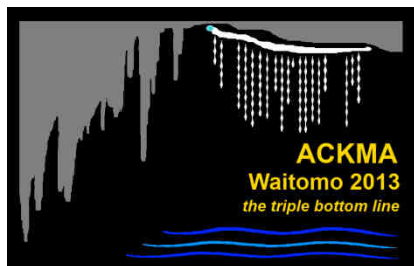


20th Australasian Conference on Cave and Karst Management

Conference handbook



**Waitomo Caves, New Zealand
12-17 May 2013**

**Australasian Cave and Karst
Management Association**

Australasian Cave and Karst Management Association

20th Australasian Conference on Cave and Karst Management

**Waitomo, New Zealand
12 to 17 May 2013**

Conference Convenor
Libby Chandler

Major sponsors
Ruapuha Uekaha Hapu Trust
Department of Conservation

Organising Committee

John Ash	Greg Martin
Dave Smith	Peter Chandler
Celina Yapp	Robert Tahī
Travis Cross	Miria Davis
Angus Stubbs	Gordon Hewston

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Waitomo Caves Conference Programme May 2013

Time	Activity	
Sunday 12 May		
12:30pm	First transport pickups Auckland CBD	
2pm	Final transport pickups Auckland airport	
4pm	Arrive Waitomo Caves (approx)	
4pm – 6:30pm	Registration open, drinks and nibbles. Discovery Centre open for visits	Education Centre, Waitomo Caves Discovery Centre
6:30pm	Assemble to depart as a group from Waitomo Caves Discovery Centre	Education Centre, Waitomo Caves Discovery Centre
7pm	Conference opening Mihi whakatau (welcome) at the Waitomo Glowworm Cave Visitor Centre	Waitomo Glowworm Cave
7:30pm	Meal and conviviality	Waitomo Glowworm Cave
Monday 13 May		
7am – 8:30am	Breakfast	Own arrangements
8:45am	Welcome and housekeeping from Conference organisers	Fred Mace Room, Waitomo Caves Hotel
	Keynote addresses Session Chair – John Ash	
9am	Opening remarks, Brian Hanna, Mayor, Waitomo District	
9:30am	Dave Bamford, TRC Tourism Australasian tourism market forces and the triple bottom line	
10:15am	Morning tea	
10:45am	Grant Webster, Tourism Holdings Ltd Creating Unforgettable Holidays – Profitably	
11:30am	Peter Douglas, Ruapuha Uekaha Hapu Trust The Waitomo Glowworm Cave - providing for its people	
12:15pm	Overview of Conference Programme	
12:30pm	Lunch	Waitomo Caves Hotel

1:30pm	Groups Yellow and Blue Spellbound Cave	Hotel pickup
1:30pm	Groups Red & Green Aranui Cave and Ruakuri Bushwalk	Hotel pickup
5pm	Relax, do your own thing or else ... Optional tours Discovery Centre archives and education Glowworm Cave climate monitoring Footwhistle night tour Historic Hotel Tour	For all options, meet at the Education Centre, Waitomo Caves Discovery Centre
6:30pm	Roselands (evening venue) open for drinks	Shuttle vans will leave from the Waitomo Hotel via the Waitomo Caves Discovery Centre from 6:30pm
7pm	Evening meal, Roselands Restaurant Over dinner speaker David Summers, ISCA The Business of Operating a Show Cave	
8pm	ACKMA Committee meet	Education Centre, Waitomo Caves Discovery Centre
Tuesday 14 May		
7am – 8:30am	Breakfast	Own arrangements
8:45am	Housekeeping	Fred Mace Room, Waitomo Caves Hotel
	Keynote papers Session Chair – Dave Smith	
9am	Paper 4 – Andy Spate The International and National Significance of Australia’s Karst Landscapes	
9:30am	Paper 5 – Paul Williams Geological background of karst in New Zealand	
10am	Paper 6 – Daniel Hikuroa Going Deeper - the Quadruple Bottom Line – People, Planet, Profit, <i>Papatuanuku</i>	
10:30am	Morning tea	
	Triple bottom line Session chair – Pete Chandler	
11am	Paper 7 – Daniel Cove Exploring cultural heritage values of karst: the development of indigenous tours, walks and displays at Jenolan Caves	

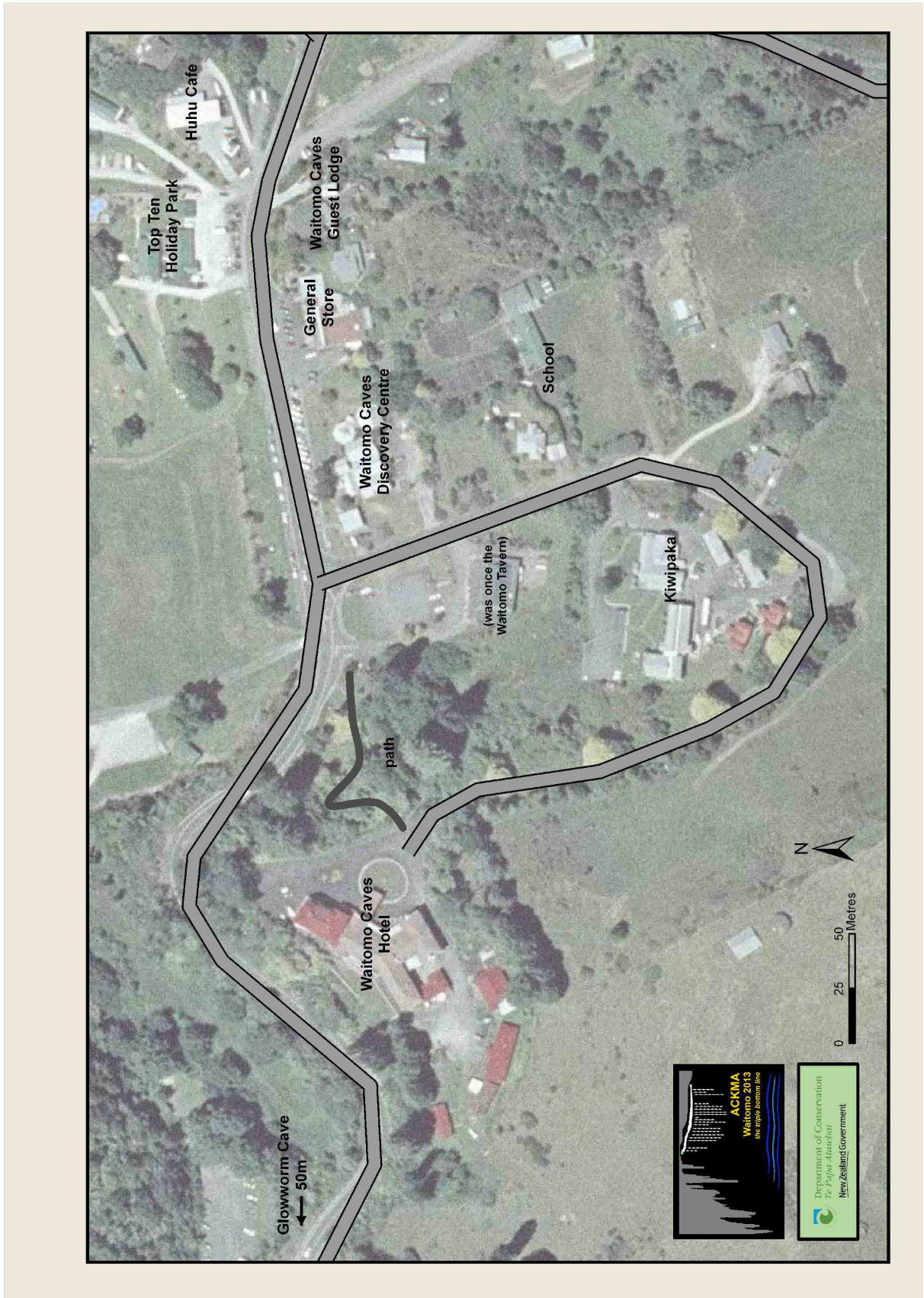
11:30am	Paper 8 – Deborah Carden Beyond the Master Plan - Naracoorte Caves World Heritage Area, South Australia	
12pm	Paper 9 – Paul Williams What Waitomo speleothems tell us about environmental change	
12:30pm	Lunch	Waitomo Glowworm Cave Walk or transport from hotel
1:30pm	Groups Red & Green Spellbound Cave	Depart from Waitomo Glowworm Cave
1:30pm	Groups Yellow and Blue Aranui Cave and Ruakuri Bushwalk	Depart from Waitomo Glowworm Cave
5pm	Relax, do your own thing or else ... Optional tours Discovery Centre archives and education Glowworm Cave climate monitoring David Head – lighting display	For all options, meet at the Education Centre, Waitomo Caves Discovery Centre
6:15pm	Special event, Waitomo Glowworm Cave	Shuttle vans will leave from the Waitomo Hotel via the Waitomo Caves Discovery Centre. Or assemble at Waitomo Glowworm Cave
7:30pm	Evening meal, Waitomo Caves Hotel Over dinner speaker, Andy Eavis, IUS	Walking distance
Wednesday 15 May		
7am – 8:30am	Breakfast	Own arrangements
8:45am	Housekeeping	Fred Mace Room, Waitomo Caves Hotel
	International karst Session Chair – Steve Bourne	
9am	Paper 10 – Julia James and Sasa Kennedy “Ecotourism” in two karst areas in Madagascar	
9:30am	Paper 11 – Sasa Kennedy Show caves of southern Spain: how differing approaches to the triple bottom line affect both the caves and the visitor experience	

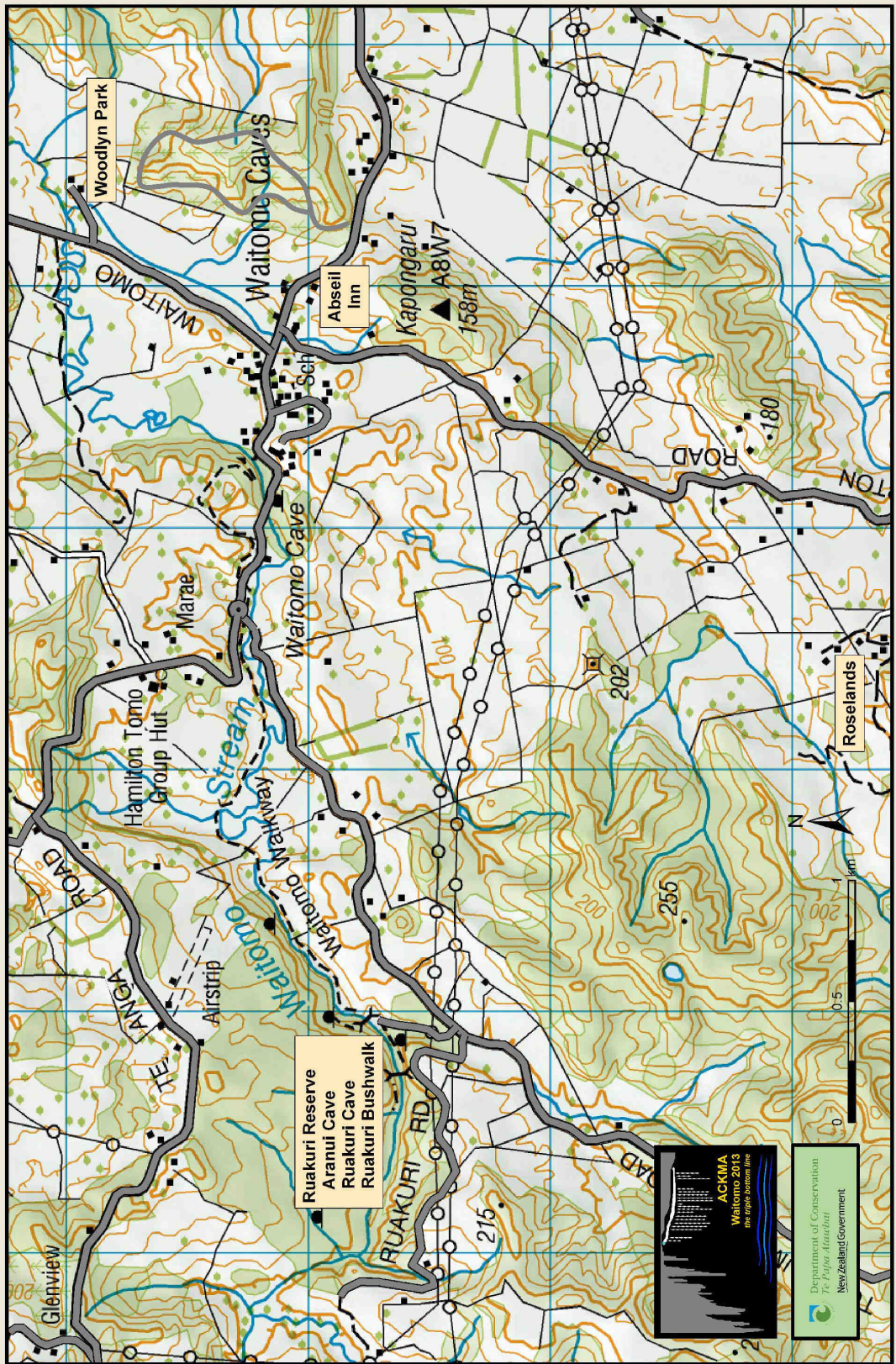
10am	Paper 12 – Arthur Clarke Dong Thien Duong (aka Paradise Cave), a new world class show cave in northern Vietnam	
10:30am	Morning tea	
	Session Chair – Julia James	
11am	Paper 13 – Andy Spate & Jess Spate Cave visitor numbers over the recent past: a preliminary survey	
11:30am	Paper 14 – Andy Eavis The International Union of Speleology	
12pm	ACKMA AGM	Fred Mace Room, Waitomo Caves Hotel
1pm	Lunch	Packed lunch distributed
1:30pm	Optional events: Do nothing Local walks and Discovery Centre visits Cave tours Caveworld – free Tube It tour; BWR – any tour for \$20; Waitomo Adventures – half price tours; Kiwi Cave Rafting – half price. Maniapoto's Cave Otorohanga and Kiwi House MacDonald's Lime quarry	Depart from the Hotel. Some longer adventure tours may need to take their lunch and go.
5pm	Relax, do your own thing or else ... Optional events David Head – lighting display Footwhistle night tour Historic Hotel Tour Technical workshop: CO ₂ and corrosion in caves: environmental management	Assemble at the Education Centre, Waitomo Caves Discovery Centre
6:30pm	Evening meal, split into two groups Red and Yellow – Huhu Café Blue and Green – Morepork Café (Kiwipaka)	Walking distance
Thursday 16 May		
7am – 8:30am	Breakfast	Own arrangements
8:45am	Housekeeping	Fred Mace Room, Waitomo Caves Hotel
	Cave biology Session chair – Deborah Carden	

9am	Paper 15 – Tim Moulds A preliminary survey of the invertebrate fauna of the Gunung Mulu World Heritage karst area, Sarawak, Malaysia.	
9:30am	Paper 16 – Troy Watson The structuring of aquatic macroinvertebrate communities within cave streams	
10am	Paper 17 – Dave Merritt Glowworms are more diverse than we thought: cave- and forest-adapted species in Australia	
10:30am	Morning tea	
	Waitomo Glowworm Cave Session Chair – Greg Martin	
11am	Paper 18 – Travis Cross Glowworm Photomonitoring in the Waitomo Glowworm Caves, New Zealand	
11:30am	Paper 19 – Matt Gillies Environmental Management of the Waitomo Glowworm Cave, New Zealand: Effects of Visitors and Ventilation on Carbon Dioxide Concentrations and Air Moisture Content	
12pm	Paper 20 – Chris Hendy Towards managing the carbon dioxide partial pressure in caves with both anthropogenic and non anthropogenic sources	
12:30pm	Groups Red and Blue BBQ lunch, Kiwipaka. Then Ruakuri Cave and Waitomo Glowworm Cave	Transport ex-Kiwipaka
12:30pm	Groups Yellow and Green Packed lunch. Caves to Coast tour	Transport ex-Waitomo Caves Hotel. Lunch en route
6:30pm	Evening meal, split into two groups Blue and Green– Huhu Café Red and Yellow – Morepork Café (Kiwipaka)	Walking distance
Friday 17 May		
7am – 8:30am	Breakfast	Own arrangements
8:45am	Housekeeping	Fred Mace Room, Waitomo Caves Hotel
	Cave and karst science Session Chair -- Andy Spate	

9am	Paper 21 – Sue White Cave science: sampling for science in caves	
9:30am	Paper 22– Anne Musser People, Planet, Profit...Palaeontology!	
10am	Paper 23 – Tim Stokes Geologic, Geomorphic and Hydrologic Constraints for Karst Landscape Evolution on Vancouver Island, British Columbia, Canada: A New Approach and Potential Applications	
10:30am	Morning tea	
	Regional caves and karst Session Chair – Dan Cove	
11am	Paper 24 – Peter Crossley Auckland Lava Caves – the problem of having caves in a city	
11:30am	Paper 25 – Nick White Scrubby Creek Cave Acquisition, Murrindal, Victoria	
12pm	Paper 26 – Scott Melton Digital Media: A modern conundrum in an ancient landscape	
12:30pm	Groups Yellow and Green BBQ lunch, Kiwipaka. Then Ruakuri Cave and Waitomo Glowworm Cave	Transport ex-Kiwipaka
12:30pm	Groups Red and Blue Packed lunch. Caves to Coast tour	Transport ex-Waitomo Caves Hotel.
6pm	Dinner venue (Woodlyn Park) open for drinks	Shuttle vans will leave from the Waitomo Hotel via the Waitomo Caves Discovery Centre.
7pm	Dinner at Woodlyn Park	
	Poroporoaki (farewell)	
8pm	Special show at Woodlyn Park	
Saturday 18 May		
9am	Post conference tour departs	
9:30am	Bus to Auckland departs	

Maps







Welcome

Convenor's welcome and introduction

Our conference organising committee welcomes you to Waitomo Caves 20th Australasian Cave and Karst Management Conference. We have had a great deal of pleasure designing this conference for you. We hope we have been able to create a programme that follows all the well-established traditions of ACKMA conferences but gives you a truly Waitomo flavoured experience.

For those who are visiting for the first time, we hope you begin to feel at home very quickly. Waitomo is a small village and everything you need can be found within a short walking distance. We are a friendly bunch and by the time you leave here you will probably know most of us quite well.

For those returning, welcome back. I'm sure you will notice some changes. We have gained some impressive new buildings at Waitomo Glowworm Cave and sadly we have lost an old friend with our local Tavern burning down. You may notice some new tours and activities too. Happily Waitomo has experienced an upward trend with new business and some reinvigorated older ones bringing more employment and new people to the district.

Our choice of Triple Bottom Line (People, Profit, Place) as a conference theme is a way of expressing our way of life in Waitomo and our optimism for the future. Cave tourism here is firmly rooted in private business enterprise, we all look towards encouraging lots of visitation and a healthy profit. Some of the caves we operate from are privately owned under farmland, some by hapu and some are publicly owned and administered by the Department of Conservation. No matter who owns them we are all very aware of the need to look after our precious karst environment for the benefit of ourselves and future generations.

Lastly we all have great pride and confidence being part of this wonderful community and look towards a shared future in Waitomo. The Triple bottom line theme lets us introduce ourselves to you and gives us scope for self-reflection as we show you around our region.

Our enthusiasm for putting this conference together is demonstrated by the size of our committee, I would like to say it has been a pleasure to work alongside friends and neighbours to bring this conference together.

Libby Chandler
Convenor

From the Office of the Mayor



Welcome from the Mayor of Waitomo

It is my pleasure on behalf of the Councillors and people of Waitomo District to welcome all participants to this, the 20th biennial conference of the Australasian Cave and Karst Management Association.

I believe this is the third time your group has chosen Waitomo as the venue for your conference, with the previous occasions being back in 1997 and 1985. For those who attended here 16 years ago, I'm sure you will find many changes, not the least of them being the new Visitor Centre at the Waitomo Glowworm Cave, and the development of the Ruakuri and Spellbound Caves.

For those who have not been here before, I am sure you will find much to do and places of interest to visit during your stay. So again welcome, very best wishes for a successful conference and we trust you will take away fond memories of your visit to Waitomo, the King Country and New Zealand.

Brian Hanna
Mayor
Waitomo District Council

www.waitomo.govt.nz

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Phone 07 878 0800 • Fax 07 878 7771 • Freephone 0800 932 4357 • Email enquiries@waitomo.govt.nz

Welcome from Ngati Uekaha & Ngati Ruapuha

The Story of Ngati Uekaha & Ngati Ruapuha – the local Maori people of Waitomo

Pepeha

Ko Hoturoa te tangata	<i>Hoturoa is the man</i>
Ko Tainui te waka	<i>Tainui is the canoe</i>
Ko Waipa te awa	<i>Waipa is the river</i>
Ko Kakepuku to maunga	<i>Kakepuku is the mountain</i>
Ko Ngati Maniapoto te iwi	<i>Maniapoto is the tribe</i>
Ko Ngati Uekaha raua ko Ngati Ruapuha nga hapu	<i>Uekaha and Ruapuha are the sub-tribes</i>
Ko Pohatuiri me Tokikapu nga marae	<i>Pohatuiri and Tokikapu are the marae</i>
Ko Waitomo te waahi.	<i>Waitomo is the place.</i>

A pepeha is traditionally used by individuals to introduce themselves to others but in this instance has been used to share some of the history of the Maori people of Waitomo with visitors to the ACKMA Conference.

This pepeha starts with Hoturoa and Tainui. This refers to the great journey of our ancestors from Hawaiki (homeland of the Maori) across Moana nui a kiwa (the great ocean of the Pacific) to Aotearoa (New Zealand). Once here they followed the awa (rivers) until they came to the final resting places of their waka (canoe).

The areas that these waka traversed defined the rohe (districts) which were sub-divided into the iwi (tribes) and then hapu (sub-tribes). Each hapu is affiliated with a waahi (place) and in each waahi is a marae. From the marae come the kaumatua (elders) which eventually leads to the individual.

Ngati Maniapoto take their name from the eponymous ancestor, Maniapoto who lived in the 17th century and overpowered other tribes to take over the region. Ngati Maniapoto affiliate to the Tainui waka (captained by Hoturoa) which was one of several waka that arrived in Aotearoa around 1350 AD.

The hapu in Waitomo take their names from their ancestors, Uekaha and Ruapuha who held mana (power) over the lands to the west and east of the Waitomo River. Their marae are Pohatuiri and Tokikapu which are places of significance as it is here that the customs and values of the hapu are maintained.

The Waipa River is the largest river in the rohe of Maniapoto and is of huge cultural, historical, and spiritual significance. Local rivers, lakes or seas can be of equal importance to any hapu with the element of wai (water) being an essential of life, source of healing as well as been a source of many traditional food staples.

