Abstracts only

Lost in Tasmania's wilderness karst

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From 1962-1995, four young men have disappeared without a trace (never seen again) after traversing separate areas of Tasmania's southern wilderness karst. During the latter part of this same period, a student teacher and two young high school pupils drowned in *Mystery Creek Cave* in the far south of Tasmania. To this day, the disappearance of the 15 year old Guy Bardenhagen near Mount Picton in late January 1962 remains a mystery. Bardenhagen was with two fellow YMCA members led by then YMCA Southern Secretary, on a bushwalk from the old *Lake Pedder* to Geeveston. On January 30th 1962, the party of four made a detour to climb Mt. Picton, departing from their campsite at *North Lake*, south of Red Rag Scarp. After lagging behind the others, Bardenhagen failed to reach the summit, but did not return to the camp site. Given the proximity of the known karstified Pre-Cambrian dolomite and nearby pseudokarst, it is possible that Bardenhagen fell into a crevice or vertical opening following his separation from the other walkers. An intense weeklong search failed to locate any sign of Bardenhagen.

In mid-October 1969, John Boyle, became lost when separated from three other cavers in the forested sub-alpine dolomite karst on the northeast ridge of Mount Anne, east of *Lake Pedder*. Reported in the media as a "lost Sydney caver", the 26 year old Boyle was actually a member of the Tasmanian Caverneering Club (TCC) on a club trip lead by former flatmate Alan Keller. In the early afternoon, on Saturday October 18th 1969, Boyle became separated from the others during their search for potholes (vertical cave entrances) in the upper reaches of Camp Spur, adjoining the northeast ridge of Mt. Anne. Despite an intensive search by cavers, rockclimbers, bushwalkers, Tasmanian Police and Navy helicopters, no trace of Boyle was ever found. On October 27th newspapers reported that the search for Boyle had ended, and that he was now officially listed as a "missing person". Interestingly, there was no TCC trip report or article in TCC's *Speleo Spiel* relating John Boyle's disappearance and at the time of compiling this ACKMA Conference Abstract, Boyle was not listed on the Tasmania Police Missing Persons Register. Descending mist and/or low cloud cover were both relevant factors when Bardenhagen and Boyle disappeared and during the subsequent ill-fated searches.

Fifteen years later, the writer was one of several Tasmanian cavers involved in the search for another 26 year old man: Robert Ferguson a student from the University of Tasmania who disappeared in or near the Ida Bay karst during Easter, 1984. While on route to *Exit Cave* with a party of youth hostellers, Mick Flint, a Dover-based member of TCC, had collected Ferguson from the Lune River Youth Hostel early on Easter Sunday morning (April 22nd) 1984, depositing him at the start of the track to *Mystery Creek Cave* (and the Southern Highlands). Prepared only for a short day walk, Ferguson told Flint and other hostellers that he was heading to the old limestone quarry near *Mystery Creek Cave*, then taking the Southern Highlands track to Moonlight Flats and possibly Moonlight Ridge, returning to the hostel that same evening; he was never seen again. A number of theories were devised by search and rescue personnel regarding Ferguson's actual walking route, all of which suggested he may have left the established track. During the weeklong search for Ferguson and subsequent forays by cavers and youth hostellers, about a dozen new vertical caves were found and explored at Ida Bay including *Chicken Bone Pot* and *Smelly Cave*, where a recently deceased wallaby was found.

On Monday July 2nd 1990, following a 5-6 day period of intense almost constant rainfall with snow in the highlands, a party of students and teachers from Taroona High School were caught by a flood surge in *Mystery Creek Cave* at Ida Bay. Well prepared for caving, wearing neoprene wetsuits and gumboots, the school party entered the cave in shin to knee deep water, but were caught unawares by a significantly deeper and faster flow during their exit several hours later. Two young pupils, Anita Knoop and Frances O'Neill and student teacher Joanne Cuthbert were swept off their feet, drowning in the passage that now bears the name: Walls of Sorrow. It was the same day that the writer (Arthur Clarke) guided Rolan Eberhard to IB-47 (*National Gallery*), inserting fluorescein into a washed-out makeshift dam (previously constructed by Ian Houshold and Andy Spate), but successfully achieving the first successful dye trace to *Exit Cave* from a cave in the near vicinity of the former Benders Quarry.

