

Journal of the

Australasian Cave and Karst Management Association



The ACKMA Journal

Official Publication of the Australasian Cave and Karst Management Association Incorporated

Published quarterly in March, June, September and December

The opinions expressed in the ACKMA Journal are those of the individual authors and not necessarily those of ACKMA Inc. or its officers.

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Photos taken by the authors or editor unless otherwise acknowledged.

PRINTER: Hansen Print, Smith Street, Naracoorte, South Australia 5271. Ph: (08) 623699

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FRONT COVER: Katerinska Cave, Czech Republic. Photo: Steve Bourne

BACK COVER: Mala dolina, Skocjan Caves, Slovenia. Photo: Steve Bourne

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FROM THE EDITOR

I have hardly seen a cave since the Waitomo conference, unlike many lucky ACKMA members who attended the International Union of Speleology (UIS) Congress in the Czech Republic, and participated in many pre and post conference excursions. I look forward to catching up on their experiences and hopefully sharing some of them with you in this journal.

Congratulations to the bidding team from the Australian Speleological Federation (ASF) who were successful, so we can now look forward to the 2017 Congress being held in Australia. This is a major coup as over the next three years we will be able to showcase Australasia's caves and karst to the world with this Congress and the International Show Caves Association Conference at Jenolan Caves next year. Of interest to many ACKMA members was the appointment of Kyung Sik Woo as president of the UIS. Kyung Sik is well known to many of us having attended the Chillagoe ACKMA Conference with several of his colleagues and visiting Australia on other occasions. He also produced two excellent cave books which were sold throughout Australia and New Zealand for a short time.

This journal has a decidedly international flavour to it. As I stated in the previous journal, I thought Sasa Kennedy's paper at the Waitomo Conference was a standout, right on conference theme with an excellent thoughtful analysis of three cave experiences in Spain. Her work prompted me to look at TripAdvisor website; perhaps a future paper on how the visiting public views caves of Australasia?! You will also find Sasa's paper on the CD ROM of the conference proceedings.

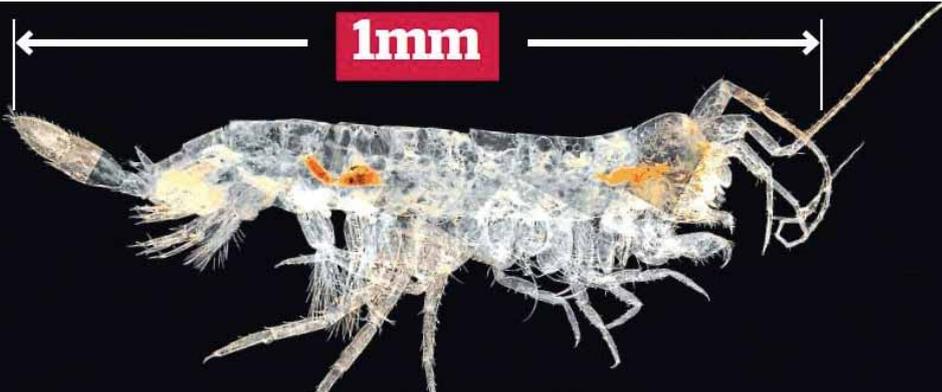
Likewise with Scott Melton's conference contribution. His paper discusses the impacts of digital technology on the delivery of cave tours from a guide's perspective. What is more important? Looking and listening to the guide of getting that photo that you share with your friends across multiple media? No easy answers to that question.

Kent Henderson and Garry K Smith have provided reports on their experiences in Malta and Germany respectively. I knew nothing of caves in Malta and have learnt there are some great fossil sites there! May need to take a visit. Garry's report covers a cave I had not previously have heard of either.

Kent and Garry's papers are excellent trip reports as they both include background geology, descriptions of the caves and landscape and comments of management. Keep this in mind if writing a report to share with members, these two papers serve as very good templates on how to produce a very useful report.

In keeping with the international flavour, we have a report from India by Yoav Bar-Ness. Written in the first person, this is a fabulous account of a visit to Cherrapunjee Cave in the Meghalaya Plateau. Now there is cave that very few people would have heard of!

We also acknowledge Julia James who was elected a Fellow of ACKMA at Waitomo. Julia has a long history of involvement in caves and karst and her citation covers a small part of this.



The bug that bit \$1 billion gas project

Exclusive
Ben Cubby
Environment Editor

They are tiny, transparent mites and worms – only a millimetre long and thinner than a human hair – but they may be big enough to throw a spanner in the works of a billion-dollar coal seam gas project.

Two previously unknown species of minuscule “stygofauna” have been discovered in aquifers beneath the site near Narrabri where resources company Santos hopes to drill the state's biggest gasfield.

The stygofauna are small enough to wander among grains of sand in the sandstone aquifers, never seeing the sun but purifying the water by eating bacteria –

playing a similar role to earthworms in soil. Under the “water trigger” laws introduced into Federal Parliament by independent MP Tony Windsor, the discovery of new species could delay Santos' plans.

A leading hydrobiologist, Peter Serov, said the drilling plans had the potential to “wipe out the entire community” of little

Continued Page 8

From the Sydney Morning Herald, 12 July 2013. Stygofauna halt plans for a gasfield in New South Wales. Thanks to Andy Spate for supplying this.

PRESIDENT'S REPORT

Dan Cove

Sitting to write my column for the journal, I found myself gazing out the window at my garden (as I often do) and was struck by how Spring-like it was with flowers blooming, the grass growing and blossoms and leaves covering the tress once more. An early Spring after the mildest Winter I have known had me recalling Professor Williams' excellent and thought provoking presentation at the Waitomo ACKMA Conference on the science of climate change and the potential for future warming in the southern hemisphere. Climate change is, naturally, highly relevant to cave management. Caves may be repositories of past climatic information over extended time periods and I have talked with a number of scientists who are excited over the information that may be extracted from serious study. The management implications for cave conservation in a world of changing climate and more highly variable weather patterns including more extreme weather events are also areas that need further consideration. And, for show cave operators, caves and cave tours offer the opportunity for communicating these issues and for public education. Once again, the issue presents challenges and opportunities for ACKMA.

Wrenching my gaze away from my garden, I am pleased to report that the ACKMA committee has continued to be a dynamic force and has been moving ahead in several areas. Thanks to Tim Moulds, ACKMA now has a Face Book page, one that has attracted a good number of followers in a short period of time. Any ACKMA members who are on Face Book I encourage to have a look at, and contribute to, this new and developing site. Webmaster and I.T guru Rauleigh Webb has very generously volunteered his time and expertise to begin the construction of an ACKMA database, whilst other Committee members have been working at a timely review of the ACKMA constitution, of committee

members roles and responsibilities and developing guidelines and processes for such future actions as sponsorship and a guide exchange program. Once again, I would like to commend all members of the Committee for their energy and enthusiasm.

I am also delighted to report that the profile of caves and of show caves in particular is set to get a boost in Australia. Ecotourism Australia has just set up a new 'Forum for Geotourism', with intent to raise the profile of geotourism in Australia. This will be a theme at the upcoming Global Eco Conference to be held at Noosa in November. I was asked to join the inaugural steering committee of the forum, and the opportunities for cave systems (one of the oldest forms of geotourist attraction in the world) to be at the forefront of a national initiative was discussed at our first committee meeting last week. I am hopeful that ACKMA's network of show caves will be able to play a prominent part as amongst the country's foremost geo-sites.

And how full of excitement the future seems? The ISCA Congress in November 2014, closely followed in Australia by the IUCN World Parks Congress in Sydney (with field trips to Jenolan Caves being planned) and now we have the next UIS Congress in 2017 also! Interesting times indeed.

Coming Events

2014: 4-11 May	ACKMA Annual General Meeting and Cave Guides Workshop Yarrangobilly, New South Wales
2014: 2-8 November	International Show Caves Association, Jenolan Caves, Australia
2015: May	ACKMA Conference, Naracoorte Caves, South Australia
2016: May	ACKMA Annual General Meeting and Cave Guides Workshop, Rockhampton, Queensland
2017	International Union of Speleology, Penrith, New South Wales

CAVE and KARST MANAGEMENT in MALTA

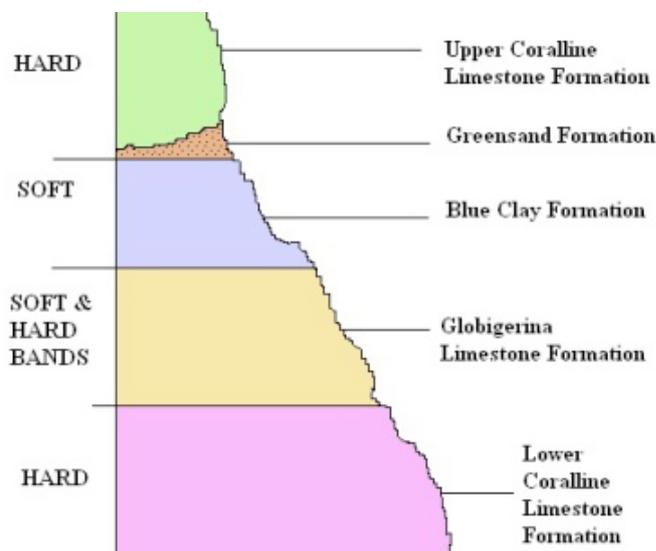
Kent Henderson

The islands of Malta (Malta, Gozo and Comino) are about 80% historic, 90% Catholic and (pretty much) 100% soluble. Situated in the middle of the Mediterranean, about 100 km south of Sicily, Malta is a tourist *mecca* – its history (both prehistoric and medieval), castles, fortresses, food, beaches, and comparative ‘cheapness’ (my very good 3½ star hotel, with breakfast, cost about \$A30.00 per night...), not to mention pretty much year-round 25-30°C sunny weather, make it about as good as it gets. Everyone speaks excellent English! You haven’t lived until you’ve seen the old city of Valetta and the ‘Grand Harbour’! ... and of course, from our point of view, the Maltese Islands are almost totally karst! What a place! I visited Malta recently for a ten day stay.



Geologically-speaking, the Maltese Islands are relatively young, with the oldest rock dating back only to the Tertiary period. The Islands are for the most part composed of marine sedimentary rocks. Although the sedimentary platform on which the Maltese Islands are situated was formed during the Triassic, there are no surface outcrops of this age. All exposed rocks were deposited during the Oligocene and Miocene periods dating back to 30 to 35 million years ago. The most recent deposits are the quaternary deposits which are found in minor. The resultant rock formations are relatively simple consisting of five basic layers laid on top of the other in a layer-cake sequence.

Lower Coralline Limestone is the oldest exposed rock in the Maltese Islands, outcropping to a height of 140m in the vertical cliffs near Xlendi, Gozo. It is mainly composed of the remains of coralline algae indicating deposition in a shallow environment. Younger beds show evidence of deposition in more open marine conditions.



Malta lithography

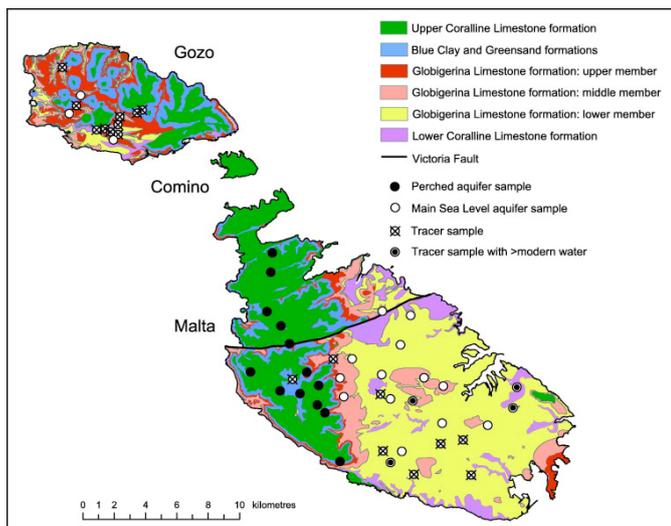
Globigerina Limestone is the second oldest rock and outcrops over approximately 70% of the area of the islands, eroding to give a broad, gently rolling landscape. Variations in the thickness of this formation are considerable, ranging from 23m near Fort Chambray, Gozo to 207m around Marsaxlokk, south-eastern Malta. This rock consists of yellow to pale-grey limestones. The formation is divided into Lower, Middle and Upper Globigerina Limestone by two beds of phosphorite pebbles.

Blue Clay overlies the Globigerina Limestone formation. It erodes easily when wet and forms taluses (i.e: a sloping mass of rock fragments at the foot of a cliff) which flow out over the underlying rock. Variations in thickness are considerable ranging from 75m at Xaghra, Gozo to nil in eastern Malta, where Upper Coralline Limestone rests directly on Globigerina Limestone. Deposition of the Blue Clay may have occurred in an open muddy water environment with water depths up to 150m for the lower part of the formation.

Greensand consists of bioclastic limestones rich in glauconite deposited in a warm sea. Unweathered sections are green but are oxidised to an orange colour when exposed. The deposit attains a maximum thickness of 11m in localised depressions in Gozo, but elsewhere is less than 1m thick.

Upper Coralline Limestone is the youngest Tertiary formation in the islands reaching a thickness of approximately 160m in the Bingemma area, Malta. Local tectonic activity appears to have resulted in the brief emergence of the formation above the sea. The strata are very similar to the lowest stratum in the

Maltese Islands. It is also named because of the abundance of the fossil algae species *Coralline*. It resembles the Lower Coralline Limestone both on chemical and palaeontological grounds, indicating deposition in shallow waters. The transition from the underlying greensands is gradual, sometimes merging into red and black granular sandstone; or red and white coralline rich limestone, which passes into a white calcareous sandstone-compact, soft or porous but always rich in organic remains. Though some layers are completely crystalline and have lost traces of the organisms from which they originated, other portions are highly fossiliferous containing casts of shells and other organisms.



Malta geology

These rocks are sporadically overlain by terrestrial, aeolian and alluvial deposits laid down following the emergence of the Maltese Islands above sea level. Much of the central and south-eastern portion of the Maltese comprises outcrops of Globigerina Limestone while the northern and north-western regions are characterised by highlands on which upper coralline limestone is the dominant outcrop. The geology of Gozo is more varied than that of Malta, with more frequent outcrops of Blue Clay being a characteristic feature.

The karst geology of Malta has had a major historical effect in terms of human habitation. There are no surface streams anywhere in Malta, and what aquifers exist are located in the blue clay areas. Historically, attempts to build water storages on karst were fraught with failure, as will be appreciated. In Roman and medieval times aqueducts were used to funnel water to the population centres, largely on the coast.

Man first arrived in Malta around 5200 BC. These first Neolithic people probably arrived from Sicily, and were mainly farming and fishing communities, with some evidence of hunting activities. They apparently lived in caves and open dwellings.