Kakepuku o Kahu (the hill that Kahu climbed over) is one of several mountains that can be seen from Waitomo and rises on the eastern side of the Waipa River. The name relates to the story of Kahu who upon the death of her husband left her home to explore the region giving names to land marks throughout Maniapoto and Waikato. For Maori it is their maunga (mountain) which anchors them to their whenua (land) - mau meaning hold.

Whakapapa (genealogy) gives your origins which determines your pepeha. A pepeha gives the listener the opportunity to establish where you are from and who you belong to. In Maori terms this is often more important than someone's name (or occupation).

In sharing this information I hope it gives you a better insight into the local Maori people of Waitomo who extend a warm greeting of welcome to those attending the ACKMA Conference.
No reira, tena koutou, tena koutou, tena tatou katoa.

Miria Davis

Whakatau – Welcome ceremony

Attendees of the conference are invited to attend a Whakatau which will be conducted by the local Maori people of Waitomo at the Glowworm Caves, starting at 7pm. The following is an outline of the format for the ceremony so that you may enhance your experience of this traditional welcome which marks the official opening of the ACKMA Conference 2013.

What is it about ...

A *mihi whakatau* is a greeting of welcome to *manuhiri* (visitors) who are accorded the status of *tapu* (sacred) by the *tangata whenua* (home people). The purpose of the whakatau is the coming together of the two groups to unite as one whereby the visitor status of *tapu* is transformed to a state of *noa* (common, free from tapu) through the various processes that take place through the ceremony.

What will take place ...

You will gather at the Glowworm Caves and your group will be guided by *Kaumatua* Joe Harawira to the Restaurant Deck. **Please note** that the front row of seats are reserved for men only and in particular for those that will be making speeches. Women are welcome to sit behind the front row.

By way of an explanation, this is a traditional seating arrangement as men are regarded as the protectors of women (whare tangata) who are the bearers of future generations. Should any conflict take place during the speeches (not seen in modern times) men will be at the forefront to protect their women.

Please stand until the tangata whenua invite your group to be seated, after which they will be seated. The ceremony will be conducted in the Maori language and will follow this format:

Karakia: A prayer precedes speeches and marks the start of the official welcome.

Mihi: The exchange of greetings by the orators (usually male). The tangata whenua will speak first and make a speech of welcome to acknowledge those that have gathered for the Conference.

Kaumatua Joe Harawira will speak on behalf of the manuhiri and further speeches may follow.

Waiata: At the completion of each speech, a waiata (song) will be performed. This provides strength and enhancement to what the speaker has said. Those taking part in the waiata will stand behind the speaker.

- Koha:** When the last speaker for the manuhiri has completed his speech and waiata, a koha (donation) will be placed on the ground.
- A karanga (call) by a woman from the tangata whenua will be performed before it is retrieved by one of the tangata whenua speakers.
- In olden times, koha took the form of food and precious taonga (gifts) but in modern times can include money which is given to the hosts to help with costs associated with the hui (gathering).
- At the conclusion of speeches the tangata whenua will stand and invite the manuhiri to move toward them so that the hongis can take place.
- Hongi:** The hongis are where two people touch and press each other's nose (the Maori equivalent to the handshake). In the hongis, the ha (breath of life) is exchanged and intermingled between the participants. In olden times the purpose of performing a powhiri (the more formal version of a whakataui) was used to determine whether visitors came as friend or foe. The hongis were a sign that a bond of trust has been established between the two groups.
- Kai:** Following the hongis, manuhiri will be invited to share a meal. Kai (food) is regarded as noa (common) and removes the tapu or sacredness from the manuhiri so that the two sides can complete the coming together as one. You are now part of the whanau (family) of Ngati Uekaha and Ngati Ruapuha!

General Information

Contacts	Libby Chandler	+64 274191644
	Dave Smith	+64 211466828
	John Ash	+64 21742033
	Pete Chandler	+ 64 273279892
Climate	Cool, possibility of frosts – expect some rain	
Adventure caving	Please take towel and swimsuit and thermal underwear	
Telephone numbers	Discovery Centre	64 7 8787640
	Hotel	64 7 878 8227
Facsimile	Discovery Centre	64 7 878 6184
	Hotel	64 7 878 8858
Email	Discovery Centre: info@waitomodiscovery.org	
Public telephones	Museum – card and credit card	
	Hotel – card, credit card and coin	
Power supply	230v 3 pin plug (same as Australia)	
Shops	Discovery Centre –stationery, stamps, phone cards, soft drinks, postcards, souvenirs General store – toiletries, limited groceries, coffee	
Supermarket, banks, pharmacy	If required we will try to get people into the adjacent towns for services. Please contact one of the organisers.	
Bars	Waitomo Hotel General Store Curlys Bar, Kiwipaka	
Post and stamps	Waitomo Caves Discovery Centre	
General information	Waitomo Caves Discovery Centre	
Speleological library	At Discovery Centre	
ATM	Kiwipaka lobby, Te Kuiti, Otorohanga	
Breakfast	See the fliers in the registration pack	

Internet and Wifi

Waitomo Caves Village is pretty much at the end of the “pipe” and there are days when the “pipe” seems to have a mind of its own.

However, for those of you who are not “smartly” connected, there are a variety of venues where you can either use their internet services for a half hour or hourly rate , or others who have WiFi on a charge or “buy a coffee” basis. Most B&Bs will have WiFi.

We are sure that the word will spread quickly as to where the best option is.

KIWIPAKA WiFi and Internet

Nomad Group “Global Gossip” card.

This has a bar code and access number and can be used at any Nomad operator in NZ.

\$4 for 24 hours

\$12 per week, or

\$2.50 / ½ hour charge for using their computers

JUNO HALL WiFi

\$1 for 15 minutes

\$5 for 24 hours

BLACK WATER RAFTING Internet

\$2 for 20 minutes

\$5 for 50 minutes

DISCOVERY CENTRE Internet

\$3 for 30 minutes

WAITOMO HOTEL WiFi

Purchase cards

\$5 for 70MB

\$10 for 200MB

WAITOMO TOP 10 HOLIDAY PARK WiFi

IAC Plan purchased at the Park or on line.

\$5 for 24 hours, data limit

\$25 for a week data limit 1TB

WAITOMO GENERAL STORE WiFi

Free WiFi password with a coffee or other victual purchase.

HUHU CAFÉ WiFi

Free WiFi password with purchase at Cafe

Abstracts of Papers

Keynote session 1, Monday

Paper 1: Dave Bamford, TRC Tourism

Australasian tourism market forces and the triple bottom line

An overview of key market influences, such as the Global Financial Crisis, and key markets, including emerging markets from countries such as China and India. The role of markets in tourism including the domestic, nature and adventure, cruise, and conference markets.

Paper 2: Grant Webster, Tourism Holdings Ltd

Creating Unforgettable Holidays – Profitably

In an industry that struggles to deliver above cost of capital returns, how do we continue to deliver to the customer?

Paper 3: Peter Douglas, Ruapuha Uekaha Hapu Trust

The Waitomo Glowworm Cave - providing for its people

A review of the recent history of the Waitomo Glowworm Cave and the ownership role of the Ruapuha Uekaha Hapu Trust. The issues and challenges facing the Trust and its future direction.

Keynote session 2, Tuesday

Paper 4: Andy Spate, Optimal Karst Management

The international and national significance of Australia's karst landscapes

Australia has 19 World Heritage Properties – many of these have karst-associated values. We had one UNESCO Global Geopark until it was torpedoed by stupid political ideologies. Australia has a program of recognising significant 'national' landscapes – again many of these have karst values and provide some recognition of karst.

There are other areas such as the Nullarbor limestone karst and wonderful sandstone karst or pseudokarst landscapes of northern Australia which are worthy of World Heritage or similar status which are again precluded from proper recognition by Australia's political system.

This paper reviews the karst areas of Australia in regard to their international and national significance. In keeping with the conference themes of 'people, planet, profit' comment will be made on what Australia's karst resources offer the nation.

Paper 5: Paul Williams, University of Auckland

Geological background of karst in New Zealand

Zealandia is a piece of Gondwana, about one-third the size of Australia, but most of its continental crust is underwater as submarine plateaux. The emergent part, New Zealand, covers about the same area as Victoria plus Tasmania, and carbonate rocks occupy about 3% of its area (compared to 4.7% in Australia). So karst is scarce in NZ, making its conservation all the more important. Before the present Australia-Pacific plate boundary was established at the end of the Cretaceous Period, about 80 Ma ago, Zealandia had been eroded almost to sea level. By 60 Ma the Tasman Sea had reached its full extent, the oceanic crust was cooling and the subsiding sea

floor drew down the land, such that by 35 Ma only small low islands protruded above sea level. The sinking continental crust first accumulated estuarine sediments, then sheets of shell fragments, silty sandstones and mudstones. Deep burial compressed the shell layers into limestones. Sediment accumulation ended in the late Miocene-Pliocene once the present plate boundary was established and resulted in convergence and uplift. Uplift started about 15 Ma and accelerated around 5 Ma. This resulted in the emergence of tilted blocks of country bounded by faults. Erosion commenced immediately uplift occurred, so the marine sediments were dissected as they were uplifted. This removed most of the Tertiary sediments from the highest country leaving fragments round the edges where uplift was less intense. Consequently, there are remnant patches of Oligo-, Mio-, and Plio-cene limestones in many parts of the country, predominantly located on the flanks of ranges but sometimes found to 1500 m. These carbonates range from a few 10s to 700m in thickness. In some places, exhumation of the eroded basement has revealed more ancient carbonates, including marble bands in Fiordland and especially NW Nelson where they attain up to 1000 m in thickness and occur to 1875m above sea level.

Most karst development has taken place in New Zealand since plate convergence generated uplift, mainly over the last 5 Ma and especially in the last 1 Ma. By the early Pleistocene the Southern Alps began to form and gravel accumulations started to develop the Canterbury Plains. During uplift the Cenozoic marine sediments were simultaneously eroded leaving the remnant patches we see today. In NW Nelson the Ordovician marbles were re-exposed and our greatest caves (to 1026 m deep; to 67.2 km long) started to develop, a process that still continues. In western North Island, near Waitomo, the Oligocene-Miocene limestones were exposed in places by the early Pleistocene, but the evolving karst was overwhelmed about 1.25 Ma ago by a vast thickness of ignimbrite from the central volcanic zone. This has now been largely stripped off and karstification has resumed. Most caves in the Waitomo region are probably less than 250,000 years old. Meanwhile in eastern North Island marine shelly limestones of Plio-Pleistocene age were uplifted only about 1 Ma ago and these thin young limestones have been karstified only in the last 10,000 years or so.

Paper 6: Daniel Hikuroa, University of Auckland

Going Deeper - the Quadruple Bottom Line – People, Planet, Profit, *Papatūānuku*'

Research Director Nga Pae o te Maramatanga/NZ's Indigenous Centre of Research Excellence

The conference theme is 'the triple bottom line'. Also known as 'people, planet, profit' – triple bottom line is a framework for looking at social and environmental outcomes, as well as financial outcomes – in short sustainability. More broadly for us, what does cave tourism really deliver for its stakeholders – financially, environmentally and socially? But can we go deeper? – to incorporate the fourth dimension, articulated in the title as *Papatūānuku*', but representing culture. Quadruple bottom line reporting requires an organisation to be responsible and accountable to all **stakeholders** of an organisation, not just the **shareholders**. The stakeholders of an organisation are anyone who is affected by the business activities of a company including shareholders, customers, employees and suppliers. The difficulty faced by many organisations is how to accurately reflect that responsibility and account for cultural values and other outcomes (social and environmental) in a cost benefit analysis. The assumption is that all four outcomes can have a quantifiable financial assessment to determine if they have been effective or not. I propose that money is not a useful measure of sustainability, and that there might another concept that could be applied – mauri.

Paper 7: Daniel Cove

Exploring cultural heritage values of karst: the development of indigenous interpretation Jenolan caves

Cave and karst areas have been important cultural sites throughout human history and prehistory. The interpretation of the cultural values of karst has often been seen as automatically secondary to the geological or other scientific values. At Jenolan Caves, NSW Australia, there was traditionally limited interpretation and little to no available information regarding the long association of Aboriginal tribal groups with the local area. The past 18 months has seen the development of a collaboration between the Jenolan Caves Reserve Trust and the Gundungurra Tribal Council which has led to the development of several new products including a self guided cave tour and surface walk both available as smart-phone apps. This collaboration has also dramatically improved general understanding of the connection of local Aboriginal peoples to the Jenolan area and to the cave system.

Paper 8: Deborah Carden

Beyond the Master Plan - Naracoorte Caves National Park and World Heritage Area, South Australia

Naracoorte Caves National Park (NCNP) is a renowned fossil mammal site, co-listed with Riversleigh in North Queensland as a UNESCO World Heritage Area.

NCNP is one of four commercial sites operated in South Australia under the jurisdiction of the Department of Environment, Water and Natural Resources (DEWNR). These sites operate businesses within distinctive natural settings. Master Planning is being conducted at each site, the recommendations of which will direct future investment.

The aims are to:

- Enhance visitor activities and upgrade assets.
- Implement an expanded business model.
- Improve productivity overall.

In 2009 master planning began for Naracoorte.

In 2013 the planning will be completed.

Beyond 2013 DEWNR will implement recommendations from the Plan.

In doing this it will sustain the triple bottom line.

Paper 9: Paul Williams

What Waitomo speleothems tell us about environmental change

University of Auckland

The most important information that speleothems can reveal is about climate. These days we hear a lot about climate change and what's likely to happen in the near future, but most evidence is derived from the Northern Hemisphere and we're not sure if predictions really apply downunder. So we need to determine if known NH climate events (like the Medieval Warm Period and Little Ice Age) are found in the SH. If this can be confirmed then it increases the likelihood that climate predictions will apply to both hemisphere – even if there are leads or lags in events. To reach unambiguous conclusions about this we need well dated high resolution data from the SH that can be compared to data of similar quality from the NH. The best interval to examine is the last 2000 years, because that's when the NH has its most accurate historical data and it's also the period of most relevance to our near future. This contribution will therefore

focus on evidence from a 29.4 mm long section of a small stalagmite from Waitomo that grew from 59 BC to 2005 AD. It shows that temperature changes at Waitomo have been generally asynchronous with respect to the NH, except in the 20th Century when warming occurred in both hemispheres. Recent 'global warming' started in Waitomo about 1913 (25 years later than in the NH), but both the amount and rate of warming through last century was not unusual in the context of the last 2 millennia. It was about as warm and sometimes warmer around 1840, 1380 and 750 AD. The general conclusion is that on a centennial scale the SH and NH are generally out of phase, except in the 20th Century when global warming affected us both, although starting slightly later and being less severe (so far?) in NZ.

Wednesday, Session 1

Paper 10: Julia James and Sasa Kennedy Ecotourism in two karst areas in Madagascar

In keeping with the conference theme of the triple bottom line, reasons will be presented for the development of "ecotourism" in the Tsingy de Bemaraha National Park and the Ankarana National Park in Madagascar. These parks are plateau massifs in Jurassic limestone and have the distinctive weathered landscape of pinnacle karst, which is known locally as tsingy. These magnificent landscapes together with their caves and exceptional biodiversity are ideal for ecotourism. However, the move to ecotourism in Madagascar in the 1990's was made not for the above reasons but as the only real solution to managing and protecting threatened natural areas. To do this ecotourism trails funded by government and various international agencies were developed in both parks. Innovative infrastructure design and the use of local materials on the trails allows them blend into the landscape. In the caves the infrastructure is kept to a minimum. The trails of variable difficulty allow the entire spectrum of tourists to view landscapes and flora and fauna with minimal damage to their environment. Malagasy guides accompany all groups. Trained in formal ecotourism courses, they are informed about all aspects karst, culture and biodiversity, which further ensures the protection of the parks. The parks and their surrounding areas benefit financially from the ecotourism either directly from park entrance fees or by employment generated by catering for the needs of tourists. The Tsingy de Bemaraha will be used to demonstrate that by changing a part of this World Heritage inscribed area from a Strict Nature Reserve to a National Park in order to enable ecotourism has not only benefitted the park, its surrounds and the Malagasy people, but is also sustainable.

Paper 11: Sasa Kennedy Show caves of Southern Spain: how differing approaches to the triple bottom line affect both the caves and the visitor experience

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 visitor experience and the caves themselves are affected by which aspect of the triple bottom line the management is most focused on. 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 Bullen 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.

Paper 12: Arthur Clarke

Dong Thiên Đường (aka Paradise Cave), a new world class show cave in north-central Vietnam

During October-November 2012, Arthur Clarke and Siobhan Carter joined a group of American cavers on a specialist tour of wilderness caves and show caves in remote areas of central and southeast Laos and northern Vietnam. Promoted as “Focused Tours”, run by Dwight Deal and Mary Fletcher, a highlight of their recent karst cave tour was the visit to Dong Thiên Đường (aka Paradise Cave) in the Phong Nha-Kẻ Bàng National Park of north-central Vietnam. Situated near the west branch of Ho Chi Minh Highway in the Quang Binh Province of north-central Vietnam, the park itself is quite remote nestled beside the small township of Son Trach and several smaller villages including the adjacent Phong Nha. Lying about 42km inland (west) from the South China Sea, by road it is about 500 km south of Hanoi and 260 km north of the port city of Đà Nẵng. The Phong Nha-Kẻ Bàng National Park is adjoins the Hin Namno Nature Reserve in Khammouan, in neighbouring Laos. Both regions contain zones of karstified limestone, each area being approx. 2,000 km². Listed in 2003 as a UNESCO World Heritage Area (WHA), the karst of the Phong Nha-Ke Bang National Park was first recommended for WHA nomination by one of ACKMA’s founders and luminaries: Elery Hamilton-Smith. The national park derives its name from its magnificent Phong Nha Cave and its unique, biodiversity rich, Kẻ Bàng forest.

Aside from the historically known Phong Nha Cave, where tourists visit the huge, highly decorated chambers via motorised “dragon boats”, the national park is particularly known for its Hang Vòm cave system and the more recently discovered Hang Sơn Đoòng. Commonly known as Sơn Đoòng, with its main chamber over five kilometres in length, 200 metres high and 150 metres wide, it has taken the title of the world’s largest cave chamber away from Deer Cave in Sarawak. Prior to the 2009 discovery of Hang Sơn Đoòng (in Vietnamese: meaning Mountain River Cave), the Hang Vòm cave system was the largest and longest known cave in the Phong Nha-Kẻ Bàng park. Led by Howard Limbert, Son Trach resident and British ex-pat, the exploration of the Hang Vòm system commenced in 1990; the length now exceeds 35km.

Located at an elevation of 200m, the Dong Thiên Đường (Paradise Cave) entrance to the Hang Vòm system was discovered in 2005. The entrance chamber is 150m wide and 100m high with some of the massive stalagmite formations extending almost to the rooftop. Paradise Cave (Thiên Đường in Vietnamese) was opened for tourism on 3rd September 2010; with reportedly multi-million dollar expenditure, the site was sensitively developed in a very short period of time. From the vehicle park, tourists are taken by battery-operated golf car buggies 1.6km to the gathering place where a gently graded wheelchair pathway or steps climb 100m to the cave mouth reception and kiosk. Entry to Dong Thiên Đường costs 120,000doong (about AUS\$6.00; NZ\$7.00). The standard commercial tour of the first 1.1km of this massive cave is self-guided along well designed elevated walkways with viewing platforms all with good railings to contain the visitors and well lit with state-of-the-art LED lighting (and no coloured lights). From the far end of the walkway, an adventure caving option provides the opportunity for adequately equipped visitors to have a guided “wild cave” experience going a further 6km into the Hang Vòm system. Continuing along the silty clay and sandy floor, you pass through massive 40-100m high chambers and 300-400m long straight passages, crossing small creeks and wading shallow pools, walking to the Vom Grotto with its sandy beach below the 255m deep “Daylight Beckons” (Tang Hole) skylight shaft. The round trip including the developed show cave section is about 14km, with lunch and bottled water provided at the halfway point, below the “Daylight Beckons” shaft.

Wednesday, session 2

Paper 13: Andy Spate and Jess Spate

Cave visitor numbers over the recent past: a preliminary survey.

The Australasian Cave Tourism and Management Conference Proceedings provided annual visitor numbers for Australian show caves for a number of years. Unfortunately in recent decades this has not happened for a variety of reasons. There has never been a review of these annual series to examine trends, peaks and troughs. Nor has there ever been an attempt to review such figures in the light of local events such as floods and earthquakes or international happenings such as the SARS “epidemic”, the GFC or the current European economic woes.

Greg Martin advised me of dramatic changes at the Waitomo Glowworm Cave visitor numbers so we thought we should look further afield and see what is happening in Australia, New Zealand and at as many show cave sites in Britain, Europe, Asia, Africa and South and North America as we could obtain responses from given the short time frame leading up to the Waitomo Conference.

This paper will present a very preliminary view of what is happening world-wide. As Brian Clarke has pointed out to us recently absolute visitor numbers do not tell us much it is what experiences we offer, what value adding we do and what the visitors contribute to the local economy and our business. Perhaps this paper can be precursor to further work examining these issues more deeply.

Paper 14: Andy Eavis

The International Union of Speleology

The International Union of Speleology has now been in existence for over 60 years. The first International Congress of Speleology was in France in 1953. Since that time there has been a International Congress of Speleology every four years, in fourteen different countries. It was in the USA in both 1981 and 2009.

The next Congress is in Brno, Czech Republic on 20th to 28th July 2013. The International Union has a Management Bureau of thirteen people. Under the umbrella of the organisation come a number of working Commissions with such titles as, volcanic caves, hydrogeology, speleogenesis etc. There is currently a list of nearly thirty Commissions, some are more active than others, associated organisations to the UIS is, the International Show Caves Association which is also associated with ACKMA.

More recently regional bodies have been formed, including Central America and Europe.

Thursday, session 1

Paper 15: Tim Moulds, Jay Anderson, Ross Anderson, Patrick Nykie

A preliminary survey of the invertebrate fauna of the Gunang Mulu World Heritage karst area, Sarawak, Malaysia

The Gunung Mulu World Heritage Area (Mulu) is situated in the north eastern corner of Sarawak, Malaysia on the Island of Borneo, adjacent to the South China Sea. The area was prescribed as a national Park in 1974 and is the largest national park in Sarawak covering an area of 528 km². The area contains significant karstic limestone, with some of the world's largest caves by volume known from the area including Deer Cave and the Clearwater System.

In 2012 a team of Australian speleologists undertook a preliminary survey of the invertebrate biodiversity of eight caves within Mulu. The caves were a mix of tourist, adventure and wild caves within the park. Invertebrates were recorded from a mixture of different microhabitats found within the caves and reference specimens from each cave were collected and preserved for future study.

The aims of the study were to document the biodiversity of the caves; provide a photo inventory of species recorded; compare the invertebrate diversity and abundance between different cave zones and microhabitats; compare the invertebrate diversity and abundance between caves used for different tourism purposes.

