

MULU CAVES 2007

expedition report

An Anglo-Malaysian Expedition to the
Gunung Mulu National Park, Sarawak



REPORT
on the findings of
**THE MULU CAVES 2007
EXPEDITION**
to the
MELINAU GORGE AREA
of the
**GUNUNG MULU
NATIONAL PARK
SARAWAK**

During January & February 2007

Edited & Produced by Matt Kirby FRGS.



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1954 Passage, Whiterock Cave

Hugh St. Lawrence

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ABSTRACT

During January and February of 2007 a team of fifteen British cavers, with the close support of National Park staff, set up a base camp at Camp 5 in the Melinau Gorge. The expedition was to continue the exploration of Whiterock Cave in Gunung Api and also Moon Cave in Gunung Benarat; both caves held great potential for discoveries. However, the caves were far more extensive than had been anticipated and within the four weeks of the expedition 25.8km of cave passage had been discovered and surveyed.

Moon Cave

It was hoped that two leads left in 2005 would lead to a higher level of passages and possibly the large open entrance high in the cliff opposite Camp 5. Unfortunately this connection was not made and the elusive upper series remains for future explorers. However, a side passage to the west of the main passage led to a connection with Cobweb Cave. This now provides a link between Benarat Caverns, Moon Cave and Cobweb Cave making the Benarat Caverns System 50.5km long, the second longest cave system in the Park.

Whiterock Cave

Whiterock Cave provided a feast of exploration. A great deal of in-filling was carried out, with new passages providing short cuts between previously discovered trunk routes. This reduced considerably the travel times to the northern reaches of the system. Exploration northwards led to two passages which ended in calcite and boulders only 370m from Camp 5. In total 21.9km of passages were explored and surveyed bringing the total length of the cave to 42.9km. With the links to Clearwater, this establishes the Clearwater System as 151.4km, the tenth longest cave in the world.

Melinau Gorge Caves

In an attempt to provide a better understanding of the locations of caves on the Api side of the Melinau Gorge, some time was spent cataloguing and linking together known entrances by means of a surface traverse. A few new entrances were explored but the main result was that most of the known entrances could be connected into the master dataset.



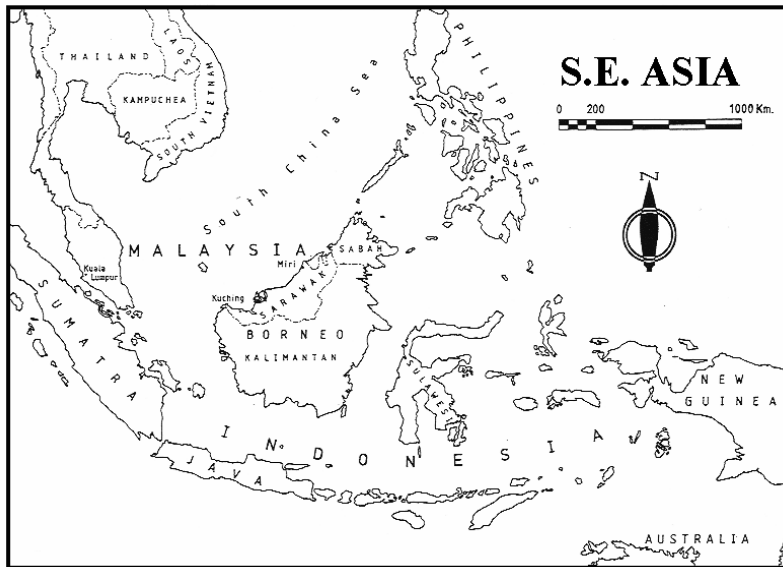
Camp 5 from the Melinau Bridge

Matt Kirby

INTRODUCTION

LOCATION

The Gunung Mulu National Park is situated in north-eastern Sarawak, with its northern boundary forming part of the border with Brunei, (Figs. 1 & 2). It was officially constituted in 1974 and opened to visitors in 1985. Lying 4° N. of the equator it covers an area of 528sq km.



The Park is dominated by the sandstone mass of Gunung Mulu, which rises to 2376m. To the west of Mulu, and on its flank, lies a band of 'Melinau' limestone, which forms the lesser peaks of Gunung Api and Gunung Benarat. The lower slopes are covered in dense tropical rainforest, which rises to meet the montane forest of Mulu's upper slopes.

Figure 1; SE Asia

Mulu is a rich mixture of plant and wildlife and in the limestones, beneath the forest canopy, lie some of the world's most impressive caves.

HISTORY of EXPLORATION in MULU

The existence of large caves in the Gunung Mulu area of Northern Sarawak has been documented for over 150 years. In 1858 reference was made to "Detached masses of limestone, much water-worn, with caverns and natural tunnels" around the base of Mulu by Spenser St. John in his book '*Life in the Forests of the Far East*', (St. John, 1862).

St. John was 'Consul General in the Great Island of Borneo' and made some of the earliest exploratory journeys of any European into the interior of Sarawak. His attempts to reach the summit of Mulu were thwarted by limestone cliffs, dense forest and sharp pinnacles of rock and he says, "It is almost impossible to conceive the difficulty of ascending this mountain". Mulu was to keep the secrets of its summit for a further 74 years until Edward Shackleton successfully climbed the mountain during the Oxford University Expedition of 1932, (Harrison, 1938).

In 1961 G.E. Wilford, of the Malaysian Geological Survey, visited the area to explore its

caves. His work included the surveying of Deer Cave and parts of Cave of the Winds. He predicted that Mulu would yield many more caves in the future, (Wilford, 1964).

During 1977-8 the **'Royal Geographical Society Mulu Expedition'** spent 15 months in the area studying many aspects of the rainforest. This was the largest scientific expedition ever to leave the UK. Included in the team were six speleologists who, in three months, explored and surveyed 50kms. of cave passages including parts of Clearwater Cave, Green Cave and others, (Brook & Waltham, 1978).

During the expedition a forest camp was established in Hidden Valley from where two major caves were explored. 'Wonder Cave' on the north side of the valley was found to have some of the largest passages in Mulu. 'Prediction Cave' on the south side also contained enormous passages which were almost filled with river sediments, (Meredith, Wooldridge & Lyon, 1992, p.10).

It was obvious from these findings that Mulu ranked as one of the world's foremost caving regions.

As a result of the RGS expedition two large scale caving expeditions were mounted in the early '80s. The **'Mulu '80'** expedition explored and surveyed a further 50km of cave

passages including the largest underground cavity, in the world, 'Sarawak Chamber', which forms the final chamber of 'Lubang Nasib Bagus' or 'Good Luck Cave', (Eavis, 1981). The end of this chamber lies very close to the end of Prediction Cave in Hidden Valley and tantalising draughts at the end of each cave suggested a connection.

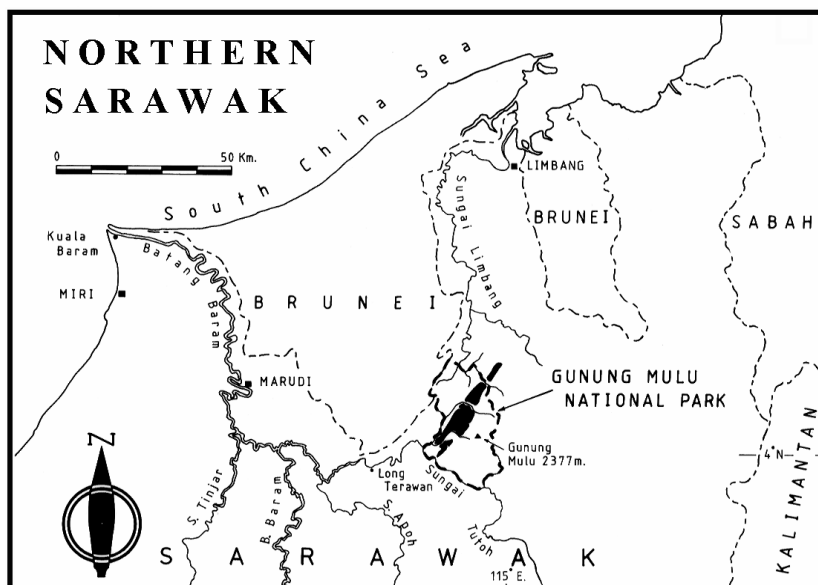


Figure 2; Northern Sarawak

In 1984 the **'Sarawak '84'** expedition spent one month in the field and explored 54km of caves. Clearwater Cave was extended by 14km but a great deal of work was carried out in Benarat where Cobweb Cave was discovered, adding a further 15km of passages to the Benarat total.

These two expeditions carried out a great deal of scientific research associated with the caves including dye tracing, geology, geomorphology, ecology, cave mineralogy, etc. However, although 150km of some of the largest caves in the world had been surveyed, some very significant areas of limestone remained totally unexplored presenting enormous potential for further exploration, (Fig 3).

During late '87 and early '88 plans were made to mount another caving expedition to the area. This would be the first expedition to visit the park since its opening to the public in 1985 and was primarily aimed at exploration, surveying and photography. Unlike the previous expeditions this was to be a lightweight venture with only six team members. The *'Mulu Caves '88'*, expedition once again proved the potential of Mulu with a further 16km of passages explored. It was also shown that exploration in Mulu using a small team was both feasible and successful.

The major discovery of this expedition was Blackrock Cave lying to the north of Clearwater and almost certainly part of the same system, (Kirby 1989, p.28).

As a direct result of this discovery, an eight strong group, including five of the 1988 team, returned to the Park exactly one year later as the *'Mulu Caves '89'* expedition. Once again a lightweight venture proved to be successful with over 24km of passages explored and surveyed in only one month. Major extensions were found in Clearwater Cave totalling 15km and the gap between it and Blackrock Cave was brought to within 90m. The Clearwater 5 streamway was discovered and explored for over 1km.

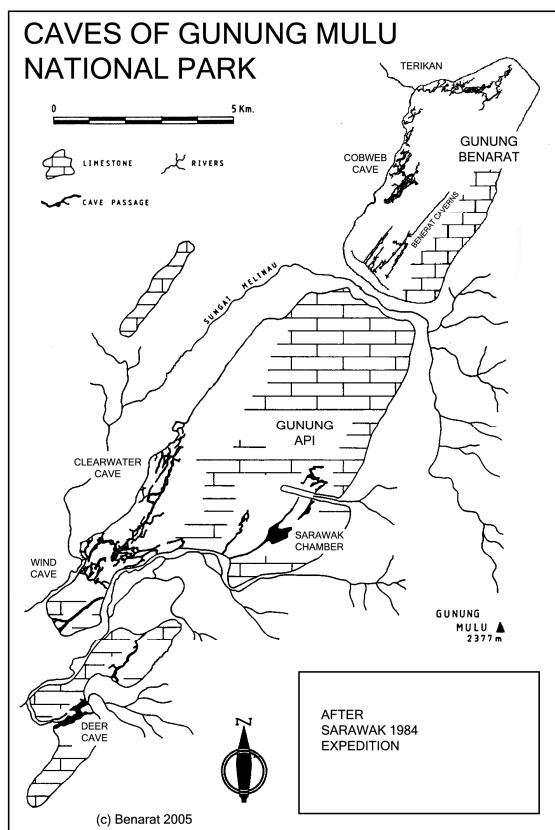


Figure 3; Exploration up to 1984

In 1991 a group of nine explorers, five of whom were from the '88 and '89 expeditions, returned to the Park to continue exploration in the Blackrock/Clearwater area. A connecting passage was discovered which linked the two caves. This discovery made the Clearwater System the seventh longest cave in the world at over 102km. This was the *'Mulu Caves '91'* expedition, (Fig 4).

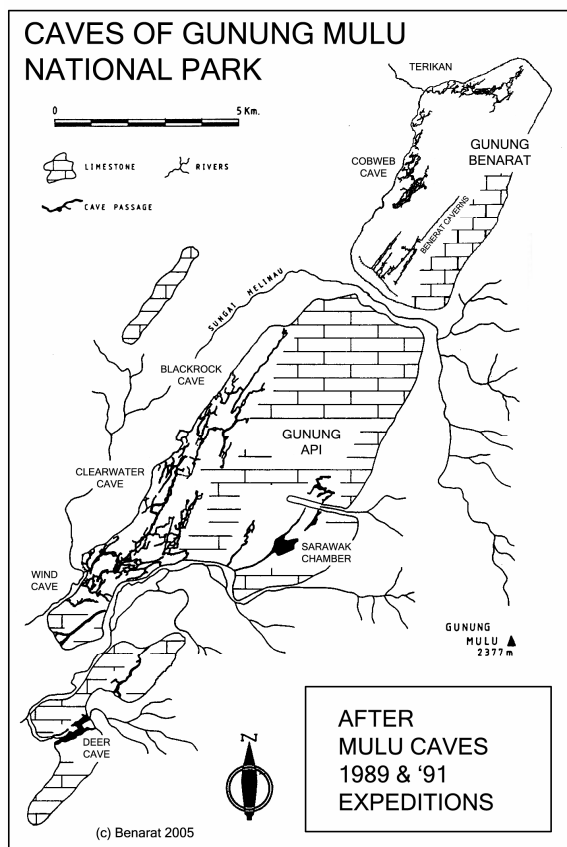
A new cave, provisionally named 'Simon's Cave', but later named 'Racer Cave', was discovered and explored and water tracing experiments proved a hydrological link from the Melinau Gorge through Blackrock and into Clearwater Cave, (Kirby, 1990). The discoveries made by these two expeditions had greatly altered the map of Gunung Api's caves.

During 1990 another British team visited the Park and continued the exploration of Racer Cave. The Clearwater 5 streamway was explored to an upstream sump. Although a sump bypass was found to lead into Clearwater 6, rain caused the bypass to sump which prevented further exploration (Weight, 1990). A physical link was established between Drunken Forest Cave and Alexandra Palace in Clearwater.

During February 1991 a Korean Team visited the Park. Some minor discoveries were made. Unfortunately these findings were not published.

A vast amount of work had, by this time, been carried out on the western flanks of Gunung Api and although discoveries were by no means exhausted it was becoming increasingly difficult to find major objectives which would justify another expedition to that side of the mountain. The remaining significant lead, the Clearwater 6 Streamway, was weather dependent and, therefore, could not be relied on as a sole objective.

Attention now focused on the more challenging eastern flank of Gunung Api with Hidden Valley as the first objective. This area was less accessible than the west as there were no major rivers which could be used for transport of stores and equipment.



Tentative enquiries were made in 1990 to see whether it would be possible to visit the Valley during the '91 expedition. A positive response was received and this became one of the secondary aims of that expedition. Unfortunately this was not achieved as other discoveries closer to park headquarters took priority. Instead, part of the '91 team returned approximately one year later in January 1993 as the *'Hidden Valley '93'* reconnaissance expedition with the sole objective of carrying out a lightweight reconnaissance of Hidden Valley.

The reconnaissance expedition proved a success with potential for further discoveries to be made in the two known caves within the Valley and a new cave discovered in the dolines to the west. Other entrances were noted for further investigation and surface reconnaissance suggested even greater potential further south in the deeper 'Third Doline', which was not entered.

Figure 4; Exploration up to 1991

With the Hidden Valley reconnaissance expedition indicating potential for further discoveries in Hidden Valley a full exploratory expedition, *'Mulu Caves '96'*, was mounted and returned to the Park in October 1996. A base camp was established within the Hidden Valley gorge between the entrances of Prediction and Wonder Caves. Although very little was found within the main gorge exciting discoveries were made in the dolines to the south west. Arch Cave was explored in the second doline. Prediction and Bridge Caves were found within the third doline and the fourth doline revealed Cloud Cave which matched Deer Cave in scale. During the last few days of the expedition a descending boulder ramp was followed which led into the far reaches of Cobra Cave. This established a through route to the Melinau Paku valley.

During 1997 an American expedition, which was exploring Gunung Buda, carried out surface searching on the northern slopes of Benarat. This led to the discovery of Deliverance Cave on the north east corner of the mountain. 3.5km of passages were explored which were heading in the general direction of Cobweb Cave.

With the success of the '96 expedition a second Hidden Valley expedition, '*Mulu Caves '98*', was mounted which returned to the Park in February 1998. As the centre of exploration was to be in the dolines it was known that this would not be best served by a camp within the Hidden Valley gorge. Not only would a camp in Hidden Valley be remote from the caves, it would also be almost impossible to supply without helicopter backup, which would be very expensive and could not be relied upon.

With this in mind, a gamble was taken on being able to reach the 4th Doline from the Melinau Paku Valley via a route, over the surface, which had never been explored. It was thought that the route through the caves would be used only as a back up, however, the severity of the climb up from Nasib Bagus, together with the surface terrain proved to be far more difficult than the underground route via Cobra Cave, which soon became the main thoroughfare.

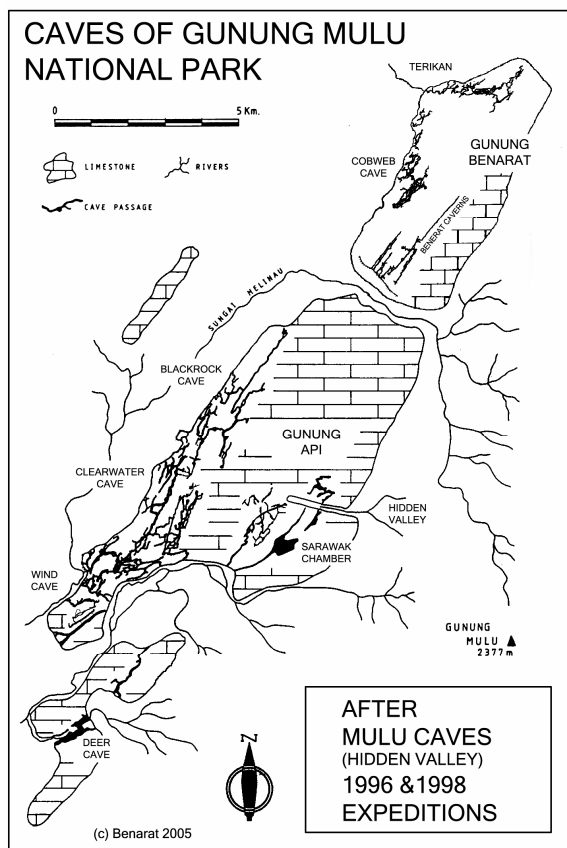


Figure 5; Exploration up to 1998

With exploration in Api now without any significant leads attention of the British team was drawn to Gunung Benarat. It had been sixteen years since a British expedition had visited the mountain during the Sarawak '84 expedition. The '*Benarat 2000*' expedition continued the exploration of Cobweb Cave where a further 10.7km of passages were explored bringing the total length of the cave to 25.9km.

This expedition proved a great success with further extensions in Perseverance Cave and a connection established between Cloud and Bridge Caves establishing the Cobra – Cloud – Bridge system at 16.1km. with a vertical range of 459m, the greatest vertical range of any cave in the Park.

Owing to the El Nino year river levels were exceptionally low so a further attempt was made to explore beyond the Clearwater 5 upstream sump into Clearwater 6. This led to another sump which was bypassed into Clearwater 7 and the inevitable upstream sump which was not passable. This expedition was the last to visit Hidden Valley.

Another American expedition visited Buda in 2000 and carried out further work in Deliverance Cave, bringing its total length to 4.3km.

As a follow up to the 2000 expedition the *'Benarat 2003'* expedition returned to the park. A further 4.4km were explored in Cobweb Cave but the significant discovery of the expedition was made in Terikan Rising Cave where 12.5km of passages were explored. Included in the team were two Api veterans who were to use the expedition, based at Camp 5, as an opportunity to prospect the northern slopes of Api between the Melinau Gorge and Blackrock's Racer entrance. This revealed a significant entrance 2.8km south west of Camp 5. The cave was named Whiterock and within the remaining three days of the expedition it had revealed 3.7km of new discoveries. Owing to its proximity to Blackrock it was thought that it would soon connect and might be of little significance.

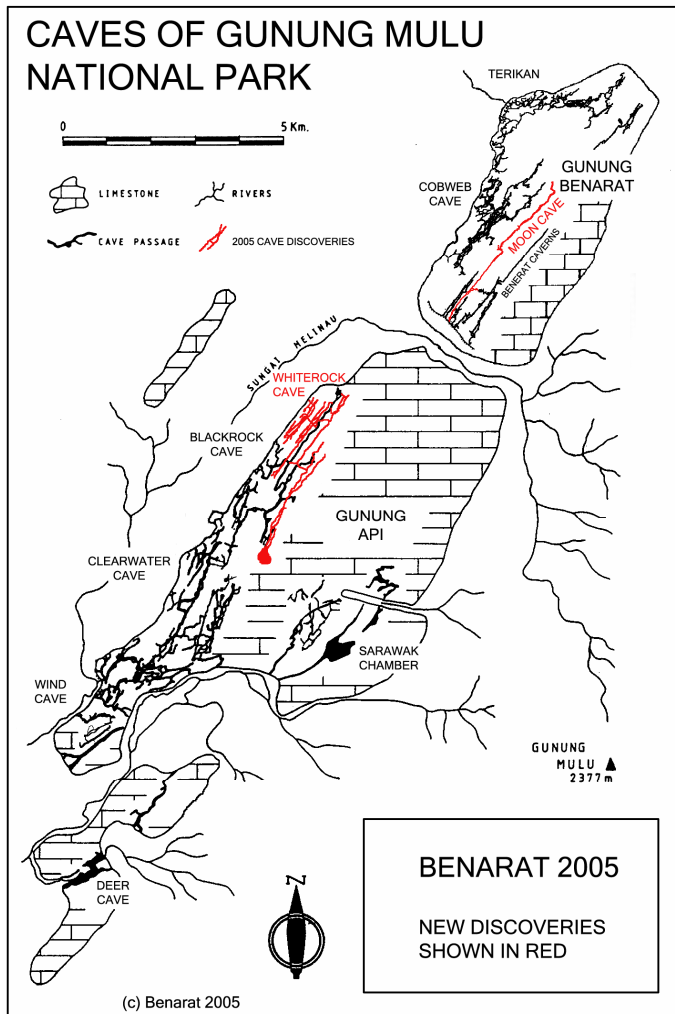


Figure 6; Exploration after Benarat 2005

The total length of caves in Benarat was now 90.4km and in Api was 172.6km.

During 2005 the *'Benarat 2005'*, expedition, based at Camp 5, continued the exploration of Whiterock which exceeded all expectations when a further 17.2km of passages were discovered, mostly lying above Blackrock. Two connections were made between the two caves which linked Whiterock into the Clearwater System.

On the Benarat side of the gorge an attempt to climb up to an entrance high in the cliffs opposite Camp 5 was cut short when a small entrance was discovered only 60m above the ground. This cave was named Moon Cave and was explored for 6.6km in an almost straight line into the mountain. A connection was also established with Benarat Caverns making the total length of this system 16.4km

Included in the expedition were two divers who investigated the sumps in the Terikan system. This proved connections between the individual elements of the system to make a total length of 32.5km.

THE MELINAU GORGE

TOPOGRAPHY

The Melinau Gorge forms the natural boundary between Gunung Api and Gunung Benarat. To the north of the river the Benarat cliffs rise to 500m and are the dominant feature of the gorge. Above the cliff line steep tree covered slopes hide a heavily pinnacled landscape which rises up to the summit of Gunung Benarat. Weather systems frequently manifest themselves as swirling mists and clouds which provide dramatic, rapidly-changing displays.



Sunset reflected on the Benarat Cliffs

Matt Kirby

A steep track rises 1200m up the shoulder of Api to provide a splendid view of the world famous limestone Pinnacles. Beyond here the summit of Api looms high. This was first climbed in 1978 during the RGS expedition but is no longer visited owing to the impossible nature of the terrain.