*Ggantija Prehistoric Temple, Gozo. Note the heavily-weathered limestone.
Photo: Kent Henderson*



*Hagar Qim Prehistoric Temple, Malta. Note the roof-erected to prevent further weathering.
Photo: Kent Henderson*

During the centuries that followed there is evidence of further contacts with other cultures, which left their influence on the local communities, evidenced by their pottery designs and colours.

One of the most notable periods of Malta's history is the temple period, starting around 3600 BC. The Ggantija Prehistoric Temple in Gozo is the oldest free-standing building in the world. The name of the complex stems from the Maltese word *ġgant*, which reflects the magnitude of the temple's size.

There are also several very old temple sites on Malta, and collectively they are World Heritage sites. I visited them all during my stay. The Temple period lasted until about 2500 BC, at which point the civilization that raised these huge monoliths seems to have disappeared. There is much speculation about what might have happened and whether they were completely wiped out or assimilated.

The history of Malta that most takes the tourist's interest today is that of the medieval Knights of Malta, who built most of its walled cities, citadels and fortresses, of which there are many. Interested history buffs can go to google,

but it is the structure of these edifices on which I will dilate here. As would be expected, all structures in Malta of any historical note are made of limestone.

Given the geology of Malta there wasn't too much choice in using limestone to build the massive fortifications one sees; its use was actually quite advantageous. Limestone, particularly the relatively-soft *globigerina* variety, is relatively light and very easily worked; yet it will readily withstand considerable cannon bombardment – a very important medieval prerequisite given the frequency of Saracen attacks from the sea in that period. However, the modern result is a very significant conservation problem. Soft tertiary limestones do not hold up well after upwards of 800 years of weathering, and not surprisingly most historic walls and buildings are looking decidedly past their *use-by date*.

As the Maltese Government is spending many millions of euros on restoration; probably a quarter of the massive walls of Valetta itself are currently under scaffold. Given the nature of the limestone, when (in 100 years time?!) they have finished their conservation work, they may well have to start all over again!

Another legacy of historic long-term limestone construction is that there are a significant number of massive limestone quarries across Malta, many of which are still mined today.



*A limestone quarry in central Malta.
Photo: Kent Henderson*

Given that the Maltese Islands are very largely karst, you would expect widespread and significant cave development. However, such is not the case. First, we are talking geologically-young limestone (we are probably several million years too early...) and second, given there are no natural surface streams in Malta, phreatic cave development is rare (although Ghar Dalam is one notable example, see below).

There are, broadly-speaking, seven caves on Malta and Gozo open to the public; some of which one could probably describe as *show caves* (a general note – *ghar* is Maltese for cave). Conversely, what are very common in Malta are sea caves, of which there are many – at least two can be classed as 'world-class' and serious tourist attractions in themselves. I will come to these too.

'SHOW' CAVES AND KARST FEATURES

Ghar Dalam

This cave is accessed through a Museum which contains an excellent collection of bones together with an interesting reconstruction of the extinct dwarf elephant *Elephas falconeri*, which was just over a metre high when fully grown. From the museum, a paved foot path 150m long leads to the cave entrance.



*Ghar Dalam – views out of (top)
and into (bottom) the cave.
Photos: Kent Henderson*

Ghar Dalam is one of the most significant Maltese prehistory sites. It contains an uninterrupted sequence of fossiliferous deposits extending from the Late Pleistocene to Modern times, a period of 130,000 years. The Neolithic Age 5000 to 4500 BC is represented by pottery.

The cave was one of the sites used by early man who crossed to the Maltese islands from Sicily via a land bridge around 5000 BC. It also contains thousands of fossilised animal bones. The cave was first described in 1647 and excavated in 1865.

Excavations revealed that the floor of the cave had five different layers. In the lower layers were enormous quantities of fossilised bones, tusks and teeth belonging to extinct species - such as dwarf elephants and dwarf hippopotami - along with red deer (*Cervus elaphus*), brown bear (*Ursus arctos*), wolf (*Canis lupis*), fox (*Canis vulpes*) and giant swan (*Cygnus falconen*). As these are all animals associated with Europe this is proof that Malta was once connected to the European mainland rather than the African mainland.

It is suggested that a rise in sea level stranded these large mammals on the island and that the lack of food caused the dwarf versions to evolve. In the upper layers archaeologists found flint tools, sling-stones and pottery which had been decorated by using the rippled edge of sea shells or by pointed sticks or bones.

Għar Dalam is entered via a wide, low phreatic tube, about 10m in diameter which cuts 140 m into the Lower Coralline Limestone, however, this entrance has been considerably enlarged by the above mentioned excavations. Most of the remains were found near the entrance, very little being found further in the cave.

The cave consists basically of a single passage about 140 m long and 7 m wide, of which 80 m is accessible to the public. There is considerable breakdown in the cave, with blocks having fallen from the roof, so much so that a path has had to be excavated to allow visitors to pass.

Relatively large dry stalactites and stalagmites occur in reasonable quantities in cave. These must have formed before the bones were deposited, as they bisect the bone bearing deposits, a factor which has protected the formations.

In the excavations you can still see layers of bone deposits. It is possible that this cave is part of a much larger system which has been bisected by the downcutting of the valley and a small, blocked, opening is still visible on the opposite side of the valley to the cave which lends credence to this theory, as it seems to have developed in the same joint.

The cave is lit with parafloods, although most of the tourist section can be viewed using natural daylight. The interpretation in the cave is quite good, particularly signage on the excavations, strata, etc. The cave is self-guided, and the lights offer no switching; there is thus a modicum of *lampenflora* around light fittings - mitigated by the fact the lighting appears to be of relatively low intensity.

The cave and Museum are run by *Heritage Malta*, a government appendage with manages affair number of historic sites in Malta. Overall, while the infrastructure would be considered 'tired' by Australian standards, I would nonetheless describe this cave as reasonably well managed.

St. Paul's Catacombs

St. Paul's catacombs are part of a large cemetery once located outside the walls of the ancient Greek city of Melite, now Mdina, in central Malta.



St. Paul's 'Cave'
Photo: Kent Henderson

The cemetery probably originated in the Phoenician-Punic period. Like in Roman tradition, Phoenician and Punic burials were located outside city walls. The many tombs discovered in areas outside the known line of the Roman city suggest that the city of Melite was close to equal size.

The early tombs consisted of a deep rectangular shaft with one or two chambers dug from its sides. This type of burial was used well into the Roman occupation of the islands, but the chambers grew larger and more regular in shape over time. It is probable that this enlargement joined neighboring tombs and led to the creation of small catacombs, which became the norm by the fourth century AD.

The site that is currently open to the public comprises two catacombs out of the 24 in the St Paul's cluster. The main complex, covering an area of more than 2000 square metres, is so far the largest catacomb ever to be found on the island. It is large enough to have served as a communal burial ground in successive phases of Malta's history. One of the halls was transformed into an early church following the expulsion of Arab conquerors in the second century AD.

The excavation of the catacombs began in the late 1800s and, other than the construction of protective rooms, no further conservation was undertaken in the twentieth century.

The most significant section of the catacombs is St. Paul's Cave, which is directly under the obligatory church above. St. Paul was, reputedly, ship wrecked on Malta on his way to Rome. While the catacombs themselves are *man-made caves*, if you will, the small St. Paul's Cave (not much bigger than the image, opposite) appears largely natural, with the odd man-made niche in its walls. Access to the cave, during visiting hours, is open slather – so one could not really describe it as managed, or mismanaged...

Ghar Hasan

There are many legends about Hasan's Cave, which is located on the southern coast of Malta. All featuring the Saracen, Hasan, who took refuge here, with most of them referring to at least one young maiden that he abducted and imprisoned.

The setting of the cave is quite spectacular – far from a rarity given the many kilometres of spectacular karst coastlines that characterize Malta. From the car park, a footpath over a *karst walk* leads to a flight of 25 precarious steps, heading down the limestone cliff high over the sea. A walk along a narrow path, carved out of the cliff, protected by a rusty guard rail, leads to the entrance.

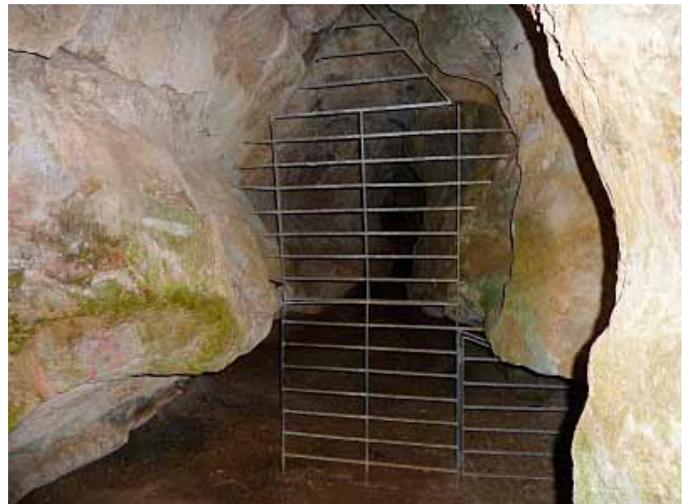


The Ghar Hasan 'balcony'
Photo: Kent Henderson

Hasan, apparently, entered the cave from below via a rope tethered at the entrance. The main entrance to the cave is 5m high and 6m wide and the entrance is of similar dimensions for the first 20m. In the top of this passage is a roof tube, sometimes separated from the main passage by a thin layer of rock and sometimes just a half tube in the roof. Partially enlarged master joints can be seen crossing the main passage.

Most of them come to a dead end but a large one extends for 48m and 73m respectively to two further entrances along the cliff face. At the eastern entrance there is a man made circular chamber, with obvious pick marks on the walls, and a stone bench around the edge, it has been speculated (as it would be) that this was, in fact, where Hasan lived.

The cave is almost devoid of decoration, although it possesses some small stalactites. A broken iron gate bars the inner recess to the cave. Given totally unrestricted access, the cave has been heavily trashed. Obviously, the cave is self guided and you do need a torch, but no gear. Given zero management, the only reason for visiting this cave other than, perhaps, the view out of it, is if you have nothing else to do

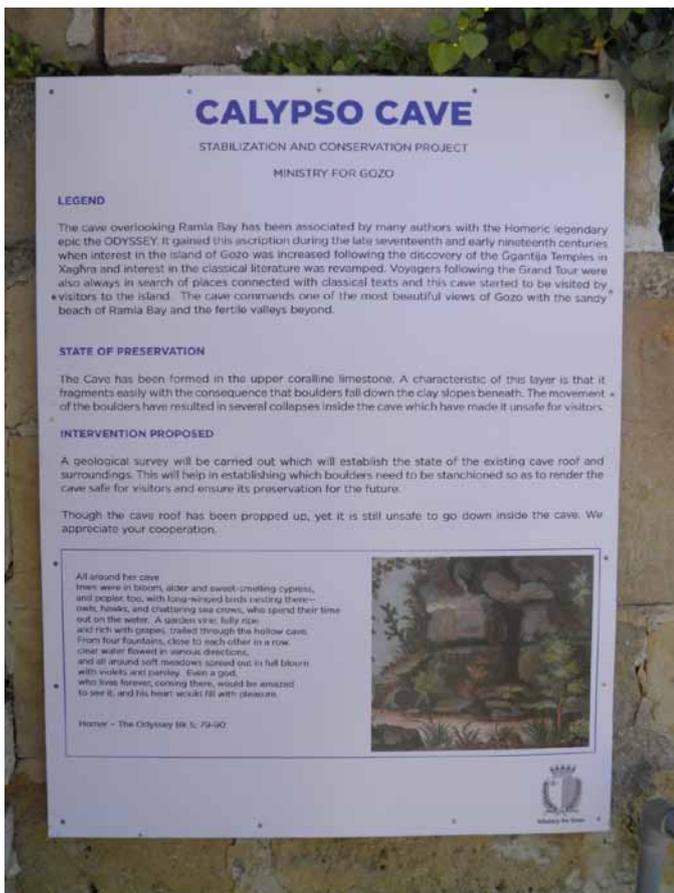


The gate 'barring access'(!!) to the inner sections of Ghar Hasan.
Photo: Kent Henderson

Calypso Cave

This cave is on the northern coast of Gozo, near the town of Xaghra. It is said to be the place where Odysseus was a *prisoner of love* for seven years. He was imprisoned by Calypso, who promised him immortality if he would stay with her. But he escaped, as soon as he had the opportunity and returned to his wife Penelope. In Greek mythology Calypso is the daughter of the titan Atlas. She was a nymph living on the magical island of Ogygna.

The cave is located near Ramla Bay. One enters down a 6m flight of steps cut in the rock at the intersection of two rainwater grikes which have been formed along the joint lines. Descending the steps brings you to a platform, the cave is on the western side a few metres lower. It offers a balcony view over the ocean, not too dissimilar to *Ghar Hasan*. The cave is currently closed for remedial safety works.



Signage at Calypso Cave.
Photo: Kent Henderson

Xerri's Grotto

This small show cave is located below a residential building in the town of Xaghra, central Gozo. It is well sign posted from the main square. It was discovered in 1924 by the current guide's grandfather while he was digging a well. As soon as he broke into the cave he abandoned the well and began to excavate what is now the show cave.



Inside Xerri's Grotto – the guide gives scale.
Photo: Kent Henderson

The entrance is gained via a 10 metre spiral staircase which is the dimension of the original well, thus this cave is not suitable for anybody suffering from vertigo, unsteady on their feet, or significantly overweight... Behind the staircase is a passage 7 m long. At the bottom one undertakes a circular tour about 30 m long. The whole passage has been dug out to about 2m high leading past plenty but mostly small speleothems in side alcoves that are only 25 cm to one metre high. About half way round it is possible to see the replacement well which was formerly used as drinking water and is now used for irrigating the garden. Part of the excavations were carried out during the second world war when the family used the cave as a shelter. The excavations have significantly lowered (and destroyed) the natural cave floor.

The roof of the cave is flat, but contains a series of shallow parallel channels, which do not appear to have been formed by water. One suspects these indicate the direction of the joints along which the cave was originally formed.

The guide to the current owner of the cave. At a cost of 2.50 euros (\$A3.50), the tour lasts around 20 minutes, and the guide's patter is totally *fairy castle*, as he gleefully points out speleothems resembling various animals. The lighting features undisguised conduit with light bulbs at intervals, surrounded by thickly coated *lampenflora*. Management is thus ordinary.

Ghar Ninu

This cave is located in the rear of No 15 January Street, about 75 m north west of the parish church, in the village of Xaghra, Gozo. It is, perhaps, 100 metres from Xerri's Grotto. A family member of the discoverer will answer questions and allow the visitor to take a self guided tour. The price of admission is a 'donation' – two euros seems to make them happy.



The guide in the entrance to Ghar Ninu.
Photo: Kent Henderson

Ghar Ninu, which is formed in the Upper Coralline Limestone, was originally discovered in 1888 whilst the owner was digging a well for water – the same story as Xerri's Grotto. It was immediately considered remarkable because of its prolific decoration.