The survey recorded over 19,000 specimens using a combination of collection and observation of species that presently represents 100 different morpho-species, from 28 orders and 9 classes. The number of morpho-species is expected to increase with additional sampling and further identification of the specimens already collected. Forty different species have been photo-inventoried thus far.

Preliminary analysis of data has shown no discernible differences in invertebrate diversity or abundance between tourist caves and wild caves. Observed differences in invertebrate populations are related to microhabitat variability and availability within sampled caves, with greater invertebrate abundance related to bird and bat guano deposits. This study represents the first stage of invertebrate research at Mulu, and future efforts will focus on increasing the photo inventory to provide a useful resource to the Mulu Park and Sarawak Forestry staff to identify cave invertebrates in the field. Ultimately increasing the local knowledge of cave invertebrate fauna will provide the best protection for these important ecosystems.

Paper 16: Troy Watson, J Harding, G Fenwick

The structure of aquatic macro-invertebrate communities within cave streams

Cave aquatic macroinvertebrate communities are structured by a host of abiotic and biotic factors unique to their environment resulting in variations between cave and surface aquatic communities. Primarily, cave stream invertebrate communities are presumed to be resource limited with a dependence upon surface-derived energy resources, such as FPOM and CPOM. This dependence upon surface derived energy was assessed down a longitudinal gradient within a cave stream using stable isotopes of carbon and nitrogen, pre-conditioned replicate algal tiles, and leaf packs. Furthermore, I investigated the potential for cave aquatic communities to subsidise subterranean terrestrial communities. Resource additions and stable isotopes confirmed that cave aquatic communities were resource limited and dependent upon surface derived materials, with an isotopic signature similar to that of C3 plants. Seston, benthic FPOM, and epilithon (i.e. bacterial, fungal, and diatom communities) were the most important basal resources within the cave, compared with seston, benthic FPOM, and filamentous algae outside of the cave. CPOM did not appear to be readily incorporated into the food-web. Furthermore, in the absence of an alternative carbon source aquatic derived energy would seem to support subterranean terrestrial predators, such as glow-worms, harvestmen, and spiders. Therefore, both aquatic and terrestrial cave invertebrate communities, including the iconic glow-worm populations, were supported by surface originating organic material, intricately linking their health to that of the surface system, leaving cave communities vulnerable to surface land-use changes.

Paper 17: Dave Merritt

Glowworms are more diverse than we thought: cave - and forest-adapted species in Australia

Glowworms emit light to attract prey into their webs. They are found in suitable wet caves as

well as in forests. In wild caves of Tasmania and New Zealand, glowworm populations (*Arachnocampa tasmaniensis* and *A. luminosa*, respectively) maintain synchronised rhythmic light output, waxing and waning together in a 24 hour cycle. Here I show how the Tasmanian species (and also probably the New Zealand species) is capable of synchronizing the bioluminescence cycle. In laboratory experiments we exposed a single larva to three others that were on a different cycle. The single larva shifted its time of glowing to match the others over about eight days. This is similar to the way humans overcome jet-lag; we either advance or delay our sleep/wake cycle to accommodate the new light/dark cycle. This synchronisation capability probably allows the glowworm colonies in caves to glow most brightly all at the same time as a way of attracting more flying insects into their webs. In comparison, the south-eastern Queensland glowworm species can't synchronise. It seems that the synchronisation ability is present only in the species that have large cave populations.

Thursday, session 2

Paper 18: Travis Cross¹ and Dave J Merritt²

Glowworm Photomonitoring in the Waitomo Glowworm Caves, New Zealand

¹Waitomo Glowworm Caves, Tourism Holdings Limited.

²School of Biological Sciences, University of Queensland.

The Waitomo Glowworm Caves have the most visited glowworm display in the world. Prior to 2009, the only monitoring program had been based on quadrat counts at two sites. Data from these quadrats was limited, not statistically robust, and difficult to interpret.

Experimental long-exposure photomonitoring was developed during late 2008 and plans for monthly glowworm photomonitoring were reported at the 2009 ACKMA conference. Data from the ensuing 2 years of monthly monitoring showed that photomonitoring was a good method, but that a better monitoring system and better resolution data were required to gain a proper understanding of glowworm population and biological cycles.

Time-lapse glowworm photomonitoring was trialed in early 2011 and a permanent time-lapse photomonitoring system installed in July 2011. Time-lapse data is collected at 30 minute intervals to match the temperature and humidity data collected by the automated climate monitoring systems. Despite some reliability issues, the glowworm time-lapse photomonitoring system had collected some very interesting and useful data that has revealed previously unknown information about glowworms.

Paper 19: Matt Gillies

Environmental Management of the Waitomo Glowworm Cave, New Zealand: Effects of Visitors and Ventilation on Carbon Dioxide Concentrations and Air Moisture Content

Environmental management of the Waitomo Glowworm Cave aims to mitigate the potential conflict between presenting the cave to visitors and protecting it. In the case of the cave's microclimatic environment, it aims, firstly, to control rise in carbon dioxide (CO₂) levels above a certain threshold, and secondly, to keep evaporation rates low so that cave drying is minimised. Reduced ventilation combined with CO₂ from visitor respiration can lead to elevated CO₂ levels in the cave. High ventilation rates during cool external conditions can lead to cave drying.

Managing visitor numbers and airflow through the cave can regulate both of these. Earlier work has shown that three ventilation regimes exist; namely, downflow, upflow, and neutral, which are determined by cave-to-outside air temperature gradient (Td). Cave ventilation can be regulated by a door at the cave's upper entrance which, when closed, seals the entrance and restricts airflow through the cave. Ineffective management of cave ventilation and visitor

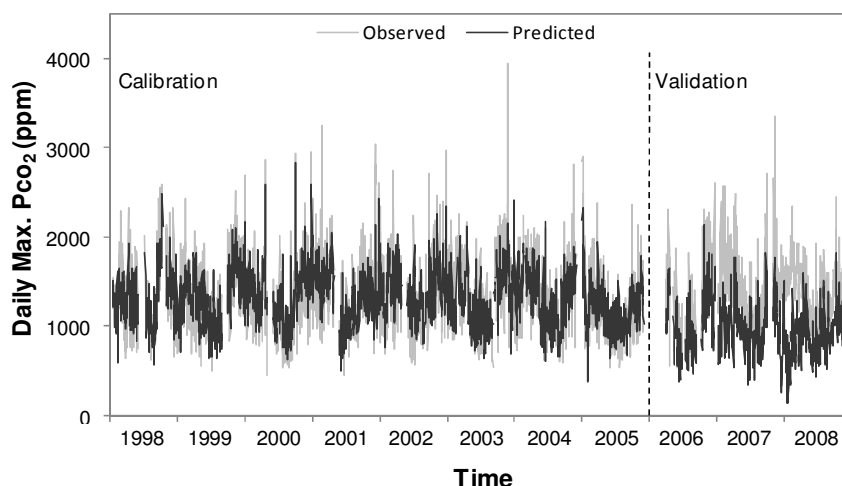
numbers can affect cave microclimate thereby compromising the glowworms' habitat. This study examines the extent to which cave management effectively minimises both cave drying and rising cave air CO₂ concentrations in the cave.

Four detailed monitoring experiments were carried out inside the cave over a 10-month period. The results of these experiments together with a statistical analysis of a five-year data archive show the extent to which visitor numbers and cave ventilation affect CO₂ concentration in the cave. Overall, the results show: cave air CO₂ levels are moderately related to visitor numbers; cave air CO₂ levels are not related to Td; and cave drying is not related to Td. From this it may be concluded that cave management practices through ventilation and visitor control is effective.

Paper 20: Chris Hendy¹, Travis Cross² and Natalie Miedema¹
Towards managing the carbon dioxide partial pressure in caves with both anthropogenic and non anthropogenic sources

¹University of Waikato ²Tourism Holdings Ltd.

Based on historic data operators of the three Waitomo tourist caves (Glowworm, Ruakuri and Aranui) have been required to maintain the partial pressure of carbon dioxide in the cave atmospheres to less than 2400 ppm_(v). Ten minute monitoring since 1998 has shown most exceedances of this limit has come from visitor respiration and exceedances have mostly been avoided in recent years by careful management of visitor numbers and passive ventilation. However one or two exceedances have occurred each year when no visitors were present. Non anthropogenic sources of high carbon dioxide partial pressures were observed in glowworm cave following periods of intense rainfall with exhalation from both stream and drip waters. A linear regression model involving the previous day mean P_{CO2} tourist numbers, temperature gradients, rainfall and Waitomo Stream discharge successfully predicted the daily maximum P_{CO2} for Glowworm Cave.



Relationship between predicted and observed daily maximum Pco2 levels in the Glowworm Cave for the calibration period 1998 - 2005 (R2 = 0.56; Nash-Sutcliffe = 0.56) and the validation period 2006 - 2008.

Ruakuri Cave showed a different problem with a side passage (Drum Passage), into which a newly constructed entrance was placed, regularly displaying continuously rising P_{CO2} when outside temperatures exceeded cave temperatures throughout the diurnal cycle. A natural source of undersaturated infiltration waters containing at least 6000 ppm_(v) appears to be active. Management of this can be achieved increasing ventilation.

Friday, session 1

Paper 21: Susan White

Cave science: sampling for science in caves

Environmental Geoscience, La Trobe University, Bundoora 3068

Calcite speleothems have become a significant component of research into past environments, especially climate research. A particular strength of speleothems in this regard is their unique ability to be accurately dated over a long period of geological time by either U/Th or U/Pb dating techniques. Stalagmites are also useful as they contain a range of climatic and environmental proxies such as oxygen and carbon isotopes, trace cations and organic compounds. How can such scientific sampling be managed and what restraints need to be placed? Do we want or need the science? Speleologists and cave managers cannot ignore the pressures for samples and need to understand the valid requirements of the science whilst balancing the need for good cave management. If we understand in general terms why particular numbers of samples are required, we will gain the best from the science without seriously damaging caves. This presentation will look at issues relating to cave conservation and makes some suggestions regarding scientific sampling, publication and use of science.

Paper 22: Anne Musser

People, Planet, Profit...Palaeontology!

Palaeontology – the study of ancient life – has long been a fascinating subject for young and old. Interest in bones and fossils has skyrocketed over the past decade as documentaries, books and popular films bring the past to life (what modern child does not know the animated Ice Age films?). Cave systems are natural repositories for collection of bones, and the constant temperature and humidity permit excellent preservation of past life in karst areas. Cave palaeontology can teach us much about our world: the past, present and perhaps even the future (importantly, distributions of animal species through periods of climate change).

Cave products reflect the significance of the area, and include cultural, geological and palaeontological values. Jenolan Caves is moving forward from a past focus on crystal, with more than one string to its bow. Today's savvy visitors want more. The palaeontological record tells a story, one that not only enthral visitors but lends itself to development of targeted tours, activities and programs. Palaeontology provides a popular conduit bringing current scientific ideas/cave science to a broad audience. Naracoorte Caves in South Australia is internationally recognised for its remarkable fossil deposits and has parlayed this into a highly successful caves operation. However, although Jenolan Caves boasts many superlatives, including the discovery that Jenolan has some of the oldest open dated caves on earth, palaeontology has never been adequately explored over the years. My aims as a vertebrate palaeontologist working at Jenolan include the discovery of potentially rich fossil deposits, identification of this material and publication of results to a wide audience, adding a deeper level of interpretation and scientific integrity to the Jenolan visitor experience.

All aspects of the 'Jenolan experience' have commercial value, and in recent years Jenolan has become increasingly more mainstream. Palaeontology is undeniably a major drawcard. To that end, Jenolan is incorporating palaeontology into forward marketing plans as one of three main initiatives for 2013-2014. Plans include palaeontology-themed activities and tours (Musser 2012), palaeo-themed product lines and production of peer-reviewed scientific publications on cave fossils (Australian Ice Age megafauna). One of the highlights of the program will be the re-opening of the Nettle Cave 'dig', a highly significant deposit of small mammal bones collected under an owl roost along the path of the complimentary self-guided Nettle Cave tour.

Interaction between palaeontologist and visitor will provide a unique opportunity to engage in 'live science', establishing a vital connection for visitors to our past, re-energising the visitor experience and encouraging repeat visitation – 'win'win' for people, profits and palaeontology.

References

Musser, A. M. (2012). Off the Track with Stones and Bones: Bringing Jenolan Caves' Past to Life. *Journal of the Australasian Cave and Karst Management Association*, pp. 10-12.

Paper 23: Tim Stokes, Carol Ramsey, PA Griffiths

Geologic, Geomorphic and Hydrologic Constraints for Karst Landscape Evolution on Vancouver Island, British Columbia, Canada: A New Approach and Potential Applications

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A new research project has been initiated to better understand the geologic, geomorphologic and hydrologic processes that have led to the evolution of karst landscapes on Vancouver Island – a mountainous region with a long glacial history and an active tectonic setting. This research aims to better understand how bedrock geology, geological structures, recent and past tectonic uplift, glacial and inter-glacial events, sea level change and isostatic rebound may have influenced, constrained and/or promoted karst development in this region.

Approximately 4% of Vancouver Island is underlain by limestone, much of which is karstified, and forested. This limestone is part of a distinct geologic terrane (Wrangellia) that collided with North America approximately 100 Ma, and has undergone significant tectonic deformation, resulting in uplift and tilting, as well as folding, faulting and fracturing. Vancouver Island is in a tectonically active region, with the subduction of the Juan de Fuca Plate below North American Plate, and current rates of uplift are in the order of 4 mm/year. In addition to these tectonic events, the region has undergone numerous glaciations. During the last glacial period (15,000 - 25,000 years ago) much of Vancouver Island was covered with a thick ice sheet. This glacial event and others have had significant effects on the karst landscapes in terms of erosion, infilling and deposition of glacial materials. In addition, glaciation has likely had a major influence on sea level change and groundwater circulation (at lower elevations), with records indicating a significantly lower sea level during the last glacial maximum 20,000 years ago. Isostatic rebound may also have played an important role in karst development.

A key part of this project is outreach and extension. Results from this project will be used to increase the awareness, understanding and appreciation of karst issues and karst resource values on Vancouver Island. For example, at a number of karst recreation sites (e.g. Horne Lake Provincial Caves, Alice Lake Loop, Upana Caves, Little Huston Caves) the current interpretation on the evolution and origin of karst features and landscapes is either not included or may be misleading in terms of the processes and geologic time scales involved. In addition, the work will highlight the importance of karst landscapes to other researchers in providing information on the glacial, climate change and tectonic history of Vancouver Island and Coastal British Columbia. Finally, this research will contribute to the ongoing discussions related to forestry and other land use activities on karst, by providing sound geoscience information for decision makers in terms of the nature, characteristics and functions of this important landscape.

Friday, session 2

Paper 26: Peter Crossley The Auckland Lava Caves.

Auckland is a city of almost 2 million built on 50 recent basalt volcanoes. These have lava tube forming flows, and have produced more than 100 caves. Aside from the obvious interest of the caves, there is the association of caves with the various civilisations that have lived on top of them from the original Maori to modern suburbia. The effects of developers, bulldozers and sporadic council protection will be discussed along with a little geology to set the scene.

Paper 25: Nicholas White, Daryl Carr Scrubby Creek Cave acquisition, Murrindal, Victoria

Scrubby Creek Cave was an exploration focus in the late 1950s by the Sub Aqua Speleological Society who tried to dive the resurgence. It was not until 1961 that entry to the cave was gained by bypassing the resurgence. This revealed an initial section above the water until a difficult section was found which required immersion and very little breathing space. The cave continues along the stream for more than a kilometre and the cave has excited cavers for the last 50 years. There are a number of related caves on the Scrubby Creek Property and the neighbouring properties. The caving community has worked with the owners to control access because of the caving difficulties and in doing so developed a very strong conservation ethic for what is a very beautiful and complex cave.

Several cavers were advised that the property was on the market in late 2011 and quick action was needed as this was a once-a-generation chance to acquire the property. Rimstone Cooperative Ltd was started in 1973 with speleological aims and it acquired the Homeleigh property in Buchan. This has provided accommodation for Rimstone members, their friends and families and has always been open to cavers. Rimstone Cooperative is a Community Advancement Society and cannot make or distribute profits to its members. This fulfilled the requirements of compliance for the ASF Karst Conservation Fund to support the acquisition of the Scrubby Creek Cave Property by Rimstone. We thus signed contracts to purchase it and set about raising the funds. We were able to settle in May 2012 with the donations and a few loans.

Rimstone is now preparing a Management Strategy, which involves protecting the cave and karst, particularly the tufa banks and continuing the grazing regime.

The ownership structure will be discussed in relation to private versus public cave conservation of karst resources. The support of all the donors from across the caving community and their friends is acknowledged in this the first such purchase in Australia.

Paper 26: Scott Melton Digital Media (a modern conundrum in an ancient landscape)

The last ten to fifteen years has 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.

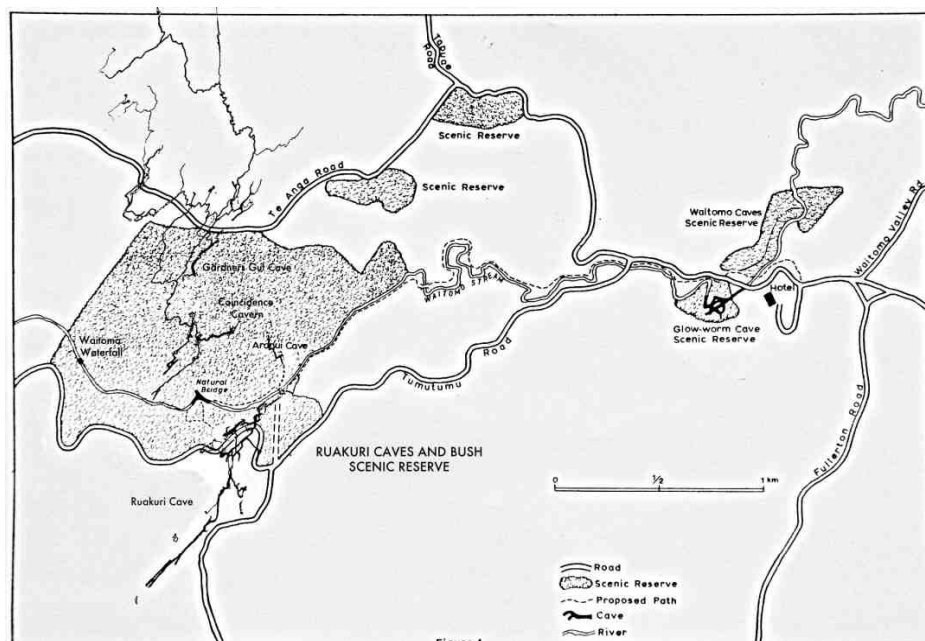
Activity Guide

Ruakuri Caves and Bush Scenic Reserve and Natural Bridge track

Setting

The 114ha Reserve is situated about 2km west of the Glowworm Cave and covers a cavernous block of the Otorohanga Limestone that is bounded to the west by the Okahua fault and to the east by the Waitomo Fault. It contains many dolines and several significant cave systems – Waitomo Waterfall, Gardners Gut, Coincidence Cavern, Aranui Cave, Yanks and Urenui. The northern margin is capped by a dissected siltstone “plateau”, which drains towards the deeply entrenched Waitomo Stream, whose steep-walled gorge is probably a collapsed cave, of which the Natural Bridge is a remnant.

On the western margin, the Waitomo Stream cuts through the siltstone to plunge down a spectacular cascade into Waitomo Waterfall Cave. Deep vertical shafts and dolines are common near the bluffs of the gorge and the fault scarps. The entire reserve is covered with 90% virgin, mixed podocarp broadleaf forest characterised by a canopy of tall tawa, rimu, miro and rewarewa with a rich understory of seedlings, tree ferns and parataniwha.



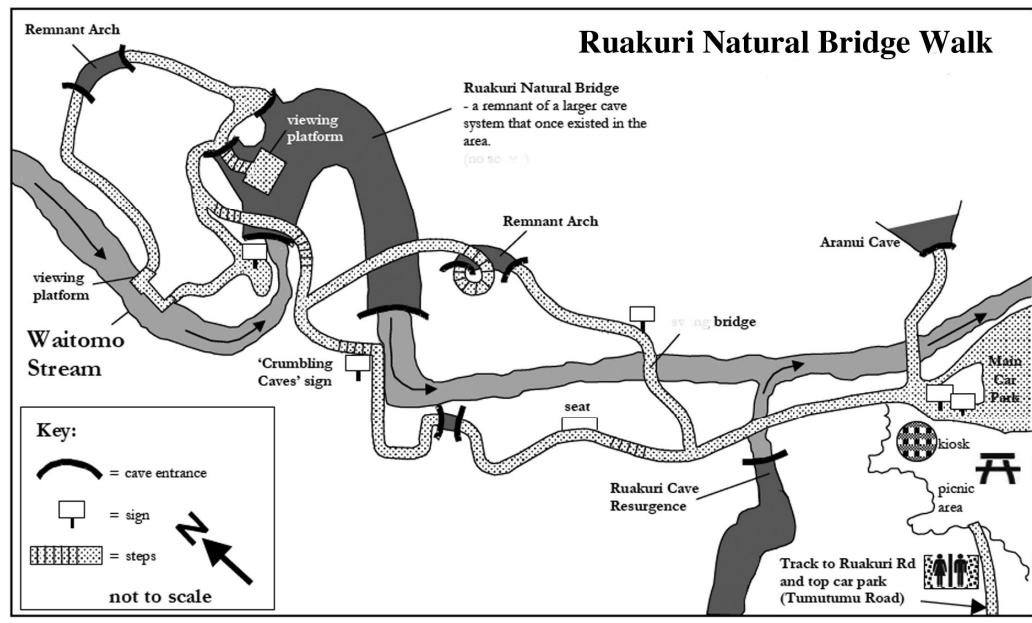
Historical Background

When the government obtained the land containing Ruakuri Cave, they were urged by the local Crown Lands Ranger to acquire more land in the vicinity for reserves, in order to prevent destruction of forest and the resulting impact on the caves. On hearing of the Government's intentions, local Maori started to clear the forest hoping to prevent any acquisition. The original 75 ha of Ruakuri Caves Scenic Reserve was protected in 1905 under the Scenery Preservation Act, with the balance of 39ha added between 1906 and 1908.

The Tourism Department (later the Tourist Hotel Corporation) managed the Reserve until it came under the umbrella of the Department of Conservation (DOC). In the late 1970s, the THC decided to extend the access track to Ruakuri Cave as far as the Natural Bridge. This track was redesigned and upgraded into a loop by the Department of Lands and Survey, which became DOC in 1987. The route was carefully planned to give wide berth to the waahi tapu burial ground at the original Ruakuri Cave tourist entrance.

