Mapping of Capricorn Caves

Lydia Georgeson

Hello! My name is Lydia Georgeson, and I am the Natural Resource Manager at Capricorn Caves. I am only new to this role but have been at Capricorn Caves for almost 4 years now working as a tour and outdoor recreation guide. At the end of last year, I graduated from Central Queensland University with a Bachelor of Science (Applied Biology) with Distinction. Working at the caves whilst studying was a great way to apply my knowledge and facilitate my learning!

Whilst in my final year of university, I was fortunate to use my degree to undertake two projects at the caves: the 3D mapping of the cave system with LiDAR technology, and the study of epilithic life on the caves. Here's a little overview of the projects and where I'm at with them.

Mapping of Capricorn Caves with LiDAR

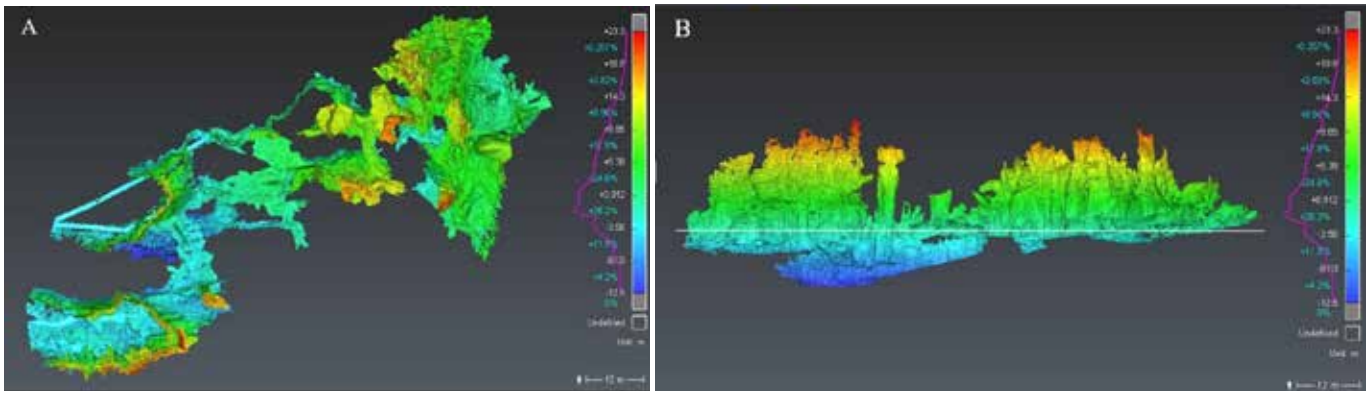
I started this project back at the end of 2020 with my supervisor Dr. Nathan English, and it was a lot bigger than I anticipated. For a single pass/fail unit, I quickly realised what I had undertaken was probably more of an Honours worthy project.

For those of you unfamiliar with LiDAR, it stands for 'Light Detection and Ranging' and is essentially a laser scanner. It is the most efficient and accurate way to scan and map caves, and there are numerous devices on the market to suit different needs. The device used at Capricorn Caves was a Leica Geosystems BLK360 that collected on average 45 million points from one stationary 6-minute scan. 6 minutes per scan might not seem like a long time but when you have to climb or crawl to the next area with a very expensive piece of equipment and try to set it up in a less than ideal location, it can be a quite challenging and time consuming.

LiDAR (BLK360) setup on tripod at top of Deep Vault cave (left), and Lydia with LiDAR at bottom of Deep Vault cave (right)

Over 300 scans were taken in total, however, I could not use all of these for a variety of reasons. 200 individual scans, and roughly 9 billion individual points were used to create three separate point clouds (i.e., three separate maps). These point clouds were then used to create 3D meshes where the individual points were stitched together to form solid walls. From this cave volume, surface area and 2D outlines were derived.

I have pinched the below figure of one of the Capricorn Caves meshes from the paper I am currently finalising. The colour depth indicator, scale bar and person (2m tall) scale give an indication of the size of the cave. 0 m (white line) is in line with where tourists currently walk through the iconic Cathedral cave.



3D mesh of the Cathedral Tour route at Capricorn Caves. A – plan view, B – elevation view.