Orientated east-west, the gorge intersects the 30° strike controlled caves which are revealed as large open entrances in the cliff face on the Benarat side. Examples of these are Lower and Upper Tiger Caves which were explored in 1980. Other entrances have been found at the base of the cliffs, which in reality is at the top of a long tree-covered scree slope well above river level. These are Benarat Caverns, Hurricane Hole and Sakai's Cave. Above the Tiger Cave entrances and further to the east is another obvious entrance which has been used by swift nesters who have set up an arduous route over the surface to the top of the cliff to a point from where they have abseiled down to gain entry. To date this cave has not been explored by an expedition and little or no anecdotal evidence exists as to its extent. During the 2005 expedition an attempt was made to reach this entrance by setting up a bolting route along its associated bedding. This was abandoned short of its goal when Moon Cave was discovered only 60m from the top of the scree slope.

Further still to the east is another obvious entrance, Melinau View Cave. This was entered in 2000 after a 40m climb up the cliff but found to be blocked after 15m.

The topography on the Api side of the gorge is far more complex. It comprises very steep tree clad slopes, which offer little visual evidence of entrances. The ground is intersected by overhanging cliffs which make exploration extremely difficult. Aerial reconnaissance has

provided little or no benefit. Although a large open entrance, 'Canopy Cave', has long been known, it has not been entered by an expedition. However, there is anecdotal evidence that swift nesters have entered to find it totally blocked with sediments after a short distance. This entrance is considerably higher than the known caves in Api and further to the east. The single minded nature of the passages in both Blackrock and Whiterock Caves had suggested that the gorge would have intersected similar large passages on its south side; however, finding any evidence of these has eluded explorers for thirty years.



The Melinau Gorge from the west

Andy Eavis

Much surface searching has been carried out on the Api side of the gorge but has revealed only small passages which appear to be a result of marginal drainage. However, a large sink feature to the east of Camp 5 had been dye traced to Blackrock and Clearwater proving a flow path at base level. This feature appears to take drainage from the slopes of Api and not from the Melinau River. Water cascades down through boulders from a rising higher up the slope. The sink is aligned more closely with the strike line of the main passages in Whiterock and Blackrock and likely to be a main feeder for the Clearwater streamway as seen in Blackrock.

The gorge continues to fascinate cave explorers and has drawn them back to this area for the past 29 years.

THE MULU CAVES 2007 EXPEDITION

BACKGROUND TO THE EXPEDITION

With the return of exploration to Benarat in 2000 much had been revealed within the known caves and a better understanding gained of the surface topography of Benarat. It was known that there was a valley feature between Terikan and Cobweb, which may have cut off a significant number of passages which could have provided high level links between the two caves. Cobweb had been extended to 30.3km. The three sections of Terikan had been joined via sumps and sump bypasses and Menagerie cave had been connected into the same system making it 32.5km. Hurricane Hole had been discovered and linked to Benarat Caverns. Moon Cave had been found and explored for 6km almost dead straight along the strike, penetrating half way into the mountain. It had also been connected into Benarat Caverns making a 16.4km system. Owing to the way in which known caves were now overlapping each other, there was real potential for establishing links between the major systems, Terikan, Cobweb, Moon, Benarat, or even linking the whole lot together.

On the Api side of the gorge, each expedition had carried out surface searching but only documented the individual caves and not carried out surface surveys to link these in to the overall Mulu master survey. For years it had been a frustration that subsequent expeditions, upon finding entrances, were never sure whether these were ones which had been previously explored or whether they represented new finds.

During 2003 the discovery of Whiterock Cave had re-fuelled interest in Api, with a potential for finding the elusive passages which were hoped would extend as far north as the gorge and possibly reveal hidden entrances close to Camp 5. The exploration of Whiterock had started at low level with the first expedition exploring 3.7km of passages. During 2005 access was gained to higher levels which demonstrated the same single-minded strike-controlled features as in Benarat. Connections were made into Blackrock, linking the cave into the Clearwater system, but large north trending passages had been left as open leads with the potential to go right to the gorge. It was these which featured at the top of the objectives for the 2007 expedition.



The world-famous limestone Pinnacles on Api

Dave Nixon

THE ROUTE IN

The expedition was based at Camp 5 in the Melinau Gorge. Normal access to the camp is from Park HQ. The first 7km section of the journey is by longboat up the Melinau River from Park HQ to Kuala Lutut, the normal limit of the navigable river. From here the rest of the journey is on foot. A footpath follows the east bank of the river to Kuala Berar where the Headhunter's Trail officially starts. From here to Camp 5 is 8.4 km, most of which is on easy going alluvial plain through primary rainforest. At this point the track crosses onto an island via a new suspension bridge. The island lies between two courses of the Melinau River. This is a highly dynamic watercourse which regularly switches between the two channels. At the north of the island another bridge returns the track to the east of the river to continue through the forest to Camp 5.



The Melinau bridge

Matt Kirby

In places the track is hard against limestone cliffs and crystal clear water can be seen emerging from resurgences which are crossed on wooden bridges. Before the expedition a recent flood had caused the river to change course here, pushing it hard against the limestone. This had eroded the normal track so a bypass had been quickly cut over the hill by Park staff. This climbed a rather awkward track over the shoulder of the hill then returned to the alluvial plain at a muddy quagmire. From this point the track is easy going to Camp 5. The journey from Kuala Lutut to Camp 5 would normally take 2 to 3 hours at a gentle pace.

A helicopter is normally used to ferry supplies and team members from Park HQ. Unfortunately, owing to a lack of fuel, only a limited number of return runs could be made so the stores took priority. On the last trip a few fortunate souls who hadn't been in a heli before were allowed to fly in. The rest of the team made the journey on foot.

CAMP 5; BASECAMP

Camp 5 lies on the south side of the river at the downstream end of the gorge. The site is dominated by the massive cliffs of Benarat to the north which reflect dramatic orange tones in the light of the setting sun. The camp was first established in 1978 as a field base during the RGS expedition. It has evolved considerably since then and now provides a comfortable night's rest for travellers visiting the Pinnacles or mid way on the 20km Headhunters' Trail between Kuala Berar and Mentawi Ranger Station.

The camp is permanently manned by Park staff with one guide and one housekeeper on duty at all times to cater for tourists passing through. Accommodation is in dormitory rooms typically ten to a room, and sleep mats are provided. Mosquito nets are not provided, these are particularly useful to keep the sand flies off at night, mosquitoes are less prevalent. Camp 5 can house sixty visitors in its five dormitories. The expedition occupied two dormitory rooms in the main block. There is a separate shower and toilet block where ‘interesting’ creatures can be found scurrying around once the lights go out. A large kitchen just off the dining area provides stoves for cooking. The dining area consists of three large tables and at night bats swoop around and around taking any sort of flying insects which are attracted to the lights; they never fly into anyone.



A night-time visitor to Camp 5

Matt Kirby

The weather conditions during the expedition were generally damp and good sunshine for drying cloths was rare, hence a mad rush to hang our laundry whenever there was a break in the clouds. Although there are cold showers on tap the preferred method of washing was in the river, which provided a quick, if rather chilly, dip to wash away the grime of a long caving trip.

OBJECTIVES

Primary objectives of the Expedition were:

Gunung Api

1. To continue the exploration of Whiterock Cave both north and south.
2. To seek a connection between Solo and Clearwater Cave.
3. To carry out surface exploration and survey work to identify new entrances
4. To carry out surface surveying to tie together the know entrances in the Melinau Gorge

Gunung Benarat

4. To continue the exploration of Moon Cave.
5. To relocate and survey Gawai's Cave.
6. To further explore Deliverance Cave.
7. To carry out surface exploration and survey work to identify new entrances.

ACCESS TO THE CAVES

Access to Moon Cave

Moon Cave lies to the north of the river and is reached by crossing the Melinau suspension bridge then following the Headhunters' Trail for approximately 50m to where a smaller, unmarked track leads off on the right. This is followed for approximately 1km through the forest, complicated by various side tracks, to the scree slopes where it rises up to meet the base of the cliffs. A left turn at this point leads after 300m to the climb up to Moon Cave. The entrance climb was left rigged during the expedition but this was de-tackled once the exploration and photography were completed. The journey time from Camp 5 to the entrance climb would normally take 30 minutes.

Access to Whiterock

Whiterock entrances are located on the northwest flank of Api just to the south of a prominent north facing white cliff. The route to the cave follows the Headhunters Trail south from Camp 5 to a point just before the first main river crossing. During the first forays into this area in 2003 a track had been cut which followed high ground heading directly to the white cliff. However, this limestone terrain proved difficult to cross so in 2005 another track was cut which avoided the higher ground and passed through the low lying alluvial terraces. Although this route became very swampy following heavy rain it proved far easier to follow and has been used for both the 2005 and 2007 expeditions. It appears to have been used by swift nesters who visit the cave occasionally. The track arrives at the base of the mountain just south of the entrances at a point known as Whiterock Junction. Turning north the track up to the upper entrance is found after 50m and the lower entrance is located a further 250m north from here. The upper entrance is now the favoured route into the cave as it bypasses an awkward step and the 60m ramp up to the Ashes Series. This track climbs steeply up the footslopes and is well worn. The Upper entrance provides a clear view out over the canopy towards Bukit Berar.

To the south from Whiterock Junction an indistinct track leads, after 1.5km, to Blackrock's Racer entrance, a difficult journey of approximately one hour.

SUMMARY OF EXPEDITION DISCOVERIES

In Whiterock Cave (Gua Batu Putih)

A great deal of new passages were discovered in the central areas of the cave infilling blank areas and creating shortcuts between previously surveyed areas of the cave. Figure 7 details the full extent of passages discovered, explored and surveyed by the Expedition, highlighted in red.

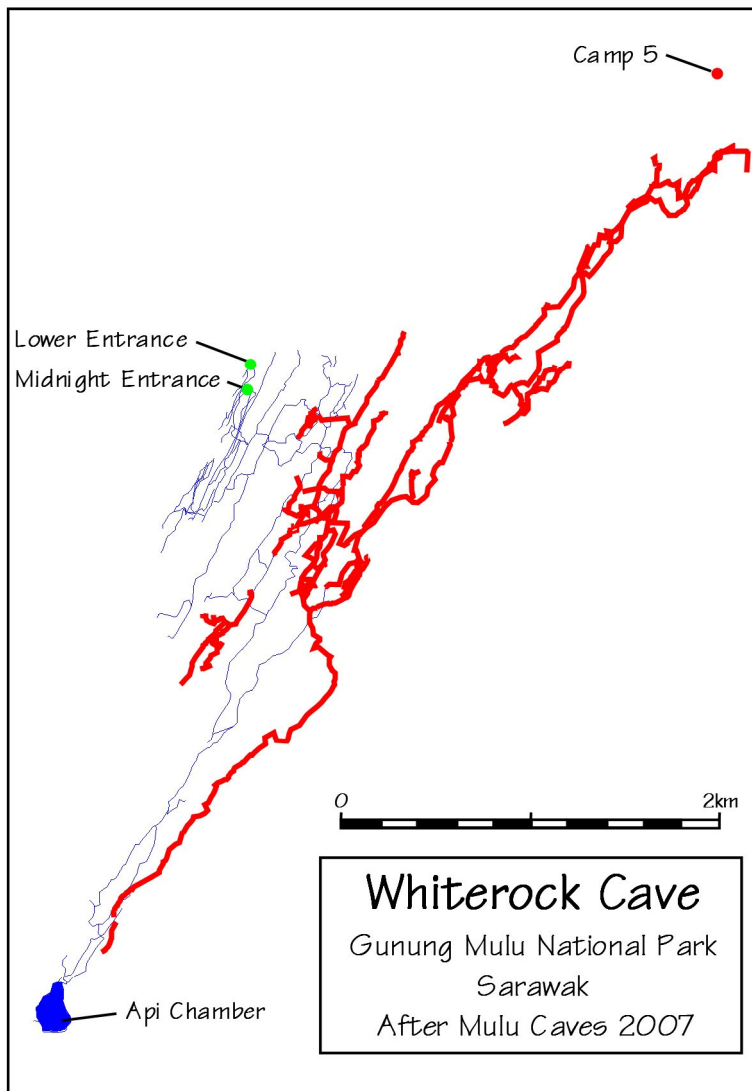
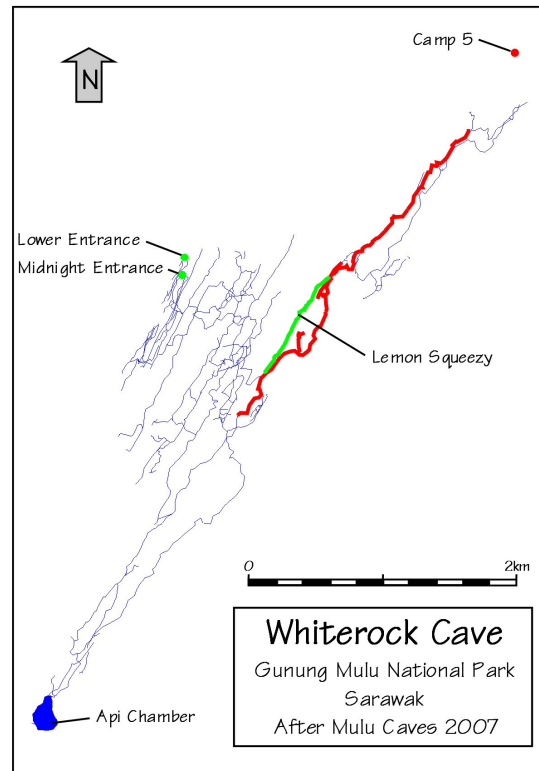


Figure 7; Extensions in Whiterock Cave

The following descriptions are of the individual explored sections of the cave as they appear in the Survex master dataset in the chronological order of discovery. Each title may contain subsections of cave which have been given individual names in the final drawn survey. Subsections are shown in brackets. The corresponding area is shown highlighted in red next to the description.

The Northern Line (including Lemon Squeezy), Explored 19 Jan '07; Length 4,857.59m
Explored by Dave Nixon, Colin Boothroyd and Dave Harley.

The Northern Line is the main northern lead left in 2005. It starts at Daydream Believer station 73 and follows the strike through arduous boulder filled chambers to terminate after 2.7km at a junction. Onwards from here is the Northern Line Lake District Passages which were surveyed on a subsequent trip and are described below. Lemon Squeezy (shown in green) forms a bypass to the southern end of the Northern Line providing an easy going alternative route between stations 54 and 118. At station 122 a large bouldery ramp leads up on the left, this leads into the 1954 passages described below. There are numerous leads which were not explored. At station 56 the Green Wing joins and forms a short cut to this section of the cave. A return journey from the far end back to Monkey Camp took 6hrs 40mins. Now that the link passages have been discovered the return to the Midnight entrance takes 5hrs.



Lemon Squeezy Passage (Part of the Northern Line Series)

Robbie Shone

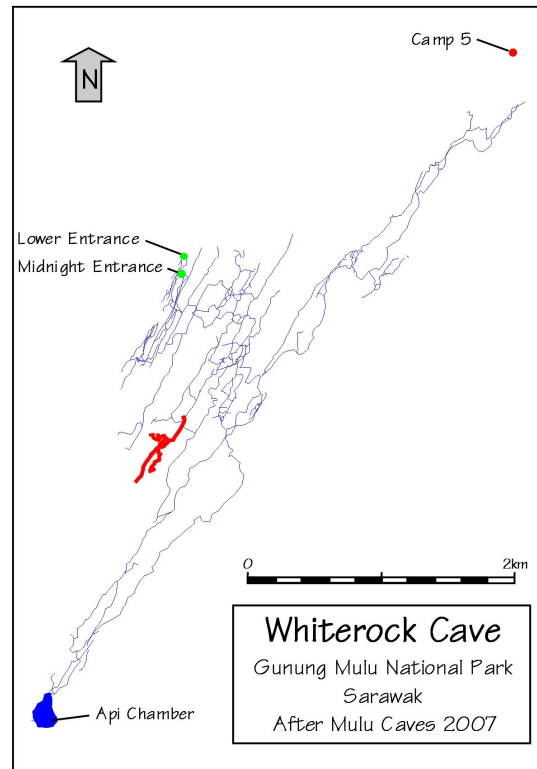
Api Birthday South, Explored 20 Jan '07; Length 1,352.90m

Explored by Dave Nixon, Colin Boothroyd and Dave Harley

The main lead south from the top of the Api Birthday ramp. The route heads off as a fine sand and cobble floored passage 20m x 20m. The main route ends in a boulder choke with a draught but no sign of a way through. Just back from here are passages in the roof which would require bolting to gain access.

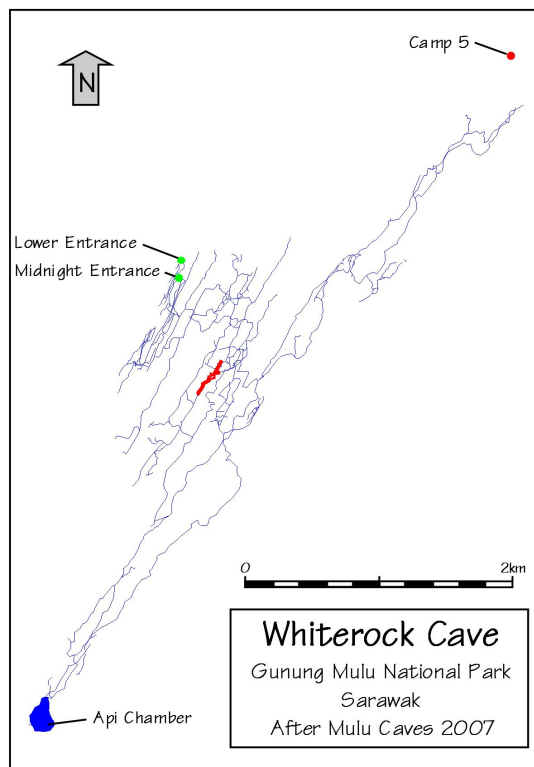
Back at a prominent junction (sta 14) a descending ramp leads down into miserable passages which split. To the left leads to a squeeze which was not pushed whereas to the right leads to an undescended pitch.

At station 12 a larger ramp leads south along the strike to a tall joint-developed pitch up where a passage can be seen at the top. This would require a bold 10m climb to gain access. There is a slight draught and a healthy echo which suggests bigger things above.



Api Birthday North, Explored 20 Jan '07; Length 500.90m

Explored by Dave Nixon and Colin Boothroyd

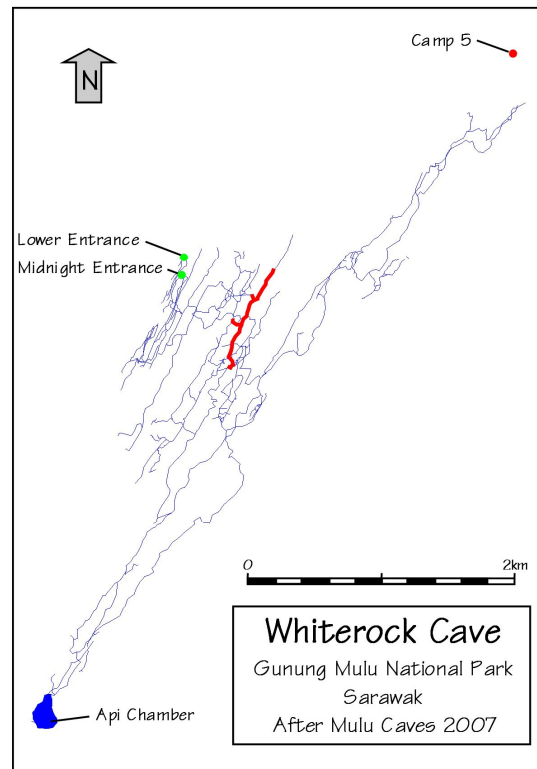


This is the main northern lead from the head of the Api Birthday ramp, left in 2005. From the previous end point the passage continues in similar style for 200m to where it swings to the east and meets a junction. The left branch was surveyed for three legs and is still open and going with the strike. The main route to the right leads under a low arch to emerge at a large four way junction. To the left was followed for 120m on the strike through sediment-filled passage to a collapse pit in the floor but remains open beyond here. Further back in this passage a lead at low level was not explored.

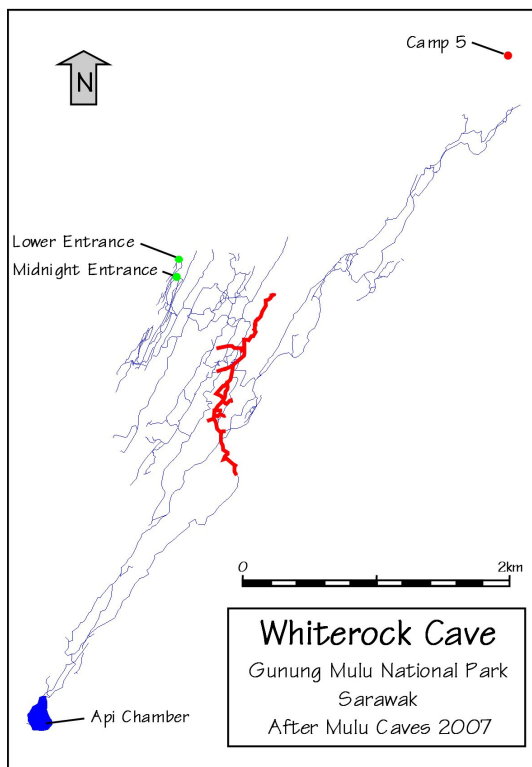
Straight ahead from the large junction leads off as a 16m wide, sand-floored passage and becomes Strong Hint of Bigness, described later.

Ancestor 3 (including Who's Cairn is it Anyway), Explored 23 Jan '07; Length 1,046.10m
Explored by Tim & Pam Fogg and Dave Harley

Continuation of the Ancestor 2 passage. After 40m a junction is reached where the right branch leads into the Green Wing. Onwards from here the passage becomes very large with a big ramp up on the right. This area is littered with swift nesters' cairns which is why this section was named Who's Cairn is it Anyway. Opposite the ramp a passage on the left leads into Black Joke. This is the area of the 2007 camp with good supply of water. The main route continues in grand style through cobble and boulder floored passage with rotting cobble cliffs. 275m further, a lead on the left closes down after 85m very close to Daydream Believer. 195m beyond a branch to the left leads to a big pit at the start of 'Into Out Of'. Over the pit the passage continues but was impossible to access without bolts. The main passage continues for a further 270m on the strike and becomes Limah Puluh.



Strong Hint of Bigness, Explored 23 Jan; Length 3,358.58m
Explored by Colin Boothroyd, Dave Nixon and David Scott



Continuation from station 15 in Api Birthday North quickly leads to a deep ramp which requires a traverse line to cross. Beyond this is where the southern lead starts (sta 2).

Northwards; Beyond the pit a powdery guano-floored passage follows the strike for 150m to a junction to the left (sta 9). Onwards a beautiful, giant-scalloped phreatic passage leads to Squirt Chamber where a passage can be seen up an 18m climb. From station 9 a passage leads off to the east. This leads to a four way chamber. One lead doubles back to emerge down the pit at station 2. Another heads north and ends at a strongly draughting boulder choke. The third way leads over Ancestor 3 to end in a blocked passage. The fourth way leads down a steep bouldery passage to emerge in Ancestor 3 near the Green Wing.