It is entered via a 4m descent down a flight of steps, which end in a large chamber approximately 20m by 8m. Thick columns stretch from floor to ceiling throughout the cave, and there appears to be a passage to the right with other passages leading off it. It would be impossible to extend the cave, tourist-wise, without unacceptable damage. The viewing area is small, at base of the stairs. 5 minutes, perhaps, is enough time to see it.

There is evidence of numerous straws which have now been broken off. There are a few helictites, as well as some reasonably large speleothems, generally. It would compare favourably to any relatively small single chamber you'd see in an Australian cave. The decoration is now dry and mainly the same colour as the surrounding rock.

The chamber is (over) lit with several large parafloods, accompanied by *lampenflora*. The floor of the small viewing area is concreted; there are metal handrails, and some large gauge chicken wire, though this is quite unnecessary, as the guide accompanies you.



Speleothems in Ghar Ninu.
Photo: Kent Henderson

The Blue Grotto

This is one of Malta's top attractions, and certainly the boat trip along the dramatic cliffs of the south coast is one of the highlights of a visit to Malta. The famed Blue Grotto is located just along the coast from the little fishing village of Wied iz Zurrieq, reached by a spectacular drive along the cliff tops. From here, traditional fishing boats ferry passengers every day, but only if the water is calm. The fishermen tend to cram in as many visitors as they can; eight is supposedly the limit... I am not sure what their definition of stormy weather is, but on the day I went the waves were at least a metre high, and the sea what I would call 'rough'. Still, the trip was fun! Life jackets were mandatory – as you'd expect.

Wied iz Zurrieq harbour consists of no more than a small cluster of houses, shops and cafés, an exhibition of sea shells, a small shrine giving heavenly protection to fishermen and a watch-tower erected by the Knights of Malta to warn of saracen ships. A slipway lined with fishing boats leads down to the minuscule harbour. The boat journey takes a total of about 40 minutes and weaves in and out of a series of limestone sea caves set in the (very) high cliffs. All the caverns have names and the limestone is tinted pink, mauve or orange by coral or minerals.

To reach the Blue Grotto itself, so-called because of the deep blue of the water inside, boats pass under a monumental arch, resembling a flying buttress in a cathedral. From here you glide into the dark grotto, which goes for 50 m deep in the cliff face. For those not wishing to do the boat trip you can walk to the top of the grotto via the coastal path from the village. The Blue Grotto trip is definitely a Malta highlight



The entrance to the Blue Grotto.
Note the boat about enter.
Photo: Kent Henderson

The Azure Window

Rivalling that of the Blue Grotto on Malta, the Azure Window natural arch on Gozo features a table-like rock over the sea, occasioned by collapsed sea caves. The Azure Window has been featured in films, such as *Clash of the Titans* (1981) at the 104th minute and *The Count of Monte Cristo* (2002) at the 13th minute. It can also be seen in the television miniseries *The Odyssey* (1997), and HBO's TV series *Game of Thrones*.

Upon arrival, after viewing the arch, one can then take a boat trip (similar to that at the Blue Grotto). One this occasion, I didn't bother with the boat. Not unexpectedly, the Azure Window arch is disintegrating. Large pieces of rock keep falling off and it is expected that the arch will completely disappear within just a few years. Clearly, the arch is in a dangerous condition and warning notices are placed to stop people walking over the top, although more than a few ignore the signs (see the photo, below). Evidence of its deterioration can be seen when the images of it as shown in *Clash of the Titans* are compared to the more recent images shown in *The*



Odyssey and *The Count of Monte Cristo*. The former images depict the Azure Window arch with a flat underside, whereas the latter clearly show that a significant proportion the flat underside has since broken away.

In April 2012 a large piece of rock was dislocated and made the window larger, more unstable and losing its almost perfect oblong shape. Once the arch has completely collapsed, it will be renamed Azure Pinnacle.

The Cart Ruts

The so-called cart ruts of Malta are something of an enigma. They occur mostly on Malta, although some are found on Gozo. They are up to 60 cm deep and have an average distance between them of 110 to 140 cm. Some cross while others form junctions, and while most are in roughly parallel lines, some are not.

There are numerous theories about how these tracks were created. The most discussed suggests goods were transported on sledges which gouged the tracks into the rock, that the tracks are real cart ruts for transporting goods, and that it was an ancient irrigation system.

Maltese archeologists think that the ruts are devices of the Phoenicians – if so this would mean that the tracks were made about the 7th century BC. Other research suggests that these may have been caused by wooden-wheeled carts eroding soft limestone. An analysis was made of the stresses that would have been caused by a cart which would fit the ruts. Apparently, the underlying rock in Malta is weak and when it's wet it loses about 80

per cent of its strength. The carts would have first made tracks in the soil but when that eroded, the cartwheels ran directly on the bedrock, making it easier for other carts to follow the same tracks – so this theory goes.

One thing that has not been discussed is the possibility that they are natural karst landforms, perhaps a form of limestone pavement? Are they shallow solution pans?



*Top. The Azure Window, northern Gozo.
So-called cart ruts, Malta
Photos: Kent Henderson*

THE SHOW CAVES of SOUTHERN SPAIN: A COMPARATIVE STUDY of the APPLICATIONS and OUTCOMES of THREE DIFFERENT APPROACHES to the TRIPLE BOTTOM LINE.

Sasa Kennedy

Abstract

This paper looks at the management and presentation of three show caves situated in the south of Spain: Cueva de Pileta, near Benaolan; Gruta de las Maravillas, in Aracena; and Cueva de Nerja, on the Costa del Sol. It examines how the managements' varying focuses on the triple bottom line affect both the caves themselves and the visitor experience. The Gruta de las Maravillas sits in the heart of the community and is valued as "Aracena's most cherished treasure", a source of local pride, employment opportunities and a significant tourist attraction. Here the three aspects of the triple bottom line seem to be all given due consideration. The Cueva de Pileta is a listed National Monument for its superb prehistoric cave art, but it remains a family concern. Fortunately for the cave and its visitors, the Bullon family is totally dedicated to the preservation of the cave and the education of visitors. Cueva de Nerja is also famous for its cultural worth as a prehistoric site. However, at Nerja the profit focus is detrimental to the natural features of the cave, which in turn impacts badly on the general visitor experience.

Introduction

In November 2012 the author visited three show caves in southern Spain with two seasoned cave tourists, one of whom is, like the author, a show cave guide. The caves were visited on consecutive days; as time was limited each cave was visited only once, and impressions from the earlier ones were still fresh as the later caves were experienced. At two of the caves, Gruta de las Maravillas and Cueva de la Pileta, informal discussions were held with the cave guide and manager. At Cueva de Nerja the staff declined the request for information, directing the author instead to their website. Each site clearly had a different focus regarding the triple bottom line. At Gruta de las Maravillas the focus was fairly balanced, though people and place were apparently of more primary concern. At Cueva de la Pileta the focus was strongly on place, with visitors also a priority. At Cueva de Nerja profit was, without doubt, the *raison d'être*. The resulting outcomes for the cave environments, the staff and the visitors at each site have implications for how cave managers in general should view and balance the triple bottom line.

Gruta de las Maravillas

The Gruta de las Maravillas is a highly decorated cave of great beauty, situated in the heart of the town of Aracena, directly underneath the medieval castle-fortress which crowns the town. Aracena itself is located in an agricultural area of Andalucia; a region known as the Sierra de Aracena y Picos de Aroche Nature Park. It



Gruta de las Maravillas: cave is in the hill below the castle ruins.

Photo: Sasa Kennedy

is in the province of Huelva, about 50 km from the Portuguese border and off the main tourist circuit.

The caverns are formed in 570 Myo Pre-Cambrian marble (Durán, 15 December 2012, pers. comm.). This rock originated in an ocean separating the super continents of Laurasia and Gondwana (Garcia, 2011, p 25). The length of the cave is about 2130 metres (Garcia, 2011, p 25).

The cave discovery related to intensive mining activity in the region during the nineteenth century. The first reference to it is in the Sevillian newspaper 'El Porvenir' in 1850 (Garcia, 2011, p11). However local tradition is that the caverns were discovered by a shepherd looking for a lost lamb (Garcia, 2011, p13). The free access that local people had to the cave in this early period led to the removal of many formations and damage to others (Durán, 15 December 2012, pers. comm.).

Due to the great tourism potential of the cave, the Marquis of Aracena, Francisco Javier Sanchez-Dalp, and the mayor of Aracena, Juan del Cid, initiated the development and lighting of the cave between 1912 and 1915; visits officially began in September 1914 (Garcia, 2011, pp15-16), making 2014 the centenary of the cave as a tourist attraction. As more sections of cave were discovered these were gradually developed and added to the tour (Durán, 15 December 2012, pers. comm.).

Royal visits from King Alfonso 13th and Queen Victoria Eugenia of Spain cemented the popularity of the caves domestically, and the rise of international tourism to Spain in the 1960s brought an influx of visitors from Europe and around the world (Durán, 15 December 2012, pers. comm.). The cave featured in several



*Cave chamber, painted tile on decorated bench.
Photo: Sasa Kennedy*

blockbuster movies, including 'Tarzan in King Solomon's Mine', 'Journey to the Centre of the Earth' and 'Clash of the Titans', bringing further attention to the site.

In the 1970s increased visitor numbers started to cause management issues and geologists from Malaga experimented with different lights, in order to reduce the incidence of lampenflora. It was found that the length of time lights remained on had more impact than the type of lights used. Guides are now responsible for lighting maintenance and cleaning the cave with bleach, following strict maintenance guidelines (Durán, December 15 2012, pers. comm.).

Ongoing research and consultancy with the Department of Geology of the University of Granada began in the early 90s (Garcia, 2011, p21). As a result the number of daily visitors was restricted to 1000, with between 20-40 visitors per tour and a total of about 150,000 visitors per annum (Durán, 15 December 2012, pers. comm.). Tour times are flexible, with tours running when enough visitors arrive, and wait times of no more than an hour. Tours last between 45 minutes and one hour.



*Gruta de las Maravillas interpretation centre.
Photo: Sasa Kennedy*

Audioguide iPods are available with cave commentary in four languages – English, French, German and Portuguese.

Gruta de las Maravillas is managed by the local Town Hall. Sixteen people are employed at the cave:

- Six permanent guides
- Four casual guides
- Two tourist officers
- Two ticket sellers
- Two managers

The town square features seating decorated with hand-painted tiles showing images from within the cave. From here the approach to the cave precinct is also very attractive, by foot up a cobbled street, with water feature, shade trees and restaurants. Adjacent to the visitor centre are a few souvenir shops. The visitor centre includes a ticket office, an information centre and an interpretation centre. The cave entrance, on the other side of a small square, looks like a large office entrance.

The welcome from staff at the cave was warm and genuine. Our tour included a Spanish coach group, which is quite common at the site. Large tour groups in Spain are very boisterous, making the guide's job quite difficult. The guide used a small personal amplifier to assist voice projection, which worked well.

The cave itself is richly decorated and in very good condition, though with occasional lampenflora in evidence. The tour is over two of the three known levels of the cave and includes a lake and large rimpools. The floors are cobbled in places and frequently wet and slippery. The few handrails are stainless steel. The cave is nicely illuminated, with water features lit particularly effectively. The overall presentation of the cave is of a very high standard. However the passages between chambers are narrow and platforms fairly small, making the guide's job more difficult, particularly in combination with noisy, sociable groups.



*Sasa and Richard Kennedy with Amparo Durán, cave guide, and Eva Jimenez, manager
Photo: Sasa Kennedy*

The tour proceeds through the Shell Chamber, with fossil deposits; the Diamond Chamber, featuring glittering crystals; the Shawl Chamber; the Grand Hall, about 50 metres high; up the Ascent to Heaven, where there are lovely views of the Great Lake, to the Cathedral; past the Sultana's Bath, a delicate rimpool; then the Chamber of God's Crystal, with aragonite and many helictites reflected in the Emerald Lake; through the Chickpea Chamber; and the aptly, if coyly, named Nude Chamber and, finally, the Lake Passage.

Our guide, Amparo Durán, was very knowledgeable about the cave's geology and history and very entertaining and lively in her presentation. She incorporated an English translation for her three English-speakers, alongside her Spanish commentary. Though her English was not fluent it was possible to follow the information easily. Safety and minimal impact was repeatedly emphasised, which was necessary due to the lack of engagement from the group as a whole. A strange divergence from the environmental emphasis otherwise in evidence on site was the proud displaying of a fern growing adjacent to a light towards the end of the tour.

The audiotour was a little less successful; the information was relevant and succinct, but the only indication when to turn on various segments was the name of the chamber, which was not always obvious in the cave, causing confusion and distracting from the cave itself. This could be remedied with simple numbered posts corresponding to information segments. There was low-level mood music running through the audiotour, which was irritating when trying to take in English commentary from the guide parallel to the audioguide commentary. Another problem with the audiotour was a lack of instructions as to how to use the iPod – probably obvious to most people these days, but not all people.

Photography is not allowed in the cave, which is understandable given the difficulty of managing the clients, even without cameras. It is, however, unfortunate, as there is so much to take in during the tour that it is impossible to retain a clear memory of the cave's many highlights. A photo is taken as you enter the cave, which is ready to purchase on departure from the tour, at extra cost. This in no way makes up for the lack of photographic opportunities during the tour, with the background of the shot not at all representative of the beauty of the cave.

Gruta de las Maravillas is a very special cave experience, with the outstanding level of decoration, high standard of presentation and quality interpretation all contributing to a great tourism experience.

Cueva de Nerja

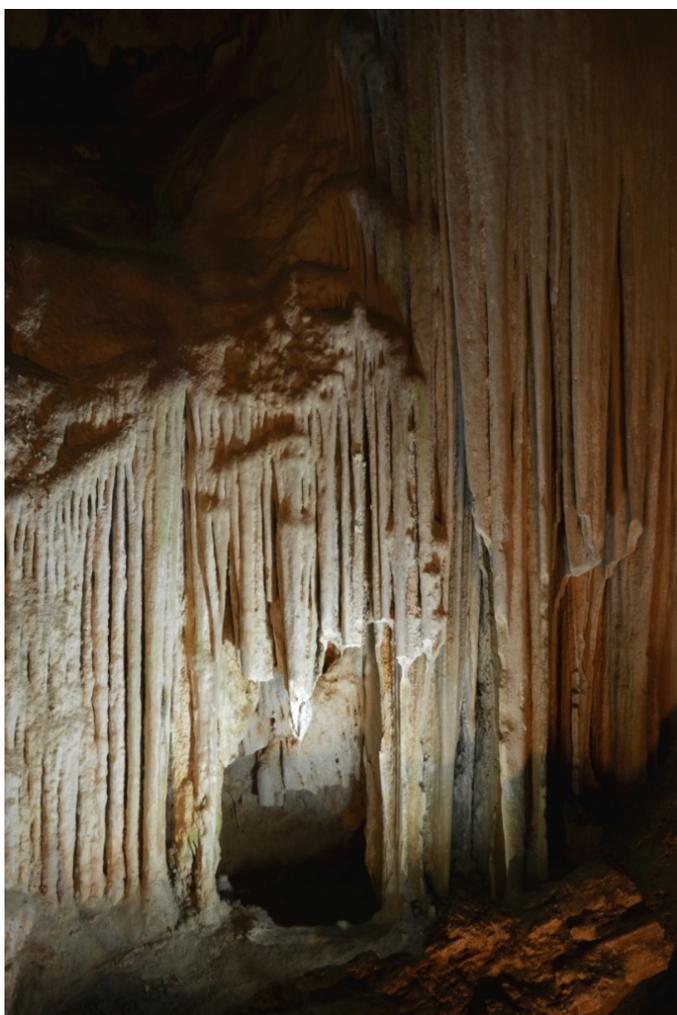
The Cueva de Nerja is situated a few kilometres outside the town of Nerja, in the province of Malaga. It is close to the coast, on the Costa del Sol, and located on the lower part of the Sierra Almirajara. It was originally known as the Cave of Wonders. The name Nerja comes from an Arabic word meaning 'spring of water' (Hierro, 2012, p 4). The cave extends over 7,200 metres from north to south (Hierro, 2012, p 10). There are three known levels to the system, the Lower Galleries, the Upper Galleries and the New Galleries. Of these the Lower Galleries are open to the general public, with the other areas reserved for scientific study.