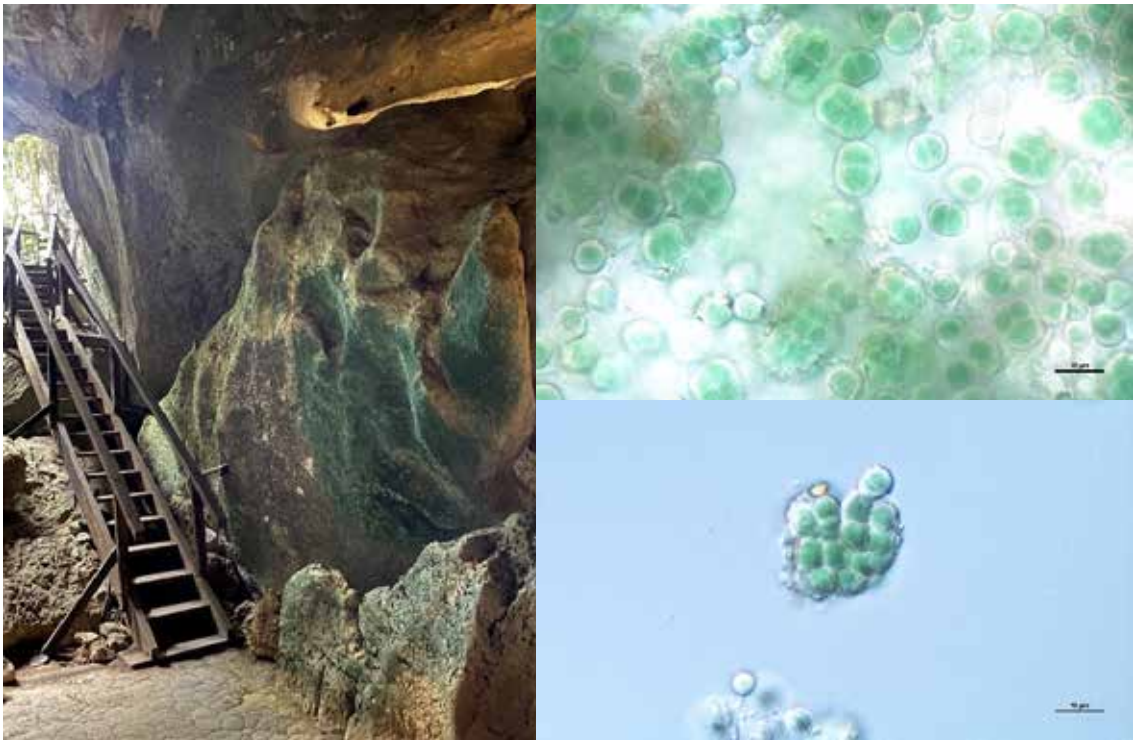
I am finalising a paper to submit for publication titled 'Importance of high-resolution 3D cave maps for research, tourism and infrastructure: a case study of LiDAR mapping in Capricorn Caves, Australia'. In the future, I would love to continue scanning the caves so that one entire point cloud of the system could be created. Maybe one day!

Analyses of epilithic life on Capricorn Caves

For this study, my supervisor was Assoc. Prof. Larelle Fabbro, an expert in cyanobacteria. The study was aimed at investigating the diversity of epilithic cyanobacteria, lichens and cyanolichens at Capricorn Caves with particular focus on the cyanobacteria. This epilithic life is found all over the karst of Capricorn Caves and where sunlight penetrates the cave. I collected three samples that were of interest to me and microscopically observed them.

From the three samples taken, a Chlorophyta and fungi lichen, as well as four cyanobacteria were identified. By analysing morphological and ecological characteristics, I was able to narrow the cyanobacteria down to at least the genus level. The genus of cyanobacteria identified were *Lyngbya, Chroococcus, Cyanosarcina and Brasilonema*.

One of the sample sites is pictured below. This is the first cave you enter on the Cathedral Tour, the 'Vestibule' cave. This green mat covers a large portion of the walls, and we will often be asked what it is. For a long time, many of us said it was a lichen but from microscopic analyses (photos on right) it is evident it is a cyanobacteria and its characteristics indicate this is likely *Cyanosarcina parthenonensis*.



Cyanobacteria growing on limestone of Vestibule cave (left) at Capricorn Caves.

Several specimens collected are of particular interest so Larelle and I will be following through with this study and sending some samples away to be genetically tested.

If you have any questions or just want to chat about the mapping or the cyanobacteria study, I'd be happy to talk. My email is Lydia.georgeson@capricorncaves.com.au. Thanks for reading!