In mid-November 1995, Wade Butler (son of Sydney mountaineering pioneer Dot Butler) disappeared during a solo walk to Precipitous Bluff (PB) near Tasmania's south coast. After being deposited at the start of the Southern Highlands track on Tuesday November 14th 1995, at the same spot where Robert Ferguson was last seen, Butler's proposed six-day walk from Ida Bay to Cockle Creek via PB involved a route through at least two areas of limestone karst. It was a walking trip he had previously undertaken and it was understood that on this occasion, he wanted to explore the possibility of finding a new route from PB to the south coast. Given the vast extent of unexplored limestone on the southern and western side of PB, it is highly likely that Butler may have fallen into one of the steep-sided dolines, possibly in the polygonal karst on the upper western side of PB. In late February 1979, the writer also suffered a mis-adventure becoming "lost" in this upper level limestone area immediately west of PB High Camp, devising an "escape" route by traversing these high level deep and expansive dolines in the dense King William Pine forest on the western side of PB. Arthur subsequently survived a night on his own without a tent seemingly lost in Tasmania's wilderness karst on the lower western slopes of PB, almost within sight of *New River Lagoon*.

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What turns glow-worms on? Baseline monitoring of the Tasmanian glow-worm and other cave fauna in Exit and Mystery Creek caves

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Exit Cave and Mystery Creek Cave in the Ida Bay karst system in south-east Tasmania contain a diverse and significant cave fauna. The most superlative faunal feature of these caves is the light displays by the Tasmanian Glow-worm Arachnocampa tasmaniensis. These displays have been recognised as a world heritage value under the criterion relating to outstanding natural phenomena. Remarkably, there has been no previous study on the ecology of the Tasmanian glow-worm. Glow-worms and other cave fauna were monitored monthly for 24 months to obtain information on their ecology and to establish baseline population data. A strong seasonal pattern was found for glow-worms, with pupae and adults most common in spring and summer. The increase in numbers of pupae and adults coincided with an increase in the number of prey caught in silk threads produced by the larvae. Larvae were present throughout the year but the number glowing varied both seasonally and spatially. In Mystery Creek Cave, the number of larvae glowing was generally highest during summer and autumn, and lowest in winter and early spring. In Exit Cave, there was no consistent seasonal pattern in the number of larvae glowing among sites, and overall there was less variation between monthly counts than at Mystery Creek Cave. This difference in seasonal patterns between the two caves may be due to a difference in cave climate, with Mystery Creek Cave possibly experiencing a greater drying out of the cave air in winter than Exit Cave. Monthly counts of cave crickets and other cave fauna, which were common in Exit Cave and uncommon in Mystery Creek Cave, revealed few interpretable patterns. The only consistent pattern observed was in the part of Exit Cave known as the 'wind tunnel' where cave cricket and cave beetle numbers were high during the warmer months and low during the cooler months. This is likely to be a response to the winter effect in that part of Exit Cave. Further information on this research is available in Driessen, M.M. (2009). "Enhancing the conservation of the Tasmanian Glow-worm (Arachnocampa tasmaniensis) by monitoring seasonal changes in light displays and life stages". Journal of Insect Conservation 14: 65–75, and in Driessen, M.M. (2009) "Baseline monitoring of the Tasmanian Glow-worm and other cave fauna". Nature Conservation Report 09/02, Department of primary Industries and Water, Tasmania. Both articles are available from the author.

Bioluminescence in cave glow-worms: do cave tours have an effect?