Southwest; From station 2 a large sediment-floored passage heads south. After 100m a branch to the east leads into ‘Unnamed Bypass’, described later. The route continues in the same style with collapse pits in the sediment floor to a junction with a branch going north. This was followed for 140m to a sediment choke. A ramp up near the end was not explored. Continuing on at the junction in the main passage a series of ramps heading up dip on the east side were encountered. The first was followed for 75m to a climb up, which was not pushed but may enter a passage above. The second ended in similar manner. The third is large, steeply-ascending and a challenging climb which requires rope to ascend. It ends in a calcited choke with no draught 80m above the main passage. This is currently the highest point in the cave. At station 90 Unnamed Bypass rejoins but, on the opposite side, a passage was followed for 45m to end at a pit which was only explored for 44m as it had no draught and was rather ‘unsociable’.

The main passage continues in grand style for a further 120m to where ‘Matrimony’ (described later) leads off to the east. After a further 300m, exploration ended for the day at a climb down where a 15m handline was required. There was a healthy draught and a hint of big things to come. At this point the passage has passed over Daydream Believer (Northern Line) ignoring the normal control of the strike. The general direction is 158° and directly towards Wonder Cave. The explorers wondered if this could provide a link with Hidden Valley. Beyond here is ‘Bigness South’ described later.



Bigness South near the pitch into Janet's Way

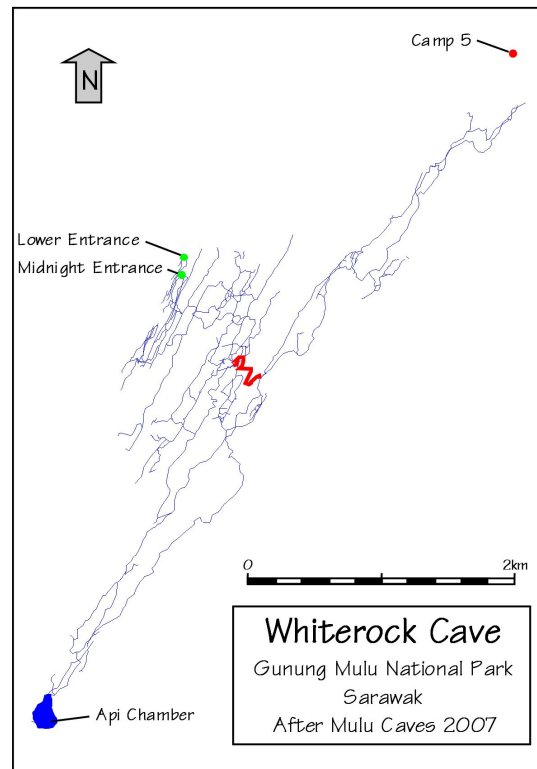
Robbie Shone

The Green Wing, Explored 25 Jan; Length 679.50m

Explored by Tim & Pam Fogg and Dave Harley

The Green Wing forms a link between Ancestor 3 and the Northern Line. The passage is typically 20m wide by 12m high and is a large sediment-filled tube with collapse pits and ancient calcite formations. A large branch heads north but this is blocked after 85m.

The route twists around large chambers and a steep descent into a pit leads immediately to an ascent up a small ledge on the left hand side with a lot of exposure on the right. The passage is well decorated throughout its length with a myriad of glittering crystals, both calcite and gypsum. Towards the eastern end the stal is stained a greeny yellow which gave the area its name. After 560m the passage pops out into the Northern Line at station 56.



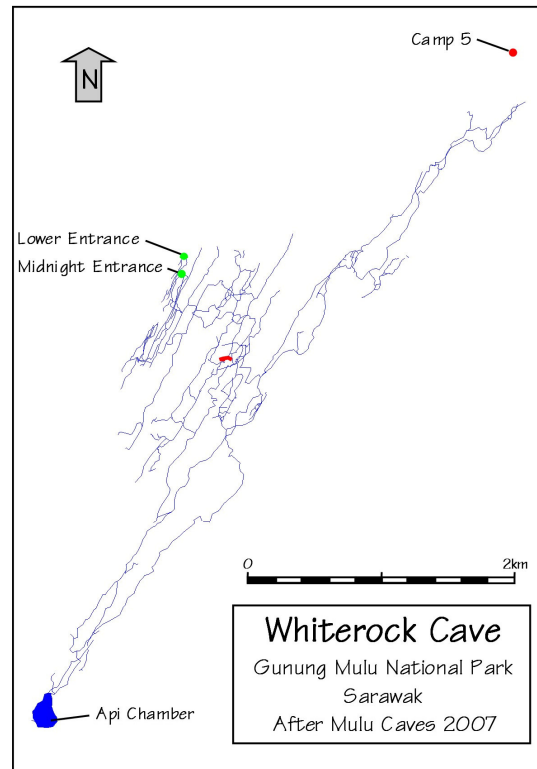
A deep pit in The Green Wing

Robbie Shone

Black Joke, Explored 27 Jan; Length 163.10m

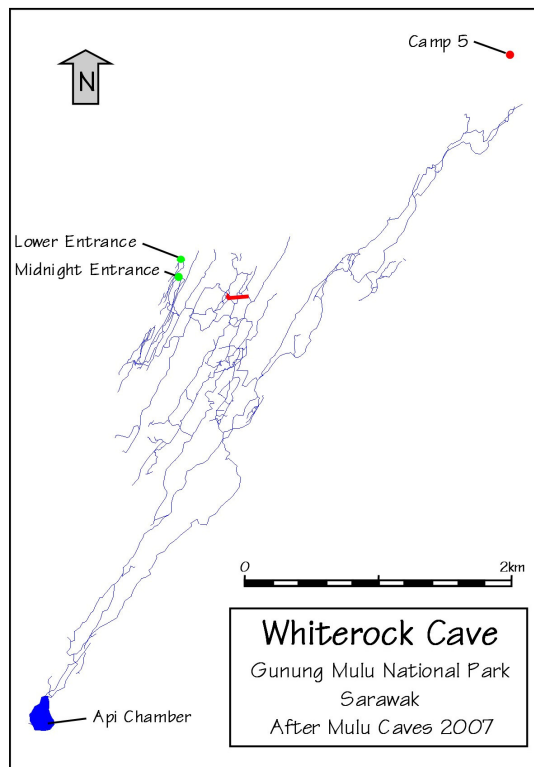
Explored by Tim & Pam Fogg and David Scott

Various down-dip leads off Ancestor 3 were explored but most of these ended quickly in collapse or sediment fill. Black Joke was an exception. The lead started as a ramp heading downwards but became small amongst loose boulders. Initial exploration led to a 30m pitch into a shiny black-walled rift which gave the impression of being at base level. This was clearly worth a second look so the passage was flagged up as a good lead for a later trip. Beyond here is Black Joke 2, described later.



Into Out Of, Explored 27 Jan; Length 185.90m

Explored by Tim & Pam Fogg and David Scott



This passage forms the link between Ancestor 3 and the Out of Africa passages which were discovered in 2005. The deep pit on the branch in Ancestor 3 is a loose climb down with a small eyehole at the base as the way on. After a drippy chamber a very loose sediment slope up, and crumbling climb over the lip, leads back to roof height where a low arched passage emerges into the main 'Out of Africa' passage. The entrance to this passage had been missed in 2005 as it is behind a sediment bank and not visible from the normal route.

This link passage crosses the bedding and forms the key to the shortcut from the entrance series to the Northern Line which significantly reduces journey times to the northern end of the system.

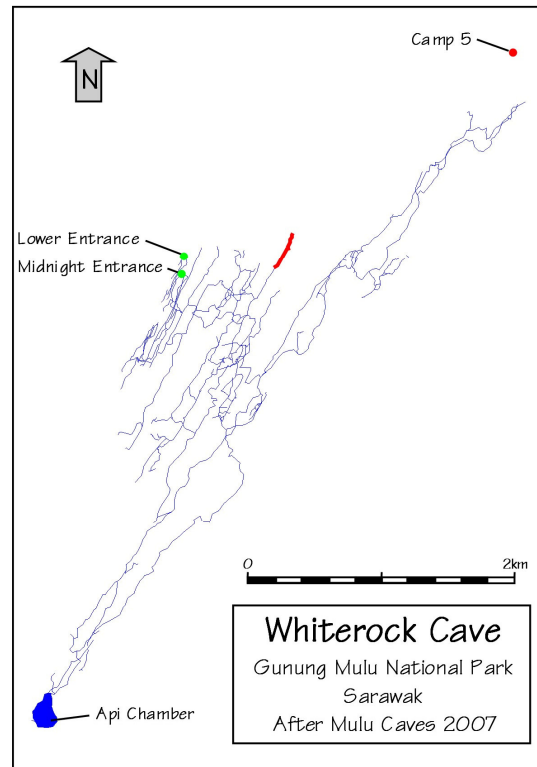
Lima Puluh, Explored 28 Jan; Length 301.20m

Explored by David Scott and Tim & Pam Fogg

A direct continuation of Ancestor 3 but given an individual name as it was explored on David Scott's 50th birthday.

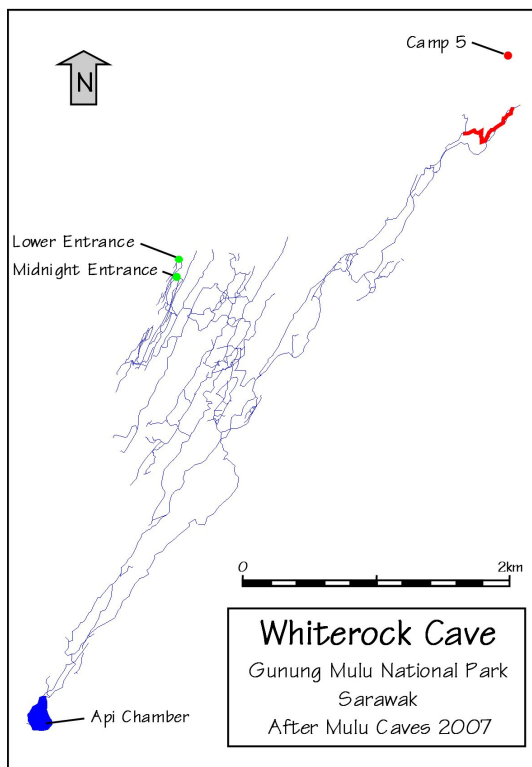
This section follows the strike for 290m to where it reduces to a tight, calcited rift with no draught and no way on.

As with all other passages in this area of the cave this one terminates close to the large white cliff feature to the north of the entrances. It would appear likely that, as the mountainside was eroded, surface rivers have broken into the cave depositing large amounts of sediment in the northern ends of the passages. Subsequent percolation of surface waters high in dissolved calcite have caused the calcification seen at the ends of passages close to the surface.



Northern Line Lake District 1, Explored 28 Jan; Length 569.60m

Explored by Colin Boothroyd and Dave Nixon



This passage forms the easterly lead from the junction at the northern end of the Northern Line which had been left on the previous trip. The passage is well decorated with flowstone and massive gour dams which hold back deep crystal-clear water. The passage ends in calcite and boulders 373m from, and 63m above, Camp 5. This point must be very close to the surface.

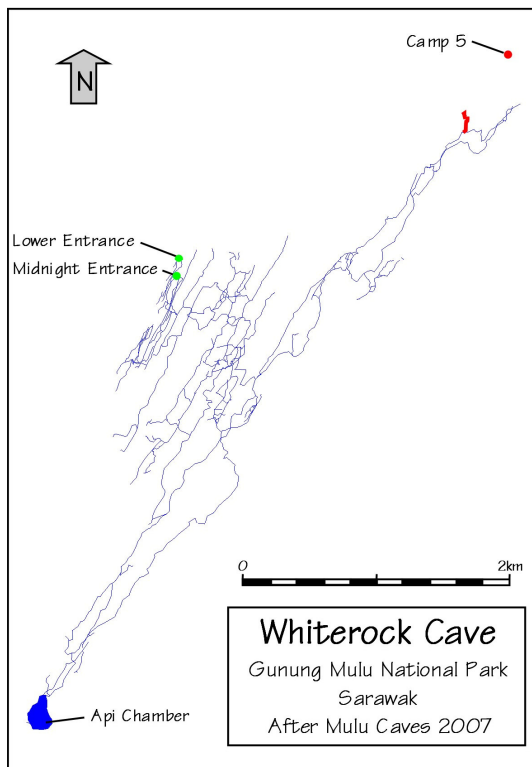


Gour pools in the Lake District

Robbie Shone

Northern Line Lake District 2, Explored 28 Jan; Length 198.50m

Explored by Colin Boothroyd and Dave Nixon

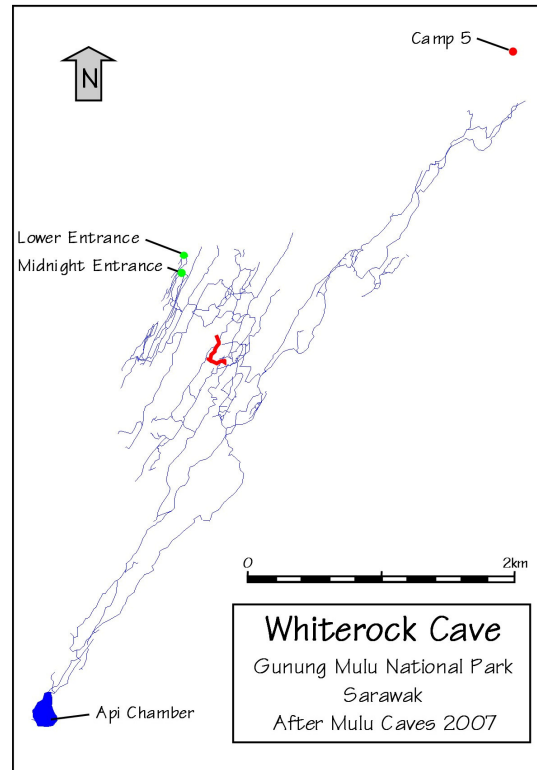


This passage forms the northerly lead from the junction at the north end of the Northern Line which had been left on the previous trip. After 120m the passage turns left where there is a display of glittering crystals. Shortly after this the passage ends at a large gour pool with flowstone rising up beyond to completely block the passage. This point must be very close to the surface.

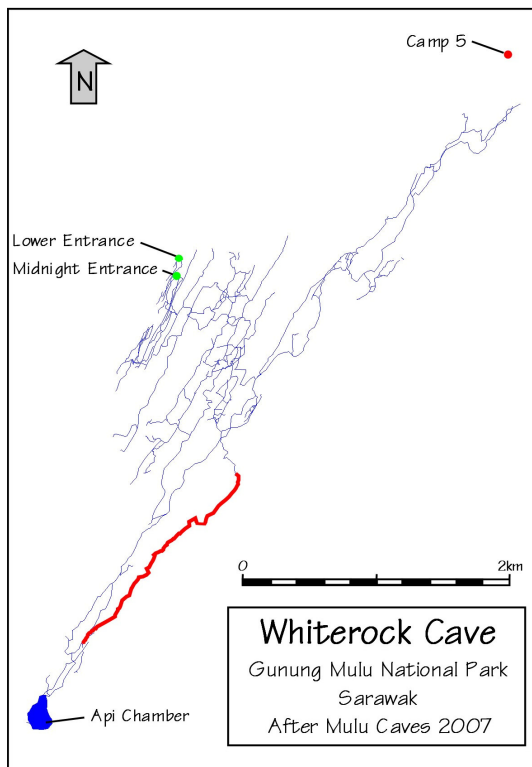
Black Joke 2, *Explored 29 Jan; Length 386.70m*
 Explored by Tim & Pam Fogg and David Scott

From the base of the pitch in Black Joke the route heads south then west and down into a complex of small sloping muddy phreatic tubes. One lead ends in a small green sump which suggests this is at base level. The way on west follows a sloping rift with fine clean formations and large pillared sections. In the furthest corner of this chamber the way on drops down then under a low-roofed section where there is a good draught. Beyond here the passage emerges into the vastness of the Firecracker River in Blackrock Cave near station f365, discovered in 1988. The same exploration team had returned after 18 years to make the connection.

This connection is the third established between the two caves.



Bigness South, *Explored 4 Feb; Length 1,933.17m*
 Explored by Dave Nixon, Tim Allen and Dave Cowley

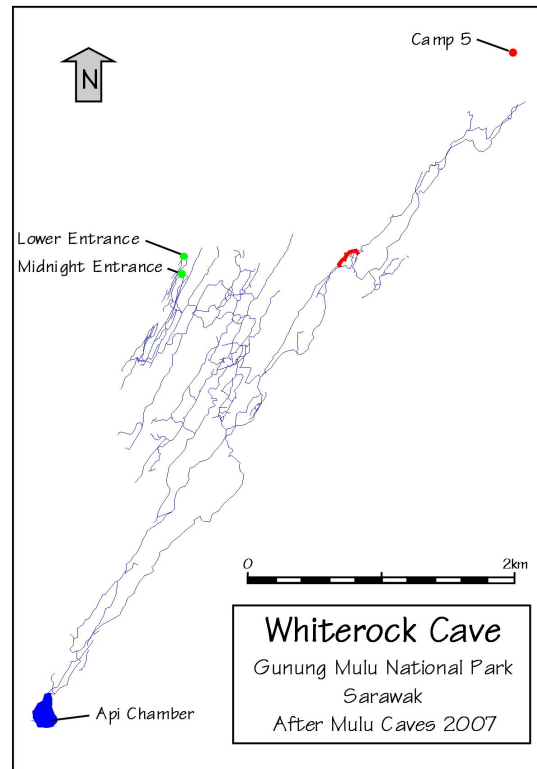


From sta. 111 in Strong Hint of Bigness the way continues in grand style with a side passage on the right at sta. 2. At sta. 7 the passage splits into high and low levels but the lower is the way on. The passage then leaves the strike and drops down the bedding to sta. 13 where several passage lead off. The way on is at low level and becomes smaller with numerous inlets entering down the bedding. At sta. 20 a ramp on the right was explored for 50m but was not pushed to a conclusion. Further on, half the passage goes into the roof and the way on enters a sumpy section with a stream. The passage becomes bigger at sta. 28 where the roof passage re-joins. From here passages enter from all directions, none of which were explored. Eventually a 10m pitch down leads onto the end cairn in Janet's Way which was explored in 2005. No side passages were explored.

Highly Delightful, *Explored 4 Feb; Length 299.58m*

Explored by Matt Kirby, Hugh St Lawrence and Dave Harley.

A large bouldery ramp leading up from station 122 in the Northern Line just north of Lemon Squeezy is the start of this series. At the head of the ramp a look back and above reveals another passage heading south on the strike which had been found as part of the Northern Line, ending in a pitch. Onwards the obvious way is down a bouldery ramp but this is blind. Straight ahead at the top of this is the most unlikely way on. However, this awkward squeeze on sharp calcite is the key to the 1954 series. A flat out crawl leads to standing passage then an interesting climb up and down again. The passage emerges into a larger bouldery strike controlled passage, the continuation of the one seen looking back earlier. To the south a pit in the floor prevents progress but to the north the way leads to a junction and the Upwind series.



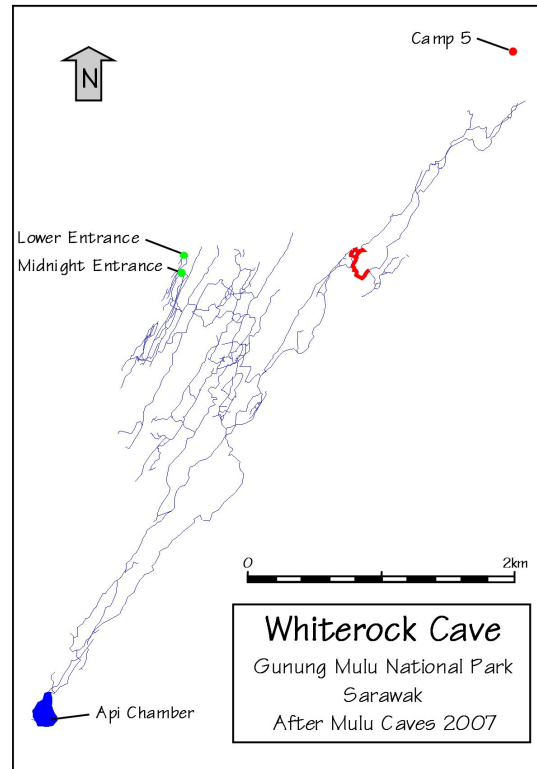
An 'unlikely way on' in *Highly Delightful*

Matt Kirby

Upwind, Explored 4 Feb; Length 558.27m

Explored by Matt Kirby, Hugh St. Lawrence and Dave Harley

This series of small well decorated passages leads off from Highly Delightful. This breaks out into the roof of the Northern Line and crosses it on a boulder bridge which defies gravity. At the far side a left branch leads round to a bouldery ramp down into the Northern Line whilst to the right leads up an awkward climb into a continuation through well decorated passages. Approaching a bend in the passage the sound of falling water can be heard ahead and at this point the floor is covered in strange formations which resemble cat's claws. These are aligned towards the draught which is generated by the falling water, just out of sight round the corner. A left 90° bend leads into a tall rift passage approximately 20m high by 1.5m wide where a waterfall fills the passage. Passing through the water the passage breaks out into the main 1954 passage at station 41.



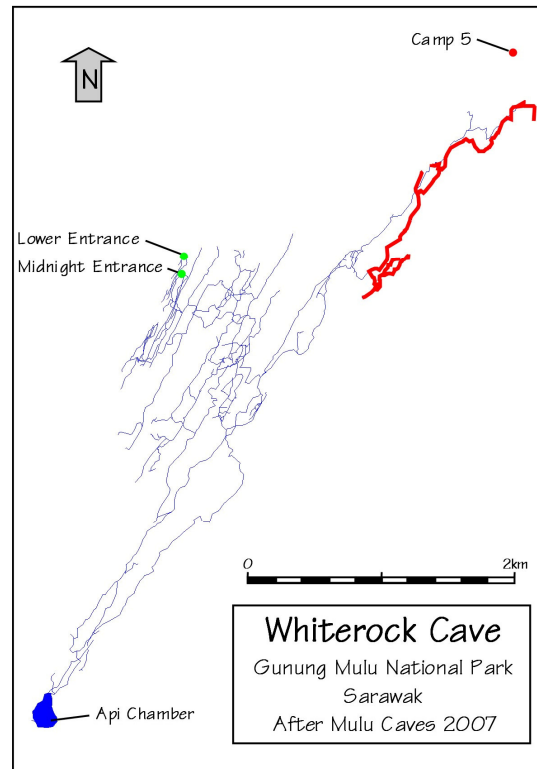
Cat's claw formations in Upwind

Matt Kirby

1954, Explored 4 Feb; Length 3,510.25m

Explored by Matt Kirby, Hugh St Lawrence, Dave Harley & Nick Williams.

Northwards; This main trunk route lies 60m above the Northern Line and follows its alignment and the strike, for 1600m to terminate in boulders and calcite flows 365m from Camp 5 and 130m above it. Entry to the series is via Highly Delightful and Upwind which emerges on a bend in the passage where the roof is 40m above the floor. The passage gives the impression of great age and is generally very dry and decorated with an abundance of gypsum and calcite formations. A large, unstable ramp, approximately half way along, climbs up to end in a loose, bouldery chamber. Large gour pools towards the northern end are surrounded by flowstone walls. No connections were found with the Northern Line but an unexplored pit in the floor may connect. A number of significant leads were left unexplored.



