those with active calcite growth where I suspect the crystal lattice is porous.

"I can remember you showing us some *lampenflora* that you referred to as 'redwoods' on such a surface, I cannot remember the cave but the *lampenflora* had stubbornly refused to be cleaned. We have the same problem in patches in Aranui Cave. I remember Ernie using heat to burn *lampenflora* but advising against it because the calcite is easily damaged but I wonder if heat could be used below the critical temperature to dry off the moisture around the ingrained *lampenflora* and then immediately after the heat is removed and algacide is applied which will be drawn into the calcite and thus contacting the plant. It is worth investigating also.

"I believe there will always be a need to use some kind of chemical to clean *lampenflora* once it has become established but that the best way to manage the problem is to prevent it."

After a query from APS...

Yes calcium hypochlorite..., the thinking was that although sodium hypochlorite was stronger we were concerned about introducing sodium compounds into the caves as this might start replacing calcium. It was also thought that any calcium compounds produced were likely to be naturally occurring anyway.

The concentration we used was 2-4% by weight of calcium hypochlorite to water. The calcium hypochlorite had an available chlorine of I think 60% (I could be wrong here but I will check). This is old fashioned swimming pool "chlorine", it is also used to disinfect drinking water so if you can drink it and swim in it can't be too dangerous, although as I have mentioned the chloramines fumes are very unpleasant. Les Kermode once said that chlorine compounds are the most detectable to the human nose of any compounds.

When mixing the water with calcium hypochlorite the directions on the container must be observed, it can be very dangerous, some years back a toddler was killed when he urinated into a drum of the stuff. It explodes in contact with organic compounds especially the volatile hydrocarbons such as petrol and kerosene. It needs to be stored safely and when spraying the usual precautions such as protective clothing and respirators should be worn. At the above concentration contact for more than 15 seconds or so will cause chemical burns to the skin. After mixing the solution is best left for a half day or so to let the insoluble chalky carrying agents settle to the bottom and then pour off the near clear yellow fluid on top. The chalky stuff clogs the sprayer lines and nozzles. The potency starts to reduce after this time so mixed solutions are best used within 24 hours. The solution is very corrosive on metals so operators should avoid direct contact with light units and other metallic items in the cave and carefully clean the spray unit with hot water and detergent otherwise they will need a new one next time.

I forgot to mention in my last email that it is important to liberally wash down the *lampenflora* sites 20 or 30 minutes or so after spraying them. The chemical would have worked by this time if it is going to and the flushing halts the ongoing reactions that contribute to the chloramines. There is a paradox here because chloramine odours indicate that not enough chlorine has been applied to complete the destruction of chlorine compounds, chloramines are compounds formed from amino acids from cell proteins that have combined with the chlorine. This is a common problem in swimming pools when inexperienced operators do not use enough chlorine and produce very smelly swimming pools which seem to have too much chlorine and so they cut back further. Smaller quantities of chlorine still produce the bleaching effect on *lampenflora* plus the chloramines so flushing of the sites soon after

dilutes everything and washes away some of the organic residue that might provide a nutrient base or a substrate for the next generation of *lampenflora*.

It is hard not to find *lampenflora* interesting, these plant communities follow all the ecological principles of zonation and succession over time and space. They are almost a closed ecosystem. We had left behind an out of the way colony in the Glowworm Cave for many years and I enjoyed talking to interested people about the issue and cave management. Unlike the sun the cave lights do not move so in the shadows of the stalactites there was no *lampenflora*, the stalactites were silhouetted in shadow in great detail. Alas one day a keen guide in one ten second sweep destroyed a 30 year colony so that was the end of that. We have a display on *lampenflora* in the Museum of Caves and it should be remembered that it is the light that is unnatural in the cave and that plants are behaving naturally. We should also be careful not to remove naturally occurring plants around the entrances of tourist caves, it is easy for a cleaner to do this when spraying *lampenflora*.

In this regard Gil Madronero from the Philippines:

"Just a few ideas I could share with regards to *lampenflora* control in the tropics. It is a very common case of forest clearance back here where I come from and caves are always directly affected with the increasing light zonation especially with an east-west entrance orientation. Since trees take time to grow to produce a good canopy to initially cover the cave entrance, we allow or introduce forest plants that are fast growing - one example would be vines that commonly hang over cave entrances."

Dave Harper talks about the Buchan approaches:

"So *lampenflora*, what do we do, and how. We use a 25% bleach solution (sodium hypochlorite) which we spray on using an atomiser, leave for a while then wash off with cave water. On flowstone we sometimes use a brush to scrub it off. The longer the *lampenflora* is left then the harder it is to get off, so we try to remove it as soon as possible. Less intervention is needed and a weaker bleach solution can be used.