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Glow-worm larvae emit light to attract prey into their sticky silken web threads. Glow-worms are found in suitable wet caves as well as in rainforest settings. In wild caves of Tasmania and New Zealand, glow-worms (*Arachnocampa tasmaniensis* and *A. luminosa*, respectively) maintain synchronised rhythmic light output. The time of peak light output is different to forest glow-worms. Cave populations glow most brightly when it is daylight outside the cave and most weakly during the night; they are completely out of phase with adjacent rainforest populations. We show that cave glow-worms synchronise their bioluminescence by detecting and matching each others' glows. Placing artificial lights in caves causes glow-worms to synchronise to the imposed light cycle because they interpret the light as coming from other glow-worms.

From studies in wild caves at Ida Bay, we also show that where *A. tasmaniensis* are located in the cave mouth, experiencing cycles of daylight and darkness (light:dark), they still possess an underlying rhythmic tendency to glow most brightly during the day, just like their counterparts deeper in the cave. When cave mouth larvae are placed in constant darkness in the laboratory, they show a free-running endogenous rhythm with a peak occurring during the daylight hours. We conclude that this underlying rhythmicity is modulated by exposure to natural light, inhibiting the glowing during daylight hours. The accumulation of drive during the inhibitory period causes the glow-worms to release their light most intensely just after dark and progressively through the night.

In this regard, the rhythm of bioluminescence in *A. tasmaniensis* is completely different to that of the Australian mainland rainforest species, *A. flava*. The bioluminescence of *A. flava* has an underlying rhythmicity that promotes maximum bioluminescence during the night. Natural light inhibits bioluminescence — just as it does in *A. tasmaniensis* — but the inhibitory period coincides with the trough phase of the underlying rhythm of *A. flava*. We suggest that *A. tasmaniensis* shows this unusual rhythmic pattern because it is adapted as a cave-dweller, while *A. flava* is not.

We demonstrate that in *Marakoopa Cave* at Mole Creek, the timing of show cave tours happens to coincide with the brightest component of the natural bioluminescence cycle. Further, the artificial lighting in the main glow-worm viewing chamber above Zambezi Falls, does not substantially affect the display. The lack of effect of cave lighting on the bioluminescence intensity is readily explained in terms of the experimental results on the bioluminescence rhythm.

The Mole Creek Karst Forest Program

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The Mole Creek Karst Forest Program was funded by the Commonwealth Government as a component of the Tasmanian Forest Conservation Fund. The object of the program was to provide landowners in the Mole Creek area with native forest overlying karst the opportunity to either sell the land to the Tasmanian Government so that it could be added to the public land reserve system or to receive a financial consideration for placing a conservation covenant on the land. The Tasmanian Land Conservancy was contracted by the Department of Environment Water Heritage and the Arts, now Department of Sustainability, Environment, Water, Population and Communities, to implement the program. A technical panel identified and allocated a priority to karst areas, a guidance group assisted with implementing the program. The program was successful in adding 376 ha of karst to the reserve system on public land and protecting a further 201 ha with conservation covenants on private land.

Palaeontology and Cave Tourism: Opportunities for Engagement

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Fossil bones are often found in caves, where a constant cave environment and undisturbed sediments can result in exceptional preservation. Most cave fossils are of Pleistocene age ('Ice Age'), since bones older than this usually disintegrate over time. Extinct animals first known from caves include the massive marsupial *Diprotodon*, the marsupial 'lion' *Thylacoleo*, and the northern Cave Bear. Some tourist caves have capitalized on their fossil faunas by promoting scientific research and showcasing the results in interpretive centres and publications. This provides visitors with new excitement, education and a deeper understanding of the caves' history. An outstanding example is Naracoorte Caves in South Australia, a World Heritage area because of the unique nature of its fossil mammals. Cave displays of extinct animals, an interpretive centre and publications greatly enrich the visitor experience. Jenolan Caves in New South Wales -- the oldest show cave system in the world - has not been widely recognised for its extinct fauna, although Ice Age species have been found (for instance, Tasmanian Devil fossils are showcased on the Imperial Cave tour). New research into Jenolan's fossil fauna, the initial results of which are presented here, aims to investigate Jenolan's deeper history through identification and analysis of fossil bones within the caves. Work to date includes the identification of a probable *Zygomaturus*, a large marsupial herbivore nearly as large as *Diprotodon*; confirmation of a Tasmanian Thylacine in the Jersey Cave, and the'discovery' of many Jenolan fossils at the Australian Museum in Sydney. Many of these species are now either completely extinct or gone from the Jenolan area (as in the case of the Tasmanian Devil). Fresh insights into Jenolan's past will undoubtedly bring new opportunities to add to the visitor experience in many ways, as well as help to raise the scientific profile of Jenolan Caves.