The Walkway

The walkway and reserve are now managed by DOC in consultation with local Iwi, in acknowledgement of the strong spiritual and cultural significance to the Maori. The typical karst topography with its caves, natural bridges, waterfalls and steep bluffs covered in thick forest is particularly appealing. Paths and stairways are well-formed and the cantilevered walkways give a comfortable degree of exposure. It is recommended to do a day trip and one at night as well, when the banks and cliffs are lit with glowworms. Cave weta can also be observed in the small caves and, if lucky, one could see native long-tailed bats roosting in the main chamber of the Natural Bridge. Adventure clients exiting Ruakuri Cave onto the walking track after a Black Odyssey or Black Water Rafting tour are an added attraction. With two tourist caves and one of the best short walks in New Zealand, the Reserve caters for up to 90,000 visitors a year.



Management Challenges:

Predator Control

Goats and pigs occasionally frequent the reserve while opossum, rats and stoats all have an impact on the fauna and flora. At present regular baiting along an established grid of stations is carried out by staff from the McDonald Lime company, which operates the large limestone quarry at Oparure. DOC support is provided for this dedicated initiative. Monitoring is also carried out for rats. Local pig hunters tend to take care of the larger species.

Funding:

At present Tourism Holdings Ltd operate Aranui Cave and Black Water Rafting tours in the Reserve. Both of these experiences are subject to licenses aimed at ensuring safe operations that have minimal impacts on the resources as well as the needs of other visitors. In general, this arrangement functions well and provides much needed income for the resource.

A local landowner has marked a track from the western edge of the Reserve, past the Waitomo Waterfall to join up with the DOC track.

Track extension

There is potential to extend another loop track to access the Waitomo Waterfall and other unique karst features. To date only preliminary route scoping has taken place. At the present time the local area office is under-resourced to pursue this initiative.

Safety

Keeping people safe within the environment without compromising the naturalness of their experience is always an issue. This is more the case when dealing with the underground resources. So far there has been a measured, “hands off” approach, encouraging self-monitoring by the caving fraternity, and visitors in general, rather than drawing up a comprehensive Management Plan.

Weeds and cast-offs

A long road frontage and easy access tends to encourage the dumping of garden waste as well as the abandonment of cats. Both of these practices can have an insidious, but marked impact on the resource.

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Aranui Cave

Setting

Aranui Cave is located in the Ruakuri Scenic Reserve, around 3 km from the Waitomo Village. Aranui has a surveyed length of 274 meters (fig 1) and is hosted within the Late Oligocene to Early Miocene Otorohanga Limestone. Speleogenesis is joint controlled with the joints also creating the weakness required for water to seep down through the limestone and create the speleothems for, which Aranui is known.

Historical Background

Aranui was discovered in November 1910 by Ruruku Aranui while chasing a pig through the bush. He followed the pig down a hole where he struck a match was amazed to find that he was surrounded by many large speleothems. He didn't explore the cave further but reported to the find to the Tourist Departments Hotel manager who asked Aranui to keep the discovery to himself with the promise of reward. The cave was inspected by the manager who realised the tourism potential. The Tourist Department was relieved to find that the cave was within a reserve that had been created in 1909. The Department decided the cave should be given an official opening in February 1911 by the Minister of Tourism and named Ngutuhihi, meaning call of the stitchbird. Unfortunately, the Minister could not pronounce Ngutuhihi and upon meeting Aranui, decided the cave should be named after its discoverer. Ruruku Aranui was reportedly rewarded £20 for discovering the cave.

Tour Development

Cave tours were underway within 12 months of Aranui Cave being discovered. The cave was known for its spectacular array of formations and colours with anything other than white being quite unusual in the Waitomo region. The guiding theme has always been based around fantasy

and the shapes of imaginary things that can be seen in the formations like 3 doves, the beehive, the butchers shop, bridal bouquet to name a few, as seen on early maps (figure 1).

The early history of lighting and infrastructure in Aranui is similar to the Waitomo Glowworm Cave in that upgrades were done at the same time. Lights were first installed in 1926, refurbished in 1947 and replaced in 1960. Wooden walkways were installed in 1926 and replaced in 1960. Successive upgrades were evident during recent pathway upgrades when older remnant pathway materials were found beneath the wooden walkways being pulled up for removal. The most recent walkway infrastructure upgrades were done during 2008 when all stairways were replaced with aluminium, galvanized steel and fibregrate structures. Flat sections of wooden walkways are scheduled to be replaced following the coming years lighting upgrade.

Management Issues

Lampenflora is currently the biggest management issue in Aranui. The 110 volt incandescent lighting system installed in 1960 is still in use. Lampenflora is controlled by spraying with sodium hypochlorite but this is not ideal. Plans are to replace the lights with LED's during the coming financial year. To date, main trunk cabling has been removed, cleaned, inspected and reinstalled, a trial LED lighting area installed using Weidmuller envirominis and rockstars and costings and budget developed for the coming upgrade. Theme and switching is still to be decided.

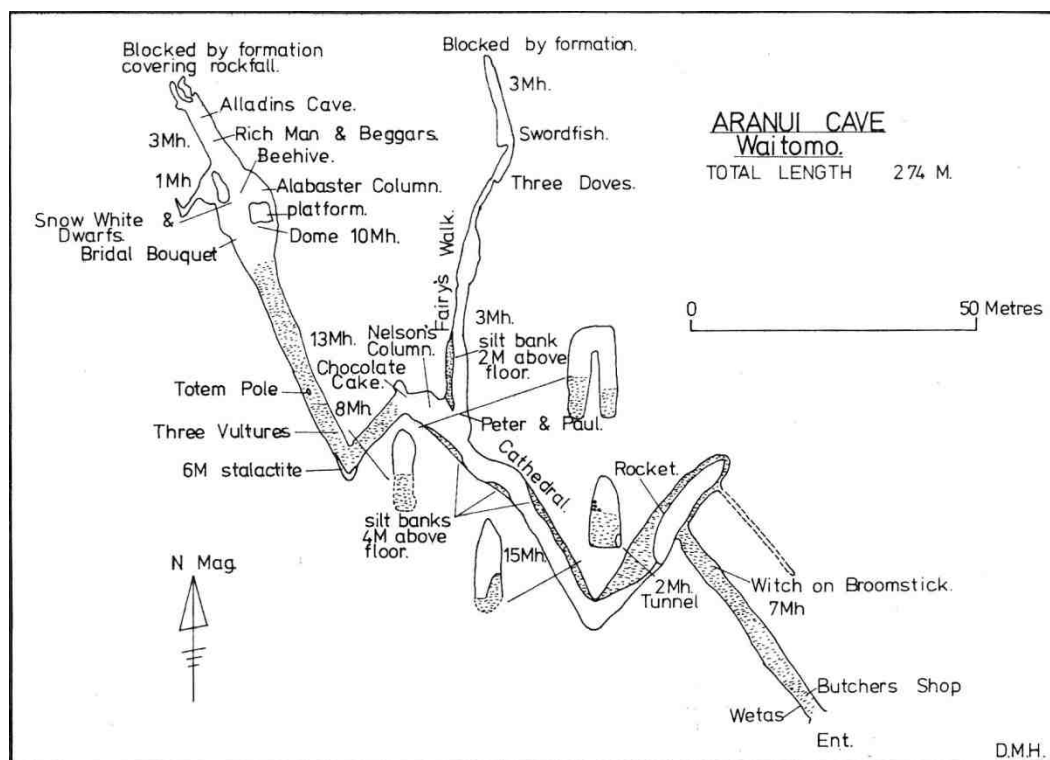


Figure 1. Early map of Aranui

Reference sources

Arrell, R. 1984. Waitomo Caves – A Century of Tourism. Waitomo Caves Museum Society Inc, Waitomo Caves.

Waitomo Glowworm Caves training materials compiled by Chris Templer.

Spellbound Cave Tour

This 3 ¼ hour excursion views the Mangawhitikau Stream cave submergence passage, (2000 ha catchment) and the previous water route through the cave Te Ana o te Atua (now only about 5 ha catchment)

Derek Mason grew up and lived on Blackdown farm with Jill and family until 2001, and the family retain ownership of the land and access around the caves, with lease/ licences to Spellbound Ltd and Waitomo Wilderness tours (Kiwi Cave Rafting). Derek saw the success of the then new Black Water Rafting tours in 1987, and developed Masons Valley Cave Tours in 1994. This was taken over by the Legendary Black Water Rafting Co in 1999, and subsequently by Pete and Libby Chandler upon the sale of BWR to THL in 2003. Four footbridges and a temporary dam were installed 1999-2002. The Te Ana o te Atua pathway was completed in December 2004, then an extension to the glowworm cave path beyond bridge #4 was completed in 2010. The present weir, with tripping mechanism and fish pass was commissioned in December 2012.

Geologically the Mangawhitikau stream flows through the Oparure Block, 8km south of Waitomo Village.

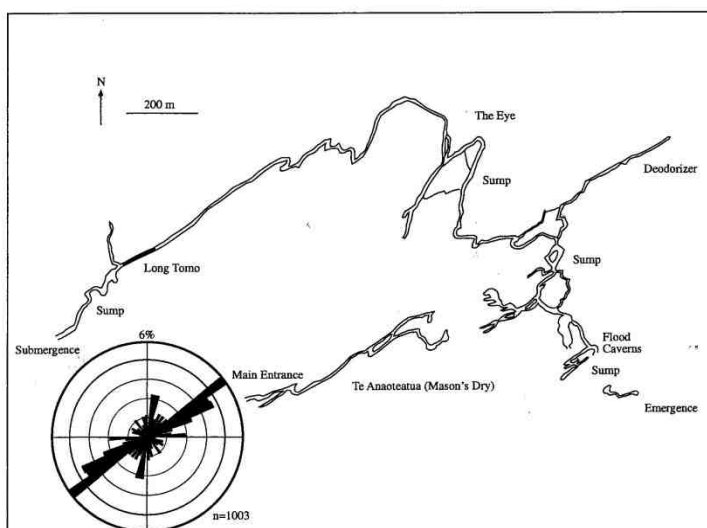
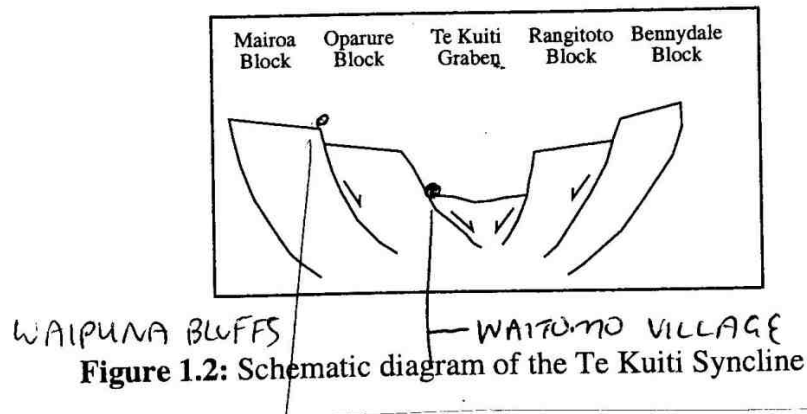


Figure 3.10: Cave Map of the Mangawhitikau system and corresponding rose plot. Cave surveyed by the members of the H.T.G. (Hamilton Tomo Group) mainly in 1979 with additions added since. Map is copyright of the N.Z.S.S. (New Zealand Speleological Society) and is used with the permission of P. Crossley (from Crossley, 1986).

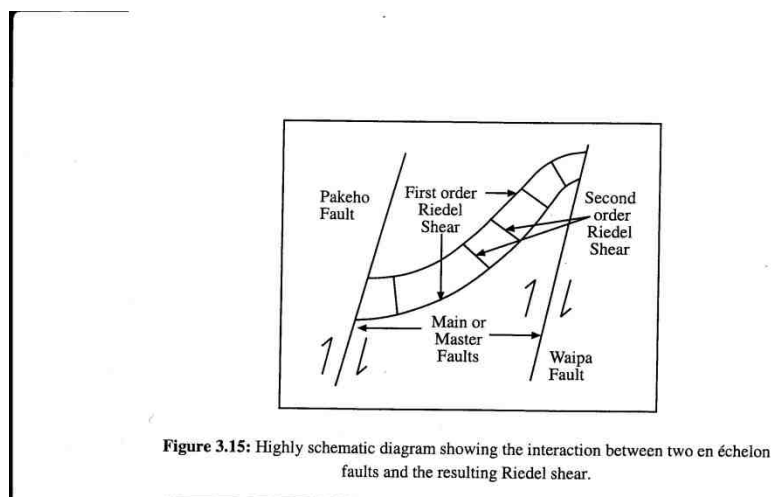
The karst of the Waitomo area is generally overlain with volcanic soils. The origins of NZ on the Australia Pacific convergent plate margin has had accompanying island arc volcanism since the middle to late Miocene- Since 20 My bp.

The ignimbrites and ash deposits have been building on the Waitomo landscape over the last 2 million years. The upper layer of Mairoa Ash 'is now more correctly recognised as up to 40 thin, but identifiable, layers - 'later tephras' from Taupo Volcanic Zone, Taranaki and Mayor Island. The present average of 2400mm p.a. rainfall has re-worked these deposits. It has also eroded the papa siltstone that at one time was estimated to be up to 2000 metres thick, to expose the hard crystalline structure of the local limestones.

The Oparure block still has a significant covering of papa on top of the limestone. The limestone outcrops are more evident on escarpments that follow ancient fault lines, steep hillsides and stream edges.



The Oparure block lies between the Waipa Faultline (running N-S through the Waitomo and Oparure village) and the Hikurangi faultline that lies east of Waipuna road, Waitomo (this is visible on the drive out- Spellbound tour). Because of this locality, the strata is dipping a few degrees to the east. As groundwater interacted with the Te Kuiti Group limestones, karst development began. Along with the epikarst zone, a shaft and conduit zone was formed along first and second order Riedel fractures. These may need explanation..... figs



So the karst evolution of the Oparure block is dependent on the interaction between bedding, fractures, regional dip and the younger Miocene Mudstone/Papa cover. Note that caves have not continued north due to an inferred hydraulic barrier along the Boddies road ridge. Boddies road is the return route on the tour.

The Spellbound Glowworm Cave/ Mangawhitikau Glowworm Cave/ Masons Glowworm Cave have long reaches in the western section, which are fracture controlled with most passages forming parallel to a main fracture in the centre of their ceilings. Fractures sets are exposed on the walls and ceilings here.

As a cave, Te Ana o te Atua has not been connected with the main Mangawhitikau Cave- yet! It is the former passage of the Mangawhitikau stream circa 200,000 y bp?? Interestingly there is a clean, sandy layer around 1 metre below the boardwalks, perhaps from a time when floods overflowed through here. Carbon dating of a kakapo skull recovered from this layer in 2004 could yield useful info.

Look out for the east-dipping layers in the (Otorohanga) limestone on the Spellbound tour, even on the cave ceilings adorned with NZ glowworms.

Partnerships

Derek and Jill Mason and family – Landowners Mangawhitikau Glowworm cave and surrounds
Ngati Kinohaku - Tangata Whenua of Oparure community and School

McDonalds Lime Co Ltd- Landowner Te Ana O Te Atua-

Note that one group of delegates can sign up to visit the limestone quarry Wednesday pm
<http://www.onlime.co.nz/about-us.aspx>

Management issues

Selecting mature staff who are happy with variable work hours/ days (note 1 ¼ pay on ordinary weekend days) and retaining them.

Fencing streams and forest remnants from pastoral farming-especially protection of the stream up from the cave.

Relying on word of mouth and web based promotion including trip advisor.com and selected travel agents rather than hard advertising.

Possibility of Glowworm cave only tour if visitors self drive closer.

Sources

The Structural Controls on Karst Development, Oparure Block. Colin Joel Frostad . Dept of Geology & Geophysics, Calgary, Alberta, Sept 2004

Geology of the Waikato area Institute of Geological and Nuclear Sciences Ltd 2005

The Wandering River – Geoscience Society of NZ Guidebook No 16 John McCraw 2011

Waitomo Caves Discovery Centre

ACKMA Conference delegates are welcome to visit the Discovery Centre displays free of charge at any time during the Conference. Please present your card to the desk staff before entering. Donations are always welcome and if you would like to join the Museum Society, it is only \$15 a year, or \$150 for a life membership.

The Waitomo Caves Museum Society (Inc.) is a not-for-profit society which was formed in 1972 and became incorporated in 1973. For its first six years the society operated the original 'Waitomo Museum of Caves' from a small room in the historic Waitomo Caves Hotel, then managed by the Tourist Hotel Corporation. In 1980 a purpose-built museum was erected on the present site in the centre of the Waitomo Caves village and was doubled in size in 1989. Followed by the addition of an Education Centre in 1994 and culminating in the development of a dedicated Audio Visual theatre and a major multi-media show 'Arachnocampa Luminosa' (the NZ Glowworm) at the end of 2002.

At the beginning of 2008, the 'Waitomo Museum of Caves' was rebranded to the 'Waitomo Caves Discovery Centre' (WCDC) and the Waitomo Caves Museum Society was registered as a charitable entity under the Charities Act at the end of June 2008.

The Centre is a community resource and has received many contributions, both in kind and labour, from the local community. The WCDC applies for grants and contracts for capital development, displays and education services. In addition to grants and contracts, the Society generates income through operating the Waitomo i-SITE, a souvenir shop, a NZPO Post Centre, society membership and exhibit entry fees.

The WCDC, together with the NZSS, holds an extensive speleological library, which along with the Collections, is used for cave and karst research. The exhibits in the Centre focus on karst and caves and attract between 20 - 40,000 international and domestic visitors each year. Collection holdings exceed 24,000 object records, most of which have multiple objects attributed. WCDC holds the largest collection in New Zealand of bone fossil material from the Waitomo Caves area. It is a nationally significant collection as it contains a large number of fossils from one source which consist of moa bones, birds, bats, frogs and lizards of which some are 'type' specimens.

The WCDC employ a fully registered teacher to run the Education Service and hold a contract with the Ministry of Education to run 'Learning Experiences Outside The Classroom'. Programmes are delivered at various locations which include the Waitomo Caves Discovery Centre, the Otorohanga Kiwi House, and the Mahoenui Giant Weta reserve. Of the 200,000 or so visitors who use the Centre annually, over 17,000 vouchers are produced for international and domestic visitors to the Waitomo Caves area who utilise the visitor information and booking services each year. Bookings are made for travel, accommodation, above ground activities and the myriad of below ground activities.

The WCDC holds three Qualmark certificates: Endorsed Visitor Activity; Endorsed Visitor Information Provider; and a Silver Enviro Award.

Welcome to Waitomo!

Waitomo Glowworm Caves

Geological Setting

The Waitomo Glowworm Cave has a total surveyed length of 665 meters and is within the Late Oligocene to early Miocene Otorohanga Limestone (fig 1). The upper levels were formed in the phreatic zone along conjugate joints formed by the near-by Waipa Fault. Lowering base levels caused the down cutting and formation of the lower vadose levels. Some collapse is evident and lower vadose levels can be seen cross-cutting older upper level phreatic passages in the Cathedral. A subsequent base level rise caused the cave and surrounding valleys to backfill forming the landscape that is seen today.

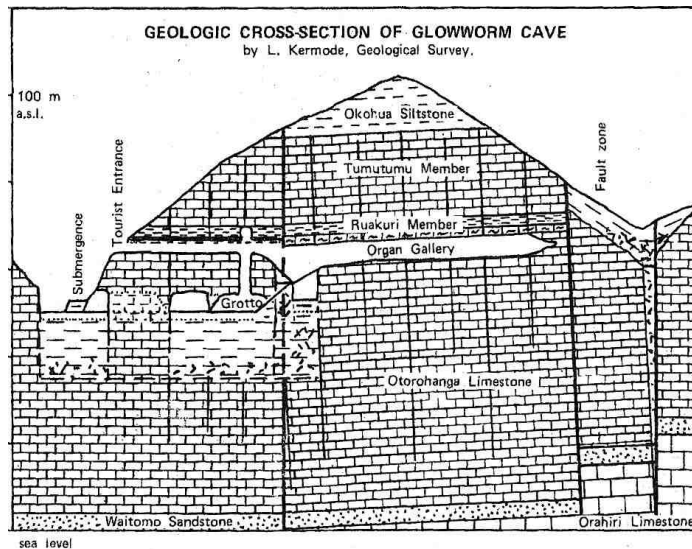
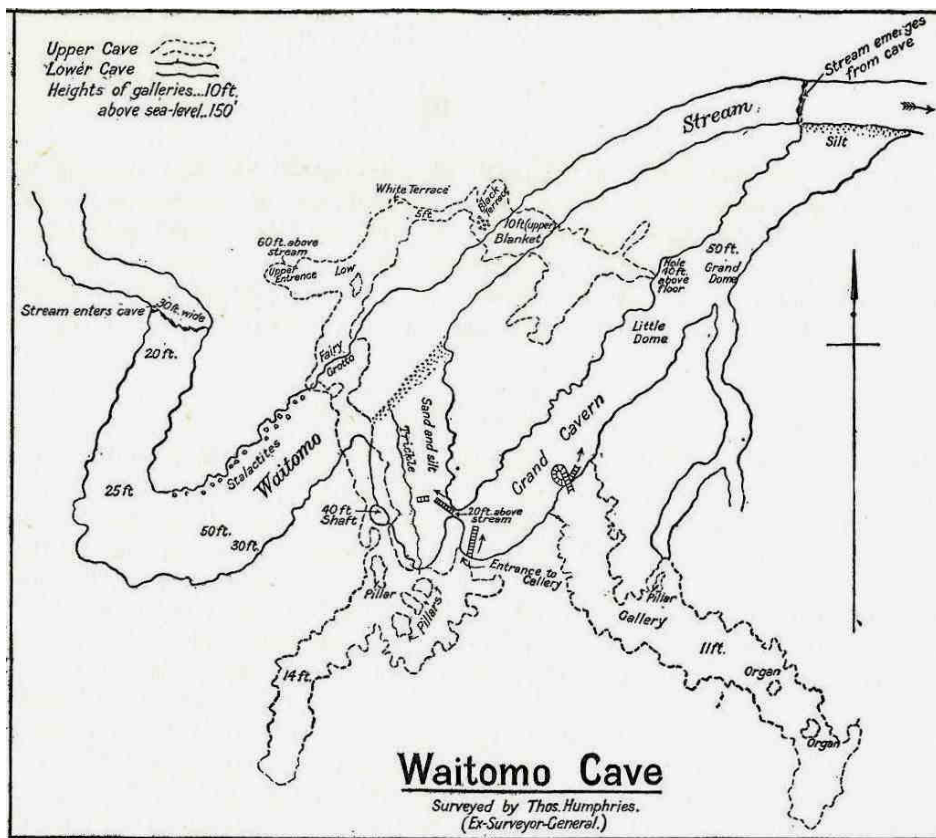


Fig 1. Geological cross section of Waitomo Glowworm Cave (Kermode 1974).

