ACKMA Cave Climate Project

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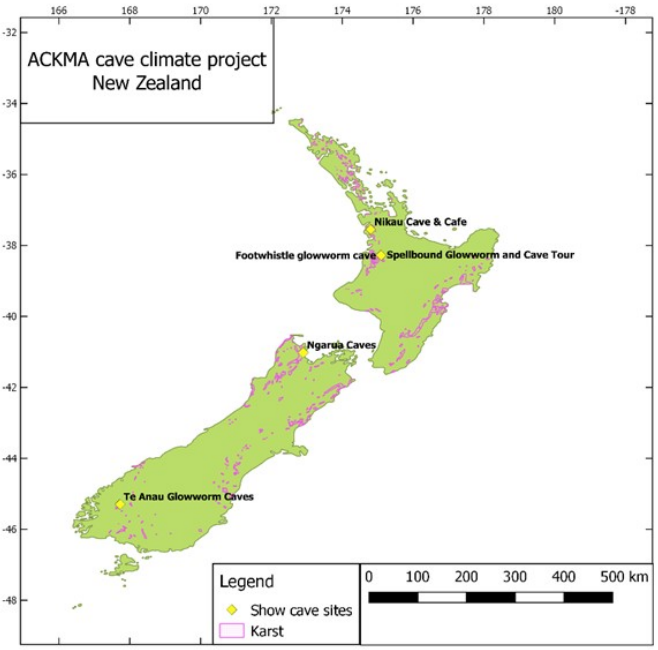
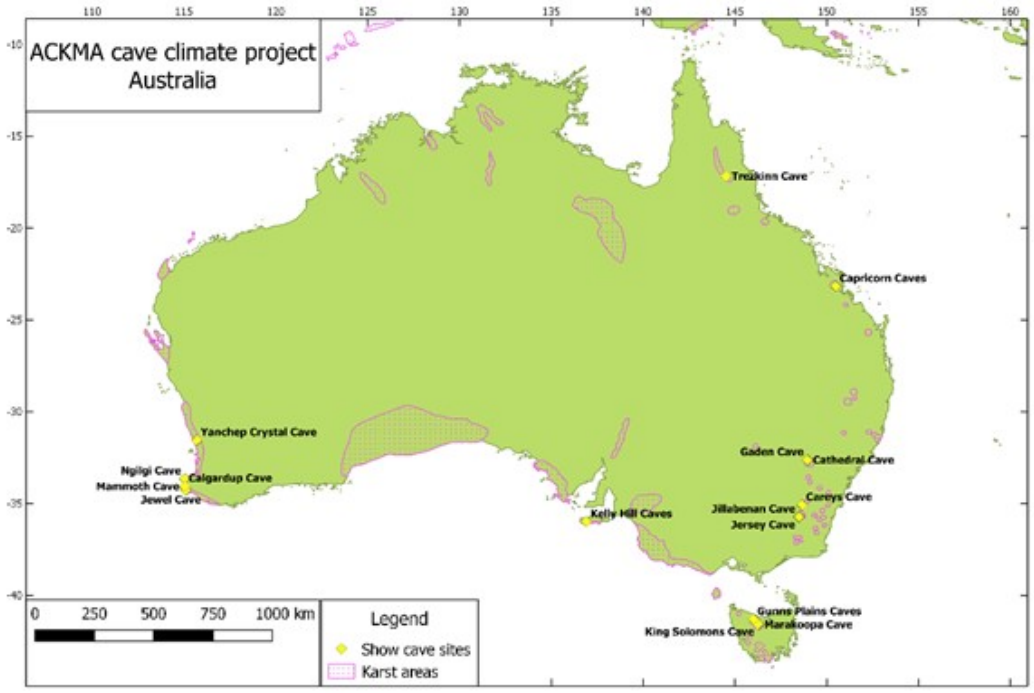
Introduction

Not long after the COVID-19 virus closed Australian and New Zealand show caves, Rauleigh Webb came up with the brilliant idea that this might be an opportunity to establish baseline show cave climate conditions in the absence of visitors. This concept was rapidly taken up by your committee, which set aside up to $8,000 for such a project. A subcommittee of Rauleigh, Peter Chandler, Andy Baker, Dave Gillieson and Andy Spate moved rapidly to put such a project in place. We purchased 50 Jaycar QP 6013 temperature and relative humidity loggers at a total cost of $4,000 - one for outside and one for inside each cave. Because we made a bulk purchase, we received a discount of $39 dollars off each unit! About $450 has also been spent on postage and associated costs.