The 1954 Series

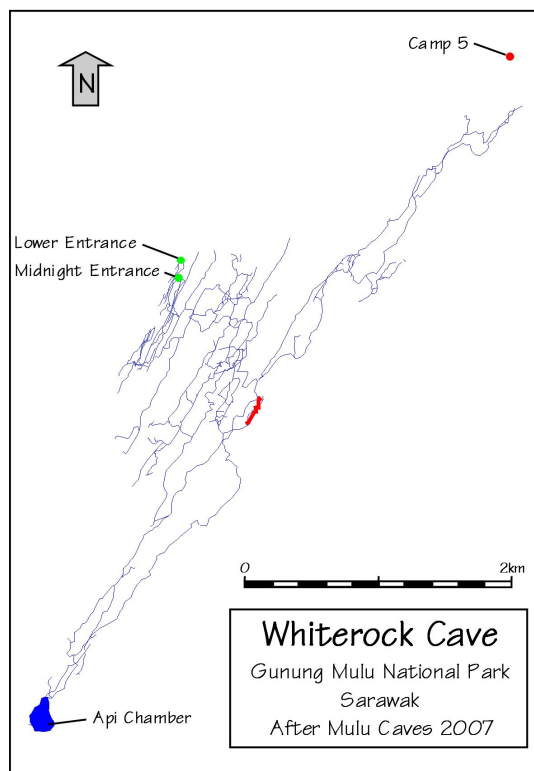
Hugh St. Lawrence

Southwards; The southern section leads off in a south-easterly direction from sta. 41 down a steep bouldery ramp. This is on an off-strike twist in the passage. The passage rises again before turning onto the strike to become tall, dark and bouldery, drenched with waterfalls and littered with clean washed broken stal. This area gives the impression of recent rockfall and has a totally different feel to the northern lead, far more active. The exploration ended when the only route was up through massive boulders to emerge at a pitch off a loose bouldery ledge where the main passage was seen to continue tall and boldly, into the blackness, along the strike. At this point a reasonable sized crossover passage, which emitted a waterfall on the south side, was noted at roof level but would require bolting to gain access. The continuation of the same passage in the north wall appeared to emerge again, round the bend to the north.

Side passages; A small complex of passages were explored in the east wall near station 155. These were well decorated with fantastic helictite formations on the roof, walls and floor. The passages were aligned with the strike and stacked on the bedding. Deep pits were found at the ends of both passages, these were not descended. This point is off the line of the Northern Line so further potential exists here.

Pamphlet, Explored 5 Feb; Length 287.90m

Explored by Robbie Shone, Nick Williams & Mark Wright



At station 82 in the Northern Line a 15m bolted climb up the east wall leads into Pamphlet Passage. The passage is generally 8m high by 4m wide and follows the strike and general alignment of the Northern Line. After 275m is a climb which, due to lack of rope, was not descended. The climb appeared to descend in a few large steps back towards the Northern Line but a continuation of the Pamphlet passage was seen to continue at the same level beyond the climb.

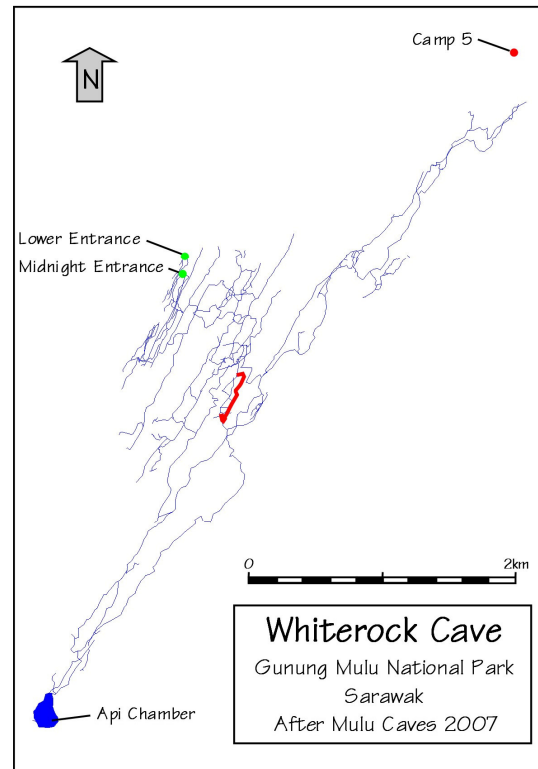
Survey data shows this passage to lie directly under Matrimony, which is 50m above, and probably associated with the same bedding.

Unnamed Bypass, Explored 6 Feb; Length 559.20m

Explored by Dave Cowley and Dave Nixon

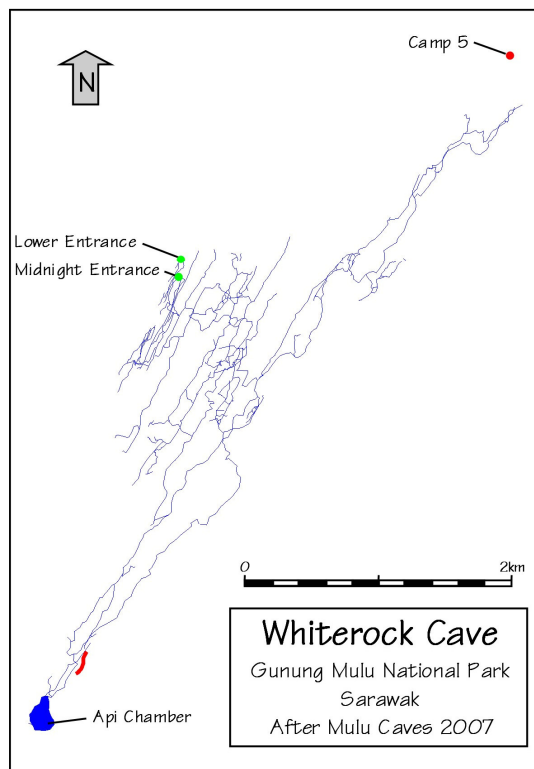
From station 79 in Strong Hint of Bigness a side passage to the east drops down climbs into a chamber with one respectable (20m wide) sized passage leading off on the strike in a southerly direction. The passage rises gently up a bouldery slope then passes three large ramps heading downwards on the west, which were not explored. A dangerous climb around the largest ramp requires a rope. After 340m another ramp down is passed with a corresponding ramp up on the east side. The passage then enters a complicated chamber with cobble banks. The way on is to the north-west and quickly rejoins the main passage at station 90.

This passage provides an effective bypass to the wet 10m pitch in the main passage.



Poppet's Passage, Explored 9 Feb; Length 216.30m

Explored by Dave Nixon and Dave Cowley



After completing the connection of Bigness South with Janet's way, which only involved a 10m pitch and one 20m survey leg, the team turned their attention to a lead 80m further south off Janet's Way.

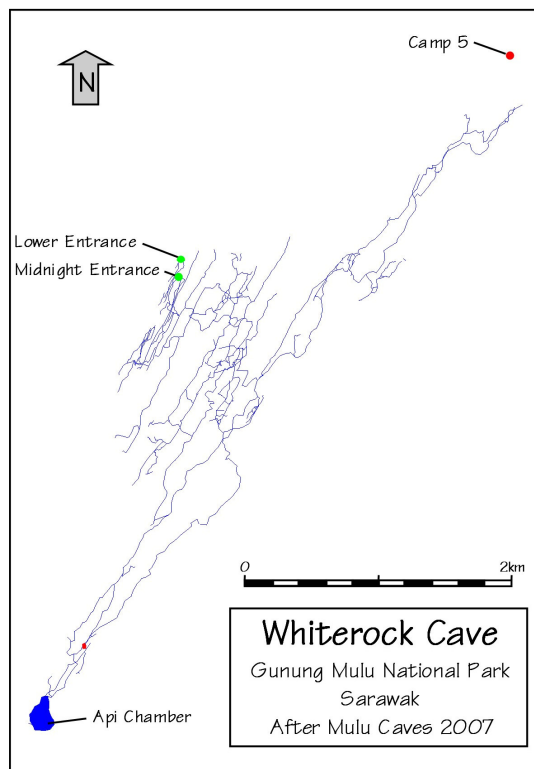
Poppet's Passage starts at station 18 in Janet's Way as a pretty, easily accessible, ramp. It follows the strike southwards in an easy going 10m wide passage for 155m to a junction. To the east leads into a series of climbs which ascend for 60m without any draught. This was not pushed to a conclusion. To the west the passage had been explored un-surveyed from the connection point of Highland and Lowland in 2005. This section of passage needs to be surveyed for completeness of the survey.



Dave Nixon and helictites in Poppet's Passage

Robbie Shone

Wild Goose Chase, Explored 9 Feb; Length 39.70m
Explored by Dave Nixon



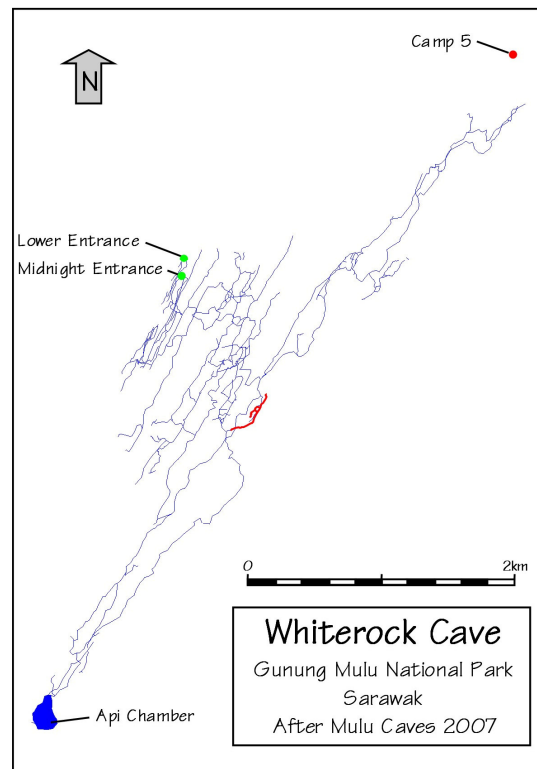
This passage was explored for a short distance, following the exploration of Poppet's Passage. A quick recce revealed a complex series of phreatic ramps and passages containing one very draughty way on.

With a prominent draught and hint of bigger passages beyond, this is quite definitely a significant lead for a future expedition.

Matrimony, Explored 9 Feb; Length 604.40m

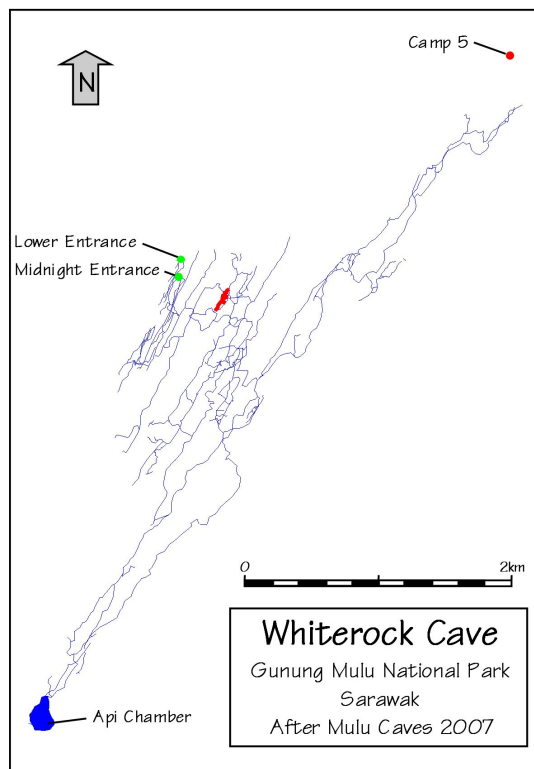
Explored by Tim and Jane Allen

From station 95 in Strong Hint of Bigness, a low arched passage heads north-east and onto the strike to end, after 400m, at the head of a large ramp down into a large passage which remains unexplored. 130m back from the end a side passage leads west. This then splits and goes north and south on the strike, parallel to the main passage. To the north this ended as a roof tube above the main passage. To the south it ended at a short climb. This is heading back to a side passage close to the start of Matrimony.



Under Out Of, Explored 12 Feb; Length 346.80m

Explored by Matt Kirby, Hugh St. Lawrence, Nick Williams & Dave Clucas



This series of passages were noticed but not explored in 2005. They run parallel with, and down dip, from the main Out of Africa passage. These are a complex series of tubes which connect back into the main passage at various points. One down dip passage was only partially explored and not surveyed, this was left as an open lead.

On the up-dip side of the main Out of Africa passage a small ramp was climbed which degenerated into a choke. Spurred on by a draught, a way through was found to emerge in a large passage, with at least two ways on, which remains to be explored. The ramp, to this point, was not surveyed.

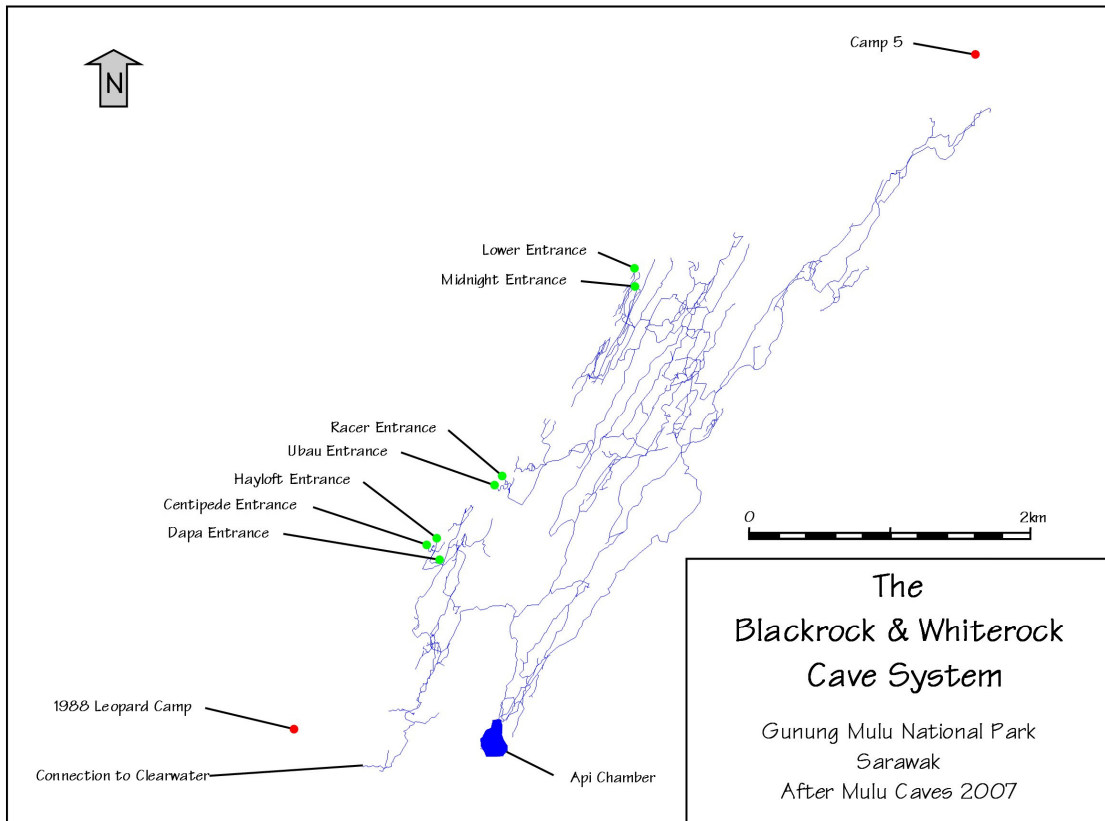


Figure 8; The Blackrock & Whiterock Cave System



Crossing a rock bridge in the Northern Line
 Robbie Shone

In Moon Cave (Gua Bulan)

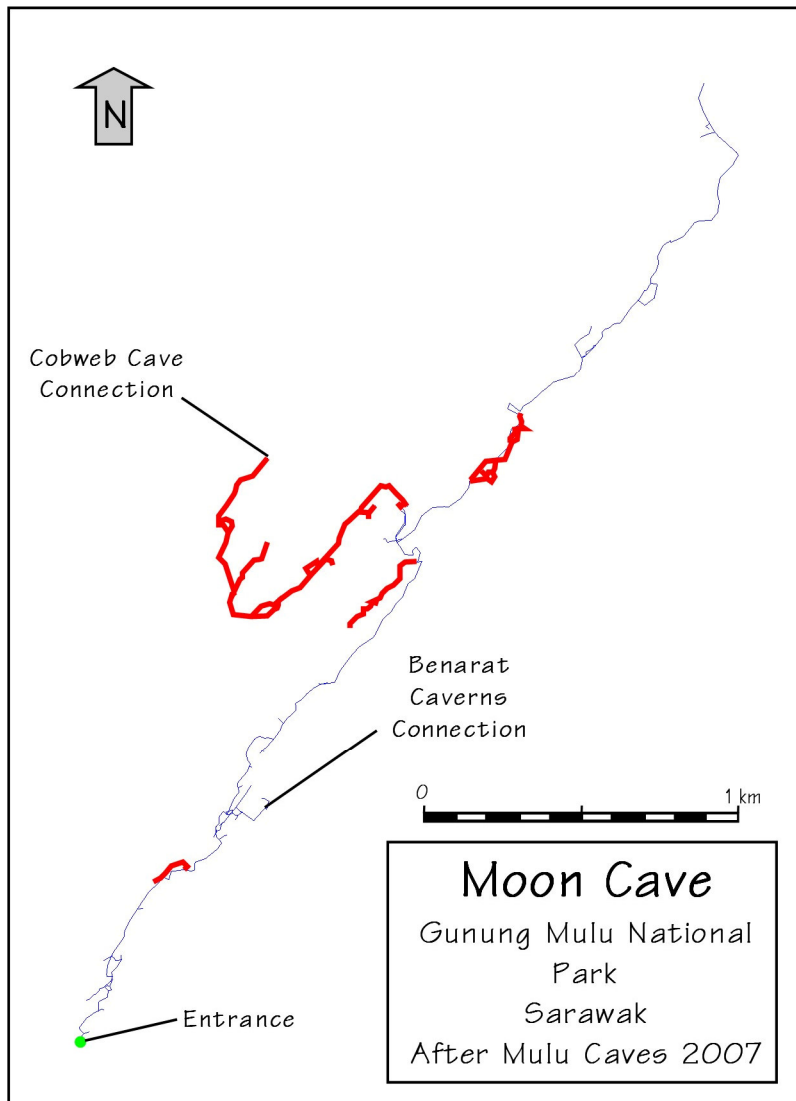


Figure 9; Exploration in Moon Cave

Moon Cave held great potential for connections with higher levels, possibly even the prominent entrance high in the cliff opposite Camp 5 which had been the original destination when Moon Cave was discovered. However, although a great deal of exploration was carried out deep in the cave to try to gain access to an upper series, all attempts failed.

Nevertheless a dig in the western branch, which had been partly explored in 2005, proved to be the icing on the cake when it broke out into passages which connected to Cobweb Cave.

Moonshadow, 7 Jan; 2314.27m

Explored by Tim Allen, Robbie Shone, Hugh St. Lawrence, Dave Cowley, Mark Wright

This is the continuation of the passage explored in 2005, heading north from station 9 in 'Benarat Mainline', to a calcited boulder choke. A determined effort in 2007 passed the choke to emerge in Moonshadow.

From the breakthrough point the passage swings round southwards onto the strike. Along this section several holes were climbed into and an area of tubes in the floor around station 30 were only partly investigated.

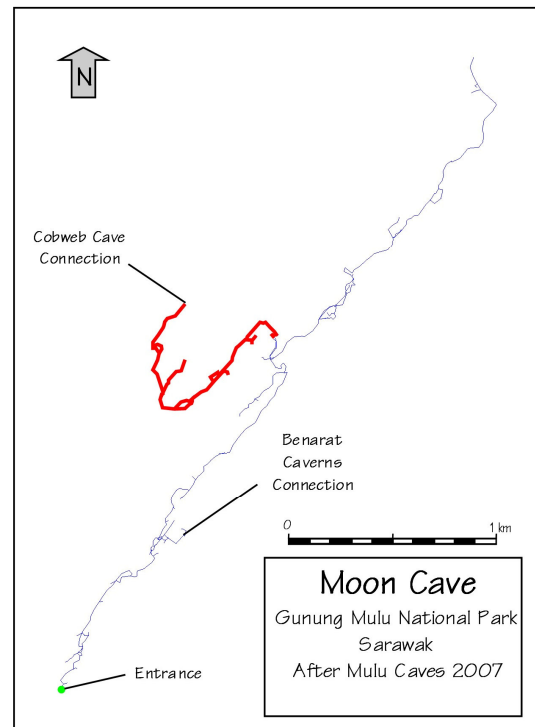
Where the route turns west at Bingo Oxbow it takes on much grander proportions. A route down the boulder slope to the right was not fully investigated. At station 43 the route splits. Right leads down a large tube and emerges in a big chamber. A traverse on ledges gains a continuation high on the far side and a fractured passage leads, with some difficulty, to a 15m drop into a larger passage. This was not descended but is presumed to be another part of Just Desserts.

A scramble up into the left hand passage at station 43 makes easy going to Windy Corner. Here, at station 53, a hole in the wall looks down into a sizeable space. This was not descended, but may prove interesting, as the main passage to the right turns onto the strike at this point.

At station 66 another side passage, on the left, ends in an undescended pitch. Beyond here, at station 68, the passage pops out in the roof of Just Desserts at a 15m pitch. Just back from the edge, a rift in the floor allows an un-roped climb down.

Moonshadow is an unusual passage as it cuts through several beds before forging a connection with Cobweb Cave. Throughout its length the passage changes dimension and shape. This may indicate that it is not a single passage but part of a more complex series.

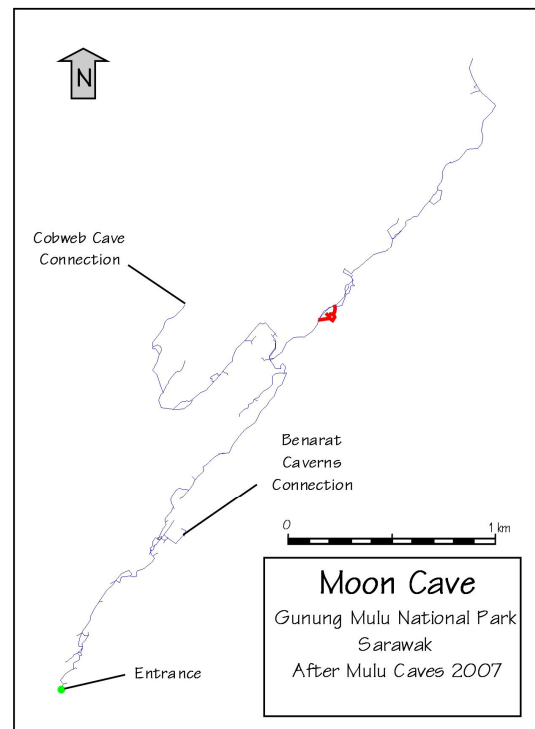
The connection with Cobweb now links Benarat Caverns, Moon Cave and Cobweb Cave together in a system named the Benarat Caverns System (fig 10).