Historical Background

The Waitomo Glowworm Cave was first explored on the 28th of December 1887 by local Maori chief, Taane Tinorau and English surveyor, Fred Mace. They enter via the Waitomo Stream entrance on a raft constructed from flax stems, each using a candle for light. The cave was further explored by the pair and 3 others during February 1888 using ladders to explore upper level passages. The cave was prepared for tourists by local Maori who began tours in 1889 led by Taane Tinorau. A visitor's book was installed on June 1889, which had recorded 360 visitors by December 1890 and a further 140 by April 1891. The cave was surveyed (see map 1) in 1889 by a team led by Thomas Humphries who were sent by the government to determine the tourist potential of the caves.



Map 1. Original survey of Waitomo Glowworm Cave (from Marwick 1941).

In July 1899, land overlying the cave was subdivided into 4 one acre blocks, the government acquiring 1 block and local Maori retaining 3 acres. The government acquired the remaining 3 acres on 31st of August 1904 by compulsory purchase under the Scenic Preservation Act of 1903 for £625. The cave owners did not receive payment until 29th of November 1907 by which time, Taane Tinorau had died.

The Tourism Department operated the cave from 1905 until around 1957 when operations were handed over to the Tourist Hotel Corporation, a state owned enterprise. In 1990 Waitangi Tribunal returned 75% of the Waitomo Glowworm Cave and associated land ownership to Maori represented by the Ruapuha Uekaha Hapu Trust, with 25% ownership remaining with the crown. The settlement included management of the Waitomo Glowworm Cave, Waitomo Hotel and Waitomo Tavern being subject to a 32 year lease. The lease was sold to South Pacific Hotel Corporation (SPHC) in 1991. The SPHC sold 50% share to listed company Tourism Holdings Limited in 1992 (then The Helicopter Line) who later acquired 100 % of the Waitomo Cave Management Licenses in 1996.

Tour Development

When tours began, party's entered through the lower stream entrance via canoe, climbed wooden ladders to various upper level passages and exited through the lower stream entrance. Initially, admission was the cost of 1 candle but by 1900 visitors were being charge 2 shillings to visit. During the early 1900 tours began entering the cave though the top entrance, traveling through the cave and re-exiting through the top entrance. During the 1970's tours began entering through the top entrance and exiting via boat through the lower entrance.

Candles were the main source of illumination on early tours, with the addition of magnesium wire used by guides to light up larger areas. Kerosene lanterns were used from 1905 as well magnesium wire. Iron railings were installed in 1906 to protect formations. Magnesium was

produced by Germany so WW1 caused a supply shortage leading to it to be phased out in 1915, alternatives sought and acetylene carbide lighting introduced. Electric incandescent lighting was first installed in 1926 as were the concrete staircases, replacing the original rotted and slippery wooden stairs. This lighting system was refurbished in 1947 after complaints of shocks when switching on lights and after problems with lead-sheathed cabling. Severe lampenflora had also appeared not long after electric lighting was installed. In 1960 the lighting system was replaced with incandescent lighting as well as wooden walkways. Light boxes were attached to walls by drilling holes that were then plugged with lead that could be screwed into. Concrete pavers were installed in 1974 replacing the wood. In 1992 the incandescent lighting system was replaced with MR16 quartz halogen lighting system. Halogen bulbs were replaced with retrofit MR16 LED's in 2009.

Management Challenges

Lampenflora has been an issue since electric light was installed in 1926. After concerns environmental were raised, a seminar was held in 1974 to discuss environmental issues. It was decided then, to steam clean the cave to get rid of lampenflora. Lampenflora is still an issue today but needs to be treated less often with the introduction of LED's.

Carbon dioxide (CO₂) also needs to be carefully managed on a day to day basis to prevent speleothem and rock corrosion. If CO₂ gets too high it needs to be controlled by either ventilating the cave, reducing or stopping tours. Ventilation can cause other issues like increased temperature and airflow and reduced humidity. This in turn, can cause cave drying and glowworm desiccation. Reducing or stopping tours affects the bottom line so CO₂ and ventilation needs to be managed very carefully to minimise impact to the cave environment as well as the bottom line. An automated climate monitoring system has been in operation since 1998 to aid with day to day cave management.

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Te Poupou a Tane Mahuta

Te Poupou a Tane Mahuta (pictured opposite) stands near the front entrance to the Waitomo Glowworm Caves Visitor Centre. Te Poupou was commissioned by the Tourist Hotel Corporation to commemorate the centenary (1987) of the first recorded exploration of the Waitomo Glowworm caves. The single tötara log was carved by Tutunui Te Kanawa and 50 others from the local Maniapoto tribe during 1986-87 and was gifted to the Caves.

Te Poupou a Tane Mahuta has four intricately carved faces. At the top (facing front) stands Tane Mahuta, with a rata vine in his hands. According to Maori legend Tane Mahuta is the god of the forest and father and protector of all living things it contains. In his right ear is a bone flute pendant, a mautaringa kōauau inscribed with the names of the 50 people associated with the carving project.

Below him is the Kawau (cormorant or shag), a bird of special significance to the Maniapoto tribe. Many centuries ago, the great forefather of the tribe, Maniapoto, left his people with a whakataukī (proverb) about the kawau. He asked them to take inspiration from the flight of the

kawau; in other words to hold fast to both their objective and their identity. Other children of Tane are also represented, including the kereru (native wood pigeon), tui and piraiaka (fantail).

Nga puratoki, or glowworms, are found in both the forest and the cave, and the pāua shell inlay represents their feeding lines. Below the glowworm fly is the cave weta, also found in the forest and cave and, further down, the tuna (eel) and koura (freshwater crayfish), both abundant in the Waitomo River.

Caves to Coast

On Thursday and Friday afternoons of the Conference, delegates will have the opportunity to see some of the wider karst and scenery away from the Waitomo Caves village. We will take a bus out towards the west coast, stopping at various points of interest along the way. This could be a long afternoon and we will take packed lunches onto the bus for eating at one of the early stops. We may add or drop stops depending on how time progresses. There will be little phone coverage and one stop with a basic toilet.

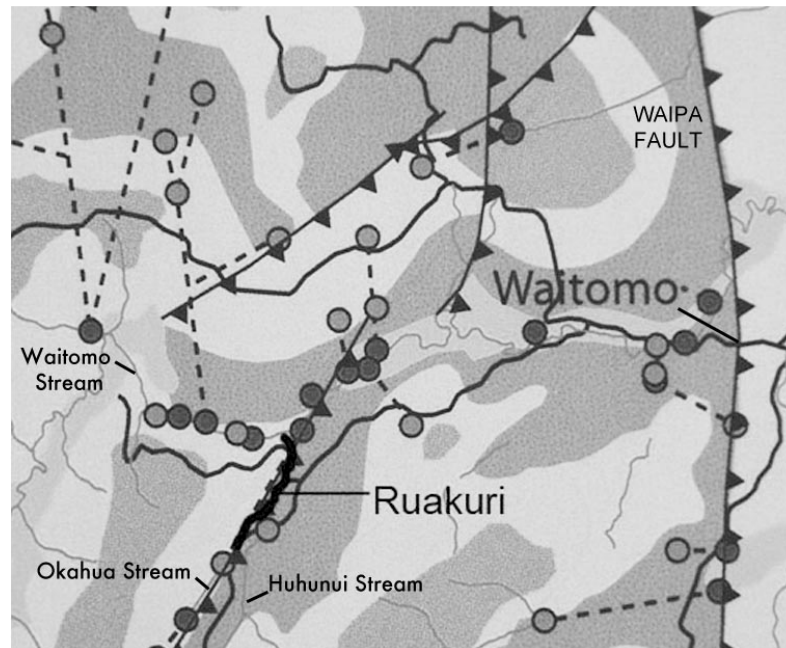
Heading west from Waitomo we will encounter:

- The northern edge of the Ruakuri Scenic Reserve
- Gardner's Gut, one of the longest caves in New Zealand
- Millar's Waterfall, one of the longest caves in Waitomo
- Various outcrops including
 - Mahoenui Group mudstones
 - Ahuroa Ignimbrite (1.18Ma) that flowed from a massive eruption 50km away
- The Waitomo Valley lookout, a good opportunity to look out over the valley and talk about the Waitomo catchment scheme and the Waitomo master system caves
- Down through the Mangapohue Gorge, which lies between the two largest blocks of karst under natural vegetation in the North Island
- Mangapohue Natural Bridge (toilet). A 30minute loop walk takes us through one of the prettiest spots in the region, a double tiered natural bridge. Are the mounds in the floor a New Zealand example of craybacks? Beyond the bridge, the track passes on to farmland, where rock outcrops show giant fossil oysters. Evidence suggests that banks of oysters grew in a tide swept seaway at 25-50m depth, at temperatures of 12-15°C.
- Piripiri Caves. Also known as Goddard's or Oyster Cave, this short cave is a 15minute walk from the road. A viewing platform has been built at the limit of daylight in the last few years. Beyond the platform the cave is relatively short. Is a lighting system an option here? This is one of the few free cave experiences for the general public.
- Marokopa Falls. The Marokopa Falls are our third short walk. These spectacular falls plunge about 40m over Mesozoic basement rocks. More recent Tertiary limestones can be seen above the falls.
- Te Anga. At this small settlement the junction north leads to the south side of Kawhia Harbour and the Taharoa ironsand mine. Just beyond Te Anga, large limestone bluffs overlook the valley at Castle Craig.
- Marokopa Beach. The Marokopa River meets the Tasman sea in a typical West Coast environment of rough seas and black sands. This small community is home to a small permanent population, supplemented by bach owners and whitebaiters. Coastal erosion is a problem up and down the West Coast as massive sediment slugs move up the coast from Taranaki over the decades. If we have time we will walk out to the heads.

Ruakuri Cave

Setting

Ruakuri Cave lies under a NE-SW striking ridge which is bounded by the Waitomo Fault to the east and the down-cutting Waitomo Stream to the west. It is a 5km plus three-tiered network of large NE-SW vadose river canyons and smaller, joint controlled NW-SE phreatic passages cut through a fault-bounded block of Oligocene, Otorohanga Limestone. These passage trends follow a conjugate set of joints resulting from high angle N-S faulting developed during late Miocene and Pliocene uplift.



Major breakdown areas have caused streams to find alternative routes along many of these passages. The system now has two dry entrances, three walk-climb-in stream entrances, two abseil shafts, one siphon, one excavated entrance, two possible digs and three reasonable questionmarks.

The ridge, which contains numerous dolines and several shafts, is about 70m above the base stream level. Sections of cave, where decoration is sparse, are probably capped with outliers of impervious Mahoenui calcareous siltstone. The entire surface above the cave is covered with layered tephra deposits derived from the Taupo and Taranaki volcanic centres over the past 2.8 million to 10,000 years. The relatively free-draining soils derived from these deposits can also store a significant amount of rain.

The depth of percolation through the soil and underlying epikarst ranges from approximately 70-20m. Tourist sections of the cave are overlain by a mixture of pasture, regenerating native forest and metalled road.

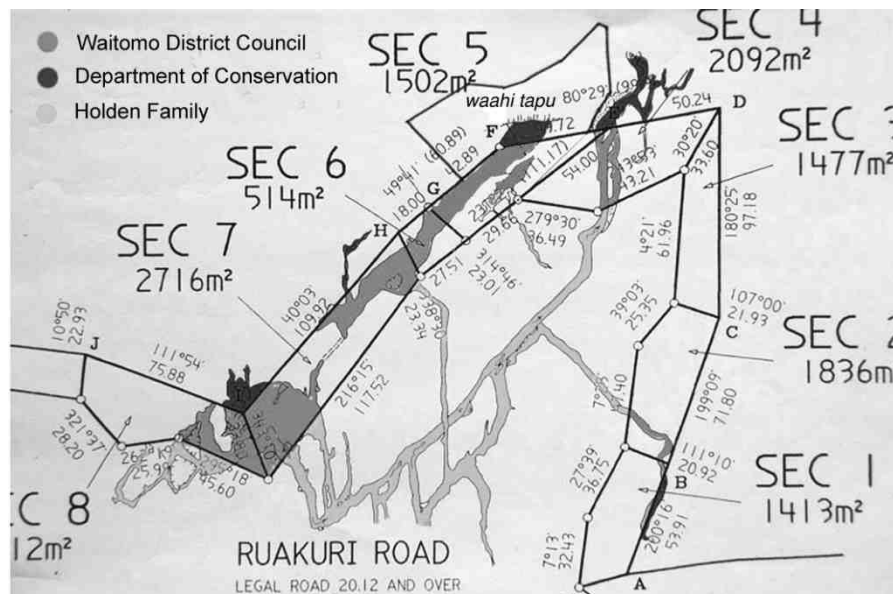
Historical Background

“Te Rua-kuri” (Ruakuri) means the “den of the dogs”. Legend has it that a band of Maori warriors, led by chief Taane Tinorau, set out from coastal Kawhia to engage with the Ngatihau tribe, who were settled near Waitomo Caves. When the party arrived at Waitomo, they camped and one of the group was sent to hunt and spear birds, whereupon he discovered the cave. At that time a pack of wild Maori dogs, Kuri, were camped in the entrance. They moved to attack the warrior, who threw his speared birds on the ground and fled.

Kuri were valued for their skins and meat, so the war party decided to set traps and catch and kill them. The hunt was successful and Taane Tinorau had several mats made from the skins. The same chief Taane Tinorau is said to be buried (along with others) in a small cave high in the cliff that contains the main Ruakuri Cave entrance. This area is now acknowledged as a wahi tapu or sacred site.

In the early 1800's, the King Country region, in which Waitomo lay, was one of the most inhospitable places in New Zealand. Government surveyors were appointed to make the first surveys of the area, to provide maps and survey stations that could be related to sub-tribal boundaries. Once this had been done, the names of the members of the sub-tribe could be researched and then included in a list of owners or shareholders. The Crown could then purchase land through the Maori Land Court.

In 1904, the year in which the Glowworm Cave was purchased under the Scenery Preservation Act, a part-Maori, James Holden, explored a cave on his ballot block of land, which had been purchased from the Maori. Holden was prepared to invest time and money in making it accessible for tourists. The press hailed the finding of Ruakuri Cave as a discovery of "great scenic wonder" and the Tourist Department sub-inspector reported that the cave far exceeded the beauty of the Waitomo Glowworm Cave. In 1906, the Crown Lands Department took the block of land under the Scenery Preservation Act of 1903 – even though Holden had introduced tours through the cave, gaining access through the entrance in the cliff below the burial caves (wahi tapu) . He asked for, and was given, \$196 in compensation.



Ruakuri, in conjunction with the Glowworm Cave and in 1911, Aranui, was operated by the NZ Tourist and Publicity Department (formed in 1901) until it became the Tourist Hotel Corporation (THC) in 1955. In 1987, descendants of James Holden learned that the majority of the tourist route in Ruakuri Cave lay under land that they owned. They tried to negotiate an agreement with the THC and, when negotiations appeared to be heading nowhere, they marked their land boundary in the cave, with a trespass notice. The THC, who still controlled the entrance and first 100m of the cave, responded by locking the entrance gate and barring anyone access. The dry tourist section remained closed until 2005.

Late in 1987 Peter Chandler commercialised cave rafting and began using the river passages of the cave for his Black Water Rafting adventure tours. The route for these tours did not transgress any of the disputed territory and exited the cave via the main stream resurgence

within the Ruakuri Scenic Reserve, remote from the waahi tapu site. Access had been sought and granted by both the THC and Holden family. Black Water Rafting then partnered with the Holdens in their commitment to re-open the dry tour, acknowledging the potential for an exciting overlap with the cave rafting experience.

Tour Development

The rest of the history consists of a careful, strategic development of tours within the one cave system.



















- 1987 BWR I – “Black Labyrinth”
- 1991 BWR II – “Black Abyss”
- 2005 Ruakuri Cave dry tour, and
- 2012 “Black Odyssey”

The Black Water Rafting company felt Ruakuri Cave was a suitable cave resource because of its robust, dynamic nature, long history of use for tourism, and part ownership by DOC. The latter ensured that any development would be subject to a comprehensive set of conditions as well as a mandate to pay due respect to any Maori/Cultural heritage. The licensing process also demanded that trips would have to operate within a rigorous set of environmental and safety guidelines.

The development of the dry Ruakuri Cave tour involved the sale of the Legendary Black Water Rafting Company to Tourism Holdings Ltd. who, at the time, was the largest tourism company in NZ. They supported the drive by BWR guides to develop a world class set of overlapping tours that would complement with, and not compete directly with, the existing Glowworm and Aranui Cave products.

Experiences have been designed to expose clients to a gradually shifting “comfort zone” and hierarchy of skills; from the walk or wheelchair, dry Ruakuri “Spiritual Journey” to the “soft rollercoaster” tubing of the Black Labyrinth; then the vertical techniques of the Abyss and finally the “alpine” skills required in modern, extreme cave exploration on the Odyssey. Each tour also highlights a set of unique selling points.

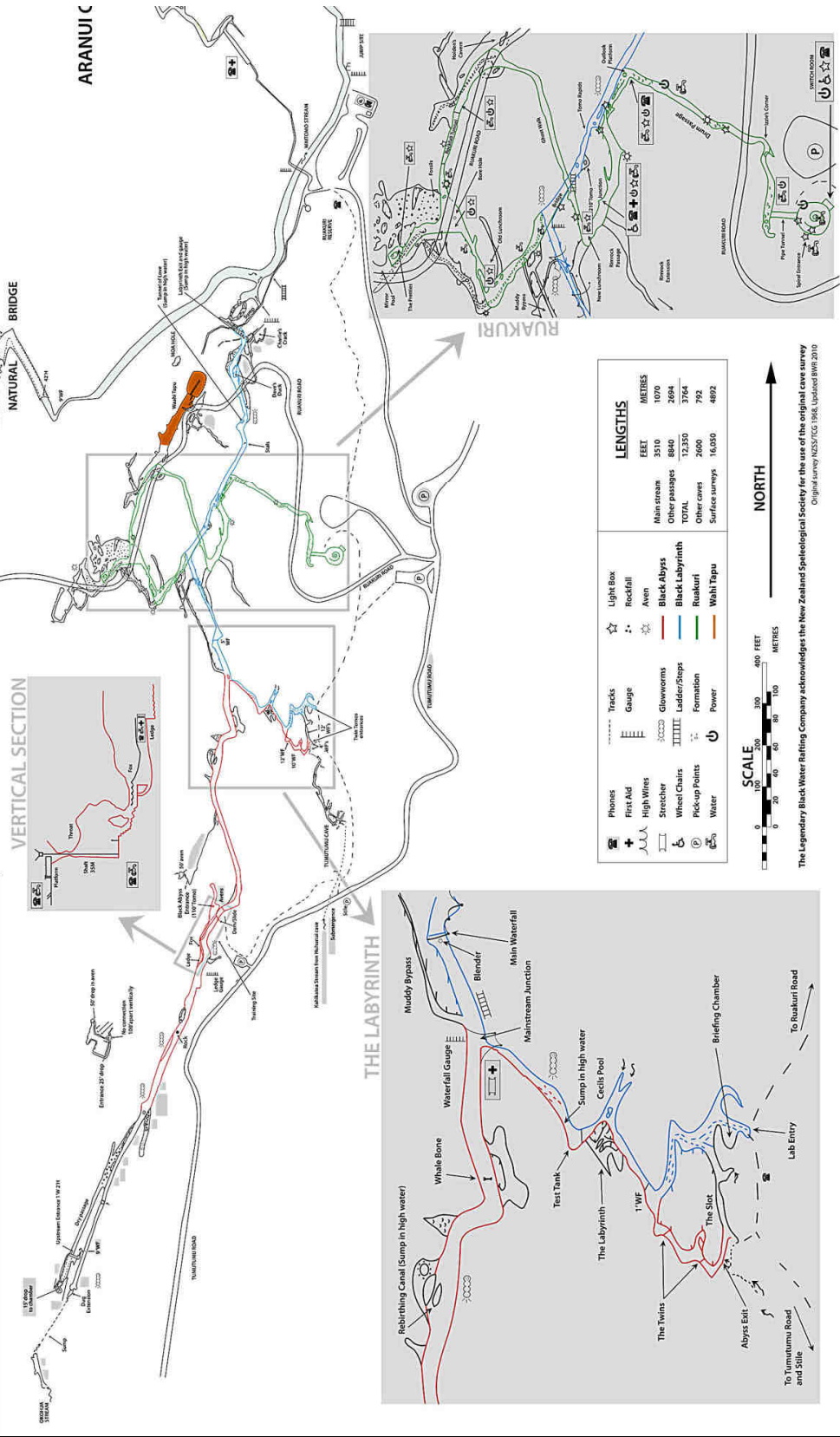
RUAKURI CAVE TOUR MATRIX

BLACK LABYRINTH 1987 3Hr 12 pax																				
BLACK ABYSS 1992 5Hr 8 pax																				
RUAKURI CAVE 2005 2Hr 20 pax																				
BLACK ODYSSEY 2012 4Hr 6 pax																				
?																				?



The strategy also involved consideration of the gradual up-skilling that would be required by guides and the fact that not everyone enjoyed being in a wetsuit and water all of the time. This provided for some sort of “career” structure, as guides gradually improved their “hard” (high rope) and “soft” (people) skills, which in turn encouraged a graduated scale of remuneration and enhanced guide retention.

RUAKURI CAVE



The Legendary Black Water Rafting Company acknowledges the New Zealand Speleological Society for the use of the original cave survey
Original survey NZSS/CC 1968, Updated BWR 2010

Management Challenges:

Environmental Monitoring and Management

It is often very difficult to predict just what features are actually at risk and effect protective solutions without compromising one's feeling of intimacy with nature. Optimising guide respect and awareness in a manner that is able to be readily transferred to the client is probably the most effective "soft" bottom line before attempting "hard" protection measures. (Barriers, IR sensors.....)

Carrying Capacity

There is always a fine balance between the popularity of a tour, spaces and extra tours, staff availability and providing a satisfactory alternative experience. Operations staff are continually grappling with the unpredictability of supply and demand in order to optimise the return from rostered staff without compromising tour aesthetics.

Client Safety

The direct bottom line impact of a damaged client will affect not just the company (board, shareholders and staff) but also the community in which the company is based. Preventative tools include robust safety reporting systems as well as an ever evolving set of training standards that are assessed and moderated within a national industry framework (NZQA). With greater risk, assessing the state and suitability of both guides and clients, on the day, becomes a sensitive area to administer.

Tour overlaps

An hierarchy of tours, which physically overlap in the cave system, is seen to be an opportunity rather than a challenge. An understanding of the "bigger picture" and fostering consistent guide interactions can turn any tour overlap into an exciting experience. (Whispers of "where have they come from?")

CO₂ Levels

Ruakuri Cave is largely a well-ventilate system. However, monitoring has picked up that CO₂ levels in the upper Drum passage may reach unacceptably high levels from time to time. "Flushing" of this area can be accomplished by leaving open some of the 'airlock' doors. However, records show that the levels may rise even when there are no tour parties in the cave. This suggests a strong source within the overlying epikarst rather than merely anthropogenic input. This is an on-going study at the present time.