"We buy it as a hypochlorite solution that has 125g/l of available chlorine and then dilute this as 25 parts hypochlorite, to 75 parts water. I am just following on with the practices of my predecessor, that's why I am interested to find out what others are doing. Even though this is a strong solution it still does not always remove the *lampenflora* successfully."

Celery Reckons:

"In the meantime, I suggest a light spray of sodium hypochlorite seems to work well - and self-destructs very quickly."

Brian Clark reports:

"From a historical perspective I tackled bloody awful *lampenflora* at both Naracoorte and Tantoola by spraying with 5% sodium hypochlorite (White King - straight from the bottle) and then rinsed with water.

Success was instantaneous but had to be repeated every three to six months depending on the proximity of the light source. We then rewired and switched to 12 volt dichroic (on your sage advice as I recall) and then only treated the *lampenflora* every two to three years in a few small problem areas.

"I am sure that technically the *lampenflora* was still there – but the caves did not look like billiard tables any more. I did try calcium hypochlorite because environmental advice was that it was more appropriate – but it just didn't do the trick."

Andy Spate (left) chats with Geoff Deer (new Manager of Gunns Plains Cave), with Ian Household and Barry Richard in the background – ACKMA AGM Weekend



Ian Household writes:

"Peter Price and I carried out trials of various concentrations of both hypochlorite and peroxide on a little *lampenflora* 'forest' at Hastings before we began overall cleaning (peroxide/UV is used to control microorganisms in the thermal pool).

"Only very strong concentrations of peroxide had much effect on the predominantly mossy growth. These levels would definitely have a major effect on bacteria (or any animal life I would imagine - including cave guides fingers). We ended up using 2-3% hypochlorite, flushed with water and trapped in downstream dams of absorbent cloth."

The Yarrangobilly experience:

"Jo Vincent and I used on several occasions 1.25-1.5% weight/volume sodium hypochlorite sprayed on, left for some hours or overnight and then washed off with low or high pressure water depending on the strength of the underlying materials. This was generally successful."

REFERENCES

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Lemon L 1976 Algae control and removal from cave formations, Proceedings of the National Cave Management Symposium, Speleobooks (1975) pp 64-65

Oosthuizen H 1981 The blue-green algae in the Cango Cave System, in Mylroie JE (ed.), Proceedings of the 1st International cave Management Symposium, Murray State University, Kentucky, p153

At Wellington Caves:

"We sprayed on both sodium and calcium hypochlorite at concentrations of 1.5% (straight from a bottle of generic 'black and yellow' brand household (not Household!) bleach) and 4% weight/volume respectively. The sodium worked extremely quickly (minutes!) whilst the calcium was far less effective. Again washed off with copious quantities of high or low pressure water as appropriate."

Hill and Forti (1997, page 305) suggest:

"Algae: Several techniques have been used to clean algae and plant growths... Steam kills algae, but not in deep crevices or pores from which it can quickly regrow. Unlike cleaning lint, which drips off with condensing steam, high temperature water must come in contact with the algae. This may explode the speleothem if its internal water reaches the boiling point (Lemon 1976). Oosthuizen (1981) reported success at algae removal in South Africa's Cango Caves with a butyl alcohol solution: however, the concentration of the solution and possible adverse repercussions were not reported. Most show caves use a 4.2-5.25% sodium hypochlorite (bleach) solution, which research by Aley et al (1984) supported as being the best for general plant/algae control. They recommended spraying it on undiluted on the algae, not scrubbing, waiting 3-5 days to kill the algae in the deeper crevices and pores, then washing it off with water. To minimize harming the cave ecosystem, excess bleach from the initial spray and later rinse water should be captured as close as possible to the cleaning site... then removed from the cave and properly disposed."

Use of strong oxidizing agents such as hypochlorites or hydrogen peroxide (more on this latter in Part 3) has OH&S implications – not to say white-spotted uniforms! Dissolving solid hypochlorite to make up solutions generates about as much heat as *lampenflora* discussions do so we need to be careful on this front. Dave Williams advice quoted above on mixing, storage and effects on equipment are very relevant. Some people find the chlorine fumes very distressing and, as Ian Household pointed out in Part 1, there are serious implications for cave life. Use of portable dams and wet/dry vacuum cleaners is definitely indicated. More on all of this next time."

And, by-the-way, Lana, someone has suggested painting your *lampenflora*-free rock surfaces with diluted yoghurt to promote growth!