*Vandalised cave signage.
Photo: Sasa Kennedy*



Above. Giant Column, recorded in Guinness book of Records as the largest in the world.
Below. Broken formations.
Photos: Sasa Kennedy



The caves are formed in marble from the Triassic period, 200 Mya, with the caverns believed to be formed about 5 million years ago during the Pliocene and Pleistocene periods. The warm period of the Quaternary is when scientists believe the formations were produced (Hierro, 2012, pp 6-11). A massive earthquake 800,000 years ago led to the devastation which gives the Cataclysm Chamber its name (Hierro, 2012, p 14) and in 4000 BP

El año 12000 años los grupos humanos que vivieron en este lugar realizaron una serie de pinturas entre las que destacan una de las más sorprendentes representaciones hasta ahora de la pintura prehistórica europea. Interpretadas por los investigadores no como peces sino como focas, por lo que muestra el importante vínculo de la caza con este tipo de fauna marina, cazada y consumida por el grupo tal y como demuestran los restos recuperados en las excavaciones arqueológicas.

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Cave art

The galleries of Nerja Cave stretch for 5 km and are divided into two sectors: the Lower Galleries (the developed tourist area) and the Upper Galleries, the former amounting to just one third of the total cave area. Prehistoric artists used the Lower Galleries mainly (halls of the Belen, the Cascade, the Phantom's, the Cataclysm and the Cubicle of the Organs). In the Upper Galleries, occupation included the Columns of Hercules and the Maze (hall of the Kitchen, Cubicle of the Dolphins and Horse Passage).

Nerja Cave holds one of the most spectacular samples of prehistoric art of the southern half of the peninsula. The hunters-gatherers of the Upper Paleolithic reflected their vision of their society and environment by drawing and engraving natural and geometric images on the cave walls.

The cavities containing cave paintings have been deemed to be sacred places or shrines playing a fundamental role in the daily lives of their inhabitants. They must have been used to demarcate territories, as meeting points for various groups and to pass on traditions and beliefs which should help to strengthen the links between the individuals of a certain group.

Cave art interpretation.
Photo: Sasa Kennedy

water deposited rocks and sediments into the cave entrance, blocking it until its discovery by modern humans (Hierro, 2012, p 10).

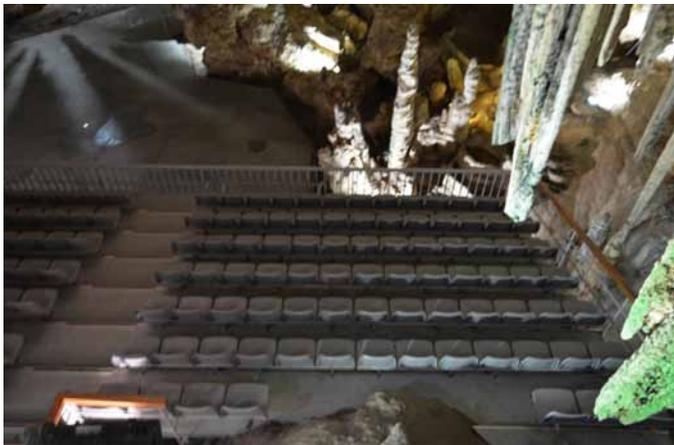
The cave was discovered by three local youths, 'catching bats for fun', in 1959 (Hierro, 2012, p4), who first entered the Cataclysm Chamber. The Upper Galleries were discovered later in the same year and the New Galleries in the 1970s.

In June 1961 the cave was declared an Artistic National Monument (Hierro, 2012, p 6). Since its discovery the cave has been the subject of continuous excavations and detailed study relating to its geology, ecology and prehistoric significance (Hierro, 2012, p 6). It is known to have been occupied from the Upper Palaeolithic period until the Chalcolithic, or Copper Age. It is believed to have served as a living place, sanctuary and burial ground (Hierro, 2012, p 20). There are over 600 paintings and engravings on the cave walls, and remains include marble bracelets, underground stores, ceramics, bone fish hooks, painted stones, engraving tools, jewels, loom weights and group burials (Hierro, 2012, pp 20-24).

The Committee for Archaeological Excavation at Malaga was responsible for opening up a visitors' entrance to the

cave and building infrastructure to facilitate visitation and scientific investigations (Hierro, 2012, p 6). The cave was officially opened on June 12, 1960. Being located in a popular tourist area, the cave has high visitation, with 527, 096 in 2001 dropping to 376,518 visitors in 2011 (The Nerja Caves, 2013). It provides employment in a range of positions from ticket sellers, restaurant workers, retailers, photographers and photo developers, parking attendants, managers and cave guides. Neither the guide book nor the website names the managing body.

The cave is a popular venue for artistic performances. Every summer the 'International Festival of the Cave at Nerja' is held, with performances of ballet, flamenco and music featuring, and up to 600 spectators attending in the Cascade Chamber (Hierro, 2012, p 14). At other times visitors are free to view the cave unguided and at their own pace. Locals can visit the cave free of charge on Sunday mornings (The Nerja Caves, viewed 3 April, 2013).



Concert seating, with lampenflora on speleothems on right side of image.

Photo: Sasa Kennedy

The cave precinct is approached via the carpark, where (on the occasion of our visit) a bored-looking attendant was in attendance for no apparent reason, and a collection of retail venues including a gift shop, a large restaurant and a photographic studio. A statue of the boys who discovered the cave is prominent near the cave entrance. There are also extensive gardens behind the commercial precinct.

The ticket office staff were very offhand and appeared uninterested in either visitors or the site. When a request was made to discuss the cave and its management they referred the author to their website, which was in contrast to the personal assistance provided at other cave venues visited. The ticket office has audioguides available (at extra cost), but these were not offered to us. The only rule we were given when collecting tickets was that no flash photography was allowed in the cave. Photos are available for downloading on the Nerja website, with most being very amateur shots (out of focus and badly framed), but their availability was not mentioned.

The approach to the actual cave is down a stairwell, past a currently blocked off section of the cave. As we stepped into the first chamber we were greeted by the flash of the professional photographer! On departure from the cave the print is proffered for purchase immediately. It would appear that only clients' flashes have an impact on the cave...

The first chamber in the cave, the Christmas Crib Chamber, contains displays of archaeological remains and interpretative material on both the geology and occupational history of the cave. The English translations, at least, are riddled with inaccuracies. However, the interpretative material is visually well presented and interesting, particularly in relation to the use of the cave by prehistoric peoples.

The chamber is marred by many broken formations, unsympathetic infrastructure and lampen flora. Sadly, this is just a hint of what is to come in terms of cave damage.

The cave is generally underlit, with the flat lighting dimming the sense of drama that the enormous caverns and potentially spectacular formations should provide. The stairs and platforms are cemented, with wooden and occasionally rope handrails. Large painted arrows point the way on. Signage is largely limited to named maps of the various sections of the cave, which, on a positive note, include audioguide segment numbers. The signs have been vandalised and remain unrepaired. At the time of our visit we did not see any visitors using audioguides and comments in TripAdvisor indicate that they are only infrequently offered to visitors (TripAdvisor, viewed 9 April 2012). Visitors are given a brochure to guide them through the cave, but it merely contains directions through the cave and names of features.

At the Cascade or Ballet Chamber is the first indication of minimal impact regulations; a large sign indicates that pets are not allowed in the cave, smoking and eating are not permitted, nor is flash photography or touching the formations. The sign also indicates that there are stairs in the cave, perhaps a little belatedly. This was the only obvious measure taken to protect the cave from visitor damage.

Apart from the initial chamber there was no guide or security presence in the cave and no indication of remote cameras to keep check on visitors. In the first chamber the guide was occupied in discussion with the photographer, showing no interest in the visitors or the cave. In the Cataclysm Chamber a female singer yowled, unrestricted, during our entire tour. She only ever completed one or two lines of each song before moving on to the next, showing absolutely no respect for the cave or other visitors. At no time did any member of staff try to restrict her, or even explain her presence – maybe she was practising for a cave performance, but we will never know (and I hope not, for the sake of visitors!).

The Cascade Chamber is dominated by an enormous, two-tiered bank of about 100 theatre seats, permanently fixed to the platform. Unprotected formations are within easy reach of the seating.

Throughout the cave infrastructure is poorly sited, often fixed to crystal formations. Formations are dull and dirty. Broken formations can be seen throughout. The most dominant feature of the cave is the omnipresent lampen flora. The cave positively glows green. Nearly every light has a forest of moss nearby.

In the Cataclysm Chamber is the most dramatic feature of the cave, the Great Column, said to be the largest in the world at 32m high and measuring 13m x 7m at the base (Hierro, 2012, p 14). Whether or not it is the largest column known, there is no disputing the magnificence of this feature.

The tragedy of this cave is that it has all once been so very beautiful, with enormous crystal formations, rich and varied decorations and chambers of grand proportions. It should be a premier show cave, but instead is a terrible disappointment – uninspiring and largely uninterpreted.

Cueva de la Pileta

The Cueva de la Pileta is set in a rugged and majestic landscape, comprised of jagged limestone peaks and valley farms. It is located on the small Harillo Farm, not far from the village of Benaolan, in the province of Malaga. It was declared a National Monument by the Spanish government on 25th April 1924, in recognition of its archaeological significance (Bullón J, 2005, p39).



*View from the entrance showing limestone outcrops.
Photo: Sasa Kennedy*

The cave is formed in Jurassic limestone and shows evidence of damage from the Lisbon earthquake of 1755 (Bullón T, 16 December 2012, pers. comm.). It contains over 3000 artworks from the Upper Palaeolithic through to the Bronze Age. There are figurative paintings in the French and Cantabrian styles, Palaeolithic engravings and schematic art from the Neolithic era (Bullón R, preface to Bullón J, 2005, p9). Inside the cave is what appears to be a Neolithic cemetery; when discovered it contained fifteen skeletons laid out in the foetal position (Bullón T, 16 December 2012, pers. comm.). There is also potential evidence of human sacrifice; at the bottom of a 72m hole lie the remains of three animals and one human (Bullón T, 16 December 2012, pers. comm.).

The cave was discovered by José Bullón Lobata in 1905. The cave 'Las Grajas' was known locally as the 'cave of the bats', due to the swarms of micro-bats heading out to feed of an evening, but the deep drop at its entrance had deterred locals from entering the cavern. José was motivated to enter by his need for fertiliser to use on his farmlands. His initial exploration led to the discovery of skeletal remains, pottery shards and markings on the walls and gradually he continued his solitary explorations of the cave, discovering more artefacts and a variety of pre-historic artworks in the new passages and chambers he traversed (Bullón J, 2005, pp 12-24).



*Kiosk and waiting area.
Photo: Sasa Kennedy*

Rumours of hidden gold led to unending attempts to infiltrate the cave and plunder its treasures, and José's family began their quest to preserve the cave, learn more about the treasures it contained and share them with the public in a responsible and respectful manner (Bullón J, 2005, p 25).

The cave has been the focus of sustained scientific study. Unfortunately, many of the specimens taken from the cave in earlier times have ended up in private collections, or disappeared without trace (Bullón J, 2005, pp 28-29).

Meanwhile José Bullón began to create some rudimentary steps in the cave in order to improve access for scientists and interested parties (Bullón J, 2005, p 23). Four generations of the Bullón family have continued in his work of protecting, preserving and promoting the cave, often at great personal expense (Bullón J, 2005, p 31, 34). Tomás Bullón García developed the current entrance in 1924 and in the same year the government declared him the official guardian of the cave, to facilitate its protection (Bullón J, 2005, p38). He also improved the internal stairs and constructed the stone approach steps and iron railings in this year. The family continued to make further discoveries in the cave up until 1993 (Bullón J, 2005, pp 40-41).

The Cueva de la Pileta remains in the care of the Bullón family, who are proud of the fact that they are backed neither by big business nor major institutions (Bullón J,

2005, p26). The breath of visitors is considered to be the major threat to the artworks in the cave and visit times are strictly controlled (Bullón T, 16 December 2012, pers. comm.). Tours are conducted by paraffin lamp and torchlight, with a minimum of infrastructure to assist access; some cut steps, a few concrete stairs and a few galvanised handrails. Only a small portion of the cave is shown, in order to protect its integrity. Tour length is about 500m each way (Bullón T, 16 December 2012, pers. comm.).

About 9000 visitors experience Cueva de la Pileta each year. A maximum of 25 per hour visit in summer and holiday periods; in the low season the number is about 20-25 per day. It is open from 10am-1pm and 4pm-6pm daily (Bullón T, 16 December 2012, pers. comm.).

Four members of the Bullón family make up the staff of the cave, with other family members working in town in occupations such as teaching (Bullón T, 16 December 2012, pers. comm.). The guides are highly trained and dedicated.

A sign leads to the small carpark above the Bullón family farm, which must have the best views of any carpark in Spain. At the carpark is an information board with an excellent cave map and a short history and description of

the cave. From here rustic stone steps climb the steep hillside to the simple waiting area. A wooden shelter shed incorporates the kiosk, open briefly as the guide arrives. A sign on the cave gate requests that visitors wait for the arrival of the guide, but it is not clear when this might be.

On entry to the cave, through a small gateway, the first chamber serves as the ticket booth and souvenir stall. On the wall are certificates honouring the work of the Bullón family in developing and conserving Pileta Cave. This is also where the guide collects his paraffin lamp and visitors are given one battery-powered lantern between four to light their path.



Plaques commemorating a century of cave conservation at Pileta

Photo: Sasa Kennedy

With minimal infrastructure and slippery, uneven floors, moving through the cave with only one diffuse light between four visitors is quite difficult. For any visitors with mobility or sight issues this could provide major problems and safety issues. Though safety warnings are delivered, little assistance is offered.