Marketing

There are a variety of sales agents operating within, and outside of, the Waitomo Caves community. Regardless of the effectiveness of brochures and websites, there can often be inconsistencies with regards to the information given at the point of sale. This is seen as an important issue, especial with regards to new and emerging markets.

References

Kermode, L., 1974. Geological Setting of the Glowworm Cave, Waitomo. NZSS Bulletin Vol. 5, No. 92, 361-369

Parsonson, M. J., 1995. Percolation processes in the Unsaturated Zone, Waitomo, New Zealand. Unpublished MSC Thesis, University of Auckland.

Williams, P. (compiler), deFreitas, C., Millar, I., Worthy, T., Hurst, B. and Crossley, P., 1999. The Current State of the Ruakuri Cave Environment. Consultants Report for NZ Glowworm Caves Ltd.

Options guide – Wednesday afternoon

Adventure cave tour options

Tour	Time and duration	Details	Cost	Numbers required
Waitomo Adventures				
Lost World 4 hour	2.30pm 4 hours	Abseil 100m, cave exploring, 30m ladder climb out, glowworms. Bring shorts or pants and t.shirt (to wear under overalls). NO JEANS	Half price. You pay \$162.50	Min: 2 Max: 8
Tumutumu Toobing	2.30pm 4 hours	Blackwater rafting, squeezing, glowworms, cave exploring. Bring swimsuit, towel and socks	Half price. You pay \$86.50	Min: 2 Max: 12
Haggas Honking Holes	2.30pm 4 hours	3 abseils including one down a waterfall, squeezing, rock climbing, spider walking, caving and exploring, glowworms. Bring swimsuit, towel and socks	Half price. You pay \$125.00	Min: 3 Max: 10
St Benedict's Cavern	2.30pm 4 hours	2 abseils – adding to a total of 40m, formations, 30m flying fox, cave exploring. Bring loose comfortable clothing (to wear under overalls). NO JEANS. Thick socks (optional)	Half price. You pay \$86.50	Min: 3 Max: 8
Black Water Rafting				
Black Labyrinth	3.00pm 3 hours	Blackwater rafting, cave exploring, two waterfall jumps. Bring swimsuit and towel.	Discounted You pay \$20	Min: 2 Max: 12
Black Abyss	1.00pm 5 hours	Pick up Waitomo Caves Hotel @ 1pm. 37m abseil, blackwater rafting, waterfall jumps and climbs, squeezing, flying fox, glowworms. Bring swimsuit and towel.	Discounted You pay \$20	Min: 2 Max: 8
Black Odyssey	2.00pm 4 hours	Glowworms, high ropes, flying foxes, cave exploring, spider walking, abseiling, squeezing, horizontal ladder walks. T.shirt, shorts, socks and a towel.	Discounted You pay \$20	Min: 1 Max: 6
Kiwi Cave Rafting				
Kiwi Cave Rafting	1.30pm 5 hours	27m abseil, glowworms, 20m rock climb exit (beginner), cave exploring, optional squeezing, blackwater rafting. Bring swimsuit, towel and socks	Half price. You pay \$99	Min: 2 Max: 6
Caveworld				
Tube It	3.00pm 2 hours	Blackwater rafting, glowworms, waterfall jump, waterslide, cave exploring. Bring swimsuit, towel and socks	Free	Min: 2 Max: 12
Footwhistle – night tour	5.00pm 1 hour	Glowworms, candlelit entrance, cave exploring, display of a traditional lighting method. Walking shoes, jacket and camera.	Free	Min: 2 Max: 12

Maniapoto's Cave

This cave is a short distance from Waitomo and is suitable for people of all abilities. The return trip will take around 2½ - 3 hours, so we will aim to leave by 2pm at the latest. There will be a limit of two van loads. This site embodies the people, planet, profit theme of the Conference.

The ~40m long cave is one of very few in the Mangaokewa valley limestones, east of Waitomo. It was once the home of Maniapoto, the 17th century eponymous ancestor of all the local iwi (people) of the district. The site is culturally and historically important, and is one of the few local records of people inhabiting cave entrances. The surrounding limestone is quite high quality and the cave now sits in an isolated 0.8ha block with quarries and quarry overburden on three sides. One quarry wall is parallel to, and only metres, away from, the cave passage. The owners have a restoration plan underway for the site.

Otorohanga Kiwi House and Shops -- strictly no caves

Departs: at 1.00pm (bring your packed lunch with you).

We will visit the Otorohanga Kiwi House and Native Bird Park first. Cost \$20 per person. Kiwi feeding is at 1.30pm hence the rush. We will stay on to look around the bird park, and there are picnic tables to sit and eat at.

Next: Otorohanga Museum. Visit to the Waka House (very worthwhile), those who are interested can stay on to see the rest of the Museum at no charge but a donation is appreciated. Others can go into town for cafe's and shops.

We will muster for return at 4.30pm at the Village Green on the Main St. We can then go to the supermarket if anyone needs to.

A local walk

If you want to relax around the village, a short walk to the top of 'Gorse Hill' is an option. Walk east of the village for about 15 minutes, to a newly constructed road entrance on the north side of the road. You can walk about anywhere inside the fenced regenerating land. A loop walk will take you up the hill for good views over the village and the lower Waitomo valley. The loop is marked on the medium scale map in the handbook.

McDonald's Lime Quarry

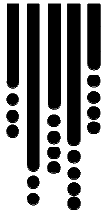
McDonalds Lime Ltd operate the largest quarry in the Waitomo area limestone. They have offered delegates a guided tour of the site. This trip will leave the village around 1:30pm, returning approximately 4 pm. No special equipment or ability is required. Note that we will not be able to leave the van during time at the site due to health and safety requirements, but we will have a company staff member on board.

The 67ha site is 9 kilometres south of the Waitomo village. As well as the quarry site, McDonalds have their main plant near Otorohanga, operating 2 rotary lime kilns; and in Te Kuiti at the old Beros lime works, a vertical, gas powered Maerz kiln. It is majority owned by Holcim, who acquired it in 1968 (Holcim then known as Milburn). Holcim also operate the cement works at Cape Foulwind, near Westport.

Agricultural, burnt lime (CaO), and hydrated lime Ca(OH)₂ products are produced and sold domestically and in the Pacific islands. Low grade limestone and fines are sold for farm tracks, and landscaping products, with some flaggy limestone going as far as Auckland for wall building.

In the past, to access the high grade limestone, large amounts of stripping off of the mudstone (known locally as papa) cap rock has been done. At present the quarry is developing downwards. Modern techniques core drilling and 3d modeling have enabled future usage planning, which could extend the quarrying beyond the present area.

Annual General Meeting



Australasian Cave and Karst Management Association Inc

Annual General Meeting Agenda

**Wednesday 15 May 2013 (12pm)
Waitomo Caves Hotel, Waitomo
New Zealand**

The Annual General Meeting of the Australasian Cave and Karst Management Association will be held at the Waitomo Caves Hotel, Waitomo New Zealand at 12pm on Wednesday 15 May. All members and interested people are invited to attend this meeting. Please come along and participate in the running of your Association.

AGENDA

1. Apologies
2. Confirmation of the minutes of the previous meeting held at the Cooradigbee Shearer's Quarters, Wee Jasper NSW 2582, on Saturday 5 May 2012.
3. Any actions arising from those minutes.
4. Receipt of reports from the Committee upon the business of the Association during the preceding year.
5. To elect officers of the Association and ordinary members of the Committee

Note that the officers of the Association are a President, two Vice-Presidents, a Treasurer, an Executive Officer, the Convenor of the Association's next conference, and an Editor/Publications Officer.

All these positions are vacant as of the date of the Annual General Meeting. Also to be elected are three ordinary members of the Committee. Currently one of these positions is allocated the following task: Interpretations Officer.

Note that the responsibilities outlined above for ordinary members of the Committee are not defined in the Rules of the Association and can be reset according to the wishes of the new committee.

6. To consider the Treasurer's report regarding budget, income and expenditure of the Association.
 - 6.1. To adopt the financial statement and agree to submit it to the Registrar of Incorporated Associations in Victoria
7. To set the membership fees of the Association.
8. To consider the day-to-day operation of the Association and the following items of general business:
 - 8.1. Conference and AGM future planning (Cathie Plowman)
 - 8.2. Selection of venue for the 2014 ACKMA AGM (Andy Spate)
 - 8.3. Elect Fellows and/or Life Members (if nominated)
 - 8.4. Consider recommendations from the ACKMA Committee (if any)

Catherine Sellars, ACKMA Executive Officer
executive.officer@ackma.org

**Nominations received for ACKMA Office and Committee positions
2013 AGM, Waitomo**

POSITION	Nominee	Proposer	Seconded
President	Dan Cove	Andy Spate	Grant Commins
Vice President (Aus)	Andy Spate	Dave Smith	Celina Yapp
Vice President (NZ)	Neil Collinson	Andy Spate	Dave Smith
Executive Officer	Dave Smith	Andy Spate	Celina Yapp
Treasurer	Grant Gartrell	Steve Bourne	Catherine Sellars
Publications Officer	Steve Bourne	Anthony Culberg	Cathie Plowman
Conference Convenor			
Committee Member	Andy Spate	Kirsty Dixon	Timothy Moulds
	Sasa Kennedy	Deborah Carden	Grant Commins
	John Brush	Andy Spate	Kirsty Dixon
	Tim Moulds	Dave Smith	Andy Spate

2012 ACKMA AGM MINUTES

MINUTES of the Annual General Meeting of the Australasian Cave and Karst Management Association Incorporated, held at the Cooradigbee Shearer's Quarters, Wee Jasper, NSW on 5 May 2012. Commenced at 11:00am.

PRESENT: 41 people – Catherine Sellars, Kirsty Dixon, Andy Spate, Sasa Kennedy, Dave Smith, Dan Cove, Deborah Carden, Regina Roach, Pat Culberg, Miles Pierce, Kent Henderson, Geoff Deer, Marjorie Coggan, John Brush, David Butler, Cathie Plowman, David Wools-Cobb, Greg Martin, Geoff Kell, Barry Richard, Andrew Baker, Dianne Vavryn, Steve Bourne, Neil Kell, Mary Traves, Celina Yapp, Libby Chandler, Julia James, Monica Yeung, John Ash, Anne Musser, Peter Moore, Ros Skinner, Phil McGuinn, Rhonwen Pierce, Angela Hamilton-Smith, Lana Little, Travis Cross, Elery Hamilton-Smith, Brian Clark & Tony Culberg.

APOLOGIES: Tim Moulds, Ann Augusteyn, Amanda Jennings, Peter Wood, Anne Wood, John Donovan, Andrea MacLennan, Lisa King, Nicholas White, John Watson, Jay Anderson, Ross Anderson, Ian Lewis, Andy Baker, Stephen Swabey, D Rebechi, Mary McCabe, Cameron James, Peter Austin, Rauleigh Webb.

Moved to accept: Brian Clark, Seconded David Wools-Cobb. Carried.

CHAIR: Peter Chandler

MINUTES:

The minutes of the previous Annual General Meeting (held at the Ulverstone Surf Life Saving Club, Beach Rd, Ulverstone, Tasmania 7315, on 11 May 2011) were considered. Moved to accept by Tony Culberg, Seconded Dave Smith. Carried.

ACTIONS ARISING FROM THE MINUTES:

Dan Cove spoke to the co-operative approach amongst show cave operators. They are looking into operator's initiative for funding at a federal level, highlighting the importance of collaboration. There is not a lot of progress to report, however are hopeful there will be shortly.

COMMITTEE REPORTS:

The 2011-12 reports of the Committee Members (except the Treasurer's report) were accepted as read (and as pre-circulated). Moved Cathie Plowman, Seconded Marj Coggan. Carried.

ELECTION OF OFFICERS:

Nominations received for positions were as follows:

POSITION	NOMINEE	PROPOSER	SECONDER
President	Peter Chandler	John Ash	Celina Yapp
Vice President (Aus)	Dan Cove	Scott Melton	Grant Commins
Vice President (NZ)	Dave Smith	Libby Chandler	Celina Yapp
Executive Officer	Catherine Sellars	Pete Chandler	Steve Bourne
	Kent Henderson	Dianne Vavryn	Ann Augusteyn
Treasurer	Grant Gartrell	Catherine Sellars	Steve Bourne
Publications Officer	Steve Bourne	Cathie Plowman	Catherine Sellars

Conference Convenor	Libby Chandler	Dave Smith	John Ash
Committee Member	Sasa Kennedy	Dan Cove	Scott Melton
	Kirsty Dixon	Catherine Sellars	Andy Spate
	John Brush	Andy Spate	Kirsty Dixon

Where nominations did not exceed vacancies, those nominated were accepted by acclaim. Election of Executive Officer. Kent Henderson spoke to his nomination. Catherine Sellars spoke to her nomination. A secret ballot followed, counted by Greg Martin. Catherine Sellars was elected as Executive Officer. Moved that voting slips destroyed by Pete Chandler, seconded Kirsty Dixon. Carried.

TREASURER'S REPORT:

The Treasurer's report was spoken to by Dave Smith. He reported that the keynote speaker costs and the proceeds of the Tasmanian conference will change what is represented in the report. The cost of journals has been reduced largely due to the Publications Officer undertaking the layout work himself.

Requested that the ACKMA bank account details are included on invoices to make payment of fees easier through direct deposit.

Moved Geoff Deer, Seconded Tony Culberg. Carried

Funds raised (\$420) during the 2011 conference for the NZ Red Cross were given to Pete Chandler for exchange and completion of the donation. Moira Lipyeat requested that the funds go towards a cavers hut. This was not passed as people could directly contribute to Moira for this purpose, where the \$420 raised, was done so on the proviso that it went to the NZ Red Cross.

MEMBERSHIP FEES:

The Treasurer recommended that membership fees for the 2012/13 year remain at \$65. Moved: Dave Smith, seconded Cathie Plowman. Carried.

2013 WAITOMO CONFERENCE

Dates set for May 12-17 2013. Proposed program to include papers in the mornings followed by activities in the afternoon. Pre and post AGM activities are also planned that may include karst area visits, lava caves. Aim to have articles in upcoming journals.

2014 AGM VENUE

No nominations have currently been received. Suggestions were put forward to consider South Eastern Australia, a city location and possibility of seeking exemption so that the AGM could be held at Jenolan prior to ISCA.

2014 ISCA CONFERENCE

Dates for the conference will be set in November. Everyone is welcome, no need to be an ISCA member. Billeting will be a possibility for accommodation. There were approximately 100 people in Slovakia and ~140 people have intention to attend Jenolan.

FELLOWS / LIFE MEMBERS

No nominations received.

RECOMMENDATIONS FROM THE COMMITTEE

No recommendations received.

Miles Pierce moved to thank the committee, seconded by Dianne Vavryn. Carried.

Meeting Closed 11:47am

TREASURER'S REPORT to the Annual General Meeting

Grant Gartrell

The ACKMA financial year runs from April to March. At 31 March 2013 our Australian bank account balance stood at \$10,571.24, down \$2905.80 on the balance at the same time last year. Included in this amount is the Australian component of the Life Members' Fund, the balance of which currently stands at \$3247.22, made up of \$2977.22 carried forward from last year and \$270.00 in new donations.

A surplus of \$400 remained from the May 2012 AGM at Wee Jasper in NSW after all accounts were paid, and appears in this year's Income and Expenditure Statement. What does not appear in that statement is the final balance from the Ulverstone Conference in May 2011. The bank account operated by the conference organising committee and used to settle accounts after the conference with creditors such as bus companies, has now been closed and the final balance of \$6564.32 transferred to the ACKMA account, but just too late to be included in the 2012/2013 Income and Expenditure Statement. It is nevertheless sensible to take heed of this amount at this time, since it is associated with prior year events now concluded, and had the payment been received only slightly sooner, the net income for the year would have been recorded as \$3658.52 instead of the official amount of (\$2905.80). The latter figure on its own would suggest the need for a contractionary budget for the coming year, whereas the true situation has a little more room for flexibility.

The full year cost of producing and distributing the Journal has risen to \$12,128.10 compared with \$7446.65 for last year, an increase of \$4681.45, but still some \$6,000.85 less than the \$18128.95 spent in the 2010/2011 year. Some, but not all, of this year's increase is in payment of extra services performed by the printers, who have also produced, stationery, envelopes and address labels, and prepared the journals for postage. As the Journal remains the major area of expenditure for funds raised by ACKMA membership subscriptions, we need to continually review our expectations of it.

Membership levels have remained virtually static this year, with a couple of new memberships balanced by a couple of resignations. Subscriptions received for Australian and Overseas membership totalled \$8974.53, only marginally less than last year's total of \$9055. There has been no advertising income again this year.

One particular area of concern is the cost of overseas membership. Our overseas members are just as important to us as our Australasian members, but three significant factors are making it expensive for them to maintain membership currency. These are the cost of airmail postage, bank foreign currency transfer charges, and the impact on exchange rates around the world of the high Australian dollar.

Overseas airmail postal charges are so expensive that we are forced to put a \$10 postal surcharge on overseas membership subscriptions. Even this only provides partial cost recovery. Next there is the high cost of Australian dollars. Several years ago our American members did not have to worry too much about the postal surcharge, because they could buy anything up to two Australian dollars with one American dollar. Today, they cannot even buy one Australian dollar with their own dollar, which effectively doubles the ACKMA subscription rate for them. Much the same applies for many other currencies as well. The high Australian dollar currently mitigates strongly against export sales for many Australian agricultural industries as well as manufacturing industries such as our car industry. There is no reason to think that ACKMA's overseas membership base is immune from the same cost pressures.

To rub salt into the wounds by the bucket load, banks charge hefty fees for transferring funds from overseas banks to Australian banks, and vice versa. For example, Australians paying

registration fees in New Zealand dollars for the upcoming conference in Waitomo would have been charged \$22 per transaction. This fee is bad enough, but being a flat fee, is a smaller percentage of the total when larger sums of money are involved. The situation becomes quite absurd when creating an international bank transfer for a relatively small amount like an ACKMA membership subscription. Even then, that is not the end of the matter. Often your own bank will only deal directly with one overseas bank in each country, and the transfer fee is charged to move the money between those two banks. If the recipient's bank is a different bank to the one to which the money is sent, then a second transfer within the recipient country must be arranged, and, you guessed it, usually there is a healthy fee charged to arrange that transfer as well. It could cost as much as about \$AUST 40 in total fees to pay a \$AUST 75 membership subscription, which is at best a really inefficient process. A much better way of doing this is to arrange overseas payment by internationally recognised credit cards such as Mastercard or Visa. This only works when the receiving body is set up to handle such payments. In a roundabout way I have been making such a service available for the last ten years for the convenience of ACKMA members. About 25% of the members use it, and about 13% of those are overseas members.

Another avenue for consideration for reducing the cost of subscriptions, particularly overseas subscriptions, would be to introduce a new membership class that only entitles online access to the Journal. Further investigation of the feasibility is needed, but I would hope that the will, time and manpower could be found to assess the merit of such a notion with a view to adoption, if practical, at the next AGM.

The New Zealand account increased by \$2058.63 over the twelve month period and at 31 March stood at \$NZ15978.67. It will be time enough to transfer some of these funds to the Australian account once all accounts for the Waitomo Conference have been settled.

2013 - 2014 BUDGET CONSIDERATIONS

In the last twelve months there have been several variations in the cost structure of the Journal, which remains our largest regular expense.

It is my recommendation that membership fees remain unchanged for the coming year, and that we seriously investigate the possibility of introducing a lower fee for members electing to access the Journal electronically rather than receive a printed copy, provided that such an option does not significantly impact on the unit cost for those who still prefer printed Journals..

The 2013/2014 financial year should again be one of consolidation. Since the last increase in membership fees, our membership numbers have remained virtually static, which is probably the best we should have expected under the circumstances in a period when most people's costs are rising faster than their incomes. We should all encourage others to consider joining ACKMA wherever possible.

I recommend that unless truly exceptional circumstances arise, we do not contemplate any extra-ordinary project expenditure over the next twelve months unless sufficient additional funds can be generated to support it.

Grant Gartrell
Treasurer
22 April 2013

**AUSTRALIAN OPERATIONS PROFIT & LOSS
PREVIOUS YEAR COMPARISON**

ITEM	2012 – 2013		2011 – 2012	
INCOME				
Subscriptions	\$ 8974.53		\$ 9055.00	
Life Members Fund	\$ 270.00		\$ 685.00	
Publications Sales	\$ 0.00		\$ 25.00	
AGM Surplus	\$ 400.00		\$ 0.00	
Bank Interest	\$ 3.77	\$9648.30	\$ 6.07	\$ 9771.07
EXPENDITURE				
Conference/AGM costs	\$ 0.00		\$ 3554.05	
EFTPOS Charges	\$ 71.00		\$ 84.60	
ISCA Subscription	\$ 355.00		\$ 0.00	
Business Affairs	\$ 0.00 ⁽¹⁾		\$ 41.80	
Post	\$ 1369.00		\$ 0.00	
Journal Printing	\$10759.00 ⁽²⁾		\$ 6016.00	
Journal Expenses	\$ 0.00	\$12,554.10	\$ 1430.65 ⁽³⁾	\$11,127.10
NET INCOME	(\$ 2905.80)			

EXPLANATORY NOTES

- (1) The fee for lodgement of the Annual Return with Business Affairs Victoria has been paid by our Public Officer. It has been billed to the ACKMA account after the 31st March. It will appear in next year's statement.
- (2) Journal Printing expenditure for 2012/2013 includes some postage and other associated stationery and service charges.
- (3) The Item "Journal Expenses" for the 2011-2012 year includes postage of the Journal.

FINANCIAL STATEMENT 2012 – 2013

Australian Operations, (Australian Dollars)

OPENING BALANCE

Opening Balance 01/04/2012	\$ \$13,477.04	

		\$13,477.04

PLUS INCOME

Subscriptions	\$ 8974.53	
Bank Interest	\$ 3.77	
AGM Surplus	\$ 400.00	
Life Members Fund	\$ 270.00	\$9648.30
	=====	
		\$23,125.34

LESS EXPENDITURE

ISCA Sub	\$ 355.00	
EFTPOS Expenses	\$ 71.00	
Journal Printing	\$ 10,759.10	
Post	\$ 1369.00	\$12,554.10
	=====	

CLOSING BALANCE

Closing Balance 31/3/2013		\$10,571.24
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New Zealand Operations (New Zealand Dollars)

OPENING BALANCE

Opening Balance 01/04/2012	\$ \$13,920.04	

		\$13,920.04

PLUS INCOME

Subscriptions	\$ 1550.00	
Bank Interest	\$ 293.98	
Life Members Fund	\$ 215.00	\$2058.98
	=====	
		\$15,979.02

LESS EXPENDITURE

Bank Charges	\$ 0.35	\$ 0.35
	=====	

CLOSING BALANCE

Closing Balance 31/3/2013		\$15,978.67
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ACKMA Inc
Balance Sheet
As of March 31, 2013

ASSETS

Current Assets

Chequing/Savings

Commonwealth Bank	10,571.24
New Zealand Account*	13,103.78
Total Current Assets	23,675.02

TOTAL ASSETS **23,675.02**

LIABILITIES **0.00**

NET ASSETS **23,675.02**

EQUITY

Opening Balance Equity (1 April 1997)	595.94
Retained Earnings	25984.88
Net Income	-2905.80

TOTAL EQUITY **23,675.02**

*This figure is quoted in Australian dollars, and is based upon an exchange rate of 1.2194 NZD = 1.00 AUD. This money is held in the New Zealand Account. The exchange rate may vary at any time, and therefore the balance of the New Zealand Account, when converted to Australian dollars, may also vary.