An Overview of Caves and Caving in Slovakia

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The tradition of professional and organized caving in Slovakia will be presented, including the history of the Slovak Caves Administration and its changes over the time. The legislative background and consequent tools for cave preservation will be mentioned. Also an overview of the types of karst and caves, approach to cave management and operation of show caves in Central European conditions will be described. The practices in protection of both wild and show caves will be introduced. Ways of computer handling of different issues connected with caves will be presented as well.

The Vatnshellir Project — a First for Iceland

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Vatnshellir ('Water Cave') in Snæfellsnes, Iceland, is a 205 m long lava cave/tube on three levels. The uppermost part (first level) is the ' original' Vatnshellir, from where the farmers at Malarrif, a farm and a lighthouse, 3 km to the SSW, fetched water for their livestock. This part of the cave is partially collapsed, just under the surface and 35 m long.

The lower part is on two levels (floors) and in a surprisingly good condition. It is accessible through askylight, or funnel, in the downfall basin of Vatnshellir. This part of the cave has been named Undirheimar (Underworld). The middle level (floor) is 12-20 m under the surface and about 100 m long. At the southern end of the middle level is a 12 m high vertical lavafall, leading into the 12 m deeper lowermost level. This part of the cave is about 32 m below the surface, almost horizontal and just over 70 m long. In December 2009 a platform was built over the entrance funnel leading into Undirheimar.

In May 2010 an 8 m high spiral staircase was put up, leading into the 100 m long middle floor. This part of the cave was opened to the public on 15 June 2010 as ' the first 20 vertical metres of the route to the centre of the earth' (alluding to the fact that Jules Verne placed the start of the journey in this vicinity in his 1864 novel, Journey to the Centre of the Earth). In October 2010 a second spiral staircase, now under construction, will provide access down to the lowermost level, to about -32 m. (Then there will be just 6,370 km to go!)

It is an interesting project; the first of its kind in Iceland. It is done with humility, wit, nature protection and service to the community in mind. The mayor of the community, a renowned architect, the head of the ruine (collapsed buildings due to earthquakes, etc) rescue school in Gufuskálar and his son, Lions, some members of the Rotary Club and the rescue squad at Hellissandur are taking part. Among other things some 28 cu metres, or 60 tons of rock, volcanic ash and soil has been hauled from a depth of 10-12 m. The Environmental Institute is financing about 1/3 of the cost, the platform over the funnel and the two spiral ladders, the rest is voluntary labour and donation. Vatnshellir is within the Snæfellsjökull National Park, the park manager and the management have wholeheartedly supported the project from the very beginning.

Four broken spatter stalagmites found in Vatnshellir have been repaired and put back. Vandalism to two of these, The Twins, was in fact the spark that lead to the development of the cave into a tourist cave. Replicas of the 37 stalagmites (now all gone) that decorated the end of Borgarhellir in Hnappadalur, when found in 1957, were put up in a sheltered corner in the north end of the middle floor, to give people a feeling of how the great caves, a world that was, once looked.