The Dream, 23 Jan; 183.40m

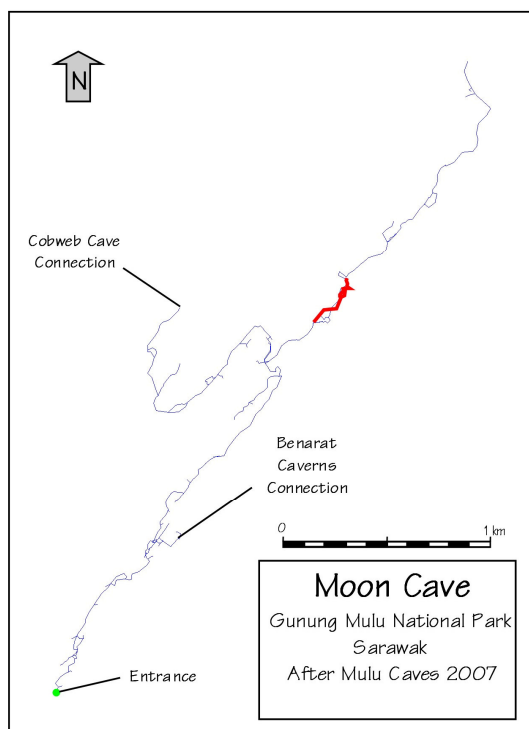
Explored by Mark Wright, Robbie Shone

Just north of the underground camp, at station 18 in Benarat Mainline, a large branch to the right leads to an 8m aid climb. This leads to an ascending passage which quickly reaches a junction. The left branch ends at the base of a 20m high aven but the right hand branch leads to a drop, back down to the main passage, 40m below. A passage 20m up on the right hand wall was climbed into but this led to another aven. No further exploration was carried out here.



The Fantasy, 7 Jan; 404.60m

Explored by Tim Allen, Dave Cowley



This was a main lead left in 2005 which was thought may lead up to the horizon of the high level 'nesters' entrance seen from Camp 5 at the top of the cliffs.

This is a complex of rising ramps in the roof of main passage.

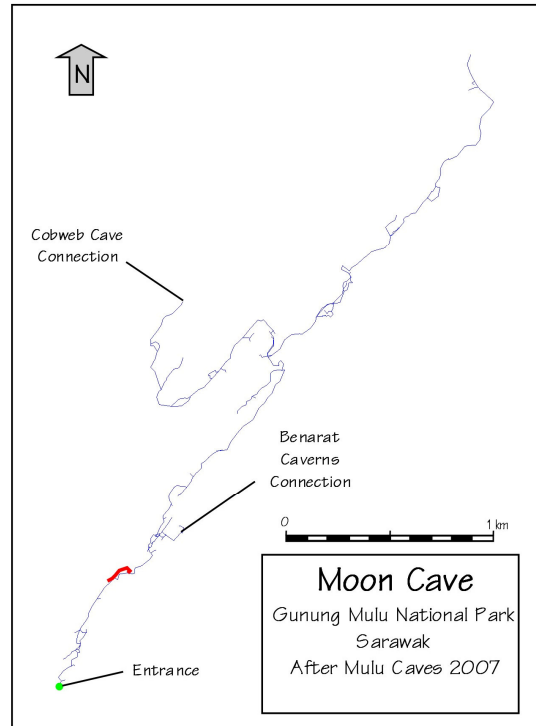
From station 24 in Benarat Mainline a branch to the right leads to a climb up a mud slope where a handline was used to gain access to the main ramp. This leads to a junction after 90m but continues upwards becoming increasingly vertical to where further progress could only be made using bolts. Exploration was abandoned at this point and the climb remains open and unexplored.

Disappointment Ramp, 21 Jan; 195.20m

Explored by Tim Allen, Hugh St. Lawrence

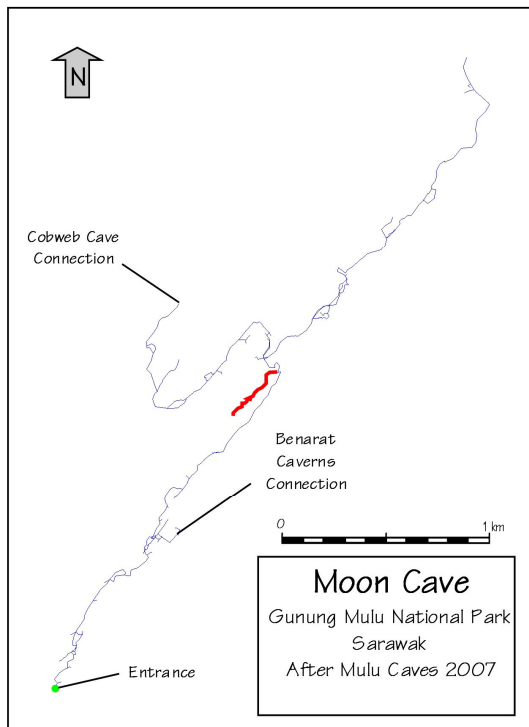
A steeply descending ramp with a vertical range of 109m. This leads from station 32 in Importance of Being Idle. From the bottom of the ramp a second short pitch leads to a muddy termination. This point is at the same horizon as Sakai's Cave.

In the south wall of the main passage, opposite the ramp, a tight, sharp ascending ramp was explored for 30m without conclusion. A further climb in the south wall hereabouts led to tight inlets.



Cake and Cheese, 30 Jan; 409.80m

Explored by Robbie Shone, Tim Allen, Mark Wright



From station 2 in Benarat Mainline a large, phreatic, circular tunnel leads to a 40m pitch. From the base of the pitch a series of very muddy descending ramps leads down to a further undescended pitch into a large chamber. The ramp has a vertical range of 135m and the base is at the same horizon as Skai's Cave. This is currently the lowest section of Moon Cave.

The Moon Cave - Cobweb Cave Connection

On the 27th January 2007 the first through trip from a Melinau Gorge cave to the western side of Benarat was made. After spending three days camping in Moon Cave explorers Mark Wright, Robbie Shone, Dave Cowley, Hugh St. Lawrence and Tim Allen decided to exit via Cobweb Cave. The route took them from their camp in Benarat Mainline, through the newly discovered Moonshadow connection and out of Cobweb via Just Desserts, LED the Way, Top of the World, Cobweb Main Streamway, Rubic Tubes, Husky Hall, Bypass Bypass, Top of the Morning and the huge Entrance Series. A total through-trip time of eight hours.



Moon Cave Main Passage

Robbie Shone

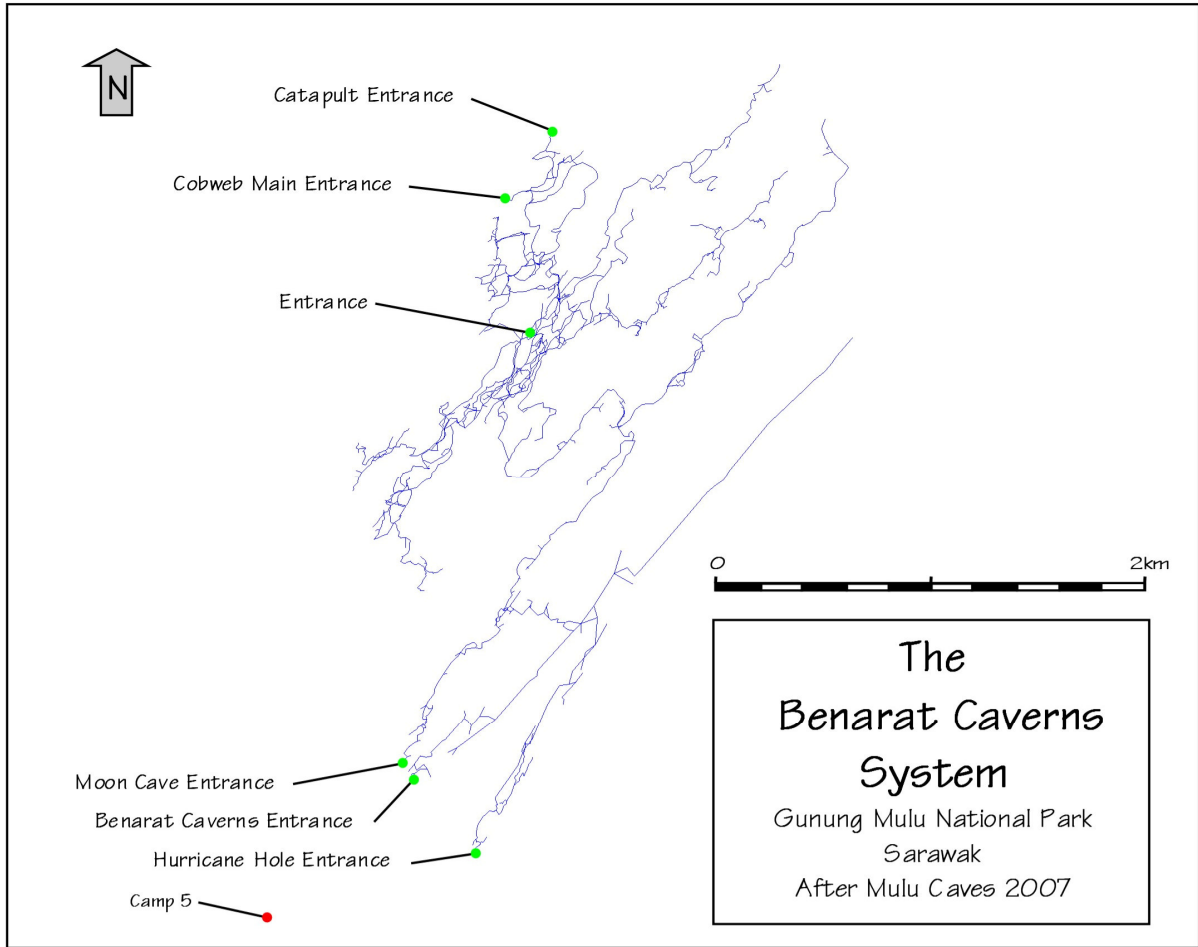
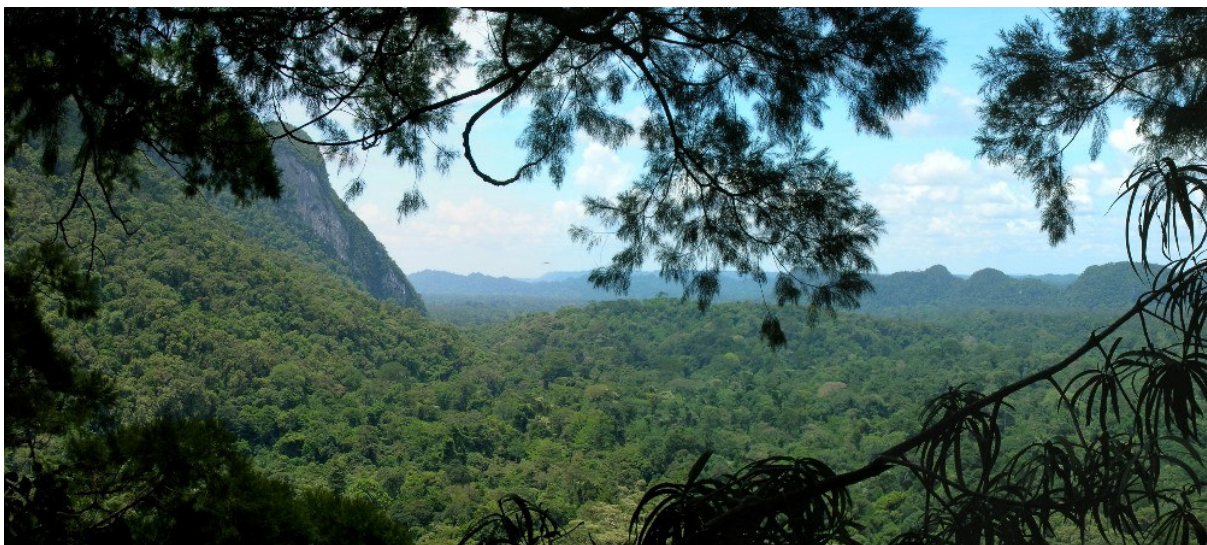


Figure 10; The Benarat Caverns System

Figure 10 shows all the interconnected passages which form the Benarat Caverns System. Upper and Lower Tiger Caves are not shown as there is no underground link between them and this system.



View from Moon Cave entrance towards Whiterock

Matt Kirby

The Search for the Solo Connection

Explored by; Tim & Pam Fogg, David Scott, Paris Wan, Ipoi Boi

Solo is an enormous surface shaft 600m above the Snake Track entrance to Clearwater. It was first explored during the 1978 RGS expedition when a 140m free-hanging pitch was descended to a steeply-sloping floor. A tantalising note by Andy Eavis in the expedition report mentioned *'a small inward draughting hole behind a large boulder. This leads to an undescended pitch'* it then goes on to say *'there are excellent prospects of a very spectacular connection and a classic through trip'*. This represented a significant lead which could connect Solo into the main Clearwater System, with a potential to increase the vertical range from 350m to more than 500m. Since the RGS expedition, the shaft had not been revisited and no further exploration, which would bring the two any closer, had taken place in this area of Clearwater.

During 2006 the BBC produced a television series titled "Expedition Borneo". As part of this series there was a requirement for footage of spectacular primary exploration and Solo fitted the bill. Prior to the film crew arriving, Tim and Pam Fogg, together with Park staff, spent three days cutting a track up to the entrance; a fairly serious undertaking. As part of the filming team, Tim and Pam entered the draughting hole noted by Andy Eavis and had descended approximately 200 metres through a boulder choke and a series of big chambers where they lost the draught. Unfortunately a broken ankle in the film crew prevented further exploration so the new finds were not surveyed.

Owing to the difficulty of reaching the entrance to Solo, the plan for the 2007 expedition was to carry out exploration from inside Clearwater in the area around the northern end of Revival in the hope of finding the same big chambers from below. Local nester knowledge reported a route up in this area; although the descriptions were skimpy, they suggested the Beckoning Finger passage area, as a short rope had been mentioned.

Three days were spent scrabbling in boulder chokes at the end of the Dune Series and at the Revival end of Beckoning Finger. Unfortunately all leads came to nothing and the link remains elusive.

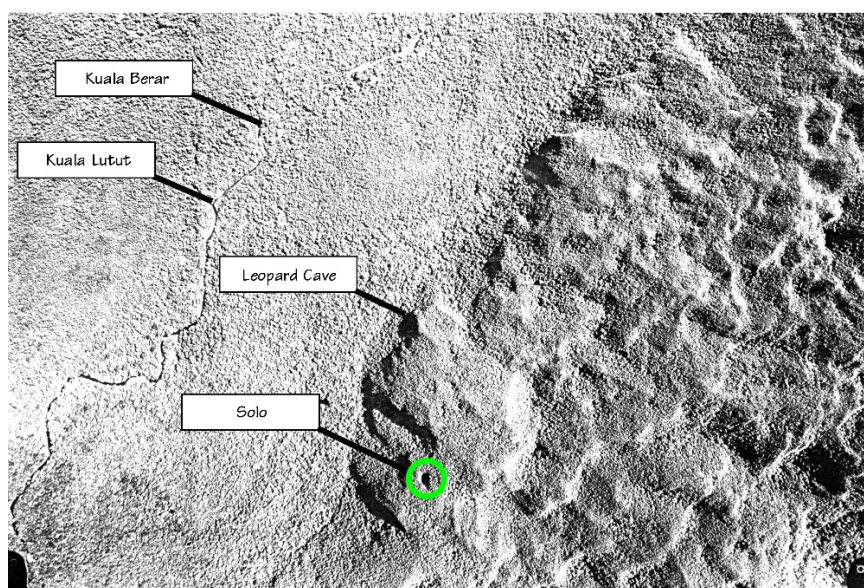


Figure 11; Aerial photo showing Solo

Surface Searching

On Benarat

The area between the Cobweb and Terikan cave systems has seen much underground exploration in an attempt to find the elusive link between the two caves. To date all attempts have failed. It has been long known that the surface between the two caves is intersected by a shallow valley feature, which is believed to have truncated the north-south trending passages. In order to further investigate this feature, a day was spent searching this area.

From the alluvial plain the ground rises up steeply, through a complex series of cliffs. In order to bypass the cliffs it is possible to pass through a small cave, but on this occasion the group took a surface route up to left side of the valley which, although steep, avoided the main cliff line. Part way up the climb a small entrance was found which was blocked after only 20m. At the point where the ground levels off, the group split to search each side of the valley. An entrance was found on the north side which led into a steeply descending rubble slope with no draught. Unfortunately, just as the two groups re-joined, the afternoon rain commenced and it was decided to make a swift return.

On the way down a large entrance was found on the south side. This was explored, whilst the rain fell, and was found to be the Catapult series, discovered in 2000. No other entrances were seen and the group made an 'interesting' descent to the alluvial plain in heavy rain.



Small entrance part-way up the climb

Matt Kirby

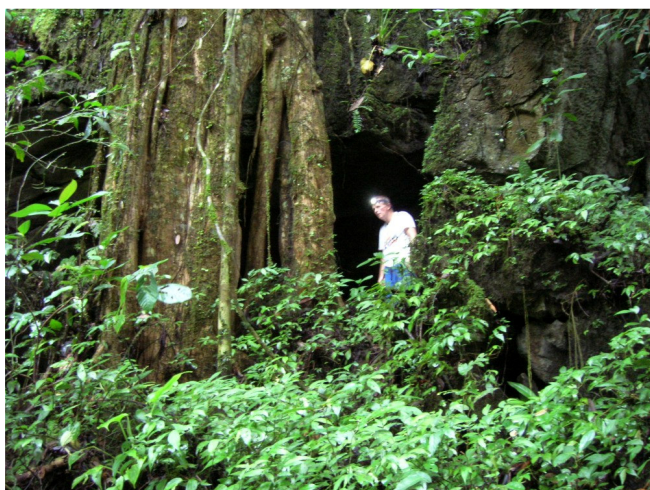
On Api

Over the past thirty years, much surface searching has been carried out in the Melinau Gorge on the Api side of the river. This is a very complex area with large cliffs intersecting steeply sloping ground. Small caves have been discovered and documented, but until 2007 there had been confusion regarding the whereabouts of the entrances and whether some of these had been 'discovered' on more than one occasion and given different names and descriptions.

In order to better understand the geography of the area a number of forays were made from Camp 5 eastwards up the gorge and a surface traverse was surveyed and linked into the known entrances. This provided a baseline into which future expeditions can link any new discoveries.

From Camp 5 the main track up the gorge heads east. This is a very pleasant walk alongside the river which eventually leads to a point where the track peters out as the valley sides become steep and the river cuts into the bank. In order to reach the upper parts of the gorge it is necessary to take a right turn off the main track approximately 650m east of camp. The track climbs steeply through the forest over alluvial deposits and occasional glimpses of the towering cliffs of Api can be seen through the canopy. As the track rises, a stream can be heard to the right and below. This is the most eastern tributary of the stream which enters the Melinau at Camp 5 (Fogg 2000).

At a point where the track levels out properly for the first time, at a small col, a shallow valley contains a small stream, which sinks in a mud and leaf choke. A few metres to the side, beneath a tree is a short drop into **Pre Repast Cave** where the sink water comes in and flows off down a low bedding. After just a few metres are two slippery 3m climbs into deep pools. The cave continues unexplored but it seems likely that it will feed through into the stream heard in the valley on the walk up. This is worth checking out on a future expedition. The source of the water entering the sink is from a resurgence 100m beyond Pre Repast Cave. This is **Snail Shell Cave**, explored in 2000. Neither of these two caves were tied into the surface survey.



Tree Cave entrance

Matt Kirby

Beyond Pre Repast Cave the track climbs to another col. From there, the ground drops away into a small valley heading east. At this point a small cave, with a tree, almost blocking the entrance, can be seen against the cliff. This is **Tree Cave** and its entrance was linked into the surface survey. At the time, it was noted as Sayang Cave. Earlier in the expedition another team had located this cave and noted it as Tree Cave. This was explored and surveyed by Pete Hall in 2000 but not documented.

This is the area from where routes take off to gain access to the slopes which lead up to Canopy Cave, (Willis 2005 p.51)



The Rock Shelter and survey station

Matt Kirby

Following the cliff line west for 70m leads into a large blind alcove, the **Rock Shelter**, which has been used as the second significant feature for future surveys to tie into. The survey station is standing on the prominent boulder in the centre of the arch (station 6).



Below the Rock Shelter

Matt Kirby

Standing in the Rock Shelter, and looking out, the ground falls away in front to a small stream which runs west-east down the valley. The main track is on the steep bank opposite and descends to cross the stream. From here the track is indistinct and difficult to follow but continues to run eastwards mainly to the south of the stream but occasionally in it.

120m down the valley another stream comes in from the south. Following this upstream leads to a small resurgence. A prominent, large, sloping slab defines the end (W) of the bluff. Below the slab is an innocuous water-worn entrance. This is **Likoh (Stream) Cave**. After 10-15m the sound of water can be heard in the floor. After 30m is a clear sandy pool. Across the pool leads to a small, sloping fall of water. This was not followed to a conclusion and is worth another check.

The track continues eastwards, crossing a dry valley, before rising again to pass through an obvious small valley feature which forms the next col. At this point the stream has moved away to the north.

Beyond here the track remains away from the cliff and is separated from it by another small valley. The base of the cliffs can be seen and **Bat Cave** forms an obvious entrance which can be reached by a scramble down slope and back up to the limestone. Bat Cave is the third obvious feature which the surface traverse links into. The entrance is 25m wide.

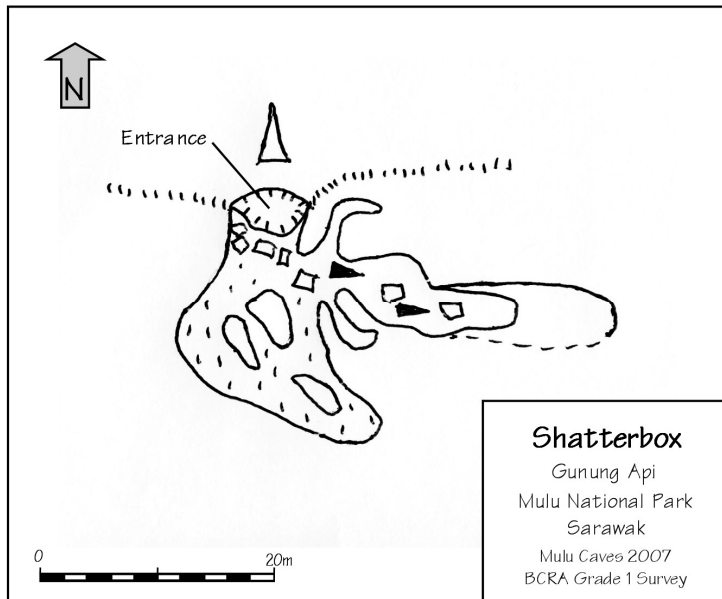


Bat Cave Entrance

Matt Kirby

Another entrance, **Pinnacle Cave**, appears in the 2000 report just above and to the west of Bat Cave. This was first explored by Wilford in 1963 and re-explored and surveyed in 2000 by Pete Hall (Fogg 2000). During the surveying of the track an entrance was found near here which was followed for 70m in a 3m diameter tube heading at 180°. This is referred to as Cave 2 in the dataset and its entrance is tied into the surface survey. No detailed underground survey of Cave 2 was carried out but this would appear to be Pinnacle Cave.

Continuing eastwards, the track drops onto flatter ground then loops away from the cliffs, as it avoids a rather swampy area, It returns to the base of the mountain near **Penan Pot Cave**, which was explored in 2000 (Fogg 2000). Penan Pot Cave is 150m to the east of Bat Cave. The entrance is 30m up-slope and is 3m wide by 2m high. Below here is a small entrance. This is **Frog Cave** which was explored in 2000.