Statement	108 (Page 1 of 2)
Statement begins	12 January 2013
Statement ends	11 April 2013
Closing balance	\$17,044.77 CR
Enquiries	13 2221 (24 hours a day, 7 days a week)

THE TREASURER
AUST CAVE AND KARST MANAGEMENT ASS INC
NANGKITA RD
MOUNT COMPASS SA 5210

Society Cheque Account

Account number 06 5156 10257455

Name: AUST. CAVE & KARST MGMT. ASS. INC
Branch: Noarlunga Centre SA
Bank, State & Branch number (BSB) 06 5156.

Note: Proceeds of cheques are not available until cleared. Please check that the entries listed on this statement are correct. If there are any errors, please contact the Bank immediately on 13 2221.

Further information about your account, including details of benefits or fees and charges, is available by telephoning the enquiry number listed above. If you have a complaint, information about our dispute resolution process is available from the same enquiry number.



Date	Transaction	Debit	Credit	Balance
12 Jan 2013	OPENING BALANCE			\$12,603.76 CR
21 Jan	Direct Credit 049053 MMPCU David Rowling Fees MMPCU		150.00	\$12,753.76 CR
29 Jan	Direct Credit 141000 D Carden 65 MSp 25 LM frnd D Carden		90.00	\$12,843.76 CR
01 Feb	Credit Interest		0.26	\$12,844.02 CR
15 Feb	Chq Dep Branch 06 5188		455.00	\$13,299.02 CR
21 Feb	Chq 000298 presented	3,498.00		\$9,801.02 CR
01 Mar	Credit Interest		0.22	\$9,801.24 CR
01 Mar	Chq Dep Branch Victor Harbor		390.00	\$10,191.24 CR
06 Mar	Direct Credit 231118 OEH-DE-CREDITORS 05/02/13 OEH-DE-CREDITORS		65.00	\$10,256.24 CR
07 Mar	CAVE MANAGEMENT GROUP SDN BHD REF 130307007257 /RFB/MEMBERSHIP RENEWAL		55.00	\$10,311.24 CR
22 Mar	Chq Dep Branch Strathalbyn		195.00	\$10,506.24 CR
25 Mar	Direct Credit 037819 MR CAMERON JAMES CAMERON JAMES 2013 MR CAMERON JAMES		65.00	\$10,571.24 CR
01 Apr	Credit Interest		0.26	\$10,571.50 CR
05 Apr	Chq 000300 presented	91.05		\$10,480.45 CR
	BALANCE CARRIED FORWARD			\$10,480.45 CR

003-0034 270807 (SAL1)

Australian credit licence 234945

6238.10140.1.1 Z2258R3 0303

2012-2013 ACKMA Committee Reports

President's Report Pete Chandler

I would like to thank all the committee members for their contributions to the functioning of ACKMA over the last year. In particular I would like to thank Steve for his work with the ACKMA journal which has transformed thanks to a very successful makeover. It is very professionally presented and a credit to our organisation.

Steve has also brought significant benefits to ACKMA by curtailing the costs of producing our journal and this will have a long term influence on the financial viability of this organisation. We do still need to resolve the ongoing problem that real membership of ACKMA has dropped over the years.

There has been some discussion with regards to moving our bi-annual conferences to alternate yearly with ASF conferences. Currently, when they are in the same year, they may be only months apart incurring financial strain on those belonging to both. Moving ACKMA's AGMs to opposite years should benefit both organisations but some careful consideration of issues surrounding a resolution will be needed.

Waitomo has not experienced an ACKMA conference for 16 years. From memory, Peter Dimond poured hours of work into organising the 1997 conference which, with around 50 delegates was run from the Waitomo Discovery Centre. This conference has retained Greg Martin, Dave Smith and John Ash from the 1997 organising committee and we have benefitted from their experience and input while setting up for 2013. For the newcomers, it is only when one is involved in the organisation of a week long conference that the immense amount of work needed can be appreciated. Well done to Libby and all the organising committee.

As for cave and karst management, things can look good or bad depending on one's point of view, let's say there is always room for education and improvement. The report writing, lobbying and networking that this organisation tirelessly undertakes really does set a benchmark for excellence in this field. Our links with the many other worldwide organisations also help to spread this work even further. My thanks go to those who hold up the standards ACKMA to those many outside organisations who work with, in and around caves and karst in the Australasian region.

Kia Ora- Enjoy the Week, Peter Chandler, President

New Zealand Vice President & NZ Membership Officer's Report Dave Smith

The New Zealand membership remains around 35, with a small turnover. Our bank balance is excessively healthy, due partly to the remains of the last Waitomo conference, and the accumulation of membership funds over many years with limited transfers to Australia

Features of the cave year include

- tight tourism markets, and an ongoing period of consolidation for many members
- the Stormy Pot - Nettlebed connection remains elusive, with only a small breakthrough needed for a 1200m deep cave on Mt Arthur
- restructuring at DOC is ongoing with operations staff currently under review

- acquisitions into the national protected areas system - of a small limestone reserve of rare plants in the Waitaki valley, and the almost completed acquisition of a large karst area under native forest west of Waitomo
- conference planning occupying the Waitomo members

Australian Vice President's Report

Dan Cove

It continues to be an interesting period for cave management in Australia. Whilst tourism remains an industry in transition, there does seem to be a genuine resilience in nature based tourist destinations such as cave systems. The growing number of Asian, particularly Chinese, visitors also presents an opportunity for growth given a strong cultural affinity with caves. However, recent years have also seen increased challenges in securing capital funds, as both Federal and State governments tighten budgets. Often, the environment is an early casualty of a budgetary deficit reduction strategy. Despite a reduction in government expenditures, it has been pleasing to note a rise in overall public engagement with environmental issues.

Relationships between Australian and International show cave systems have also been expanded, and are expected to be further solidified following the ISCA Congress in Australia in 2014. Interest remains high in attendance, and it is likely that the Congress in November 2014 will bring delegates from every continent (excepting Antarctica) together at Jenolan Caves. The possibility of the UIS Congress being held in Australia in 2017 is an equally exciting prospect which would round off a hugely significant decade for Australian Cave and Karst Management.

Executive Officer's Report

Catherine Sellars

The administration of the organisation has run smoothly.

Publication Officer's Report

Steve Bourne

Four journals have been produced since the AGM in Wee Jasper last year. We are still printing 300 copies at a cost of between \$1859 and \$2387, depending on the number of pages and the amount of colour used. This equates to approximately \$7.00 per copy, with postage \$1.80 for Australia and up to \$7.05 for some international members. Journals are delivered in bulk to New Zealand at a cost of around \$2.50 per journal and posted individually from there. Astute members will note that the journal cost per Australian member is about \$36.00 (including envelopes), with New Zealand costs only slightly more. The most expensive international destinations are costing approximately \$58 per member for 4 journals each year.

There are a few other sundry printing costs for membership, AGM materials, receipts and other administrative requirements for the organisation. I have incurred a small additional expense by having the printer pack the envelopes to improve efficiency in posting the journals which is working well after an error with the mailing list the first time. Postage per edition runs to approximately \$700 in Australia plus costs for posting individual journals from a central New Zealand point.

June 2012	300 journals 40 pp plus cover (4 pages colour)	\$1859 (GST inc)
Sept 2012	300 journals 36 pp plus cover (8 pages colour)	\$1892 (GST inc)
Dec 2012	300 journals 40pp plus cover (12 pages colour)	\$2387 (GST inc)

Costs for the March journal have not been received at the time of printing.

The journal is made available on line as a full journal and individual articles in the members only section of the website. The quality of the full journal download was improved with the December edition, number 89, after a suggestion from Greg Middleton and some IT advice from Rauleigh Webb. As always, Rauleigh has the journal on the website as soon as I provide the files.

I am currently printing many more journals than we have members. ACKMA has reciprocal membership with many other organisations and we provide a journal to them each quarter. In return, we receive a couple of email newsletters, plus a paper copy of Australian Caver from the ASF. To help keep our costs down, I propose that we send advice to non paying members and advise them that the journal may be downloaded from the website and only send hard copy to paying members. This proposal does not include life members, libraries or Australian and New Zealand cave associations we liaise with.

The second area that needs addressing is having email contact for all our members. I routinely put out a call for articles, but am only reaching a portion of the membership. We inserted a slip into one journal seeking email addresses with only a few responding. The ACKMA list email does not impact the mailbox to any great extent, with some really useful postings at times. We need to ensure all members receive these postings.

The third and most important item is providing material to be published in the journal. Since I assumed the role of Publications Officer, my first effort was 6 weeks late and the gap has never been closed. I urge all members to be on the lookout for suitable material, put pen to paper and encourage those doing good work in cave and karst management to put pen to paper. I would like to see the ACKMA Committee take on a far more active role with producing the journal, our major method of communication.

I have been assisted by Andy Spate over the past year with editing and sourcing articles. I am especially grateful to Tony Culberg for his extraordinary editing skills. I enjoy our lengthy calls going through each article, and the debate between Tony and his wife Pat as they debate the correct use or spelling of a particular word. Tony's eye for detail greatly improves the quality of the journal. I appreciate the efforts of authors who have submitted articles over the past 12 months and look forward to receiving many more in the year to come.

International Officer's Report

Andy Spate

My main activities this year in relation to the above role have been in contacting more than 150 show cave operations around the world to gather data on visitor numbers. Some of these data will be presented in a paper at the conference. This data gathering will be extended next year so that a more comprehensive paper can be prepared for the ISCA Symposium at Jenolan late next year.

I have also fielded about a dozen queries from overseas visitors seeking more information on Australian and New Zealand caves. These have either been forwarded on to individual areas, caving clubs or other organisations for their direct responses or have provided the information myself.

My own work overseas has been largely desktop work for the Korean Cave Research Institute coupled with one short trip and major report dealing with lampenflora issues in two Korean show caves. I have also provided advice on lampenflora to the Grotta Gigante show cave near Trieste, Italy.

Information Technology Officer and Webmaster Report Rauleigh Webb

The “Jobs“ section that advertises jobs in the cave and karst arena has been very lean this year with NO jobs being advertised during the year. The “Members only” area Journal articles is now fully organised by journal article number. The full ACKMA journal has now been available for electronic download for two years as well as the articles within the journal. This is an excellent resource but it would be better if all of the articles could be searched. Testing of products to search the articles is still ongoing.

Costs for the website remain consistent. The hosting site suffered two major issues during this year. Firstly the statistics for the site stopped collecting from April 2012 until they were restarted again in Dec 2012. During November and December 2012 the website was forced to be taken offline due to a denial of service attack from unknown sources. The website was getting over 1 million hits per day. Measures were taken by ACKMA and the service provider to reduce the possibilities of any further attacks and then the website was put back online and the attacks have not returned.

The use of PayPal to pay annual ACKMA membership subscriptions online has again been examined. The last committee meeting requested that I implement this but I have had no response from the committee members regarding this. Requests to create the required PayPal accounts have not been actioned.

The ACKMA mailing list activity has increased slightly from last year with 119 messages posted in the last twelve months compared with 104 in 2011/12.

The usage stats for the website cannot be provided this year due to the loss of the data when the service stopped working for over 8 months. I will provide data next year once we have logged another year’s data.

As an indication of how everyone is accessing the website here’s the top 20 pages used to enter the site for January 2013

Top 20 of 870 Total URLs					
#	Hits		KBytes		URL
1	73443	25.92%	488631	52.34%	Home Page
4	316	0.11%	11414	1.22%	/journal/51/CONFERENCE MAGIC - Kent Henderson.htm
11	80	0.03%	171598	18.38%	/membersonly/journal/89/89 Full ACKMA journal.pdf.pdf
12	66	0.02%	213	0.02%	/nzcaves/north/waitomo.html
13	53	0.02%	95	0.01%	/conf2013/
14	49	0.02%	1034	0.11%	/membersonly/
16	47	0.02%	1390	0.15%	/membersonly/mmenu.js
17	44	0.02%	4334	0.46%	/conf2013/glowworms.jpg
18	44	0.02%	3098	0.33%	/journal/journals_pub.html
19	42	0.01%	12571	1.35%	/conf2013/waitomovc.jpg
20	41	0.01%	272	0.03%	/membersonly/
21	39	0.01%	13166	1.41%	/conf2013/Ruakurimirrorpool.jpg
22	39	0.01%	12409	1.33%	/conf2013/boatingrotto.jpg
23	39	0.01%	13345	1.43%	/conf2013/bwr.jpg
24	39	0.01%	6687	0.72%	/conf2013/mangapohue.jpg
26	37	0.01%	4615	0.49%	/membersonly/journal/journals.html
27	33	0.01%	20722	2.22%	/conf2013/Welcome_to_Waitomo_2013.pdf
28	25	0.01%	2513	0.27%	/journal/74/GLOWWORM POO - Peter Chandler and Dr Claire Baker.pdf
30	22	0.01%	1228	0.13%	/conf2013/conference_registration_form.pdf

I removed hits on items such as menu's, logos etc and left behind actual pages or groups of pages that are being accessed. Kent Henderson's conference article has finally knocked out the Glowworm Poo article as the most downloaded page. The 2013 conference pages also proved popular but guess what article still remains in the top 20 - yep that Glowworm Poo fetish remains :-)

Good to see interest in caving areas in New Zealand with hits on Waitomo caves the highest. Clearly members and others are checking out what they may see at the 2013 ACKMA conference in New Zealand. If you want to see how the website is going at anytime just go to:- <http://ackma.org/webalizer/> This link will show you the last 12 months statistics for the site (except at present were only the last 4 months are displayed) and you can look at many more statistics by the month.

Agenda item, 2013 ACKMA AGM
Cathie Plowman

ACKMA holds a conference every second year. The Australian Speleological Federation (ASF) also has a conference every second year and both conferences fall in the same year, usually within six months of each other.

I have started some conversations with some key people from both organisations about issues that this raises and whether there might be an option to move one of the conferences to 'another year' so as to separate the conferences.

Why separate the two conferences? There are a limited number of people engaged in caving, cave conservation and cave management and the current conference calendar limits further participation. People who are members of both organisations are often limited to attending one conference or the other due to cost and time issues. Having the conferences in different years would add to the number of people who could be active in both organisations.

To date I have had personal, email and phone discussions with a number of people from ASF and ACKMA and there seems to be:

- 1) No objection to separating the two conferences; and
- 2) A number of people who feel this would be a positive thing to do.

The next ACKMA conference is scheduled for Naracoorte in 2015. My suggestion is that the next ACKMA conference following this not be until 2018. There is a bid by the ASF to host the International Union of Speleology Conference (IUS) in Sydney in 2017. If this bid is successful, the next scheduled ASF conference will be in 2019.

Hence the upcoming schedule of ASF and ACKMA conferences is:

2014 No conferences
2015 ACKMA (Naracoorte); ASF (Kimberley)
2016 No conferences
2017 Bid for IUS conference in Sydney (Penrith is the proposed venue)
2018 I propose that this is when we have the next ACKMA conference (following Naracoorte)
2019 ASF conference

This agenda item is put forward so as to have further discussion.

ACKMA Financial Members as at 10 April 2013

Aley C & T
Cango Caves
Cave Management Group SDN. BHD.
Downey W
Griffiths P
Nick Powe
Ramsey C L
Stone Dr F
Terry Bolger
William Bagshaw
American Cave Conservation Association
Bat Conservation International
David Summers
Devevec A
Dr Guilhelm de Gruilly
Dr Janez Mulec
Dr Pavel Bella & Ing. Peter Gazik
Gordon L Smith
Indiana Karst Conservancy
Lynn K. Roebuck,
M. Alain Frances
Malaysian Karst Society
Marinelli R
National Caves Association
Peter Harrison
Rumei Bian
Simun Jeffry
Tomas Zorman
Clark B
Anderson J & R
Andy Baker
Aquifer Tours (Gary Turner)
Atkinson A & V
Augusta-Margaret River Tourist Bureau
Baddeley G
Baker Andrew
Bauer Peter
Bennett, Jill
Bourne S
Bradford G
Brooks, Lisa
Brown Peter
Brown, Russell
Brush J
Lewis, Ian D
Maclucas J
Matthews E. W.
Matthews P.
McCabe M
Merritt, Dr D
Middleton G
Mole Creek Caves (Senior Ranger)
Moore T
Moulds T
Mouritz R
Butler D & Plowman C
Capricorn Caves (Ann Augusteyn)
Carden D
CAREY'S CAVE (Geoff Kell)
Cave Exploration Group [S.A.] Inc.
Chillagoe Caving Club (The President)
Clark, Ian D, Prof.
Coggan M
Commins G
Cove D & D
Culberg A & P
Cummings, Graham
Dalzell B
Dept of Conservation & Land Management (Anne Wood)
Dept of Environment & Natural Resources (Deborah Carden)
Dept of Environment & Natural Resources (Nick Heath)
Dept of Environment & Natural Resources
Dixon K
Dr David Gillieson
Dr Mark Sefton
Drysdale Dr. R
Eberhard R
Eberhard S
Eddison A & I
Farquharson, A.
Farquharson, B
FERRARI B.
Fleming K
FLINDERS UNIVERSITY SPELEOLOGICAL SOC.
Foulds Rob
Ginnane, Vincent
Griffin A
Grills P
GRIMES. K.G.
Hatcher J
Haygarth, Dr N
Heath N
Highland Caving Group
Hunter D
James C
James J Dr.
Jenolan Caves Reserve Trust (General Manager)
Karst & Geodiversity Unit
Kennedy S
Wools-Cobb D
Yanchep National Park (Julia Coggins)
Yarrangobilly Caves
Yeung, Monica
Little L
Australasian Bat Society
Australian Serials Unit
Bradley C
DUNKLEY. J.
ENGELBRECHT CAVE (Cave Co-ordinator)
GARTRELL G.

Moylan M & R
Murrindal Caves
Nykiel Patrick
Orange Speleological Society
Osborne Dr R
Parkes. G.
Peck Dr W
Petrovic, Lilly
PIERCE. M.& R.
Poulton R K
REBBECHI. D. A.
Reilly, S.
RICHARD. B.
Roach, Regina
Robins T & Taylor N
ROBINSON. L.
Rowe, Alison
Rowling D
ROWLING J
Rutledge J
Sellars C.
Shannon C H
Sharples C
Smith G K
Stoffels, Dirk
Sydney, Joe
UNDARA EXPERIENCE (G. Collins)
W.A. Speleological Group (G. Thomas)
Waterworth Pippa
Watson. Dr. J.
Weidmuller (David Head)
Wellington Council (Chris George)
White. N.
White. S.
Whyte R
James and Claire Holden
George and Maria Wells
Real Journeys staff
Jane Baird
Libby Chandler

Guiding Organisations Australia
HAMMOND. G.
HENDERSON. K
Jenolan Caves Historical & Preservation Society
National Director, CDAA
State Library of Victoria
Chalker M
Costigan A
Hamilton-Smith. E.
Holland E
Shaw C & K
SPATE. A.
Vavryn. D.& J.
Webb. R.
WOMBEYAN CAVES
Dave Williams
Kevan Wilde
Greg Martin
Peter Chandler
Dave Smith
John Ash
Neil Collinson
Phil Wood
Philip Woodward
John Moran
Mary Trayes
Norm Fleming
Angus Stubbs
Robert Tah
Travis Cross
Van Watson
Kyle Barnes
Richie Kersel
Celina Yapp
Simon Hall
Janet Morgan
Moir
Lipyeat
Gordon Hewston
Chris de Freitas
Alice Shanks

AIMS OF ACKMA

- To develop improved standards in the management and interpretation of cave and karst heritage in the Australasian Region.
- To enhance liaison between agencies and those interested in cave & karst management.
- To encourage and support scientific research which may further the improvement of standards in cave and karst management.
- To formulate and promote policies and initiatives in cave and karst management.
- To do any other things which are conducive or incidental to the attainment of the above.

A BRIEF HISTORY OF ACKMA Inc

Conferences on Cave and Karst Management have been held in this region since 1973. From then until 1987, they were organised under the auspices of the Australian Speleological Federation, the first five being termed Australian conferences on Cave Management and Tourism.

In 1987, The Australasian Cave Management Association (ACMA) was formed at a meeting held at Yarrangobilly Caves during the 7th Conference in NSW. All conferences since have been referred to as Australasian Conferences on Cave & Karst Management.

The Association re-named itself the Australasian Cave & Karst Management Association (ACKMA) at the subsequent biennial General Meeting associated with the 8th Conference held at Punakaiki, New Zealand, in 1989. At the 1995 biennial General Meeting at Derwent Bridge, Tasmania, during the 11th Conference, the Association became incorporated as ACKMA Inc. Prior to that date Officers of the Association were elected to two year terms. The tenure of officers is now twelve months. The Proceedings of all twelve Conferences thus far held have been published.

The first edition of The ACMA (later ACKMA) Newsletter was published in June 1988 - a mere 12 pages. It was thereafter published half-yearly until 1993. For the subsequent 18 months, it was published quarterly, with two full "Journal Editions", and two (minor) "Newsletter Editions". The publication was permanently renamed the ACKMA Journal from edition 16 issued in September 1994, and from edition 19 (June 1995) it was been issued quarterly as a full Journal. Membership of ACKMA inc. is open to all individuals or organisations who support these

Contact Information for ACKMA: 2012-13 Committee

President - Peter Chandler

Australian Vice President - Dan Cove

Conservation Officer - Dave Smith

New Zealand Vice President - Dave Smith

Executive Officer - Cathy Sellers

Treasurer - Grant Gartrell and Membership Records Officer

Publications Officer - Steve Bourne and ASF Liaison Officer

Forthcoming Conference Convener - Libby Chandler

Interpretation Officer - Dan Cove

Public Officer - Miles Pierce

International Relations - Andy Spate

Webmaster - Rauleigh Webb

Committee Member - Kirsty Dixon

Committee Member - Sasa Kennedy

Committee Member - John Brush

Conference Delegates

JOHN ASH

Counter Delivery 5, Waitomo Caves Post Centre, Waitomo 3943, New Zealand

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ACKMA member, Waitomo Discovery Centre and Environmental Advisory Group – co-founder of the Legendary Black Water Rafting Company, Member of Waitomo Catchment Trust.