Caves and Ruiniform features in Sandstones of Northern Australia

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The flat-lying sandstone areas of tropical north Australia have a range of interesting landforms that include caves, dolines, and other karst-like features, and also spectacular ruiniform terrains. These landforms can be classed as silicate karst, parakarst, pseudokarst and non-karst (but the last have ruiniform areas that have considerable scenic and scientific interest). Caves range from small rock shelters through small tunnels and large tubes which may have dark zones, to larger stream caves (both active and abandoned) and complex maze systems. Dolines are mainly collapse or subsidence features, and some may be due to subjacent karst effects. Blind valleys and stream sinks are associated with the stream caves. Small-scale features include solution pans and runnels, sculptured walls that resemble karren, and sandstone pillars within some caves or exposed in cliffs. The pillars appear to be a type of diagenetic cementation by focussed vertical water flow.

Ruiniform features are giant grikefields, stone cities and stone forests which result from structurally controlled weathering and erosion. At the edge of a plateau developed on flat-lying sandstones one finds that erosion first attacks the joints, widening them to form grikes which grow larger and deeper to become giant grikefields. As the grikes enlarge further they widen at the expense of the higher areas between them to make stone cities. Eventually the low ground dominates and we get a stone forest and finally scattered pinnacles on a low-level pavement. Stone cities are referred to by the tourism industry as “lost cities”. These features are analogous to karst grikes, pinnacles and towers, but solution is not the main process involved. Whilst solution of silicate cement may be involved in the original weathering process (along with oxidation of iron and aluminium compounds, and clay mineral formation), the majority of material is subsequently removed by fluvial processes, or, less commonly, by wind. Grikes etc on both limestone and sandstone are best classed as ruiniform, rather than “karst-like”, as the structural control is more important than the processes of chemical and physical weathering that are involved.

Many important sites have developed in Proterozoic sandstones and quartzites. Whalemouth Cave in WA is a particularly large and spectacular stream cave in sandstone. On the plateau above the cave several blind valleys and stream sinks can be seen from the air. In the NT there appear to be large and complex horizontal maze cave systems at Kakadu and possibly at Bunju, but these have not been studied in any detail and access is difficult. Also in the NT, large collapse dolines, some with water-table lakes (i.e. cenotes), occur in sandstones of eastern Arnhem Land, near Borroloola and on the Newcastle Range in the Gregory/Judbarra NP. Again, access is difficult and the genesis is uncertain as the host sandstones either have a carbonate cement or are underlain by limestone units. In Queensland, Widdallion cave in the Lawn Hill (Boodjamulla) NP is a stream cave similar to, but much smaller than Whalemouth. Further east in Queensland, Mesozoic sandstones have a range of features. A surface stream within the grikefields of Cobbold Creek Gorge has several underground segments. In the sandstone ranges of central Queensland there are many rock shelters, and also large tubes and small tunnel caves. The main interest there is in the extensive small horizontal tubes, and three-dimensional networks of smaller tubelets, even though they are too small for human access.

Managing Climate Change Impacts in karst — The Lake Cave Eco-Hydrology Recovery Project

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Lake Cave, located in the Margaret River region of southwest Western Australia is renowned for its beautiful and spectacular underground lake. The cave has been visited by tourists for more than 100 years, and it continues to be a major tourism drawcard in the region, attracting more than 44,000 visitors annually. Besides its important tourism values, the cave also harbours a Subterranean Groundwater Dependent Ecosystem (SGDE) comprising aquatic subterranean invertebrates (stygofauna) recently nominated as a Threatened Ecological Community (TEC) under the *Environmental Protection and Biodiversity Conservation Act* (status critically endangered).

Groundwater levels in Lake Cave remained relatively stable and showed no sign of decline up until 2005, after which time there has been a progressive decline and noticeable reduction of the size of the lake in the cave. This has reduced the visual appeal for visitors, and threatened the stygofauna community. Without management intervention, at the current rate of decline (1 mm per week) the lake will be dry within two to three years.