Thirteen metres to the east of Penan Pot Cave is **Shatterbox**, which is six metres further up the slope. This was entered in 2000 but not documented. The entrance is a death-defying climb down a small shaft which is loose underfoot as well as having an unstable roof. Great care should be taken to enter this cave. At the base of the entrance climb a bouldery ramp leads down to the east but this is blind. Onwards is a series of small inter-connected chambers. A grade 1 survey was carried out but there was no draught and no obvious way on.

Figure 12; Shatterbox

Ninety metres to the east of Shatterbox is **White Rift Cave** which was explored and surveyed. The entrance is 30m above an obvious resurgence. A 3m x 3m passage leads to a climb down with three ways on. The main way leads into a sharp, loose, white rift which closes down into two tight cracks with a draught coming from a tiny hole in the wall.

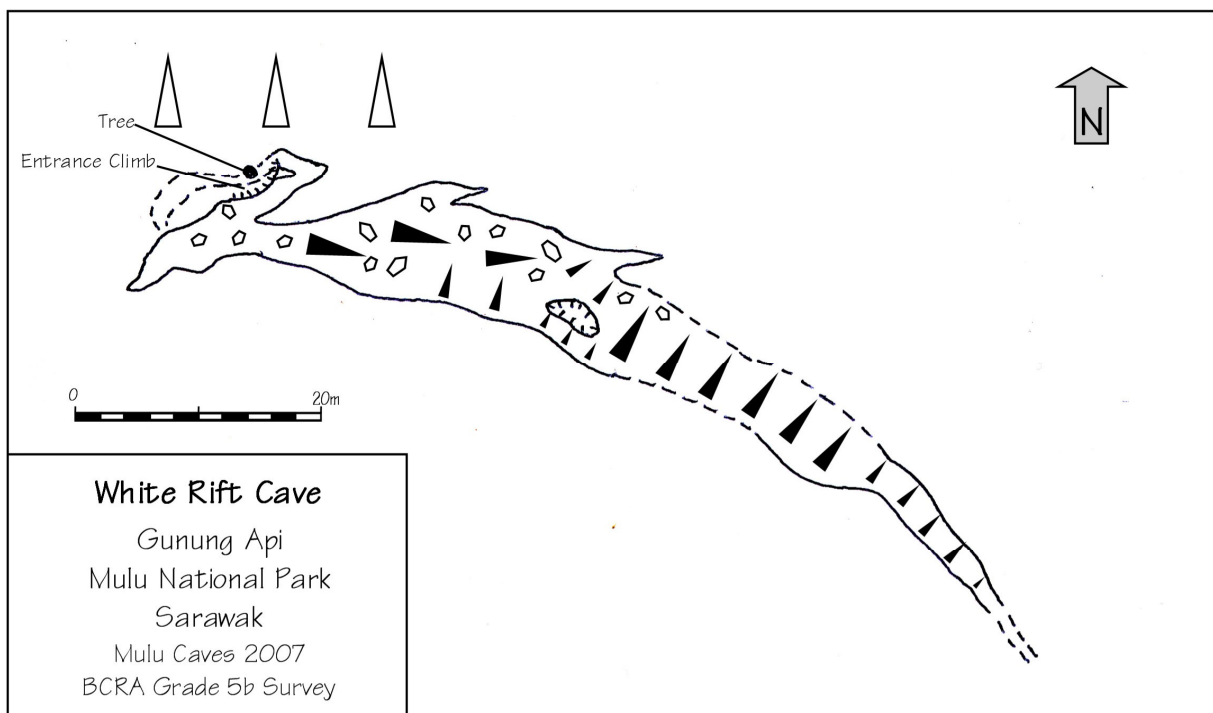


Figure 13; White Rift Cave

250m beyond White Rift Cave is **Pinnacle Cave No. 2** which was explored and surveyed in 2000. Other previously discovered caves were not relocated. These are Rat Cave and Frog Cave, which appear in the 2000 expedition report (Fogg 2000).

During 2000 a surface survey was carried out between Pinnacle and Pinnacle No. 2 Caves, to link all the local entrances together. This has been combined with the 2007 survey to provide a plan showing all the known entrances. This forms part of the master dataset.

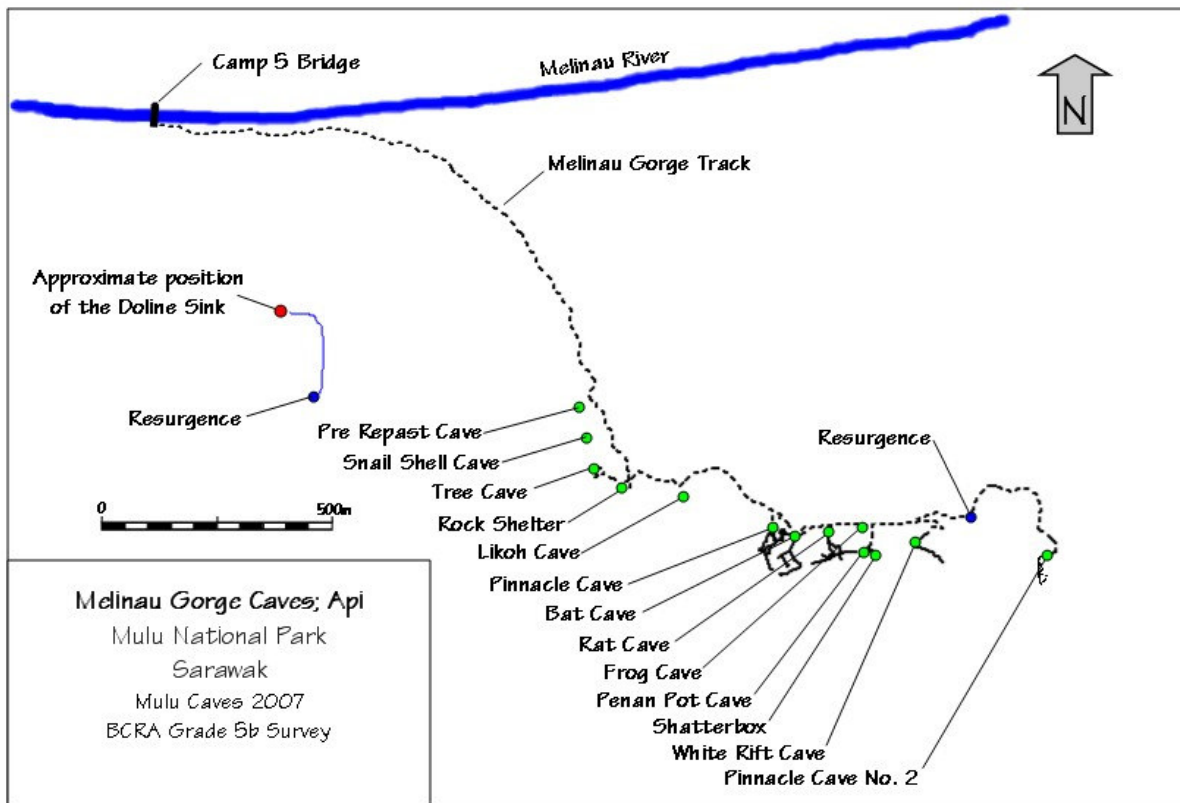


Figure 14; Melinau Gorge Caves, Api

Behind Camp 5

Two forays were made to the cliffs immediately behind Camp 5. After crossing the stream, which joins the river just east of the Camp 5 bridge, a track was cut to the south to intersect the cliff line. Crossing the same stream again reaches the base of the cliff. The rock in this area is a shattered conglomerate. At this point a cave feature was noted but not entered.

Somewhere above here lie the northern ends of 1954 and the Northern Line in Whiterock. Tantalisingly close to Camp5, a way into these remains for future expeditions to find.

The cliff line can be followed to the east with the stream on the left. This emerges from a swampy area to the east of the camp. After a short while the cliff line turns away south and upwards but the main slope soon turns east again. This was followed to a point where water could be heard below. A climb down-slope led into a large sink feature, the **Doline Sink**, which appears to take a considerable amount of water during wet conditions. This was the location from where dye tracing which was carried out in 1989.

A small stream was entering boulders at the base of the sink and the whole area was damp and very humid.

This is a strange feature lying between the cliffs and the Melinau River. First thoughts would suggest the source of this water is from the river but, on closer inspection, it was found that



the main flow came from up-slope where a sizable stream was running under boulders. The sound of the water was followed up-slope for a considerable distance to the head of a gully where a small entrance was found. Hugh St. Lawrence wormed his way into this but it choked after 30m.

It would appear that this water is resurging from the Api cliffs as this point is well above the level of the Melinau River. This suggests that water is leaving the mountain at high level only to run down the scree slope to sink again at base level. It is known from dye tracing that the water entering the sink runs into the Blackrock and Clearwater rivers to emerge at the Clearwater resurgence. It would be worth investigating this feature in high water conditions. A surface survey to the sink from Camp 5 would be a worthwhile task for a future expedition.

Large cliffs above the Doline Sink

Matt Kirby

Above the sink it is possible to gain access to a significant cliff-line rising upwards, west to east. This was followed but only a couple of blind alcoves on precarious ledges were found. It is advisable to carry a handline in this area as descending from the cliff-line can be difficult. The base of this cliff is littered with the remains of large trees which have fallen from high above. A difficult climb down through broken timber at the east end of the cliff led back onto the scree slopes.

Traversing east at the same level comes to a bedrock exposure with large choked fissures. Continuing round these soon leads to the Melinau Gorge track at the sink adjacent to Pre Repast Cave.

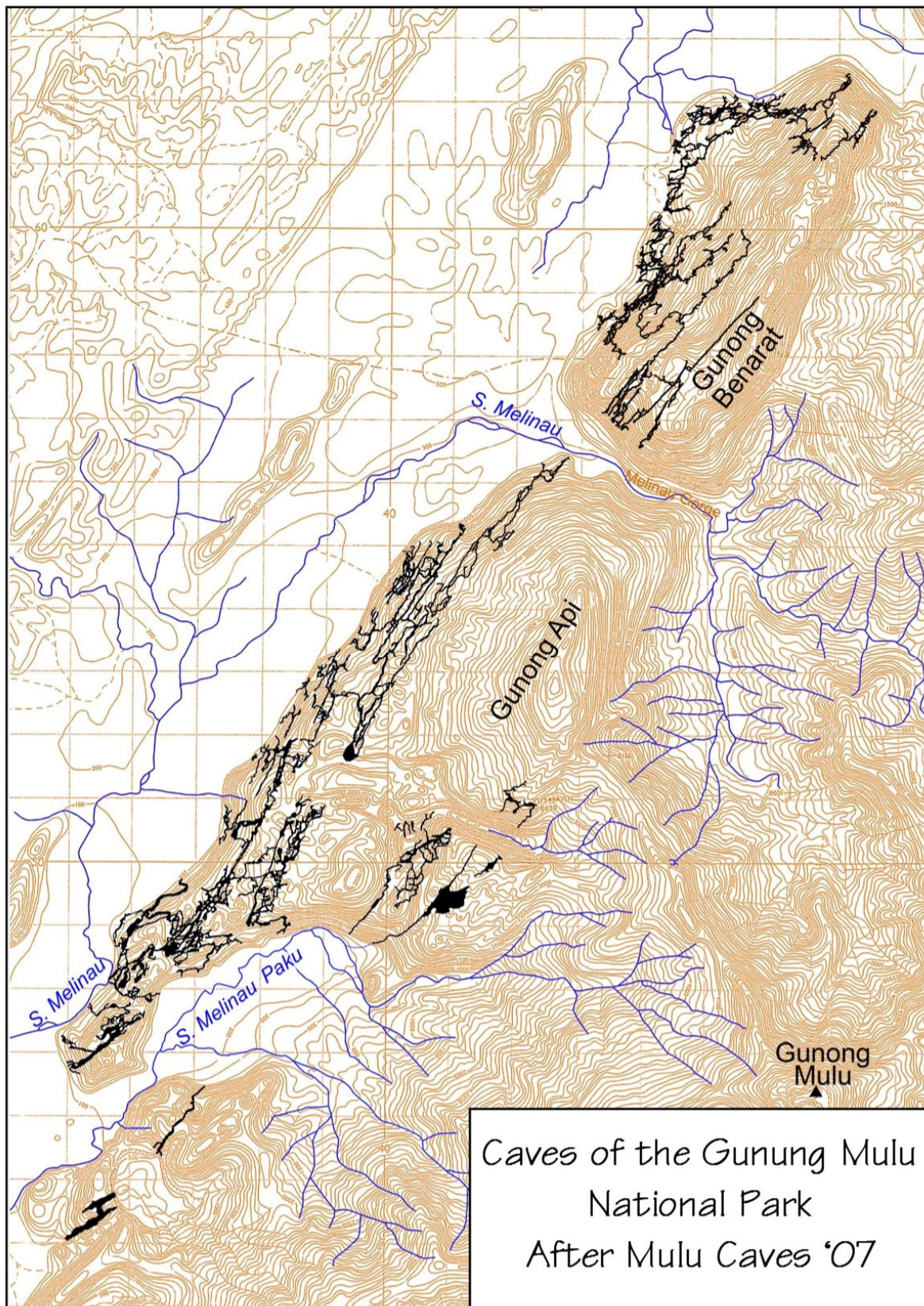


Figure 15; Caves of Gunung Mulu National Park after the 2007 Expedition

CONCLUSIONS

Mulu never ceases to amaze the seasoned veteran. Just when there appears to be no hope, a huge discovery is made, just where it was least expected.

In 2003 one such discovery led to what could be described as a 'feast of exploration'. Richard Chambers and Matt Kirby were hoping to find a new way into the known passages of Blackrock when they stumbled on Whiterock Cave. Within three days it had grown to 3.7km with no sign of Blackrock. The 2005 expedition thought a couple of days caving would wrap up all the known leads. Not so, the cave burst over the top of Blackrock and revealed a further 17km of enormous passages including Api Chamber, the second largest chamber in Mulu. Two links were established with Blackrock and far more leads were left than there were to start with. Along came the 2007 expedition, keen to push northwards. Not only did the cave go right to the Melinau Gorge as required but it did so at two separate levels without revealing an entrance. Passages were also discovered in the centre section where there appeared to be no room for more cave. Southern extensions revealed parallel passages and an alternative route to Api Chamber. A total of 22km were discovered including a third link into Blackrock. Each expedition leaves this cave with more open leads than it started with.

In 2005, across the river in the Benarat cliffs, Mark Wright never reached his goal of entering the nesters' cave high in the cliff opposite Camp 5. Instead, Mulu came up trumps and revealed a far easier target, Moon Cave, only half an hour from camp and squeezing itself neatly in between Benarat Caverns and Cobweb Cave. Not only that, but it headed due north for 6km, half way through the mountain, with the potential to burst out of the other side. It was then linked to Benarat Caverns. The return in 2007 revealed a link into Cobweb Cave which confirmed the Benarat Caverns System to be the longest cave in the mountain at 50km.

The next expedition will not be short of objectives. Although Moon Cave has been fairly well explored, Whiterock will keep explorers busy for a long time to come. The 2007 team only followed the biggest open leads so there are many more open passages and ramps waiting to be explored. A review at the end of the expedition listed 40 open leads. The proximity of the northern passages to the Melinau Gorge makes this a tantalizing focus for further pushing to find the elusive entrance. Although the lack of draughts would suggest that this may be a difficult prospect, the potential for a 10km through trip between Camp 5 and Cave of the Winds is well worth pursuing. The stacked nature of the passages in the cave provides potential for further development at higher levels, with the possibility of entrances similar to Solo being found high on the mountain. It is estimated that there is 340m of limestone above the highest point in the cave and 550m above Bigness South.

In Solo the connection to Clearwater remains elusive, but a concerted effort here may reveal the breakthrough, which would extend Clearwater's depth range to over 500m. If only we knew where to look.

And so to Benarat, where the Cobweb and Terikan systems are within 250m of each other. With the potential for an 82km master system, this deserves some attention.

Keep exploring.

EXPEDITION MEMBERS

From the UK

Tim Allen
Jane Allen
Dave Nixon
Colin Boothroyd
Hugh St. Lawrence
Robbie Shone
Matt Kirby
Dave Clucas
Nick Williams
Tim Fogg
Pam Fogg
David Scott
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Dave Harley
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Roland Gau
Syria Lejau
Jenny Malang
Jeffrey Simun
Paris Wan
Anderson Gawan (Andy)
Kallang No
Steven Lewe (Lan)
Ramsey Henry (Eugene)



2007 Team Photo

Robbie Shone

Back Row

Matt Kirby, Hugh St Lawrence, Tim Fogg, Dave Harley, Lan, Dave Cowley, Eugene, Kallang, Mark Wright, Colin Boothroyd
Dave Nixon (seated)

Front Row

Tim Allen, Jane Allen, Pam Fogg, Dave Clucas, Nick Williams, David Scott, Roland Gau, Robbie Shone, Andy Gawan

ACKNOWLEDGEMENTS

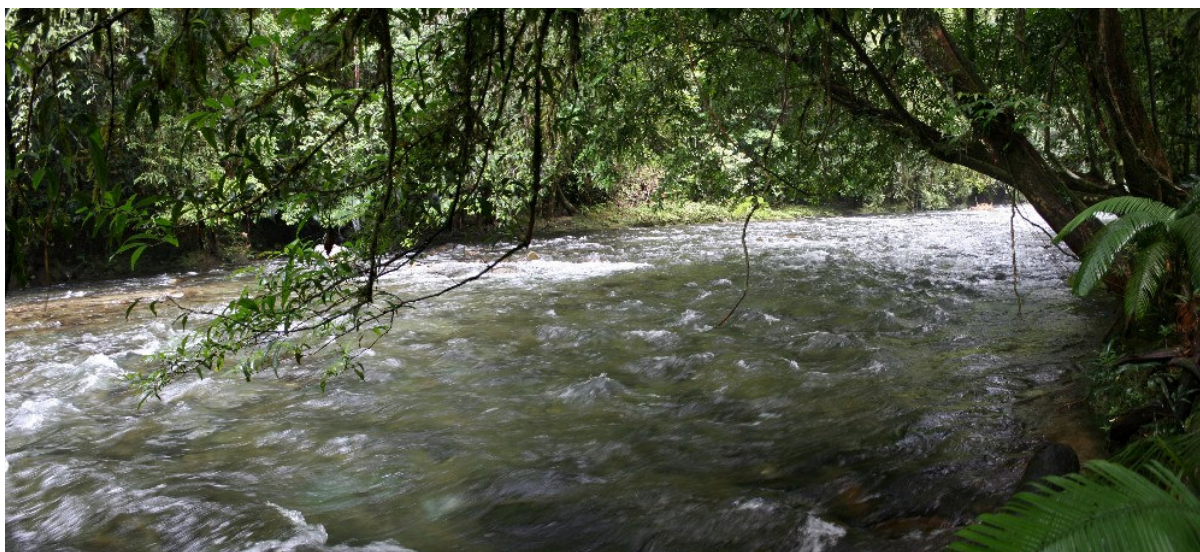
Members of the Mulu Caves 2007 expedition are grateful for the support of the following.

In Sarawak

The Chief Minister of Sarawak
The Sarawak Secretary of State
The Director of Forests, Sarawak
Protected Areas & Biodiversity Conservation Unit, Sarawak Forestry Corporation
The Sarawak Ministry of Planning and Resource Management
The Resident, Miri Division
The Sarawak Immigration Department
The Sarawak Police Department
Gunung Mulu National Park Management & Staff
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Howard & Deb Limbert (Vietnam Cave) for loan of basic medical kit
Richard Chambers for supply of rope
Liz Kirby for logistical support



The Melinau River above Camp 5

Matt Kirby

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APPENDICES



Mark Wright drinking from an inlet in Moon Cave

Robbie Shone

Surveying in Mulu (The Mulu Survex Dataset)

Mention cosine tables to a young cave explorer of today and expect a blank look. It seems a long time since raw data had to be crunched using such ‘primitive’ tools but in reality it is within the timescale of the Mulu expeditions and is well remembered by the veterans as a laborious process.

The advent of computerised survey management programmes has revolutionised the way in which cave surveys are handled. The first major step forward was the use of programmable calculators in the ‘80s, which allowed calculations to be made at the touch of a button using the ‘Basic’ programming language. Although the results still needed to be entered by hand into the expedition log book this speeded up the process and made data quickly accessible for surveys to be drawn up on graph paper in the field, using x, y, z co-ordinates.

Three dimensional computer based survey programmes were the next revolution, ‘Compass’ software being used in Mulu in the ‘90s. This was abandoned when the new Survex application¹ became available and it is a version of this software that is in use today.

Survex allows raw data to be entered in the field to produce a three dimensional centreline survey which can be printed at any scale for initial surveys to be drawn. Individual sections of survey can be quickly attached to the master dataset, allowing new finds to be viewed relative to other passages. The advantages of this are immense. It is not so long since explorers only had a rough idea of where they had been or which area they were heading for. It is now possible to input the day’s data to give a full three dimensional representation of where the latest find fits into the master survey. Not only the alignment but also the level, surveyed length, vertical range and, most importantly, what it is likely to connect to if pushed further.

The beauty of this system is that all survey data is contained within one dataset instead of lots of different paper plans, all at different scales and in various people’s possession. In the case of Mulu this is a monstrous amount of information which requires careful management. With a complex dataset such as this it is essential for information to be entered in a standard way so that wherever you are in the system the dataset structure is the same.

Getting Started with Survex

During the 2003 expedition survey data from previous Benerat expeditions was entered into Survex to create a master dataset for the mountain. Where raw survey data was not available, existing surveys were used to create a set of three dimensional coordinates which were then entered into the dataset as if they were raw data. By the end of the expedition a fairly comprehensive survey of all the known caves in Benerat was available. During 2003 & 2005 the discovery and extension of Whiterock Cave caused a large amount of data to be entered for the Api side of the Melinau Gorge. The subsequent connection of Whiterock and Blackrock/Clearwater in 2005 begged for all the historic Api data to be entered into the same dataset.

¹ www.survex.com

Construction of the Dataset

During the winter of 2005/6 Matt Kirby, who was new to Survex, decided to learn to use the system by re-entering the recently entered Whiterock data. Matt decided to standardise the way in which data was entered and stored in order to simplify the existing model and make it as user-friendly as possible. This resulted in a new Survex model for Whiterock. With the new structure for Whiterock in place Matt proceeded to enter all the available raw data from expeditions as far back as 1988, to create a model for the whole mountain. Unfortunately data from expeditions pre '88 was not available so Tim Allen went through the laborious process of creating fake data for the Clearwater system (with the exception of the Armistice Series for which raw data existed). This set the format for the current Mulu dataset.

With a working model in place for the Api side of the river Matt decided to re-work the Benarat dataset to bring the structure in line with that of Api. This was a laborious task as the data had been entered by various people over the course of several expeditions which had resulted in some complex links and commands that would make interrogation very complicated at a later date. When the Benarat data had been re-worked, the two datasets were joined together to produce the Mulu Dataset we use today.