The paintings and engravings throughout the cave are in pristine condition, are varied in style and content and of high quality. The main themes are animals, including a beautifully executed pregnant mare, a large fish sketch and goats; and a series of symbolic line drawings, which are believed to be shamanic calendars (Bullón T, 16 December 2012, pers. comm.). The crystal formations in the cave are also in good condition, but are not outstanding examples, though minerals in the cave (including iron oxide, manganese and copper) provide a range of colour. Prehistoric fires have dulled the crystal in many areas (Bullón T, 16 December 2012, pers. comm.).

This is one of the best and most atmospheric guided tours ever experienced by the author, in a cave or anywhere else. Our guide, Tomás Bullón Almagro, was very knowledgeable about the cave's history and significance, being the great grandson of the discoverer, a co-owner of the site and an archaeology graduate. He delivered a completely bi-lingual tour, being very fluent



Steps leading to the cave.
Photo: Sasa Kennedy

in English as well as his native Spanish. The low light was sufficient to see the paintings easily and clearly but also contributed greatly to the atmosphere.

Though geology and cave fantasy comprise part of the tour, the focus is on the prehistoric artworks and the lives of the artists. The interpretation is delivered clearly, with authority and passion. The stories are fascinating and detailed, with the added intimacy implied by the guide's links to the site and the history of its exploration and development. In addition to interpretation of the artworks themselves, visitors are told of the human cemetery located in the cave, the possibility of human sacrifice having taken place here, the different family and tribal groups who occupied the cave at different periods, the pottery shards and other finds, including a hollowed out stalagmite used as a mortar for the grinding of pigments.

The protection of the cave and its artefacts is clearly the priority, with all aspects of cave and tour management stemming from this central concern. One of the seven people on our tour requested a private tour, where she could sit for longer and sketch the cave. Tomas explained that as the major risk to the artworks came from human breath a longer viewing was not an option.

This tour is a unique experience. Though the sections of the cave included in tours are do not contain particularly memorable formations, to be able to enter a cave with such high quality prehistoric artworks and have the cave and its prehistory interpreted with such passion and knowledge is a rare honour.

Visitor Impressions of the Caves

To obtain a broader impression of the visitor experience at each of the cave sites a survey of TripAdvisor ratings and reviews was completed on April 9, 2013. This website covers tourist attractions and accommodation worldwide and, while it cannot guarantee a balanced view of visitor experience, it is at least a fairly reliable site, where operators can reply to visitor comments and complaints. In addition it applies the same ratings system across the cave sites, allowing a fair comparison. The overall ratings are listed as raw numbers in Figure 1 and as percentages in Figure 2.

The figures show that Gruta de las Maravillas was rated highest of the three show caves, though the caves were all rated very highly and the results were quite close. At Gruta de las Maravillas 95.8% of visitors rated the experience as either excellent or very good, Cueva de Pileta rated 91.9% in these two bands and Cueva de Nerja 88.8%. The figures were also similar between the caves at the bottom end of the satisfaction scale.

Visitor reviews on TripAdvisor provide more detailed feedback on how the general public experiences the cave sites (TripAdvisor, viewed 9 April 2013). A brief overview of the major positives and negatives for each site is presented in Figure 3.

Many posts regarding Gruta de las Maravillas describe it as the most beautiful cave they have ever seen and many comment on the friendly guides. The complaints are

TRIP ADVISOR	Aracena	Nerja	Pileta	Jenolan
Excellent	63	285	37	140
Very Good	31	181	18	53
Average	2	47	5	12
Poor	1	7	1	3
Terrible	1	5	0	3
TOTAL	98	525	61	211

Figure 1. Trip Advisor ratings - numbers

TRIP ADVISOR	Aracena	Nerja	Pileta	Jenolan
Excellent	64.2	54.3	60.6	66.3
Very Good	31.6	34.5	31.1	25.1
Average	2.0	8.9	8.2	5.7
Poor	1.2	1.3	1.6	1.4
Terrible	1.0	1.0	0.0	1.5
TOTAL	100%	100%	100%	100%

Figure 2. Trip Advisor ratings - percentages.

about slippery floors, having to wait for tours to fill before departure and the ban on taking photographs. But all visitors agreed the glories of the cave made it a wonderful experience (TripAdvisor, Gruta de las Maravillas, viewed 9 April 2013).

Cave	Positives	Negatives
Gruta de las Maravillas	• Most beautiful cave	• Slippery floors
	• Friendly guides	• Waiting for tour to fill
	• Wonderful experience	• Ban on photography
Cueva de Nerja	• Sheer size and beauty of caverns	• Ban on flash photos
	• Nice restaurant with good views	• Pushing of professional photos
	• Alternative to heat/sun	• Cost of tickets
Cueva de la Pileta	• Non-commercial atmosphere	• Cost of audioguide
	• Quality of artworks	• Ban of photos was lamented but agreed
	• Guide's knowledge	• Slippery floors
	• Custodian's devotion	• Waiting time for tours

Figure 3. Trip Advisor feedback.

Even with all the drawbacks cited above, most of the reviews describe the experience at Nerja in very positive terms; the ban on flash photography in combination with photo sales being pushed seemed to be the major irritant. Another regular complaint was the cost of tickets and additional cost for an audioguide. One visitor complained that the security guards throughout the cave (not in evidence on the occasion we visited) would not be engaged in conversation. However, it seems that the grandeur of the caverns and the sheer majesty of the formations were enough for most visitors. A major positive for visitors was the contrast to the heat and bright sun (or sometimes rain) to be found outside. While other sites drew comment on the quality of the guides, there was little comment on the lack of this at Nerja. It is likely that the demographic visiting this cave makes it a less discerning group of visitors than those at the caves in areas lacking highly developed mass tourism (TripAdvisor, Cueva de Nerja, viewed 9 April 2013). However, the complaints about cost of tickets indicate that visitors do not consider they are getting value for money. Given the price is a reasonable €8.50 per adult, the same as Gruta de las Maravillas and slightly higher than Cueva de la Pileta at €8, and that neither of these sites had complaints about their cost, it seems that there is something lacking in the experience, though visitors do not specify what it is.

At Pileta visitors generally appreciated the non-commercial atmosphere of the caves and were impressed by the paintings and guide's knowledge. Negatives noted

include the problem of slippery floors combined with low light levels, and the issue of having to wait for tour numbers to build prior to a tour departing. Visitors lamented the lack of photographic possibilities, but were understanding of the reasons for this (TripAdvisor, Cueva de la Pileta, viewed 9 April 2013). Many noted with approval the dedication shown to caring for the cave.

Overall, the visitor feedback for each site was as positive as the ratings would indicate. In light of this, further study would be required to clarify the factors leading to the large and steady downturn in visitor numbers at Nerja, which will have had a significant impact on the profit margin of the caves.

Conclusion

At each of these three cave systems the tourist experience and the caves themselves have been shaped by their location, the circumstances and timing of their discovery and the history which has led to the particular bottom line focus of each managing authority.

The Gruta de las Maravillas was discovered in the nineteenth century, a time of scientific discovery and fascination with the natural world. Located in the heart of the town, it is also close to the hearts of the local population, as demonstrated by its unofficial title of 'Aracena's Treasure'.

The bottom line focus becomes clear on reading the introductory section of La Gruta de las Maravillas, the tourist booklet available at the cave:

CAVE	Gruta de las Maravillas	Cueva de Nerja	Cueva de la Pileta
Bottom line, with apparent focus	Planet, people, profit	Profit, people, planet	Planet, people, profit
Cave presentation	Very good	Very poor	Excellent
My experience rating	Very good/excellent	Poor	Excellent
TripAdvisor rating very good/excellent	95.7%	88.7%	91.7%
Bottom line result	Success	28% drop in visitation over 10 years...	Success

Figure 4. Triple bottom line results.

To work for the caves is a delight. Our daily challenge and responsibility is to conserve and take care of this jewel of nature so future generations can continue coming. Our other responsibilities are to offer the best high-quality service to all those who honour us with their visit, and to attract more visitors through frequent promotional campaigns...

Generations of tour guides, managers, office staff, tourist agents, town councillors, investigators and conservationists have all treated Aracena's star attraction with care and affection for nearly one hundred years...

... We cannot forget the local inhabitants of Aracena, who show off their rich patrimonial legacy with pride and modesty... We cannot forget our visitors either, who, through word of mouth, have recommended Aracena to others, and we would like to thank them for their fidelity over so many years.

The purpose of this guide is to make your visit to the Maravillas cave a unique experience. It is also a way of showing our appreciation and gratitude to all those who, directly or indirectly, have been working for the Cave for nearly a century (Garcia, 2011, p 5).

The priorities here are quite clear – environment, closely followed by people, including staff, visitors and the local population. From this profit will follow.

This ethos was also quite clear at Aracena - from the guide's commentary, through to the warm welcome and generous assistance which the author was offered. The passion felt for the caves was evident; cave protection was emphasised, but in an easygoing manner; a range of interpretative strategies was in place, from guides and tour translations to an interpretation centre. Locals are obviously proud of their 'star attraction', as evidenced in the attractive seating in the main square of the town, which features tiles painted with images of the cave formations.

The cave is protected by regular, monitored maintenance, considered infrastructure and watchful guides. Though visitation is high, and groups may not all be environmentally focussed, the cave, open for nearly a century, is in remarkably good condition. The only detractors to the experience were the lack of photographic opportunity and the occasional lampenflora in difficult to access places.

All of this contributed greatly to the extremely positive visitor experience, which is reflected in the reviews and ratings seen on TripAdvisor, the most widely viewed tourism ratings site on the web. These, in turn, contribute to word of mouth, assisting the bottom line aspect of profit.

Cueva de Nerja was discovered at a time when tourism was about to boom in Spain, and the Costa del Sol, where it is located, was to play quite a part in that boom. The mass resort and beach tourism which dominates the economy of the area were bound to influence the development of the cave as a tourist site. The typical visitor is less likely to appreciate the environmental and archaeological intricacies of a cave and more likely to look at it in a superficial manner. The cave is managed and presented accordingly, seemingly as a cash cow and certainly with little care for the environment, apart from the pre-historic paintings and artefacts, which are out of bounds to the average visitor.

As the guidebook to Cueva de Nerja states:

The cave at Nerja is an important element in the promotion of this coastal zone of the Axarquía as a tourist destination (Hierro, 2012, p 4).

The first impression on arrival at Cueva de Nerja is of a small retail centre and this illustrates the bottom line focus at this site; profit is paramount. While the majority of visitors to the site seem to cope well with this and, indeed, many enjoy their visit to a high degree, the cave

is suffering gross neglect and environmental degradation as a result. The decision to allow untimed, unguided access to the cave means that lights are on constantly, creating an extreme degree of lampen flora to flourish throughout the cave. The unsympathetic placement of infrastructure has also contributed a degree of damage.

The author's experience at this cave was one of extreme disappointment in the presentation of the cave and anger at the level of environmental damage and disregard. Though generally the reviews for this cave on TripAdvisor were positive it seems possible that, with a steady drop in visitation of 28.6% over ten years, and the lowest satisfaction rating of the three caves on TripAdvisor (especially notable in the excellent category), perhaps other visitors are not entirely satisfied either.

If Nerja is to turn its fortunes around, a rethink of its bottom line priorities may be in order.

Cueva de Pileta was fortunate to be discovered by, and on the farm of, José Bullón Lobato. Though a simple farmer he quickly understood the importance of the cave and its artworks. He worked tirelessly to protect it and instilled in his family the importance of their ongoing custodianship of the site.

The location of the cave in a more remote and wild area, along with low-key publicity, also helps protect the cave from undue visitor pressure.

Again, the bottom line focus is evident in the guidebook available at the cave:

Despite the deterioration caused by the activity of prehistoric man, the beauty of the rock formations found in the cave is almost boundless. There are still virginal areas which astound even the most experienced geologists...

After a century in the custody of the Bullón family, the rock paintings in the Pileta are amongst the best preserved in the world. The scientific community testifies to this and it can be appreciated by any visitor who cares to compare it with other, similar caves. The microclimate found inside the cave has been undisturbed by the strictly controlled regime of visits. Evidence of this are the colonies of bats which still inhabit its interior, something

that is rarely seen in other caves open to the public. (Bullón R, 2008, pp 9-10)

The booklet concludes:

When you leave this cave, dear reader, it is with the assurance that when next you return you will find it still the same.

Visitors are welcome, but not at the expense of the cave. It might seem that visitors would be put out by their clear relegation to second place in the list of priorities, but from comments in TripAdvisor it would appear that, on the contrary, they appreciate the devotion shown to the cave by its custodians and are happy to co-operate.

Due to the minimal infrastructure in the cave, minimal maintenance is required, and with the small-scale operation, restrictions on numbers and the low-key nature of the site few staff are required. Profit does not appear to be a major consideration; 9000 visitors per annum are enough to keep four people employed. The impression is that if less were required this would be fine by the family; they would find employment elsewhere.

The clear focus on the environment actually enhances the visitor experience and certainly benefits the cave, its biota and the important archaeological artefacts it contains. Positive visitor word of mouth will help ensure that profit continues to flow.

The evidence from these caves suggests that if the bottom line focus is primarily on the environment and people, then, with reasonable planning and management, the third aspect of the triple bottom line, profit, will follow (see Figure 4). However, if the focus is primarily on profit, this will potentially have detrimental effects on the cave environment, staff and visitors. This, in turn, may well lead to declining profit.

Acknowledgements

The author thanks Amparo Durán, cave guide, and Eva Jimenez, manager, of the Gruta de las Maravillas, Aracena and Tomás Bullón Almagro, guide and custodian, Cueva de la Pileta. Without their generous assistance and patience this paper would not have been possible.

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THE CAVE of CEMENT: ADVENTURING in UNDERGROUND MEGHALAYA

Yoav Bar-Ness

One early winter's morning, I stood before a stern building of grey, on the edge of India's Meghalaya plateau, awaiting the sunrise. Below, and beyond, the prodigious waterfalls spilled their bounty of raindrops over the edge and down to the marshlands of Bengal. Behind me, the grey cube brooded silent, taking an early morning pause from its rock-grinding. It was a cement factory, devouring its raw materials from the limestone rock. Farther along the escarpment, the tourist town of Cherrapunjee served as a gawking-point for waterfall-viewers and cliff-enthusiasts.



Overlooking the cement works above Cherrapunjee Cave.

Photo: Yoav Bar-Ness

A young man approached me, with the bright smile and laughing eyes of the Khasi people. He carried a large plastic bag, and walked with strength and agility. He was to be my guide and companion within the darkest wilderness in Meghalaya. He was Toby, and we were to embark on a small excursion under the flag of the Meghalaya Adventurer's Society.

A few days before, in Shillong, I had sought out a connection with this august band of trekkers and cavers. I had been given the contact details for the General Manager, one Brian Kharpan Daly. On the telephone, he invited me to the State Bank of India branch that he managed. Threading through the pedestrian mall of Police Bazaar, and down towards the vegetable market, I found the building and was promptly sat down with a cup of tea.