Andy Baker then calibrated them and sent them off to those sites that wished to participate across Australia and New Zealand. Sixteen sites have joined so far and have received a total of 42 loggers. We do have a few more loggers available - so please contact us if you'd like to be part of the project. We hope that each site will be able to record data for a significant period of time without visitors, but recognize that every site would like to get up and running again. Once tours recommence, the loggers will provide a fascinating set of data on how individual caves are responding to the seasons, to weather and to the varying number of visitors.



Participating sites as at early June 2020

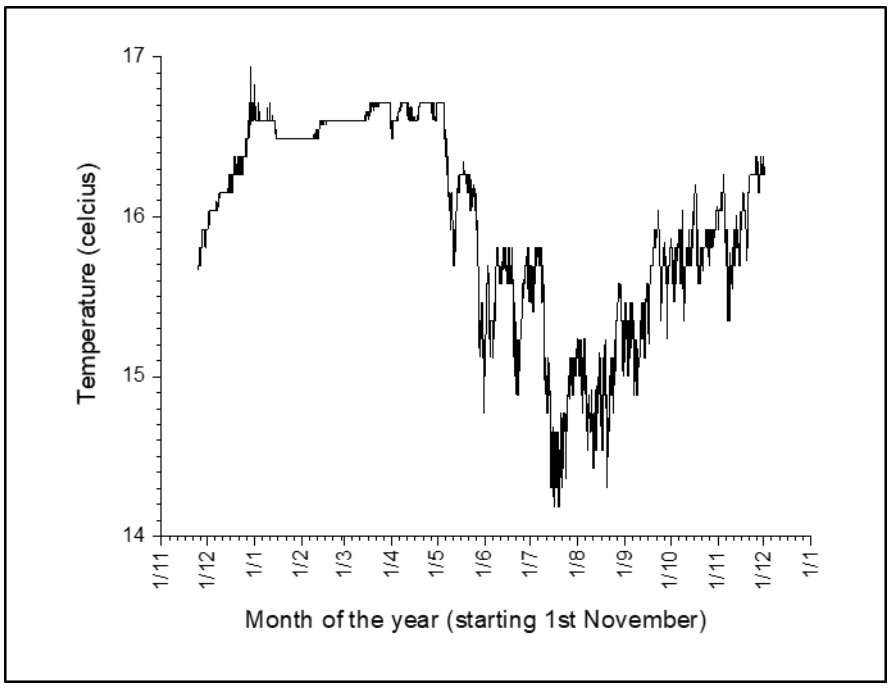


Caves and cave temperature fluctuations

First, the science. The air temperature in a cave is due to two main processes. One is conduction of heat through the rock. The source of this heat is sunlight reaching the surface above the cave. Conduction is a slow process, with the heat signal getting smaller and delayed as heat is conducted from the heat source to the subsurface. Around ten metres underground, the rock will be warmest a couple of months after the hottest summer months.

The other process is the transport of heat (or advection). This is most commonly due to the movement of air. In caves, ventilation can introduce air with a different temperature. This is a fast process, as cave ventilation can change rapidly. In caves, we typically experience a cooling of the cave air temperature in winter. How fast this takes place will depend on how warm the cave air is relative to the outside air, and the morphology of the cave—e.g. does it have one or more large entrances. And the only other thing you need to remember is that warm air rises.

What do we expect to happen in caves? Something like the adjacent example.



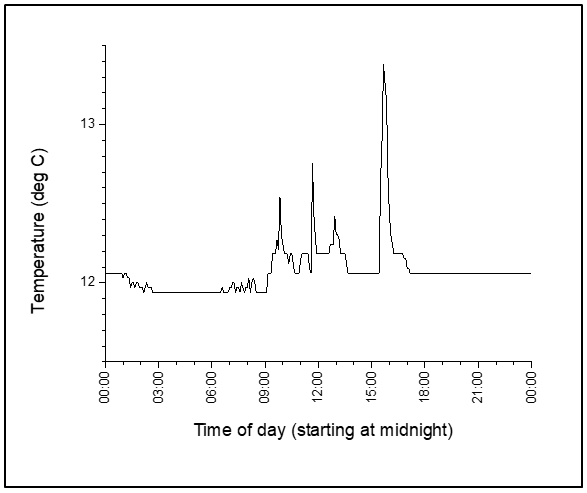
An example of seasonal temperature variation in a cave

In late autumn/early winter, cave air is likely to start to be warmer than outside air. Because warm air is more buoyant, it will leave the cave if it can, and will be replaced by colder air from outside that can sink in to replace it. You start to see some variability in cave temperatures and a cooling trend.