Dataset Structure

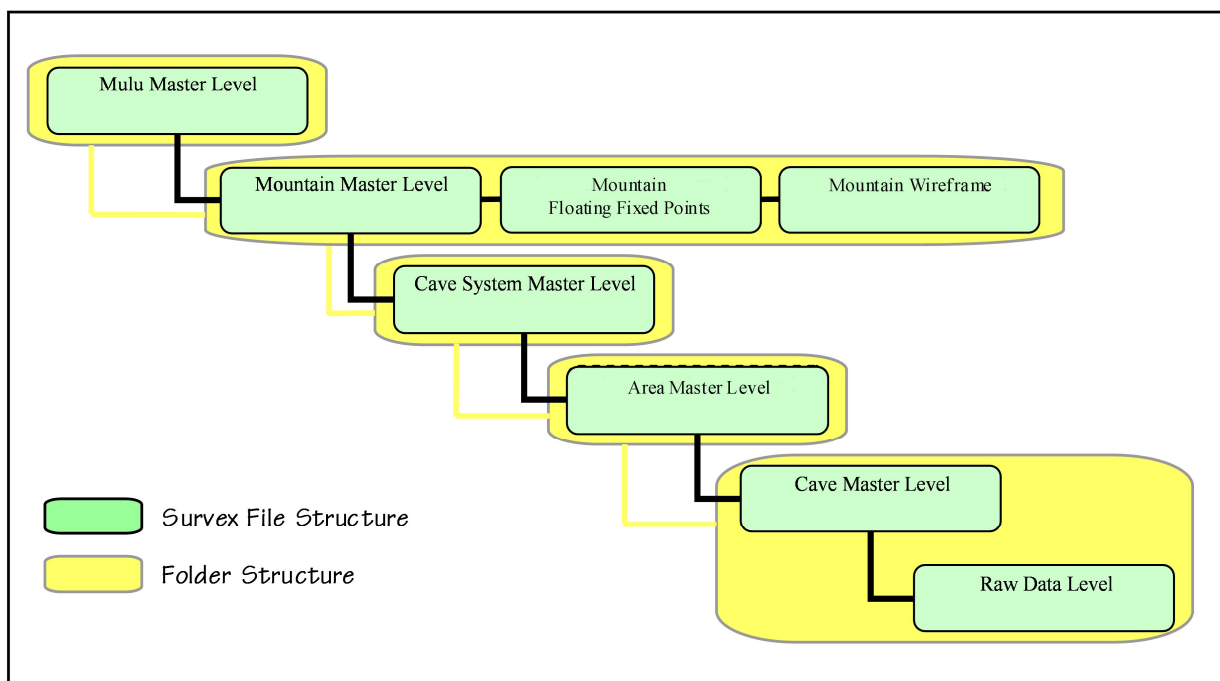


Figure 16; Dataset hierarchy

The dataset has been structured to conform to a strict hierarchy of .svx files on six levels. Figure 16 details the key levels within the structure. The files are stored in folders (shown yellow) which follow a similar hierarchy apart from the bottom level where raw data .svx files and the cave master .svx files are both stored in the same folder. This ensures that all the information required to produce a 3D image of a cave is in the same location. Mountain Master files, Mountain Wireframe files and Mountain Fixed Point files share the same folder.

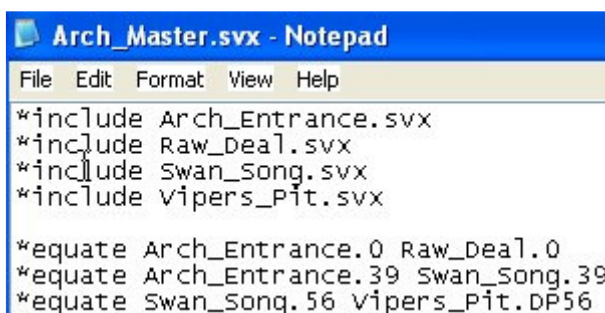
A brief description of each level is given below, starting at the lowest level in the structure:-

Raw Data Level

All the raw survey data is at the lowest level in the structure. All levels above this are simply used to include and link subordinate data. Raw data files include all the information from surveying trips.

Cave Master Level

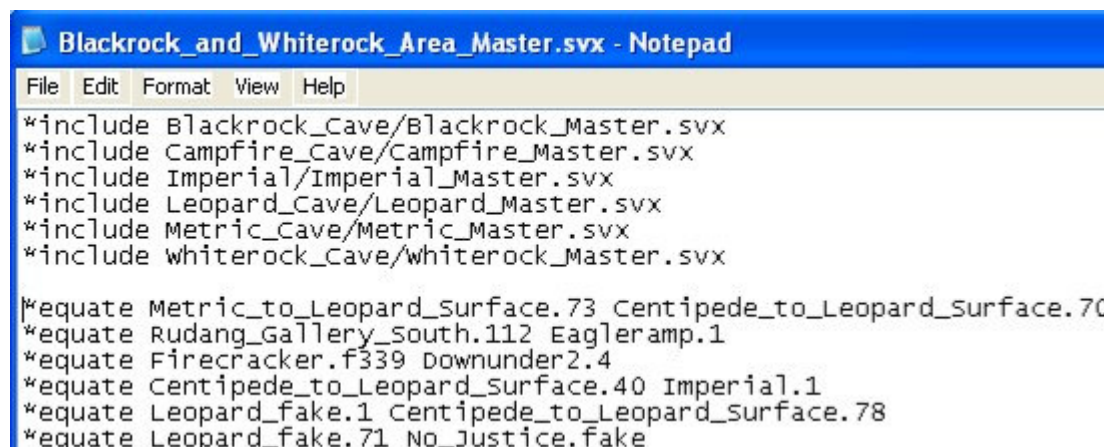
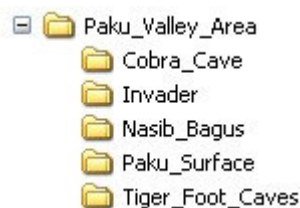
The Cave Master level is a .svx file which tells Survex which subordinate raw data files (in the cave folder) to include and how to link them together using the 'equate' command. The Arch Cave Master is shown as an example. Where a GPS fixed point is used to position a cave the 'fix' command appears in this file.



```
Arch_Master.svx - Notepad
File Edit Format View Help
*include Arch_Entrance.svx
*include Raw_Deal.svx
*include Swan_Song.svx
*include Vipers_Pit.svx
*equate Arch_Entrance.0 Raw_Deal.0
*equate Arch_Entrance.39 Swan_Song.39
*equate Swan_Song.56 Vipers_Pit.DP56
```

Area Master Level

The structure is laid out to allow connected groups of caves to be viewed together either as a small group at the 'Area' level or the whole system at the 'System' level. The Area Master level is a .svx file which tells Survex which Cave Master .svx files to include in the area and how to link them together. This level is always used but in some cases, where the system is uncomplicated, there is only one area file within a system. The Area folders are used to break systems into smaller parts for ease of viewing. This has been very useful to break the Clearwater System into the Clearwater end and the Blackrock/Whiterock end. The area files overcome the need to open the Cave System files when only a small portion of data is required. The Blackrock and Whiterock area is shown below as an example. To the right is the Area folder structure.



```
Blackrock_and_Whiterock_Area_Master.svx - Notepad
File Edit Format View Help
*include Blackrock_Cave/Blackrock_Master.svx
*include Campfire_Cave/Campfire_Master.svx
*include Imperial/Imperial_Master.svx
*include Leopard_Cave/Leopard_Master.svx
*include Metric_Cave/Metric_Master.svx
*include whiterock_Cave/whiterock_Master.svx
*equate Metric_to_Leopard_surface.73 Centipede_to_Leopard_Surface.70
*equate Rudang_Gallery_South.112 Eagleramp.1
*equate Firecracker.f339 Downunder2.4
*equate Centipede_to_Leopard_Surface.40 Imperial.1
*equate Leopard_fake.1 Centipede_to_Leopard_Surface.78
*equate Leopard_fake.71 No_Justice.fake
```

System Master Level

The System Master level allows all caves belonging to a particular cave system to be viewed as one. This level is a .svx file which tells Survex which subordinate Area Master .svx files to include in the System and how to link them. This overcomes the need to open the whole dataset when a particular system is to be viewed. The Hidden Valley system is shown below as an example. To the right is the System folder structure.



```
Hidden_Valley_System_Master.svx - Notepad
File Edit Format View Help
*include Hidden_valley_Area/Hidden_valley_Master.svx
*include Paku_Valley_Area/Paku_Caves_Master.svx

*equate Cobra_Cave.59 Kamakazi_Passage.92
```

Mountain Master Level

The Mountain Master level is a .svx file which tells Survex which System Master .svx files to include and how to link them together. This allows each mountain to be viewed without having to open the full dataset. Three Mountains are included Benarat, Api and the Southern Hills. The Api Master .svx file is shown below as an example. Mountain fixed point files and Wireframe files share the same Mountain folder. To the right is the Mountain folder structure.



```
Api_Master.svx - Notepad
File Edit Format View Help
*include Clearwater_System/Clearwater_System_Master.svx
*include Hidden_valley_System/Hidden_valley_System_Master.svx
*include Melinau_Gorge_System/Melinau_Gorge_System_Master.svx
*include Api_Floating_Fixed_Points.svx
*include Api_Wire_Frame.svx

*equate Api_wire_Frame.2999 Clearwater_Fake.0
```

Mulu Master Level

The Mulu Master level is at the top of the tree. This level is a .svx file which tells Survex which Mountain Master .svx files to include and how to link them together. The Mulu Master file is shown below. To the right is the Mulu Master folder structure.



```
Mulu_Master.svx - Notepad
File Edit Format View Help
*include Api_Master/Api_Master.svx
*include Benarat_Master/Benarat_Master.svx
```

The WireFrame

As an enhancement to the three dimensional representation of the cave passages it is possible to overlay the surface topography by means of a wireframe. This is based on a grid of squares which relies on AOD levels being attributed to each corner of each square. The levels are derived from the topographical map of the area. Tim Allen built up a wireframe for Mulu to overlay the area covered by the dataset using 200m squares, at present this is limited to the three mountains. This was a laborious task which required many hours of painstaking work.

Survex only allows two types of line to be drawn, underground and surface. At first the wireframe was detailed as a 'surface' traverse which resulted in it being represented as hatched white lines, however, this proved difficult to view. The detail was then changed so that the wireframe was shown as underground passage which proved far better to view. Unfortunately neither option is perfect. Survex has the ability to graduate any underground survey so that the lowest passages are shown blue and the highest red with graduations through green, yellow and orange in between. Surface traverses do not effect the graduation so with the wireframe in 'surface' mode the caves are graduated correctly with the highest passages shown in red. However, when the wireframe is set to 'underground' Survex sees the top of Api as the highest level and causes all the cave passages to appear in blue. This is seen as a weak point of Survex and the Mulu Caves Project have requested that a new category be incorporated to show a 'wireframe' classification in green. Watch this space.

Figure 17 shows the Api wireframe with colours reversed for clarity.

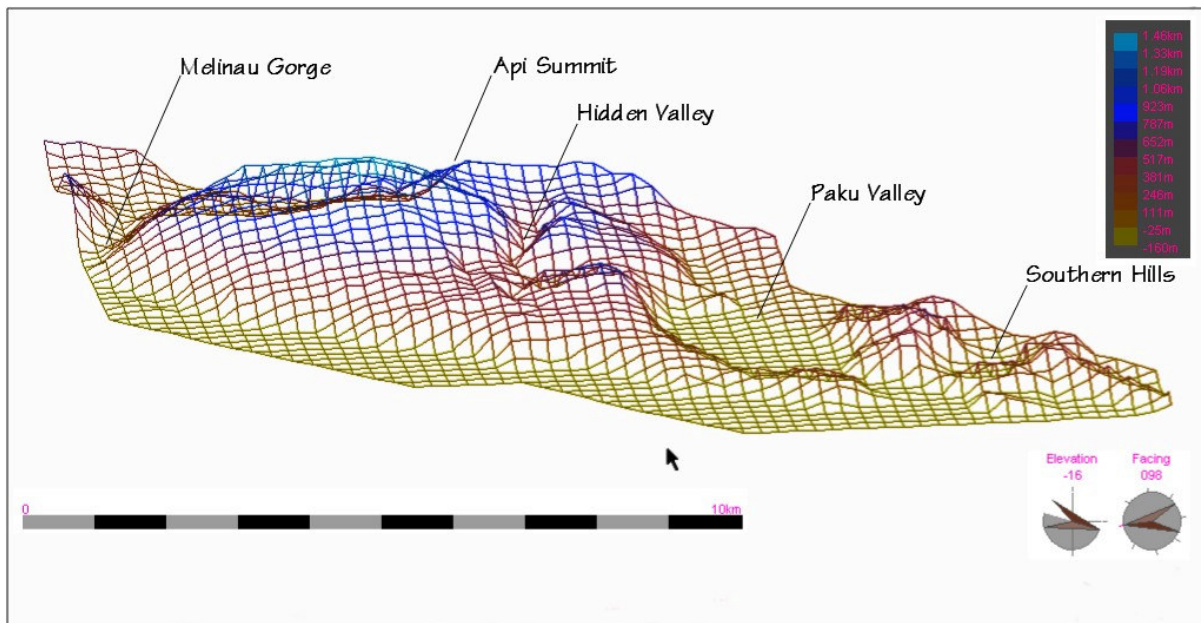


Figure 17; Api wireframe

The Use of Fixed Points

Survex generates a series of X, Y, Z coordinates which can be linked, by means of a 'fix' command, to the global positioning system using UTM (Universal Transverse Mercator) coordinate data. The fix command is assigned to a particular survey station in the cave, normally the entrance or a short distance from the entrance, which causes the rest of the survey to be positioned globally around that point. Where GPS data is used to fix the position of a cave, the fix command is contained within the Cave Master file. For survey data where no fix command is used, Survex will automatically set one station at 0, 0, 0 and this will be reported in the log file for the survey following the processing of the .svx file.

Obtaining GPS coordinates in Mulu has proved to be difficult owing to the density of the forest canopy and steepness of the foot slopes, both of which limit the number of satellites which are 'visible' at any one time on which to gain a precise fix. Owing to the limited accuracy of GPS data, the use of genuine GPS fixes in the dataset has been restricted to a few key points to enable isolated caves to be linked into the dataset. As more accurate fixes are achieved these positions will be corrected.

The dataset positions and links caves together in three different ways, in the following order of preference:

- By means of surface traverses (where available)
- By GPS data (where a fix is considered to be of sufficient accuracy)
- By fake GPS coordinates derived from original surveys

Where surface surveys have been carried out, these are the preferred method for linking cave entrances. To date, all the major caves in Benarat (with the exception of Deliverance and Tiger Caves) have been linked into a long surface traverse along the Headhunters' Trail from the Terikan River to Camp 5. A GPS fix at Camp 5 provides the global coordinates for the whole of the Benarat dataset. Deliverance is linked into the dataset by means of a GPS fix of unknown accuracy. Tiger Cave has been positioned using fake coordinates.

In Api, the Clearwater System is positioned by a single GPS fix on the track outside Whiterock Cave at a position named 'Whiterock Junction'. Lagan's, Drunken Forest, Ipoi's and Racer Caves are all positioned by fake GPS data. Solo is positioned by a reasonably accurate GPS fix gained during the BBC filming expedition.

In Hidden Valley no reliable GPS data exists, so fake GPS positions were created for the entrances to Cobra, Nasib Bagus, Helicopter and Invader Caves. All other parts of this system were then connected by surface traverses and underground connections.

In addition to the GPS data used to fix the positions of cave entrances, each mountain has a 'floating fixed point' file. This inputs GPS data to the dataset at the mountain master level in order to provide a fixed-point layer which floats above the main dataset and does not link into any stations. This allows checks to be made between surveyed positions and GPS data without the GPS data 'bending' the survey. In Api, this allows fixes such as the Park HQ helipad (accurate fix) and Api summit (fake data) to be shown. This file also contains fake fixes for the summit of Mulu and Camps 1, 3 and 4.

Fixed point information is constantly being updated and it is important to indicate, on any information contained in the dataset, where the data came from (date, instrument, person) so that it can be evaluated and updated as more accurate fixes are achieved.

Fault Finding

In order to ensure that the dataset can be interrogated, in the event of an inputting error, a prime requirement is that each file must be capable of processing itself to generate a 3D image of itself in the form of a .3D file. Once data is entered it must be processed and shown to produce its own 3D file. There is no point in trying to solve a problem where the whole dataset won't run when the problem is with a newly entered raw data file which contains a small error. In this way, if it isn't possible to get a cave master file to produce a 3D image then one knows that the fault is not with the individual file (unless an export command has been missed which would be reported in the cave master log file anyway and could be quickly fixed). The same philosophy continues up the structure.

Ongoing Issues

In general the Survex system is an excellent tool. However, there are flaws in this type of system, mainly around the way in which data is entered and named within the final dataset.

In order to explain this, it is necessary to understand the difference between the way in which data was handled and named during the x,y,z coordinate era and the way in which it is handled now. With x,y,z there was no requirement for any names to be attributed to data other than a few explanatory notes next to the crunched data in the expedition log book. Only when the final surveys were drawn up were passages named and their extent detailed. The new era has changed this. Now each parcel of data requires an individual file name which is created when it is input to Survex. Where there is only one lead, which isn't connected to anything else, this is fine because the lead can be given a unique name. However, where a day's surveying contains multiple leads and connections, the filename may bear no relationship to the final naming of the passages included in the survey. Major leads can become passages in their own right and under their own names.

An example of this is Lemon Squeazy in Whiterock. Explorers know this distinctive major bypass to the Northern Line and it is individually named on the final survey, but because the data was entered as part of the exploration of the Northern Line there is no individual filename for the passage in the dataset. Although this may be fully understood by anyone who knows the geography of the system, it will cause major confusion to future explorers. Another example is Lima Puluh, which in reality is the northern end of Ancestors' Passage, (a passage already broken down into Ancestors, Ancestor2 and Ancestor3). However, this section of cave was explored on the 50th birthday of one of the explorers so was named and entered as Lima Puluh (Malay for 50). The Ashes Series is another example. The passages which are on the level of the Midnight entrance are known as the Ashes Series, however, this major series does not appear on the Survex dataset because all its elements were entered under their individual filenames.

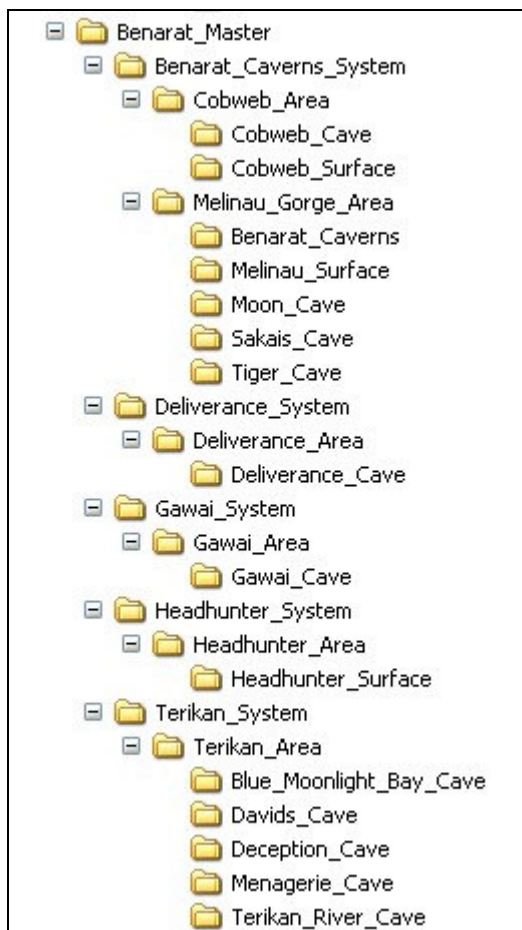
One way of sorting out this confusion would be to re-enter and re-name all the sections of cave according to the final survey, however, Survex does not allow duplicate station numbers between any two 'begin - end' commands. If data from more than one trip were added to the same file then inevitably there would be duplication of station numbers within the same file. As a principle the numbers allocated at the time of surveying must be used throughout to provide an auditable trail of information. Altering the station numbers isn't the answer as this would mean the survey notes would not tie up with the survey data and links in other files would have to be altered. Trying to unravel this in the field would be a nightmare, especially if a note was found on a cairn giving a station number which subsequently can't be found in

the dataset because it has been changed to allow duplicate numbered stations to appear in the same file.

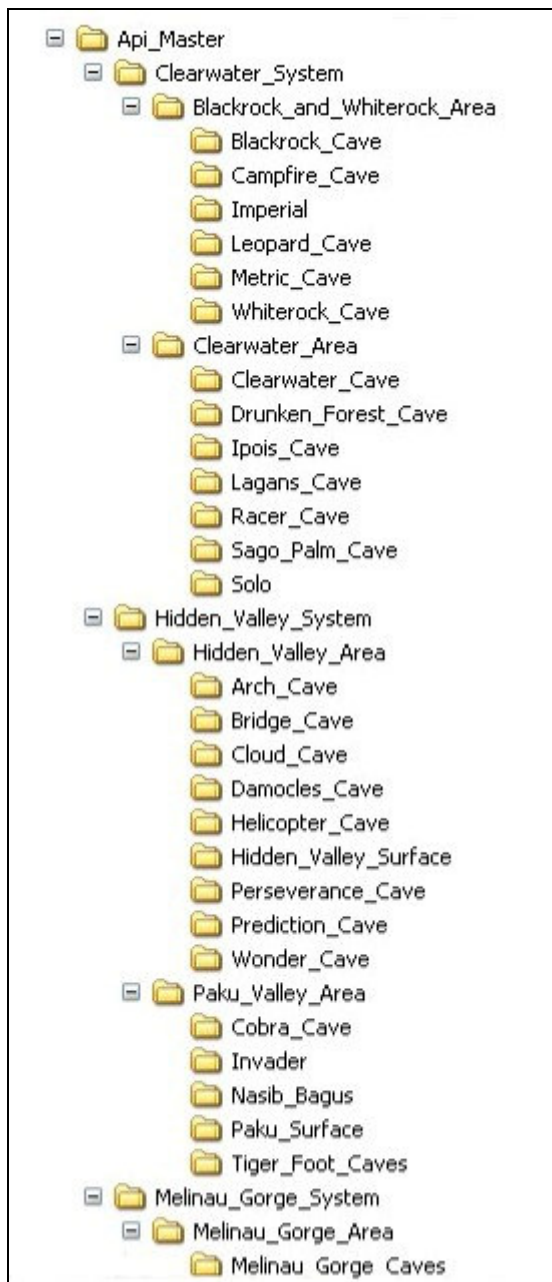
Also, at the time of data entry, links are made with other sections of the dataset to incorporate the new file into the system, existing files are amended to include the linked stations. New finds are then added to this and further links added. It soon becomes an almost impossible task to remove or amend recently added sections without major surgery affecting multiple files. One small command left in the wrong place can cause the whole dataset to crash.

It is generally possible for a novice to pick up the required inputting skills fairly quickly and for relatively simple cave systems this will be adequate. However, the size and complexity of the Mulu dataset demands a sophisticated and uniform approach to the way in which data is entered.

Benarat Folders



Api Folders



The Southern Hills

The Southern Hills are the limestone block containing Deer and Green Caves and the Garden of Eden. Apart from these two major caves this area contains some significant development and classic through trips. Stone Horse Cave was first explored in 1991 and later connected through the hill to Fern Rock Cave. At the time of this report the dataset for the Southern Hills remains under construction. No original data remains for Deer and Green Caves, so fake data will be generated to represent these passages.