Brian, an established Khasi man in his fifties, told me of the origins of the Society as a children's excursion club. As the point of contact for several European expeditions, it had become a keystone network for the exploration and study of India's caves. Meghalaya, in

particular, was famed for its caves. Some of the longest and deepest of the world's caves were to be found here, but there were very few local people with the skills, equipment, inclination, or ability to explore them. The Society, as gracious hosts and local experts, had been the recipients of a wealth of caving expertise and gear. Brian, and his nephew Toby, had at first been guided, and then later been the guides, on a series of ambitious and valuable caving expeditions.

Brian told me how the plateau was unique place: geologically, culturally, and biologically. But the landscape was threatened by rampant mining of coal and cement. Mines both legal and illegal had chewed into the wildest and most fragile places of Meghalaya, and showed little sign of stopping. The Adventurers' Society had lodged complaints, launched lawsuits, and advocated tirelessly for the preservation of both cave and wilderness. But they could only forestall the legal mining operations, and those, unfortunately only temporarily. I had tasted, literally, this ravaging of the rock: on the road from the Assamese lowlands, I had breathed the airborne dust of a cement quarry. The limestone brought a sting into the air; it had the taste of a sharp thorn.



The cement works above Cherrapunjee Cave.

Photo: Yoav Bar-Ness

I told him of my travel plans towards Cherrapunjee to see the living root bridges, and he graciously offered to invite Toby to guide me underground. Toby, it turned out, was glad for the caving companionship, and we would be going to a cave he knew well. It was no problem for him. So, by telephone from the bank office, I arranged the skills and friendship of this Khasi brave, and, a few days later, there he was at the steps of the cement factory.



Toby points towards Cherrapunjee Cave.

Photo: Yoav Bar-Ness

There is a special type of companionship that cavers have, and a special knowledge. We know about the heartbeats in the darkness, and the whispers of breaths in the inky blackness. We know about the isolation, and the responsibility, and what it means to return to the living blue sky.

Toby and I were, instantly, friends within the Society, and we swapped short stories about our adventures below ground as we walked around the back of the cement factory. I heard of the teams of motivated Europeans that had become addicted to the Meghalayan caves, and who returned regularly. I mentioned the underground waterfalls and hidden chambers beneath the Tasmanian mountains, and of the limestone of Chhattisgarh and Arkansas and China, and of the lava tunnels, and wind caves - and then stopped, mid-sentence, in surprise as we stumbled upon the river.

The scene was grim, at odds with the graceful waterfalls visible in the distance. The cement factory towered mournfully above us, looming above pools of water. It was the dry season, and upstream the water was diverted: it flowed only sullenly along the wide channel. A stone ridge across the watercourse was covered in dusty vegetation. The factory was of the drabest grey cement, with tearful stains leaking from the too-small windows. It radiated claustrophobia and poison dust. Corrugated iron panels seemed poorly anchored, and windows hung raggedly open. Moss covered walls were topped with rusting barbed wire. Toby saw my surprise, and told me that it was even uglier on the other side of the ridge.

He led onwards, and we hopped across the pools of water. As we moved closer to the ridge, we could see a faster channel of water, which moved along the base of the stone to disappear into a dark rift. This chasm in the earth was our destination- an entrance to the limestone caves within the ridge.

We found a dry place to arrange our equipment, and a crack in the rock to hide our possessions. From the European caving sack he was carrying, Toby produced coveralls suits, rubber boots, helmets, and, critically, torches. All of it was high quality gear, donated by friends and co-Adventurers that had collaborated with the Society. We stripped off our dry clothing and donned the caving suits. My camera, fragile but essential, was wrapped in several plastic bags. The torches shone brightly, we looked directly at the sun to remember its warmth and love, and then, without hesitation, dove into the chasm.

On whatever continent, in whatever terrestrial landscape, limestone caves are both familiar and unique. The familiarity comes from the recognizable patterns of the limestone dissolution features like stalactites, stalagmites, and flowstones are congruent in all grottos of similar geology. The unique identity comes from the infinite ways in which these familiar patterns are manifested. The unexpected and wondrous combinations of stone, mud, and water can, for some people, become an obsession and an addiction.

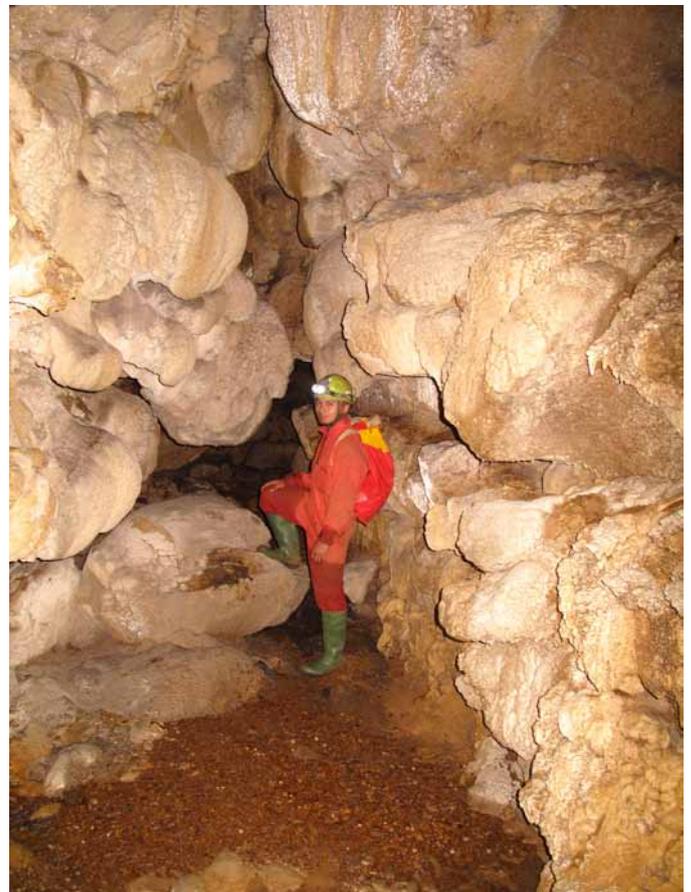
Entering this wild cave was for me like greeting a long-lost friend. I knew the feel of wet limestone and flooded



*Above. Just west of Cherrapunjee Caves is Nohkalikai falls, one of the world's tallest.
Below. L &R. Deep inside Cherrapunjee Cave.
Photos: Yoav Bar-Ness*

gumboots, and it brought my memory back to dark caves in other lands. I remembered to move my head to track the beam of the head torch, and to never to blind Toby by pointing it at his eyes. We followed the water channel, straddling it as we walked with wide steps through a tunnel. In here, the trickle of water that had entered this cave was a raging torrent, bellowing and roaring in a liquid frenzy.

We passed through a side portal from the waterway, and entered the chambers of the cave. In ancient time, water





Above. Sta-rag-tites! Pollution in Cherrapunjee cave.

Below. More pollution.

Photos: Yoav Bar-Ness



had dissolved these hollows from the living rock, and as the acidic mixture had dripped from the roof, fantastic formations of white crystal had formed. Stone flowed like melting ice into blades and fins. Narrow straws and rods hung delicately, or lay shattered where a previous visitor had accidentally shattered them.

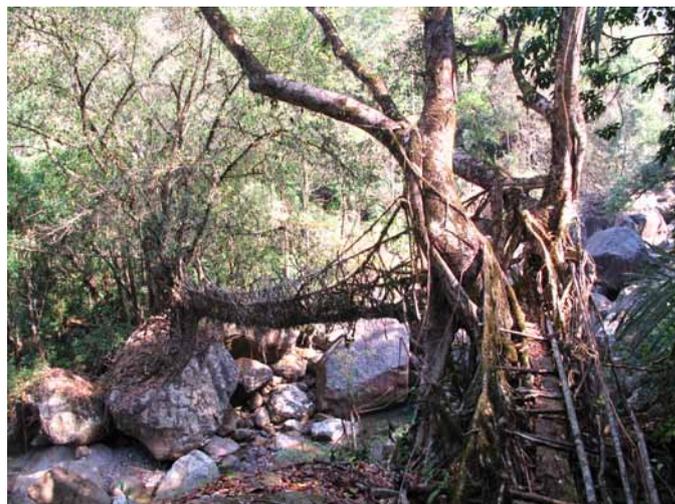
In one slanting tunnel, streamers of colourful scraps were caught on the ceiling. The shredded clothing and plastic rubbish of the Cherrapunjee town, and the settlements upstream, had been discarded into the stream. It was pollution, and the complex structure of the cave had netted it as it flowed toward the ocean. Our pockets were not deep enough to collect this rubbish. We had no way of knowing how much more plastic was trapped in unknown chambers deeper underground. So much energy had gone into removing the fossilised fuels from the Earth, and now, it was being sequestered for another eternity. We marveled at the surreal display, disgusted.

In another chamber, we stood on a gravel beach, looking across the grotto to a flat tongue of white crystal, flowing across a shelf in exactly the same fashion as an ice glacier. In yet another chamber, I found a standard electric light switch lying in the mud. I knelt down and hit the switch, but no lights turned on. I found this immensely funny, and could only wonder as to where the original light bulbs were located.



Waterfalls below the Meghalaya escarpment.

Photos: Yoav Bar-Ness



Meghalaya is famed for its living roots bridges

A small piece of wood lay on a stone surface, washed in by the monsoonal floodwaters. From its decaying corpse, a star-like spray of fungal fuzz radiated outwards. It sought more biomass to eat, but it would die in this cold and dark cave.

We entered a high-ceiling, narrow tunnel, of dark red stone. It was solid, and jagged. The floor had been dissolved away in a terrifying network of holes and bridges, and we tiptoed gently across them. We reached a new chamber, crowded and messy, where the stalactite formations had fallen to the floor in a spiked jumble. The once-graceful masses sat in a strange and sad angle.

A slot canyon, decorated with bulbous flowstones jutting from the wall like cauliflowers, led to our exit. Here, for the only time in this cave, we had to squeeze between the rounded blocks. With held breath and slippery thoughts, we approached an impossibly bright and narrow hole. The sky outside glimmered, and as we exited the cave into the green living world, I was overcome with the familiar post-speleological feeling of rebirth and hope.

We were on the side of a steep sinkhole, which dropped down to a tumble of boulders. The cave exit was hidden in jagged rocks; it would have been impossible to find without knowing where to look. Ferns grew over the entrance, and moss softened the rocks. It was a blessing to feel the warmth of the sun, and even better to breathe the fresh air of Meghalaya. I gulped down the vital essence, but there was a slight taste of stone dust.

We started hiking out of the sinkhole, scrambling with some difficulty on the confused boulders. At the top, we were in an obviously degraded landscape of weeds and stone, which ramped away from us. I had lost all sense of direction, and followed Toby, blinking in the brightness. We spoke about the things we had seen below, and the joys of returning to the world of the living, but again, I lost my words in sudden shock at the ugliness of the scene beneath.

At the top of the ramp, we had come to the edge of a vast scar. It was the open face of the cement mine, cut away

into terraces. The mountainside had been scoured away to bare rock. Its revealed shades of grey, brown and white were stark and naked under the sky. The chunks of cave - stone were lying under the sun, bleached and ravaged. The factory could be seen in the distance, far larger than our initial view from the roadside. Towers and steel frames were clustered together, malevolently. Below us, an entire mountainside had been converted into powder for building materials. Thick green water pooled in depressions, and the tracks of truck tires marked the stepped terraces of the open pit mine.

Darkly, Toby told me of the Society's battles to save the caves, and its worries that they would, one day, be ground into dust. Beyond the factory, we could see the dull brown grasses of the deforested and overgrazed plateau, and the waterfalls sliding limply over the escarpment edge. We traversed the highest terrace, and picked our way down the weed-choked edge. We walked past the barbed wire fence to the plastic-polluted river, and fetched our equipment.

We resolved to meet again in Shillong, and hoped to one day in the future adventure in other caves underground. We were both sobered by the damage to the landscape, and the thought that the wild space below could be turned into cement dust. It saddened me that there were too few Adventurers, and too many building projects.

This Meghalayan cave was only one of a handful of Indian caves I had the good fortune to visit, and like the others, it showed me extreme ends of the spectrum. It is not just a wild cave, but also a severely impacted cave. It is not a tourist cave, but is located near Meghalaya's most famous escarpment holiday town.

Should you travel to India, consider visiting Meghalaya for its forest wilderness, its unique living bridges of banyan roots, and its wonderful geological diversity. The Khasi people, matrilineal, Christian, and educated, are a distinct and welcoming community in India's Northeast. Like the British expeditioners, I was delighted to connect with the Meghalaya Adventurer's Society, and hope to explore more of this underground wilderness.

WENDELSTEIN HOHLE (CAVE), BAVARIA, GERMANY

Garry K Smith



*Panoramic view of the visitor facilities and surrounding landscape.
Photo. Garry K Smith*

The Cave and Location

The Wendelstein Höhle (pronounced – ven-dell-styne hooler), literal translation equals “spiral stone cave”, is a cave system located within an 1838m high limestone mountain peak of the same name. It is in the far south of Germany at the eastern end of the Bavarian Alps. The natural cave entrance is at an elevation of 1,711m ASL making it the highest altitude show cave in Germany^[1]. The ‘Show Caves of Germany’ website classes this cave as an Alpine Cave due to its elevation and describes it “as probably the most extraordinary show cave of Germany, just because of its exposed location”^[2]. This is a self-guided show cave and visitors are welcome to amble through at their own pace, taking in the surroundings and literature at the interpretative stations. There were 35,800 visitors to the cave in 2012.

Snow and ice decorations can be found almost year round in the “Cold Trap” just inside the natural entrance of the cave.

Getting To The Cave

The cave can be reached by catching the privately owned BOB train from Munich to Bayrischzell and getting out at the Osterhofen station^[3]. There is a 5 minute walk to the cable car (gondola) bottom station which takes visitors to the restaurant near the top of the mountain in 8 minutes. From the restaurant there is a 5 minute walk to the cog railway train - top station and follow the ‘Höhle’ signs to the turnstile and cave entrance.



*Track to Observatory.
Photo: Garry K Smith*

Alternatively take the DB (German National Railways) Munich – Rosenheim – Kufstein train. Get out at Brannenburg then it is about a 30 minute’s walk to the rack (cogwheel) railway valley station (signposted). The 30 minute train ride up the mountain takes visitors right to the cave entrance. This is Germany’s oldest operating high mountain railway. Construction started in 1910 and it commenced operation in 1912. The original train and wagons were replaced with modern ones in the late 1980s. The scenic rack railway route is



*Entrance tunnel into Wendelstein Höhle.
Photo: Garry K Smith*



*The Natural Entrance as viewed from the Cold Trap Chamber.
Photo: Garry K Smith*

9.95 km long and has seven tunnels, eight galleries, twelve bridges and many retaining or supporting walls^[3].