Lake Cave is managed by the Augusta Margaret River Tourism Association (AMRTA), and its Environmental Management Plan makes a commitment to conserving natural values within the cave and its water catchment, including monitoring and maintenance of hydrology, subterranean fauna and habitats (AMRTA 2008). As part of this commitment, AMRTA initiated the Lake Cave Eco-Hydrology Recovery Project in July 2010, supported through grant funding from the W.A. Government's Natural Resource Management Grant Scheme.

The Lake Cave Eco-Hydrology Recovery Project aims to:

1. Control the water level decline in Lake Cave, by harvesting rainfall and using this to supplement recharge of the lake;
2. Monitor the ecological condition of the aquatic root mat community and other stygofauna in Lake Cave;
3. Develop a hydrological model of the cave and karst catchment with a view to managing water resources and dependent SGDE's in the face of a drying climate future.

Since October 2010, AMRTA has been supplementing the natural flow of water in Lake Cave by subsoil discharge of rainwater into the cave. Initially this is a 12 month trial with assessment of the success of the trial to take place in September 2011. Baseline monitoring of water quality was undertaken during the preceding year to ensure that ongoing post-trial monitoring can detect any changes within the cave system, enabling appropriate management actions to be taken. This presentation documents baseline water quality and water levels, and the ecological condition of the aquatic root mat community and stygofauna, prior to commencing the recharge trial.

In relation to water quality, EC, pH, DO, redox and major ions were analysed for both lake water and drip water in the cave. The two water bodies exhibited different characteristics, confirming earlier indications that a portion of the lake water is of different origin from the vadose percolation waters.

In relation to stygofauna, the declining water levels and drying out of the root mat habitat in Lake Cave has resulted in a 74% decline in species richness over the past 10 years. Fourteen species with root mat associations were not recorded in 2010. Maintenance of the current water level is imperative for the conservation of the remaining stygofauna community.

The next stage (12 months) of the Project will continue monitoring of water levels, water quality and stygofauna, and undertake a detailed catchment-scale investigation to build a hydrological model of the cave and its catchment. This will be used to inform management and conservation of Lake Cave's water resources and SGDE's in the face of a drying climate future.

The Plains Karsts of the Smithton Basin

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The Togari Group of younger Precambrian rocks in the Smithton Basin of far northwest Tasmania includes two thick horizons of karstic dolomite, namely the upper Smithton Dolomite and the lower Black River Dolomite, separated by volcanics and clastic sediments. These were folded into a broad north-south oriented synclinorium, and subsequently reduced to a broad coastal plain by an unusually long (for Tasmania) period of continuous sub-aerial exposure and erosion lasting over 400 million years from Late Cambrian through to Early Tertiary times. Lateral karstic corrosion at the water table has created very broad, flat and (formerly) swampy karst plains on the Smithton Dolomite in the Duck and Montagu River valleys, with characteristic short steep marginal slopes. This extensive karst plain is one of the largest distinctively karstic landscapes in Tasmania. Mound springs in the Duck Valley are a notable feature of the plains karst; however the high water tables and flat relief mean that only a few caves have developed on isolated residual outcrops of dolomite rising above the plains surface; nonetheless some of these contain notable marsupial megafauna remains as at Montagu Caves. The mostly poorly-drained conditions resulted in accumulation of peat swamps during the Pleistocene, from which numerous megafauna bones have also been recovered near Smithton. Nonetheless much of the plains karst has been cleared and developed for agriculture, which historically required development of possibly the most extensive complex of artificial drainage channels in any part of Tasmania. The underlying Black River Dolomite is relatively siliceous, and so outcrops in a fringe of hillier country surrounding the plains karst, where sinkhole lakes such as Lake Chisholm and the Trowutta Arch cenote have developed along with some cave development as at Julius River Caves. Despite this, Tasmania's best example of an enclosed plains karst or polje has also developed in carbonate rocks assumed to correlate with the Black River Dolomite at Dismal Swamp. Although some logging has occurred in the past, Dismal Swamp remains undrained and much of the polje has been protected as an important remnant Blackwood swamp forest habitat.