Survex Images

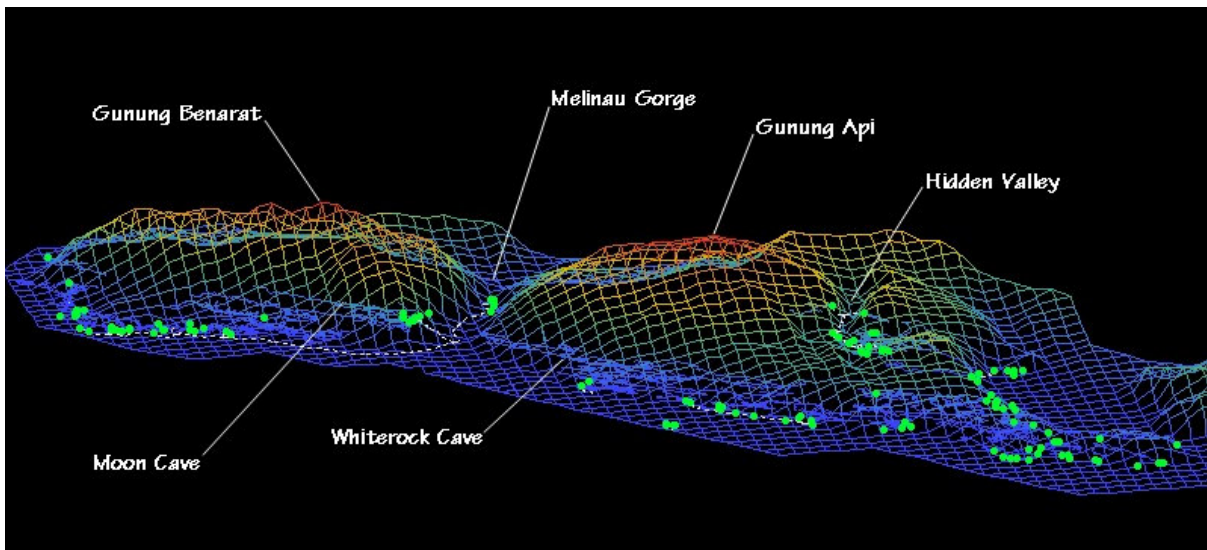


Figure 18; Mulu Survex image from the west

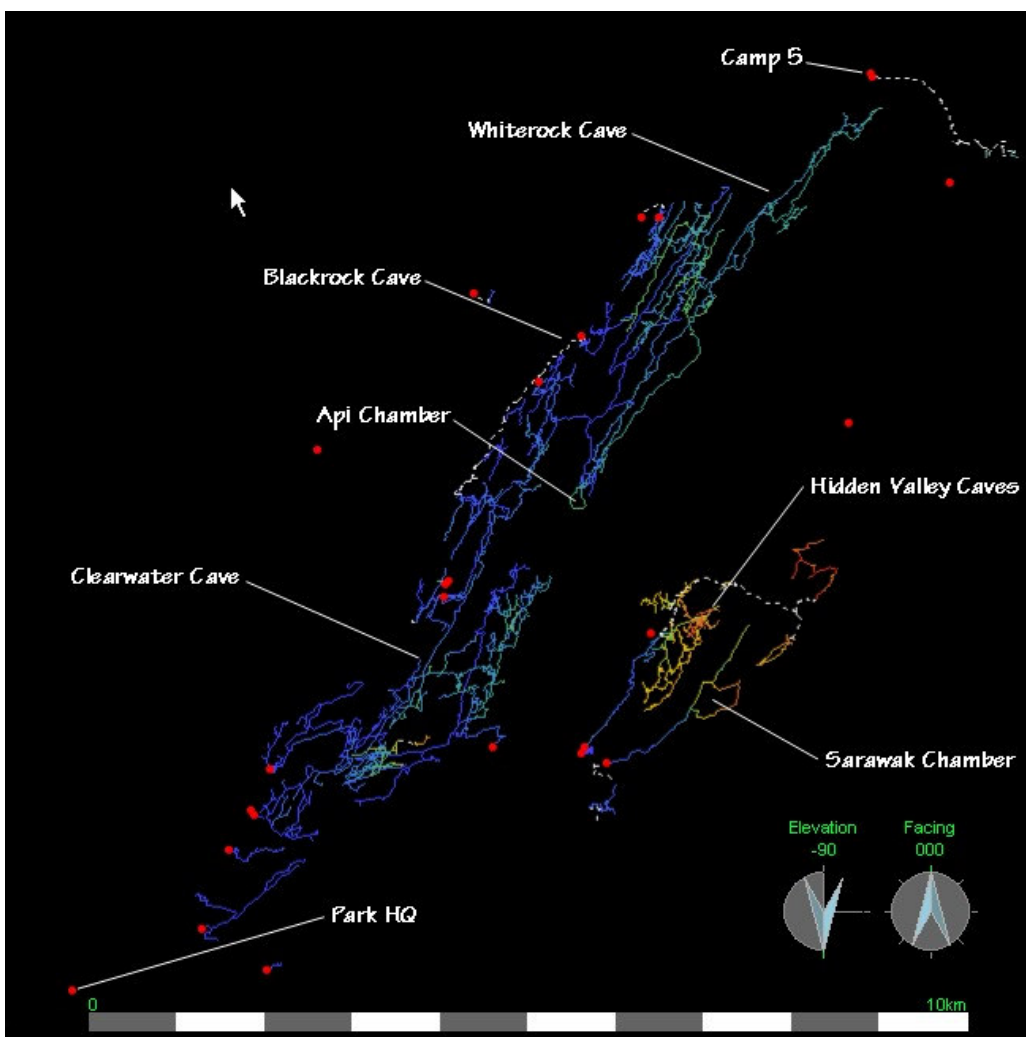


Figure 19; Api Survex plan image

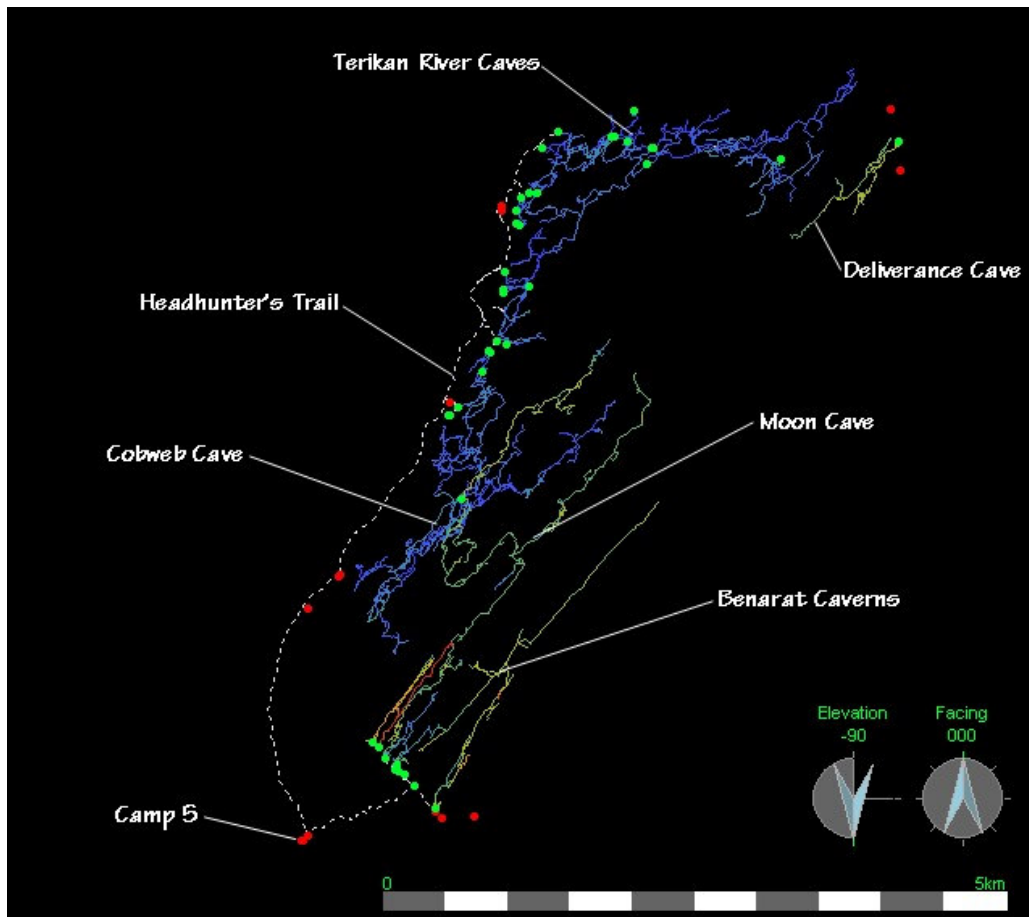


Figure 20; Benarat Surveys plan image


The Caves of Gunung Benarat 2007

English name	Malay name	RGS '78	Mulu 80	S'wak '84	Buda '97*	Buda 2000	Ben't 2000	Ben't 2003	Ben't 2005	Mulu 2007	Total Lengths
Moon Cave	Gua Bulan								6635.00	3787.77	10422.77
Benarat Caverns	Lubang Benarat	1355.00	4870.00	2095.00							8320.00
Hurricane Hole	Lubang Taufan						372.00	1106.00			1478.00
Cobweb Cave	Lubang Sarang Laba-Laba			15185.00			10747.00	4414.00			30346.00
Sakai's Cave	Lubang Sakai		1120.00	1525.00							2645.00
Tiger Cave	Gua Harimau			3800.00							3800.00
Daud's Cave	Lubang Daud							349.00			349.00
Deception Cave	Lubang Tipu			1510.00							1510.00
Menagerie Cave	Lubang Kumpulan Binatang			1875.00							1875.00
Terikan Rising Cave	Gua Sungai Terikan	775.00						12532.00			13307.00
Terikan River Cave West	Gua Sungai Terikan Barat	2270.00							20.00		2290.00
Terikan River Cave East	Gua Sungai Terikan Timur	3840.00							40.00		3880.00
Blue Moonlight Bay Cave	Gua Teluk Cahaya Bulan Yang		9400.00					257.00			9710.00
Deliverance Cave*	Gua Pembebasan				3577.00	740.00					4317.00
Expedition Totals (Benarat)		8240.00	15390.00	25990.00	3577.00	740.00	11119.00	18658.00	6748.00	3787.77	
Benarat Caverns Running Total		1355.00	6225.00	8320.00	8320.00	8320.00	8692.00	9798.00	16433.00	50566.77	
Terikan System Running Total		6885.00	16285.00	19670.00	19670.00	19670.00	19670.00	32459.00	32572.00	32572.00	
Gunung Benarat Running Total		8240.00	23630.00	49620.00	53197.00	53937.00	65056.00	83714.00	90462.00	94249.77	

* Buda '97 & Buda 99/2000 were American expeditions.

The Caves of Gunung Api 2007

English Name	Malay Name	RGCS '78	Mulu '80	S'wak '84	Mulu '88	Mulu '89	Api '90	Api '91	Mulu '91	1992	Reece '93	Api '94	Mulu '96	Mulu '98	Brat '03	Brat '05	Mulu '07	Total Lengths
Clearwater Cave	Gua Air Lemah	26330.00	11255.00	14015.00	212.00	15048.50	922.00		2837.80		893.10	160.90		1476.40				73150.70
Cleartop Cave	-			0.00														0.00
Lady's Cave	-			0.00		323.80												323.80
Cave of the Winds	Gua Angin	2300.00	4250.00	960.00	59.50				133.70		85.00							7788.20
Drunken Forest Cave	-			1300.00														1300.00
Blackrock Cave	Gua Batu Hitam					6570.40			1352.60			174.30						22320.50
Leopard Cave	Gua Harimau Bintang				14123.20							344.10						3719.10
Whitewick Cave	Gua Batu Putih														3707.72	17261.21	21956.14	42925.07
Water Polo Cave	Lubang Lagang																	0.00
Water Polo Cave	-			0.00														0.00
Solo	Sundiran	259.00																259.00
Cobra Cave	Lubang Lipah Silih			3400.00														3400.00
Good Luck Cave	Lubang Nasib Bagus			2900.00														2900.00
Prediction Cave	Lubang Ramalan																	652.10
Wonder Cave	Gua Apath	610.00											42.10					652.10
Imperial Cave	Gua Imperial	4770.00											200.00					4970.00
Barthday Cave	Gua Harriyadi																	705.00
Birthday Cave	-				200.00													200.00
Neil's Cave	Lubang Nohh				425.00													425.00
Python Exit	-				80.00													80.00
Simon's Cave	Lubang Simon					1072.70	3412.00	398.00	320.50	104.00								86.00
Mélie's Cave	Gua Mélie					1085.30												5307.20
Snail Cave	Gua Smit						281.00											1085.30
Ipoti's Cave	Lubang Ipot								233.80									361.00
Palua Cave	Gua Sago							163.00	686.50									849.50
Dummeles Cave	Gua Dummeles																	233.80
Ne Naue Cave	-												244.90					244.90
Yellow Viper's Pit	-												70.00					70.00
Arch Cave	Gua Gerbang												124.00					124.00
Perseverance Cave	Gua Ketabahan												980.50					980.50
Bridge Cave	Gua Jambatan												953.10	625.70				1578.80
Cloud Cave	Gua Awan												6053.30	3843.10				9896.40
Invader Streamway	-												2192.50	17.40				2209.90
Tiger Back Cave	Gua Harimau													618.60				618.60
Tiger Water Cave	Gua Harimau													296.70				296.70
Highest Cave in Mulu	-													1285.80				1285.80
Helicopter Cave	-													280.00				280.00
Western Front Cave	-													30.00				30.00
Moonmilk Cave	Gua Bualan Susar									115.00								115.00
Expedition Totals (Api)		34269.00	22485.00	25655.00	15099.70	24100.70	4615.00	561.00	5564.90	219.00	893.10	764.30	10860.40	8503.70	3707.72	17261.21	21956.14	
Clearwater System Total		26330.00	37585.00	51600.00	59381.50	74753.80	76975.80	76975.80	101993.50	101993.50	102886.60	107025.90	107025.90	108502.50	108502.50	129471.23	151427.37	151427.37
Cobra System Total		0.00	0.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	3400.00	15506.30
Gunung Api Total		34269.00	56754.00	80409.00	95508.70	119669.40	124224.40	124785.40	130350.30	130350.30	131462.40	132226.70	143087.10	151590.80	155298.32	172559.73	194515.87	194515.87

Mulu Caves '07 Discoveries Log					
Whiterock Cave					
Northern Line	4857.59				
Api Birthday North	500.90				
Api Birthday South	1352.90				
Ancestor3	1046.10				
Green Wing	679.50				
Strong Hint of Bigness	3358.58				
Black Joke	163.10				
Black Joke 2	386.70				
Lima Puluh	301.20				
Into Out Of	185.90				
Lake District 1	569.60				
Lake District 2	198.50				
Bigness South	1933.17			<i>Clearwater to 2005</i>	129471.23
Highly Delightful	299.58			<i>New Discoveries 2007</i>	21956.14
Upwind	558.27			<hr/>	
1954	3510.25			Clearwater total	151427.37
Unnamed Bypass	559.20			<hr/>	
Pamphlet	287.90			<i>Whiterock 05</i>	20968.93
Matrimony	604.40			<i>Whiterock 07</i>	21956.14
Under Out Of	346.80			Total	42925.07
Poppet's Passage	216.30			<hr/>	
Wild Goose Chase	39.70			<hr/>	
Whiterock '07 Total	21956.14			<hr/>	
Moon Cave				<i>Cobweb</i>	
Moonshadow	2546.27	<i>Benarat Caverns</i>	30346.00		
The Dream	231.90	<i>Hurricane Hole</i>	8320.00		
The Fantasy	404.60	<i>Moon 2005</i>	1478.00		
Disappointment Ramp	195.20	<i>Moon Cave '07</i>	6635.00		
Cake and Cheese	409.80		3787.77		
<hr/>		Benarat Caverns System	50566.77		
<hr/>		<i>Moon '05</i>	6635.00		
<hr/>		<i>Moon '07</i>	3787.77		
<hr/>		Moon Cave Total	10422.77		
<hr/>		<hr/>			
Other Bits		<hr/>			
White Rift	83.90	<hr/>			
<hr/>		<hr/>			
Other Total		<hr/>			
83.90		<hr/>			
<hr/>		<hr/>			
2007 EXPEDITION TOTAL	25827.81	<i>2005 Expedition Total</i>	24009		

Much of the logistics for the 2007 expedition followed the successful formula used on the previous three trips with two main exceptions. Due to increased direct flight costs to Miri, the teams flew to Banda Seri Begawan in Brunei and traveled overland across the border to Miri. The other difference was also related to international flights. Previously all equipment had been brought in with hold and hand baggage often with a small excess baggage allowance. With the security scares and hand baggage restrictions in force at the time it was decided to ship the heavier group equipment out in advance. This process was greatly assisted by having one member temporarily resident in Miri. As usual only limited essential equipment was brought from the UK. This consisted mostly of personal kit, survey, photographic, rope and rigging equipment. All other supplies, including food, were purchased locally.

The team flew out in two main groups a few days apart. The first group organized the purchasing of food, supplies and courtesy visits to local government departments. Again we were assisted by the advance preparations made by our local member to the extent that everything including visa extensions was completed in one day.

As with all previous Mulu expeditions we used outfitters Tropical Adventure for all our local arrangements. The equipment was moved up to Park Headquarters by a combination of 4x4 vehicle and river transport. As team members moved up to our objectives we stayed in the National Park accommodation. A Helicopter was hired to fly all the equipment up to Camp 5. Unfortunately no fuel was available for refuel in the area so most of the team had to settle for a trip up the river and the two hour walk to Camp 5. The helicopter did manage five lifts which was enough to move all the gear and four of the team so at least the walk was unburdened.

The expedition benefited from four permanent staff who managed the camp and assisted with moving supplies around. Four Senior National Park Guides became full participating members of the expedition for one week each, assisting with exploration, surveying and photography.

Using Camp 5 as a base allowed exploration deep into the Benarat and Northern Clearwater system. However for a sustained effort in these remote caves bivouac camps were set up which could be used two to three nights at a time.

During the course of the expedition, porters brought up some essential supplies and all rubbish was carried out. At the end, twenty porters, expedition members and staff transported all the equipment and remaining rubbish to boats waiting at Long Berar and on from there to Park Headquarters.

The expedition used the field medical kits originally compiled by Dr. Angela Hare for the 2005 expedition. Over the years these have been altered to suit the requirements of each expedition. Previously used on the Vietnam expedition in 2006, they had been designed to suit small reconnaissance groups heading out into the jungle for two to three days before returning to base camp. This generally suited the needs of the Mulu Caves 2007 Expedition as the underground leads were a significant distance into the caves which required two to three-day underground camps.

Prior to the expedition out of date items were removed along with any intravenously injected drugs, as none of the expedition team were adequately qualified or confident enough to administer them. Suitable replacements were added after consultation with Dr. Brendan Sloan.

The kits consisted of one main base camp kit containing replacement items for the field kits as well as the continuation of the antibiotic courses and ointments for around camp. It also contained anti-malarials due to the increasing risk of malaria encroaching on the park. There was also a subsidiary base camp kit to prevent everyone going through the main kit. This contained a small number of dressings, iodine, and creams for bites and rashes. The main underground kits contained items for emergency care, dressings, creams and three days worth of various antibiotic courses. Each kit also contained a medical card detailing common conditions encountered on caving expeditions.

Whilst in the field the team initially thought these kits were too bulky and decided that teams would compile their own smaller kits for underground trips. This was later altered when it was realised the time that would be spent underground was significant and that the risk of requiring slightly more than a plaster was likely.

Thankfully during the course of the 5 week expedition few medical problems were brought to my attention as medical officer. Team members made good use of the general kit available at Camp 5. Treating minor cuts with iodine and potential fungal problems with Daktarin (an anti-fungal) and anti-fungal powder. A few team members required painkillers but this was only very occasional. Generally speaking good facilities at Camp 5 allowed team members to maintain good hygiene and reasonably clean clothes.

One member required Piriton (antihistamine) for bites which seemed to diminish the itching and inflammation. There was a suspected case of Mulu Foot toward the end of the expedition but this cleared up after a few days with an anti-fungal/antibiotic powder and Daktarin cream.

The anti-malarials were put to good use when a team member travelling onwards to Sabah National Park, an area of increased risk of malaria, realised that it may be pertinent to take these whilst visiting the area. Malarone was given as this does not require the patient to take them for many days prior to visiting.

For future expeditions these kits would be ideal unless the operation in the field changes drastically. Some small additions to the kits would include small volumes of sterile saline solution for irrigating wounds or eyes. More forceps and scissors etc in the kit would be useful.

The expedition was a success and all medical problems were dealt with effectively. The 'Expedition Medicine Handbook' published by the Royal Geographical Society is the ideal resource for any non-medically trained team medical officer.

The careful nature of all team members prevented any serious injuries or illnesses and this should always remain foremost in future team members' minds, but, should the unfortunate happen, the kits and the team will more than adequately be able to deal with most situations.



Hugh St. Lawrence receiving a 'local' cure for an infected ankle

Matt Kirby

Cave photography has progressed dramatically over the years and the Mulu team of 2007 were fully equipped with the very latest in digital technology. Most members, if not all, had brought with them a digital camera; the very least was a small compact. Only a handful of team members ventured underground with their cameras. This practice was left to a select few. The data was stored on a laptop, which was not being used for surveying, and backed-up onto a specially assigned external hard drive. This kept photography separate from the surveying side of the expedition. Dave Clucas and Matt Kirby worked together to ensure everyone's images were downloaded regularly to their personal folders and backed up daily. Robbie Shone also stored his images on an Epson P2000 40GB external hard drive (with a viewing screen). This enabled him and the team to have a separate back-up to the usual, Mulu Project's, external hard drive.

Robbie Shone led the main assault underground with assistance from the most willing team members. The expedition's major discoveries, in Moon and Whiterock Caves, were recorded. The team used a combination of lighting techniques from remotely fired electric flashguns and flashbulbs to candles and LED headlamps. Passages and tunnels of great size required even more light and larger flashbulbs. However, thankfully no more flashbulbs were brought out from the UK during the trip.

Following the completion of Moon Cave the photographic assault turned to Whiterock Cave in the vast Clearwater System. The majority of the expedition's discoveries had been made here which required a concerted effort to record, owing to the vast distance between the ends of the system where the recent discoveries had been made. It was decided to set out a three-day camping trip purposefully to photograph these finds. Varying from small, delicate gour pools of great beauty to huge railway tunnel sized boreholes the team documented as much as time would allow.

Following the expedition, Dave Clucas issued each team member a CD with their images. Another CD was made up later with a large selection of images from all the photographers on the expedition.

Appendix 9; The Mulu Caves Website – Hugh St. Lawrence

Since the advent of the internet the Mulu Caves Project has rather hidden its light under a bushel. We have, in fact, had a single simple page (kindly set up and maintained by Wookey) where various reports and surveys could be downloaded. But there was no cohesive record or account of all the expeditions pulled together in such a way as to attractively present the past, present and future of Mulu caving.

An improved 'shop front' for the Mulu caves project was needed and Dick Willis drew up an outline plan for a new web site during 2006. During the course of the 2007 expedition and whilst in the field, Hugh St.Lawrence started on the design of the web site which was completed after the expedition's return to the UK. Summaries of all past expeditions have been incorporated together with a review of the current state of exploration. Work has also started to provide summary descriptions of the main caves, and completing these cave descriptions will be an ongoing 'work in progress'. It is also hoped to provide access to download reports and surveys, although the best way to do this is still under consideration. John Volanthen who was on the 2005 expedition is kindly hosting the web site, through his company, HNS Ltd. (www.hns.net).

In the usual voluntary way of things, the web site will not be built in a day! A good start has been made, but much more information remains to be included as and when expedition members have the time to contribute. Information is always welcome and should, in the first instance, be forwarded to Dick Willis who can also advise on the nature of required content. Cave descriptions and photographs are key areas for content.

In the meantime the current state of the website can be viewed at <http://www.mulu caves.org>



Figure 21; The Home Page