ANN AUGUSTEYN

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Fellow of ACKMA. Ann and her family have owned and operated Capricorn Caves, Rockhampton, Queensland since 1988. Now semi-retired.

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Fellow of ACKMA. Director with local council. Publications Officer. Has spent many years observing and researching the endangered bat population at Naracoorte Caves and involved with palaeontological research.

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Fellow of ACKMA and Manager, Naracoorte and Tantanoola, South Australia. Tantanoola is a delightful showcave - one of Australia's most exquisite. Naracoorte Caves National Park is one of Australia's World Heritage Fossil Mammal Sites, being co-listed with Riversleigh in Nth Queensland. Interests: Family, friends, fossils. Walks, hikes, caves.

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Life Member of ACKMA. President of ACKMA. Operator of Spellbound Glowworm and Cave Tours. Previously co-owner of Blackwater Rafting (for 16 years). Interests in all aspects of cave management and visitor experience.

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Member of NZSS

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Ph: (03) 6243 0546 (home) (03) 6243 0829 (facs); email: culbergf@bigpond.com

Conference organising committee and retired geography teacher who was active taking school groups into caves while teaching.

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Started caving January 1966, led the cave-in at Church Creek Caves in August 1968, attended 8th ASF Conference, and field trips, in Dec 1970 in Hobart. Has been Secretary of ASF, manager of ASF newsletter, co-convened 2nd Australasian Conference on Cave Management in 1976, and is now a Trustee of the ASF Gift Fund. In 1990 started Exit Cave Adventure Tours, which ran for five years. Was Treasurer of Tasmanian Licensed Guiding Operators Association from 1992 to 2007 and helped convene the 14th International Symposium on Vulcanospeleology in 2010.

BRETT DALZELL

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Previous manager of S.A. Nullarbor karst area, keen caver and environmentalist

LAURA DAWSON

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Te Anau Glowworm Caves operations supervisor.

GEOFF DEER

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email: gunnsplainscaves@bigpond.com

Owner/operator (with wife Trish) Gunns Plains Caves since 2004.

TRISH DEER

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Ph: (03) 6429 1133 (home) (03) 6429 1388 (work) (03) 6429 1362 (facs) 0411 294 761 (mobile)

email: gunnsplainscaves@bigpond.com

I started work at caves when I was 13 years of age and fulfilled my dream when Geoff, Benjamin (our son) and I took over the lease in 2004. What a great office to work in.

KIRSTY DIXON

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Kirsty's Mum!

ANDY EAVIS

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Background limestone geology of the Waitomo Area

Extracts kindly supplied from the field trip guide for Geosciences 2012, the annual Conference of the Geoscience Society of New Zealand, Hamilton:

C3 - Cenozoic Carbonates and Caves

Cam Nelson and Chris Hendy, University of Waikato

Bibliographic reference:

Nelson, C.S. and Hendy, C.H. (2012). C3 – Cenozoic Carbonates and Caves. In: Lowe, D. and Pittari, A. (eds). Field Trip Guides, Geosciences 2012 Conference, Hamilton, New Zealand. Geoscience Society of New Zealand Miscellaneous Publication 134B. XX p.
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Nontropical (or temperate or cool-water) limestones

The birthplace of shallow-water or platform limestones has traditionally been regarded to be in the warm shallow seas of tropical regions (Table 3A). However, we now know that modern shelf carbonate sediments can also be widespread in cool to cold waters beyond the tropics, and there is growing awareness that extensive tracts of shelf limestones in the geological record probably also originated in cool waters at more temperate latitudes (Nelson 1988a). The paleoenvironmental interpretation of shelf carbonate rocks is consequently not always so straightforward, and the geologist requires criteria that can help distinguish this broad spectrum of carbonate facies types.

Despite the tectonically active setting of New Zealand, presently at 35-45oS latitude, modern cool-water skeletal carbonates are common on those shelf sectors where terrigenous sediment supply is low (Table 3B). Moreover, skeletal limestones that are fossil analogues of the modern deposits are widespread at times during the Tertiary, when the New Zealand subcontinent was drifting northwards (60-40oS paleolatitudes) out of the Southern Ocean, away from Antarctica (Nelson 1978b). The carbonate facies in the Oligocene Te Kuiti Group exemplify all the characteristics of such a nontropical or temperate or cool-water shelf carbonate regime (Nelson 1973; Anastas et al. 1997, 2006; Tripathi 2008), as do all NZ occurrences of Tertiary age limestones (Nelson 1978b; Table 3C).

Limestone composition

Compositional aspects of the Te Kuiti Group rocks are fully described in the theses of Nelson (1973) and Tripathi (2008), and summary information is provided by Nelson & Hume (1987). The carbonate fraction is dominated by the fragmental remains of a wide variety of invertebrate skeletons, principally bryozoans, echinoderms, foraminifera (benthic and planktic), and epifaunal bivalve molluscs, but also infaunal bivalves, calcareous red algae, brachiopods, and serpulids (Nelson 1973; Nelson et al. 1988b; Hayton et al. 1995). Overall, whole fossils are rare (Nelson 1978). Siliciclastic material includes quartz, plagioclase and potash feldspar, volcanic and sedimentary rock fragments, and clay minerals (smectite, chlorite, illite, and kaolinite). Pelletal glauconite is ubiquitous, sometimes abundant, and rare limonitised pyrite spheres occur. The rocks are strongly cemented most commonly by granular and syntaxial rim calcite spar or microspar, and locally by micrite (very fine-grained calcite). Except for local marine cemented horizons associated with some unconformities or persistent high energy current conditions (Nelson & James 2000), the cements are mainly of burial origin as evidenced from the widespread development of pressure-dissolution features in the limestones, such as dissolution seams, stylolites, and microstylolites, so that rock fabrics are tight and rock porosity values are very low or zero (Nelson et al. 1988a; Hood & Nelson 1996).

Using Folk's (1962) petrographic classification for carbonate rocks the Te Kuiti limestones are biosparites and biosparudites, less commonly biomicrites and biomicrudites, while Dunham's (1962) scheme would have them as predominantly skeletal grainstones and rudstones, or occasionally packstones (Fig. 6).

Table 3: Comparison of tropical shelf carbonate model (A) with NZ modern (B) and Cenozoic (C) carbonate deposits (adapted from Nelson 1978, 1988b).

Environmental or facies parameter	A. Tropical shelf carbonate model	B. New Zealand modern shelf carbonates	C. New Zealand Cenozoic shelf limestones
Latitude	From 30°S to 30°N	From 49°S to 33°S	From 60°S to 35°S
Depositional setting	Shallow rimmed shelves and platforms	Deeper open shelves, ramps and platforms	Open shelves, platforms and seaways
Marine climate zone	Tropical-warm subtropical	Warm-cool temperate	Warm-cool temperate
Sea-water temp. (mean)	Above 23°C	13-19°C	Below 20°C
Sea-water temp. (min.)	About 14°C	9-12°C	About 5°C
Sea-water salinity	Normal-hypersaline	Normal	Normal
CaCO ₃ saturation at/in sea bed	Highly supersaturated	Mildly supersaturated to ?locally undersaturated	Infer mild supersaturation to local undersaturation
Water circulation	Restricted-open	Open, strongly storm- and tide-dominated	Open, storm- and tide- dom. shelves/seaways
Tectonic regime	Stable, slow subsidence	Stable-unstable	Stable-unstable
Shelf gradient	<0.5 m/km	0.25-2 m/km	>0.5 m/km
Reef structures	Common (especially coral/coralgal)	None (some oyster banks)	Rare (oyster banks; bryozoan mounds)
Sedimentation rates	10-1000+ cm/ky	1-15 cm/ky, often relict	<5 cm/ky, many diastems
CaCO ₃ content	>90%	50-100%	50-100%
Siliciclastic grains	Rare	Rare-abundant	Rare-abundant
Glauconite	Rare	Common, especially in skeletal chambers	Common, pelletal and in skeletal chambers
Dolomite and evaporite minerals	Common-rare	Absent	Absent (locally rare late diagenetic dolomite)
Non-skeletal carbonate grains (e.g. ooids, pellets)	Common-abundant	Absent	Absent
Major skeletal grain types	Calcareous green algae Corals (hermatypic) Benthic foraminifera Molluscs generally Coralline algae	Bryozoans Molluscs, mainly bivalves Forams, mainly benthic Echinoderms Barnacles Coralline algae Serpulids Brachiopods Corals (ahermatypic) Sponges	Bryozoans Molluscs (epifaunal bivs.) Forams, mainly benthic Echinoderms Barnacles Coralline algae Brachiopods
Main skeletal assemblages (Hayton et al. 1995 Sed. Geol. 100: 123-141)	Chlorozoan Chloralgal	Bryomol Bimol (Nannofof)	Bryomol, Echinofor Barnamol, Rhodechfor Bimol (Nannofof)
Algal mats/stromatolites	Common	Absent (or not preserved)	Absent
Overall diagenetic regime	Constructive	Destructive	Destructive
Carbonate mud	Common-abundant	Absent-rare, flushed and by-passed offshore	Absent-rare, locally as matrix, increases offshore
Main origins of carbonate mud	Disintegration calc. green algae and inorganic pptn.	Physical abrasion, bioeros. & maceration of skeletons	Skeletal abrasion and bioerosion; nannofossils
Primary sediment mineralogy	Aragonite > HMC > IMC > LMC	LMC+IMC > HMC ≥ aragonite	LMC+IMC > HMC ≥ aragonite
Main envir. of alteration of metastable carb. grains	Subaerial/meteoric	Beginning submarine	Submarine to shallow burial, rarely subaerial
Environment of major lithification	Submarine and subaerial/meteoric	Unlithified	Subsurface burial, rarely subaerial/meteoric
Timing of cementation	Mainly early diagenetic	-	Rarely early, mainly later diagenetic
Major carbonate cements	Aragonite and HMC	-	Rare IMC, mainly LMC (often ferroan)
Major sources of cements	Sea water and dissolution of aragonite grains	-	Pressure-dissolution of calcitic skeletons
Carbonate petrography	Mud-, wacke-, pack-, rud-, grain- and boundstones	Grain- and rudstones	Grain-, pack- and rudstones

Table 1: Lithostratigraphic subunits in main Te Kuiti Group limestone formations (Nelson 1978a)

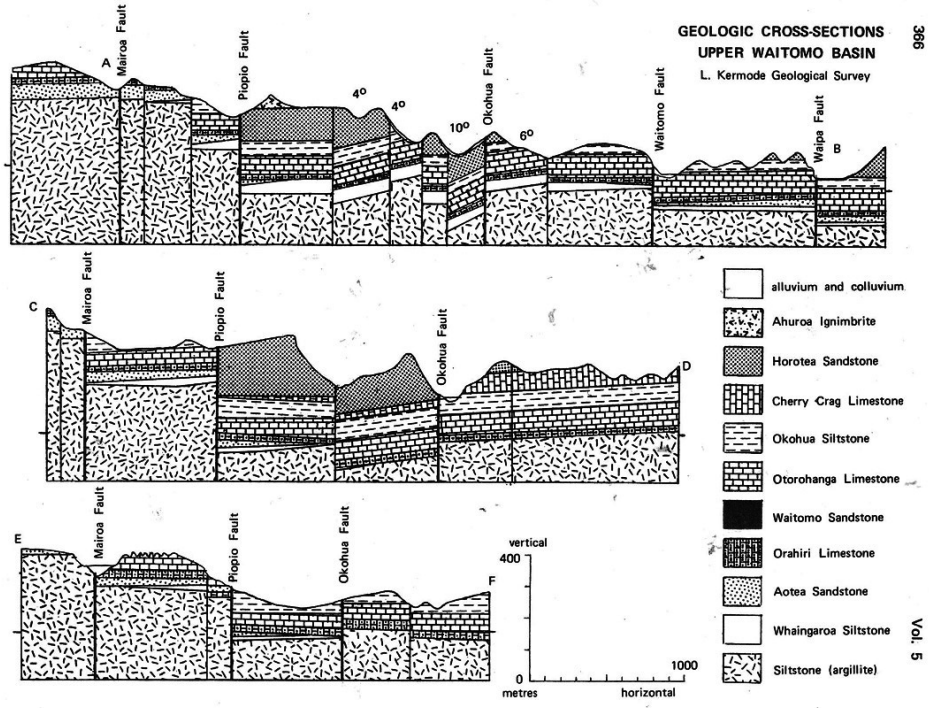
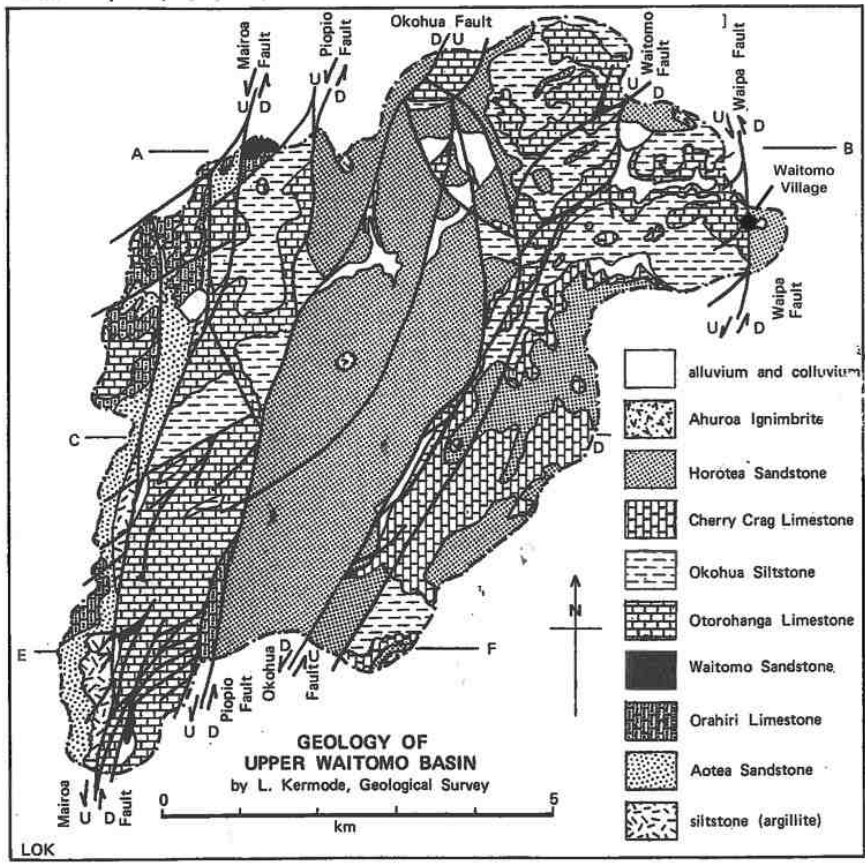
Subgroup	Formation	Member	Beds
Castle Craig (old Upper Te Kuiti)	Otorohanga Limestone (Ot)	Piopio Lst (OtC)	2. Argillaceous Limestone 1. Upper Flaggy Limestone
		Waitanguru Limestone (OtB)	3. Open Knobbly Limestone 2. Packed Knobbly Limestone 1. Blocky Limestone
		Pakeho Limestone (OtA)	3. Irregularly Seamed Limestone 2. Lower Flaggy Limestone 1. Basal
	Waitomo Sandstone (Wt)		
	Orahi Limestone (Or)	Te Anga Limestone (OrB)	7. Coquinite 6. Limestone-in-Limestone 5. Fossil-hash 4. Massive Sandy Limestone 3. Semiknobbly Limestone 2. Oyster 1. Flaggy Limestone
		Mangaotaki Limestone (OrA)	6. Pebbly Micritic Limestone 5. Bimodally-Sandy Limestone 4. Upper Banded Sandstone 3. Massive Sandy Limestone 2. Glauconitic Limestone 1. Basal

Table 2: Av. carbonate-sand-mud contents for formations (from Nelson 1973).

Formation	%CaCO ₃	% Siliciclastic sand	% Siliciclastic mud
Otorohanga Lst	91.0	3.7	5.3
Waitomo Sst	46.6	37.2	16.2
Orahi Limestone	76.2	18.5	5.3
Aotea Fm (Sst)	44.7	43.3	12.0
Whaingaroa/Glen Massey Fm (Zst)	54.1	9.6	36.3

Table X – Petrographic classification of some Te Kuiti Group lithologies.

Formation	Petrographic classification
Otorohanga Lst	- Poorly to well sorted sparitic coarse and very coarse biocalcarenites or biocalcirudites (=bryozoan biosparites/biosparudites [Folk], or bryozoan grainstones/rudstones [Dunham])
Waitomo Sst	- Poorly sorted microsparitic bioclastic muddy very fine or fine quartzarenites
Orahi Lst	- Poorly to moderately sorted sparitic sandy medium and coarse biocalcarenites - Poorly sorted micritic coarse and very coarse biocalcarenites or biocalcirudites - Poorly to well sorted sparitic coarse and very coarse biocalcarenites or biocalcirudites
Aotea Sst	- Moderately well sorted sparitic bioclastic fine quartzarenites - Poorly sorted microsparitic bioclastic muddy very fine or fine quartzarenites
Whaingaroa Zst	- Poorly sorted quartz bioclastic claylutite



(diagrams above from Les Kermode, New Zealand Speleological Bulletin)

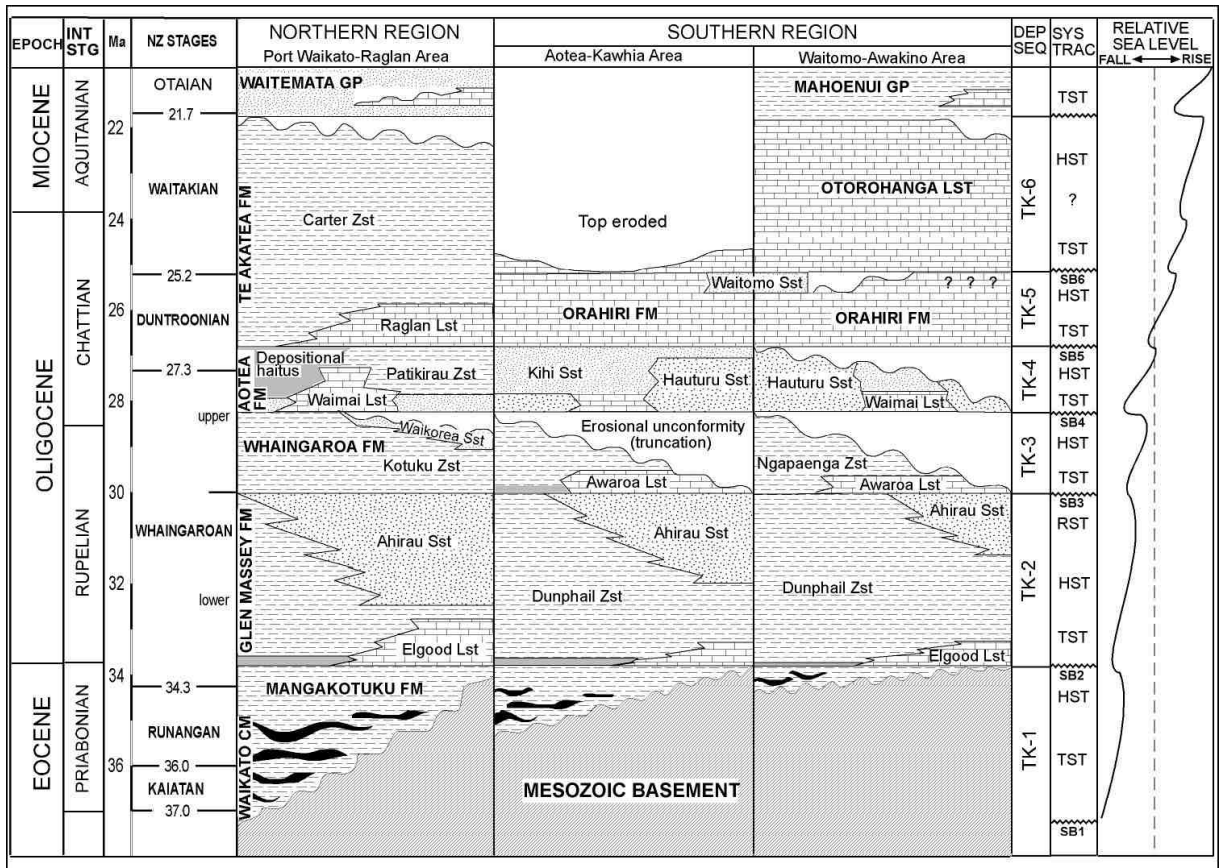


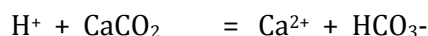
Fig. 3 – N-S lithostratigraphy of Te Kuiti Group formations and members From Tripathi (2008). (Tripathi, A.R.P. 2008: Basin Analysis of the Late Eocene – Oligocene Te Kuiti Group, Western North Island, New Zealand. PhD Thesis, University of Waikato. 368 p)

Karst geochemistry

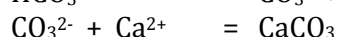
Plants expire large quantities of CO₂ from their roots raising the PCO₂ of the soil atmosphere to several % of an atmosphere. Water passing down through the soil will dissolve this CO₂:



When this solution comes into contact with the limestone the hydrogen ions attack the carbonates

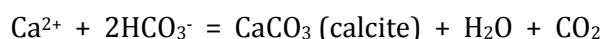


which results in solution of calcium ions and a disturbance of the chain of equilibria:



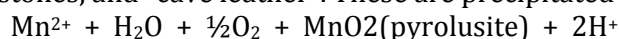
If the soils are shallow, as CO₂ is removed from solution through attack on CaCO₃ more is replaced from the soil atmosphere (open system). However, if the soils are deep and plant roots are isolated from the limestone, the PCO₂ will drop substantially, and the pH will rise as the water passes into the limestone.

When the solution re-emerges in a cave the PCO₂ will readjust to achieve equilibrium with the cave air. If it is higher than the cave air CO₂ will be lost from solution forcing carbonates to be precipitated.



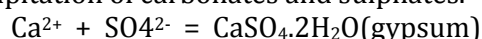
But if it is lower than the cave atmosphere the reverse will occur and further solution of calcium carbonate will take place. Where calcium carbonate is precipitated, formations known as "speleothems" will be deposited, such as stalactites, stalagmites and flowstone. Both of these effects occur in Ruakuri Cave.

A special problem can arise when large numbers of people occupy small or poorly ventilated caves. As people respire CO₂, the partial pressure rises in the cave atmosphere and can exceed that of the drip waters causing speleothems to redissolve. Other deposits can also occur as a result of the loss of CO₂ (and rise in pH) for example deposits of black MnO₂ (pyrolusite) in the form of cave varnish on stones, and "cave leather". These are precipitated by:



as the pH rises and oxygen is readily available.

Evaporation also causes precipitation of carbonates and sulphates.



This leads to deposits with a crumbly appearance as water moving by capillary attraction is not as constrained by gravity. Examples of "Cave Coral" can be found in many caves, including Ruakuri.

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