Cave Visit – A Personal Account

In spring (late May 2013) my wife and I caught the train from Munich to Osterhofen station. This is a very pleasant journey through ever changing countryside. From Osterhofen station there was no obvious sign indicating how to get to the cable car station, however the overhead cables pointed to the building we needed to get to. There are two ways; under the rail line then along a narrow track through paddocks, alternatively follow the road over the rail line and weave your way through a number of narrow streets. We used both routes during the course of our day trip.

The ride on the cable car was excellent and afforded spectacular views during the ride up to the Wendelsteinhaus restaurant – have your camera ready.

The walking path from the top station/restaurant was well signposted 'Höhle' to the cave entrance, a very pretty sight with thick patches of snow everywhere. Despite the sunshine, the light breeze and ambient temperature, probably around 5°C, made it a little nippy – thankfully we were prepared with jackets.

The staircase down the artificial tunnel into the cave was well lit and easy to negotiate, however I would have to say without gloves, I think my hands would have stuck to the freezing metal pipe handrail. So be prepared with gloves. As we descended a couple of tourists heading out, commented "hope you have a raincoat". They were right, as it was rather wet with melt water pouring from above along most of the cave pathway. Thankfully we had an umbrella, which was put to good use. First time I have needed an umbrella for the full length of an underground cave tour. The 'Cold Trap' chamber contained a substantial quantity of snow and ice on the slope leading from the natural entrance and there was a considerable

number of ice sculptures, which looked pretty good. However, not all the seepage water freezes in this chamber as we stood on the observation platform under our umbrellas to avoid being soaked.

The entrance tunnel and majority of the cave passage was narrow, making it rather difficult to pass visitors going in the opposite direction. An umbrella certainly added to this dilemma.

There were four multi-media stations with themes covering biology, geology, psychology and philosophy^[4]. These touch screen interactive stations could be viewed in a variety of languages (including English). I found the information to be generally non specific and extremely basic, although each presentation did end with thought provoking questions. The information provided is probably reasonable given that a reference papers states that the stations were designed for visitors with an attention span of 4-5 minutes per station^[4]. During our visit the multi-media station at the 'Cold Trap' was not operating, however given the freezing conditions and constant streams of water pouring everywhere from the ceiling, it is no wonder there are occasional failures of electronic equipment. Thankfully all the excellent LED track lighting was working.

Overall the cave was worth seeing despite the rather wet conditions and I did manage to get some reasonable photos without slave flashes. The alpine cave has some very interesting features and the scenery above ground is truly spectacular (thankfully we had a clear day – bad weather would have been another story).

Comments on Management

With regard to cave management and tourism, I would have thought it prudent to advise visitors to be prepared by bringing warm clothes, gloves, substantial if not waterproof footwear and include a raincoat with a hood, however I could not find this information in any of the

available literature. We went prepared for the cold conditions, despite this my wife became cold after 20 minutes, as her gloves absorbed water from the entrance tunnel handrail and our shoes became saturated from the splashing water.

In a number of places where large quantities of water was really gushing from the ceiling onto the tourist path, it would make sense to have installed shields to redirect the stream. I will say the path way was well drained through the inlaid gravel floor and there were very few places where water pooled.

Overall the lighting was excellent but I personally found the interpretative stations lacking somewhat in content specifically relating to the cave in question.

General Information About The Cave

At 1711 metres ASL this is the highest altitude show cave in Germany. The natural entrance to the cave is located at the foot of a southeast wall just 127 metres beneath the summit and approximately 1400 metres above the present Leitzack River valley at the town of Osterhofen (310 metres ASL).

Visitors walk just 30 metres from the coin operated turnstile to the excavated tunnel entrance. This is a steep (12m) tunnel, containing 82 stairs which lead into the main passage of the natural cave. This excavated tunnel was constructed to improve safety due to possible snow and rockfall at the natural entrance and allow visitation during inclement weather. The cave is 573 metres long, of which 170 metres is open to the public. Vertical range of the cave is 106 metres and mean average air temperature inside is 3°C except for the 'Cold Trap' which is at or below 0°C^[1,6].

After descending the entrance tunnel to the cave passage, the natural entrance chamber can be reached by turning right and proceeding just 30 metres. This rather impressive chamber, called the 'Cold Trap', has a 17m high ceiling. A shaft of daylight from the entrance partly illuminates the steep snow covered slope and the reflected light provides a soft light to the rest of the chamber.

There is a tourist observation platform in the lower part of the 'Cold Trap' where the cold air is trapped (as the name suggests), thus freezing some of the incoming seepage melt water to form icicles and other fascinating ice sculptures. These ice forms stay intact for most of the summer^[2].

To the left of the entrance tunnel the main passage is wide and about 3 metres high. This part of the cave has plenty of air circulation and is almost as cold as the 'Cold Trap', however the passage soon becomes narrow and up to 15 metres high. After 170m the path ends in the 'Dome' also known as the 'Cave Cathedral'. Despite its name, this is not a chamber, but a junction of three passages. The air temperature at this point is approximately 3°C^[1,2]. The 'Dome' is the end of the tourist route and contains the last interpretive station. There is a crucifix fitted to the wall at this point and high above are some good examples of stream meander niches

carved into the ceiling. On the way out I could see other meanders in the ceiling at approximately the same height.

The cave is lit by an energy efficient 2 x 3 watt LED light system which has a backup power supply in the event of a mains electricity failure^[5].

Geology

Wendelstein mountain is mainly Wettersteinkalk (Wetterstein limestone) from the upper Triassic, consisting mainly of Dasycladacean algae (*Chlorophyceae*). These are marine algae, which inhabited shallow lagoons in a tropical climate. The color of the stone varies from light gray to gray-white and spotted^[1].

Over millions of years the limestone was uplifted to form rolling hills and the Wendelstein Cave was created by a stream which had its catchment area to the West and South. After the river had cut into the limestone to create the cave about 60 million years ago, the northern rim of the Alps continued to be uplifted and folded to the point where the river no longer ran through the cave. Uplifting, folding and valley erosion continued over millions of years till the limestone containing the cave became the high peak it is today^[1,2,4].

In general, the Alps mountain range was a result of the African and Eurasian tectonic plates colliding and causing the marine sedimentary rocks to be thrust upward and folded over hundreds of millions of years^[1].

The German Show Caves Website describes the cave as a "fissure cave, a narrow gorge formed along a vertical fissure in the rock, with impressive erosional forms, but no big chambers and no speleothems" ^[2]. (After viewing the 3D cave model and visiting the cave, I personally have some reservation relating to this cave being accurately described as a 'fissure cave' – I will leave it to others to debate this aspect.)

The cave is formed in fossil-rich Triassic Wettersteinkalk, and fossils can be seen at various locations along the cave walls^[2].

Opening Times and Entry Fee

Wendelstein Höhle depends on snow and weather conditions, it is normally open between May and October to coincide with operating hours of the cable car and cogwheel railway^[2]. Cave entry is €2 per person (must have €2 coin) payable at the automatic turnstiles next to the cogwheel railway top station.

Cable Car (Seilbahn) - Operating times: during summer season daily 9 am to 5 pm every full hour and in winter 10 am to 4 pm every half hour, subject to weather conditions^[3]. Single adult return ticket is €20.00, Children (6-15yo) €14.00, Families (2A+2C) EUR €44.00

Rack or Cogwheel Railway (Zahnradbahn). Operates the same hours as the cable car, subject to weather conditions^[3]. Adults €29.50, Children (6-15yo) €14.50, Families (2A+2C) €64.00

DIGITAL MEDIA: A MODERN CONUNDRUM in an ANCIENT LANDSCAPE

Scott Melton

Abstract

The last ten to fifteen years have seen an increase in the use of digital devices to record images. In 2013, it is not uncommon for all family members to be carrying at least one device capable of capturing digital images. This paper will explore what impact, if any, this exponential increase in image generation capability has had on the conduct of a guided show cave tour. It will also seek to explore ways of mitigating any identified impact in order to strike a balance between visitor satisfaction and profitable tour operations with conclusions drawn from personal experiences guiding the Lucas Cave tour at Jenolan Caves.

Introduction

Jenolan Caves, located approximately 180 kilometres west of Sydney in the Greater Blue Mountains World Heritage Area, is an award winning show cave. Jenolan Caves has been part of the Australian “psyche” for over 150 years and millions of visitors have visited one or more of the ten guided show cave tours on offer. As such, it would be impossible to even estimate the number of images captured either on film and by digital media. It would be conceivable to say however, that the majority of these images have been captured in the last 10 years by digital media. Personal experience from twenty years of guiding tours at Jenolan Caves has shown that despite a decrease in the number of visitors on a Lucas tour (from 75 to 60), it can often take longer to complete the tour with much of this slowdown attributable to an increase in the use of digital media. On a recent tour of the Lucas Cave, 28 visitors had 35 devices between them capable of capturing digital images. These devices included phones, cameras and tablets.

The Early Years

For an excellent account of the early days of photography at Jenolan Caves, the 2010 publication “Click go the Cameras at Jenolan Caves 1860-1940” by Elery Hamilton-Smith (Hamilton-Smith 2010) is recommended reading. This publication outlines the development of photographic services at Jenolan that were offered by various commercial operators and contains an excellent selection of the early works of photographers such as Charles Kerry and Frank Hurley.

A popular souvenir of a visit to Jenolan Caves was a group photo taken at Hartley Court House with the driver and his Charabanc (an early form of open topped motor coach).

This was only the beginning of things to come however...

The Post War Years

The decades following the Second World War saw an increase in visitation to Jenolan Caves as more people could afford to travel. To cater for the needs of photographers, special photographic inspections were conducted at 11.00am and 4.00pm. These tours however, were phased out by the 1960’s. Camera technology evolved and by the mid 1960’s, small compact cameras were affordable for the majority of visitors and were commonplace on tours (B. Richard Pers Comm. 2013). A downside of these cameras however, was the external removable “flash cube” which, once expended, was often discarded along the pathways within the caves. A large number of these were located in the Lucas Cave by Dan Cove and Russell Commins during the relighting project in 2003-2004 (D. Cove Pers Comm. 2013).



During a fifth class school visit to the Lucas Cave in 1977 as an 11 year old, my mother would only buy me one four shot cube as she wanted me to take photos of places other than Jenolan Caves. The wisdom of mothers as none of the four photos taken in the cave turned out...

Early Experiences as a Guide

I commenced guiding at Jenolan Caves on Boxing Day 1993. At the time the Lucas Cave had a limit of 75 visitors although I would often take 80-90 people on a tour. Even so, it was still possible to visit the well decorated Mafeking Chamber and finish the tour on time.

On tours, it was common for visitors to ask what scenes they should save their remaining photos for given



that most rolls of film were either 12, 24 or 36 exposures. In addition, a typical family would only have one camera. Popular photographic subjects in the Lucas Cave included the Cathedral Windows, the Lace Curtain, Mafeking, the Pink and White Terraces, Underground River and the Coloured Lights in the Bone Cave – a typical average of six photos only. I would also offer to take photos of visitors with the Lace Curtain as a backdrop; which was an offer which many people accepted.



The Digital Revolution

In the space of the last 10 to 15 years, the capturing of images of the Lucas Cave has changed significantly. From a film roll of 36 where possibly 6 photos may have been allocated to the Lucas Cave, the introduction of digital cameras and the San Disk (SD) Card, amongst other devices, has allowed almost unlimited generation of images. For example, on my own digital camera, a 4GB SD card can conceivably hold 2700 images dependent on the pixel setting. This has allowed visitors the ability to capture more of the cave but – to what extent has this impacted on the tour?



Impacts on Tours

So the obvious question is – what impact has the increasing use of digital media had on the conduct of a guided cave tour and what are the ramifications, if any, for managers/owners of these sites? The following potential impacts have been identified:-

- Perceived slowing of tours

Nowhere is this more evident than in the Lucas Cave where ten years ago a tour could be completed with 75 clients where as now it can be a struggle with a number reduction to 60. This may cause tours to run overtime with clients possibly missing other tours or even coach connections. This may detract from the reputation of a site.

- Blocking Pathways

With an almost unlimited capacity to take photographs, visitors will often stop in narrow sections to take photographs, with little regard paid to fellow visitors. The guide may be placed in a situation where he/she is continually asking the group to move on (getting visitors to move into

the Anteroom in the Lucas Cave is a prime example) which may cause the group to perceive the guide/site in a negative manner.

- Guest irritation with photographers

Guests may become irritated with photographers without purpose taking photos of non subject specific matter. In other words, people taking excess photos (for example “selfies”) simply because they can. This may create a negative impact in the minds of visitors of a site. However, it should be pointed out that photos of family members are important in many cultures.

- Excessive use of flash

This can have several ramifications. First, it can reduce the ability of the guide to present the cave as there is an excess of light generated by digital devices. Second, clients can use this excess light to move forward from the group, risking injury to not only themselves but also the resource. Third, clients may inadvertently fire the flash in the eyes of visitors and/or guides creating possible safety issues.

- Trip Hazards

Visitors looking at the cave/site through the view finder may trip and fall, risking injury to themselves and/or the resource. This could lead to compensation claims.

- Inattention to Commentary

How often have you just spent five minutes explaining cave geology only to have a visitor who has been taking excess photos ask you – How does a cave form? Clients may also miss important safety information from the guide.

- Photo Editing

Many clients will edit their photos during the tour, either to delete failed photos or often to remove photos to make room for new ones. Again, this can delay tours unnecessarily.

Nowhere is this more evident than in the Lucas Cave where ten years ago a tour could be completed with 75 clients where as now it can be a struggle with a number reduction to 60. This may cause tours to run overtime with clients possibly missing other tours or even coach connections. This may detract from the reputation of a site.

These are just some of the impacts that have been identified that can potentially affect a tour and, given the right circumstances, could also have more serious

consequences for cave managers/site owners. Before discussing what can possibly be done about mitigating these impacts, perhaps it would be best to look at policies (if any) in place at other cave sites.

Photographic Policy at other Cave Sites

Discussion with colleagues at Jenolan Caves and at other sites has indicated the following policies are in place:-

Mole Creek Caves, Tasmania

Haydn Stedman of Mole Creek Caves in Tasmania advises that they do not have an official policy regarding the use of digital devices on tours. They do not allow tripods and do not allow photography in the glow worm areas. They allow visitors a reasonable amount of time before they turn the lights out. (H. Stedman Pers Comm. 2013).

Naracoorte Caves, South Australia

Frank Bromley of Naracoorte Caves in South Australia advises they too do not have any official policy regarding digital device use. They do ask people to stand still when recording. Frank also advised that video recordings were banned in the past but that rule was discontinued due to all devices now being able to record. (F. Bromley Pers Comm. 2013).

Wellington Caves, New South Wales

Barry Kelly of Wellington Caves advised that they have no specific policy. (B. Kelly Pers Comm. 2013).