In summer, cave air is likely to be cooler than the outside air temperature. It is not buoyant and can get trapped in the cave. Now all the variability in cave air temperature is gone. The cave air will slowly equilibrate to the temperature of the heat conducted through the rock. The cave is warmest in late summer/early autumn, as it takes a few months after the summer for the rock temperature to reach maximum temperature.

As the air is not buoyant and trapped, there is minimal ventilation and carbon dioxide and other gases can build up.

Spring and autumn are intermediate periods. Around the equinoxes, caves might exchange air with the outside only at night, when the outside air is cooler, and not in the daytime. The exact time that a cave might start or stop exchanging air with the outside air will depend on the cave morphology (the number of entrances, how wide they are, etc) and the night-time temperatures (cold nights are needed to allow air to escape from the cave).



A day in the life of a cave

The loggers we have supplied record both temperature and relative humidity. Temperature is precise to 0.1 degrees centrigrade. We have suggested programming the loggers to record every 10 minutes. This will allow you to understand how the cave temperature responds to natural processes (conductive heating and advective cooling, as described before) as well as any possible human influences (heating from body heat, lights, opening and closing doors, etc).

Now - if your cave ventilates, it will have started recently. The loggers will tell you about the extent of ventilation. You might see daily ventilation, with warm air leaving the cave every night, and cooler air replacing it. This tells you that you have a well-ventilated cave with good air exchange. Or, you might only see cooling every week or two, which would be when low pressure systems pass over you, and the lower pressure onto the cave atmosphere means some of that cave air can leak out. This cave would have less air exchange. Or you might see no variability at all, indicating a very stable cave atmosphere.

The second figure on the previous page shows the day in the life of one cave last October. In this relatively well-ventilated cave, you can see the air is cooler and temperature more variable in the pre-dawn, as the cave is ventilating overnight. Peaks in temperature can be seen during the daytime, as student groups go past the logger. The last temperature peak dissipates in less than three hours; this is termed the relaxation time and is a measure of how quickly the cave returns to equilibrium. As the day concludes, temperatures are stable as the cave hasn't ventilated all the day, and the temperature is slightly warmer as the rock temperatures are just starting to warm after the winter minimum temperatures.

The examples: the first example is one year of data collected by the KSS Cave Studies Team from Deep Slide Cave, Yessabah. The second example was collected over one day on a UNSW Environmental Geophysics student field class to Wombeyan Caves in 2019.

Credit: Part of this text is based on that previously published by Andy Baker as 'Caves and climate' in the 60th Anniversary Edition of the Kempsey Speleological Society TROG Vol 54 No 5 (Nov 2018).

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Election of Tim Moore as a Fellow of ACKMA

Andy Spate

At the 31 May 2020 on-line AGM, Tim Moore was made a Fellow of our Association by adoption of a motion moved by Andy Spate and seconded by Kent Henderson. The AGM wholeheartedly supported the motion—the citation for which which read:

Tim started his caving career as a teenager in caves such as Tuglow. As the 'cave man' in the NSW NPWS, I came to Tim's attention sometime early in his 'reign' as Minister for the Environment - we became friends very quickly. I took him and his staff through Eagles Nest at Yarrangobilly - despite the then Premier's intervention.

Tim has been involved in ACKMA almost from its inception. For most of those years he has been very much behind the scenes. But, and a very big but, he has contributed much to cave and karst management in NSW and, in more recent years as Editor of our Journal. His acceptance of this role for another year is another example of his devotion to ACKMA.

Tim hosted two important meetings with the caving community in NSW. The first, in Sydney, was to discuss cave and karst management across NSW and a second one at Tallong, near Goulburn, to discuss cave management issues, and the possible extension of the limestone quarry, at Bungonia. Both meetings were well attended by both ACKMA and ASF members.

Most importantly, Minister Moore introduced legislation in NSW to recognize karst as an important part of our environment and to introduce the concept of karst conservation reserves - five of which now exist across NSW - Ashford, Jenolan, Wombeyan, Borenore and Abercrombie Caves. The legislation also introduced a 'strata title-like' system for protection and management of caves beneath private lands - as far as I am aware this has not been acted upon.

The downside of the Bill for this legislation was a phone call at 3.00 am from a Parliamentary draftsman seeking a definition of 'karst'!

Tim at the entrance to Croesus Cave near Mole Creek with his (now 40 year-old) twin daughters at the time he joined ACKMA