Cave Works, Western Australia

Supervisor Heidi of Cave Works in Western Australia advised that they have no ban other than the use of tripods. On larger tours they ask visitors to restrict photography to the main platforms only. (Heidi. Pers Comm. 2013).

Mammoth Cave National Park, USA

The policy in place at Mammoth Cave National Park in Kentucky USA when I participated in a guide exchange in 2001 was no video recording. This policy was in place before the increase in the use of digital devices so it would be interesting to find out if this policy has been modified since then.

Jeita Caves, Lebanon

ACKMA member Dr. Julia James advises that Jeita Caves in Lebanon has a strict no cameras policy and even goes so far as to provide lockers for people to store cameras. (Dr. J. James Pers Comm. 2013).

The Spanish Experience

ACKMA member and Jenolan Guide Sasa Kennedy advised the following from her recent travels in Spain (S. Kennedy Pers Comm. 2013):-

- Grotte de la Maravilles - No photos allowed
- Cueva de la Pileta - No photos allowed
- Cueva de la Nerja - Photos allowed but no flash

Has anyone ever been told you cannot take a flash photo in a cave as it will fade the formations?

The Jenolan Policy

Other than a ban on tripods on tours, Jenolan does not have a firm policy regarding the use of cameras on tours. Various guides do ask people to be mindful of their camera use at the start of and during their tours. At the start of my Lucas tours I request the cooperation of visitors not to take photos in the narrower sections of the cave and advise them that there will be times on the tour where I will ask for all devices to be turned off for presentation reasons (cave darkness and the music presentation in the Cathedral). Generally I receive a good level of cooperation from visitors.

What can we do about it?

What can we do, as cave managers/guides about this exponential increase in digital device use? Perhaps the most obvious answer is to accept the status quo; that is to accept the problem which leads to the obvious question – does anyone not see a problem? This would appear to be the easiest and least confrontational solution. This will of course require tolerance and acceptance on behalf of both guides and management as we need to bear in mind that the overriding factor is the satisfaction of our guests as it is, after all, their experience.

The following however, may be alternative solutions/suggestions with any potential issues arising noted:-

- Ask visitors to restrict photographs to the main platforms only.
- Decrease tour commentary to accommodate more photography time.

This could however, lead to a decreased perception of the professionalism of a tour/site.

- Give visitors a ten second warning and then turn the lights out in order to move on.
- Take photos and sell them to visitors.

This was the practice in 1988 at The Lost Sea in Tennessee but had been discontinued upon my return visit in 2000. When I asked the guide why he stated that there are now too many cameras in groups! A similar set up was trialled at Jenolan Caves in the late 1990s in the Lucas Cave but was not a success with a very limited uptake by clients. We do however, take photos of visitors on our Plughole Adventure Tour which they can download for free from the Media Fire website and this is a popular value added service.

- Ban the taking of photos altogether.

This would solve the problem but would be almost impossible to police in this digital age and would

of course lead to customer dissatisfaction and a possible reduction in visitor numbers.

- Specialist Photographic Tours.

Would visitors be willing to pay the price required to offer such tours?

- Reduce Tour Numbers.

This may be an option but could result in increased costs and possible reduced viability for the business as extra staff would need to be employed.

There is no easy solution and what could work at one site may not necessarily work at another site. Perhaps the time has come for cave sites to develop a digital media use policy in conjunction with an organisation such as ACKMA or ISCA (International Show Caves Association).

Conclusion

The capturing of images at Jenolan Caves is not a recent phenomenon; from the days of Kerry and Hurley to the current digital age, photography has always been an intrinsic part of the cave tour experience. While this paper has documented the issues and impacts that the increasing use of digital media can have on tours and business success, it has also explored several ways for potential mitigation of these. A cave visit can mean various things to different people and cultures and as guides/managers, we need to be adaptive and take these factors into consideration during our presentations. As cave managers/owners we also need to be mindful of the benefits that these images will bring for us in the form of promotion of our sites. As the saying goes – a picture is worth a thousand words. However, the issue is perhaps best summarised by Jenolan Caves guide Tina who said “as people can take almost limitless numbers of photographs to document their experience, they may in fact be missing their experience through their own actions. However, perhaps as guides we need to be accepting that photographs of their visit will provide meaningful memories for them”. (T. Willmore Pers Comm. 2013).

Who knows where technology will take us in the future...



After Scott's conference presentation, Barry Richard played the role of an enthusiastic cave tourist, capturing Scott and Dan Cove and sharing the image with them - a comic end to the paper presentations.

Photos: Steve Bourne

Reference

Hamilton-Smith, Elery (2010). Click go the Cameras at Jenolan Caves 1860-1940. Jenolan Caves Historical and Preservation Society, Jenolan, N.S.W.

THE BUSINESS of OPERATING a SHOW CAVE

David Summers

This is the address given by David Summers, President of the International Show Caves Association to ACKMA at the Waitomo Conference.

Mr President, Conference Convener, Conference Organizers, ACKMA Members and Invitees.

It is a wonderful privilege not to only be able to attend your Conference this year, but also to be able to address you. After a relatively slow start, Australasia has burst onto the international stage of show caves in a spectacular fashion. It started with the attendance of your genial wanderer, Andy Spate, at the ISCA Conference 2006 in Bermuda. Andy did a wonderful job of telling the attendees of the wonderful caves that existed in Australasia.

This was followed by the attendance of a veritable gang, comprising Dan Cove, Barry Richard, Kent Henderson and Andy Spate, at the 2010 ISCA Congress in Slovakia. This Australasian crew secured the unanimous support of ISCA to hold the 7th Congress of ISCA at Jenolan Caves in 2014, as well as causing a constant disturbance, I might add! Quite a track record, and well deserved. Australasia followed this up with the attendance of Dan Cove and Gregory Middleton at last years ISCA Conference in Greece and Turkey. Australasia has certainly stamped its presence on the world of show caves in recent years.

This is my second cave related visit to Australasia, and I have a third visit scheduled next year. Having originated, and grown up, in the southern hemisphere I can assure you all that it feels really good to be in this half of the world again.

When I read about the Conference Theme of “the triple bottom line” of “people, planet, profit”, I became really excited. I have spent the past six plus years of my presidency of ISCA, stressing the need for full attention to be paid to the visitor, the environment, and for effective economic management of show caves.

The theme of people, planet, profit covers the full scope of what show caves are all about. I commend the author, or authors, of this theme. The down side of this theme is that if I tried to address all three of these components I will be talking to you all day. In these circumstances, I will focus on the third part of profit and a very, very important aspect of that.

There is no doubt that a show cave is a business. Not only is it a business, it must be a successful business, a business that must be continuously successful. A business that may be able to withstand one or two years of not being successful, but not for an extended period of time. Why is it so essential that the business of a show cave be successful? Because of the cave which is the very basis of the business, that is why.



*David Summers addressing ACKMA.
Photo: John Brush*

When most businesses fail, they usually close down their operations, and the place that the business was operated in, is sold, recycled, or otherwise disposed of. These options are not available to a show cave. The cave remains, long after the business that operated it as a show cave has gone, and inevitably it will become vulnerable as the gating eventually fails to remain secure, as well as a whole myriad of other consequences.

Having broadly painted the picture of what will happen if a show cave ceases to function, I will now focus on one aspect of the “profit”, or economic side, of show caves that I have found to be commonly overlooked, or misread, all over the world. That is the seemingly simple matter of inflation.

The scourge of inflation is one of the most common hidden traps lying in waiting for show caves. It is, in all

probability, the single most misunderstood financial factor that affects the economic fortunes of a show cave. Even the most seemingly astute operator seems paralysed to the potential ravaging effect that inflation can have on the business of operating a show cave.

Inflation, which is a general increase in prices and the fall in the purchasing power of money, is like a slow cloud enveloping a business, if not properly attended to. One of the most disconcerting aspects of inflation is the degree of any decrease, or the rarely encountered increase, in the purchasing value of money, is not known until after the fact. Annual inflation cannot be calculated for a given year until after the year is over, and the next year is beginning to be well advanced.

The dangers of inflation affect show caves of all sizes. Not just the mega size caves, but the smaller ones as well. Let us have a look at how inflation can affect small and large caves over a five year period, with inflation averaging a seemingly modest three percent per year throughout the five year period.

First let us consider the purchasing value of money at a small cave, with an admission price equivalent to 10 euros (or dollars if you prefer) with an average admission level of 50,000 per year, where the impact of inflation is ignored and the admission price is held at the same rate for the full five year period.

- ★At the end of the first year the value of the gross income is $50,000 \times 10 = 500,000$
- ★At the end of the second year the value of the gross income is $50,000 \times 9.70 = 485,000$
- ★At the end of the third year the value of the gross income is $50,000 \times 9.41 = 470,000$
- ★At the end of the fourth year the value of the gross income is $50,000 \times 9.13 = 456,500$
- ★At the end of the fifth year the value of the gross income is $50,000 \times 8.86 = 443,000$

In effect the small cave operator, in this example, is receiving 57,000 less than was being received five years previously, in terms of the value of money.

Let us now look at the effect of ignoring the purchasing value of money on a larger show cave operation with an admission price of 15 euros (again dollars if you prefer) held at the same rate, with an average admission level of 200,000 per year, and an inflation rate of three percent for the five year period.

- ★At the end of the first year the value of the gross income is $200,000 \times 15 = 3,000,000$
- ★At the end of the second year the value of the gross income is $200,000 \times 14.55 = 2,910,000$
- ★At the end of the third year the value of the gross income is $200,000 \times 14.11 = 2,822,000$
- ★At the end of the fourth year the value of the gross income is $200,000 \times 13.69 = 2,738,000$

- ★At the end of the fifth year the value of the gross income is $200,000 \times 13.28 = 2,656,000$

The larger cave operator, in this example is receiving 344,000 less in the fifth year than was being received five years previously, in terms of purchasing power.

As the President of ISCA I have visited a lot of show caves around the world, and I can tell you that I have not come across a small cave operator who would willingly, and knowingly, give away 57,000 euros or dollars a year. Or a large cave operator, who would willingly and knowingly, give away 344,000 euros or dollars a year. Note that I said willingly and knowingly. I have come across many who are unknowingly losing these amounts.

The answer to the scourge of inflation is vigilance and awareness. The show cave operator must be fully aware of the effect that inflation will have. On average I would offer you the notion that if a show cave holds its admission price unchanged for more than two years, it is making a huge problem for itself.

Another important message that I have for you on admission prices is do not be afraid of arriving at fractions of whole numbers. I can recall proposing that the admission price at the Crystal Caves of Bermuda be increased to \$17.50. The General Manager, at the time, protested that the price should be \$17.00 otherwise we would have to be dealing with a lot of coins. After I pointed out that 80,000 times 50 cents equaled \$40,000 a year, there was no further argument.

My final message to you all is that you increase your understanding of the effect that inflation has on your show cave. Stay current with it, and react accordingly. It can be a great friend, or an awesome enemy. Do not let inflation creep up on you.

Thank you.



David Summers and Debbie Ray, Business Manager of Crystal Caves, Bermuda, in Aranui Cave.

Photo: Steve Bourne

NOMINATION of JULIA JAMES as a FELLOW of ACKMA

Julia James has had a long and distinguished career as a caver, cave scientist, and more recently in management of karst through her membership of such bodies as the Jenolan Caves Scientific and Environmental Advisory Committee, NSW Karst Management Advisory Committee and the Greater Blue Mountains World Heritage Area Advisory Committee. She was Senior Vice-president (1989-97) and President (1997-2001) of the International Union of Speleology (IUS). Since 2001 she has been Honorary Life President of IUS. She is the only person of her gender to have served in these positions. She has been an office bearer in a number of other speleological organisations, and has been an editor of *Helictite*.

She has supervised some 35 Doctorate, Masters and Honours students – about half on cave and karst subjects. She has also carried out many consultancies in Australia and overseas on karst related matters.

Julia is the author of some 200 published papers, numerous book chapters and the editor of a number of books as well as many consultancy reports. Notable among the consultancies demonstrating her contribution to cave and karst management are:

- *Caves and Karst of Lukwi; A report for Ok Tedi Mining Ltd., With B. Pawih, D.J. Martin, G.B. Smith, P. Nieuwendyk and M. Bonwick (1985).*
- *Lukwi Caves, May Speleological Investigations; A report for Ok Tedi Mining Ltd., With B. Pawih, D.J. Martin, G.B. Smith, P. Nieuwendyk, M. Bonwick and M.B. Slade (1985).*
- *A Preliminary Speleological Study of Harvey Creek Cave Spring; A report to Ok Tedi Mining Ltd., Tabubil, Papua New Guinea (1986).*
- *A Speleological Study of Harvey Creek Cave Spring; A Report to Ok Tedi Mining Ltd, Tabubil, Papua New Guinea. With A.T. Warild, E.J. Cochrane and M. Bonwick (1987).*
- *Burdekin Falls Dam - Chemical Surface Deposits and Water Analyses. Privileged document for the Crown Solicitor of Queensland (1988).*
- *A Heritage Assessment: Slaven Cave. A report for the Electricity Commission of NSW. With S. McIntyre (1988).*
- *Geochemistry and Mineralogy of Slaven Cave. A report for the Electricity Commission of NSW. (1988).*
- *World Heritage significance of karst and other land forms in the Nullarbor region. A report to the Commonwealth Department of the Arts, Sport, the Environment and Territories, 1992 With A.G. Davey, M.R. Gray, K.G. Grimes, E. Hamilton-Smith, and A.P. Spate (1992).*
- *World Heritage significance of The Lunnan Stone Forest, Yunnan China. A report to Stone Forest Management (1995).*
- *Tietken's Plain Karst - Maralinga. Australian Radiation Laboratory special publication. With G.A. Williams (1989).*
- *Occupational Exposure to Radon in Australian Tourist Caves: an Australia-wide Study of Radon Levels. Report of Worksafe Australia Research Grant (93/0436). With S. B. Solomon, R. Langroo, J. R. Peggie, R. G. Lyons (1996).*

Julia has a particular interest in the management of Jenolan Caves, where she has provided specialist advice to various cave management authorities over at least three decades. This interest, or perhaps love, continues to the present day as is evident through her on-going involvement with the Jenolan Caves Survey Program.

Apart from Julia's technical expertise and broad-based experience in karst management, she has mentored and provided practical support to many aspiring karst managers and scientists. In this way she has helped to build a network of karst practitioners who are not only aware of, and understand, the issues surrounding sustainable karst management, but have a genuine respect for these unique environments.

Based on Julia James significant contributions to the conservation, management and promotion of karst over many decades, at both a national and international level, I would like to nominate her as a fellow of the ACKMA. My nomination is seconded by Stephen Meehan, Manager of the NSW Karst and Geodiversity Unit.

Nominated by: Andy Spate

Seconded by: Stephen Meehan on behalf of the Karst and Geodiversity Unit NSW NPWS



Julia James

Left. Stunned with her nomination at Waitomo.

Right. With Gavin Young, Wee Jasper 2012.

Photos: Steve Bourne



