Explorers Club Flag Expedition

Flag 160

The Pearse Resurgence, New Zealand. January 2010

Dr Richard Harris FI ‘09

Figure 1. Participants L-R Sandy Varin, Richard Harris, John Dalla-Zuanna, Dave Bardi, John Vanderleest, Craig Challen

Background
The Pearse Resurgence marks the origin of the Pearse Stream located on the eastern side of the Arthur Range, New Zealand. It is a vauclusian spring with an average discharge of approximately 2 cubic metres per second. Dye tracing has proved a connection as far away as the Ellis Basin; a distance of approximately 6km.[1] The cold (6-8 degree C) waters of the resurgence were first dived in 1975 but the remote nature of the cave and harsh conditions have precluded extensive exploration over the years.
Several divers have played a major role in the exploration of the Pearse since the earliest dives. Keith Dekkers from NZ was pivotal in the early days visiting the cave on several occasions and pushing down the start of the main shaft. 1995 saw an ill fated expedition led by NZ caver Kieran McKay during which one of the divers (Dave Weaver) perished during an attempt at a depth record whilst breathing air. From 1997, expeditions by Sydney based diver David Apperley made the most significant advances in the cave’s exploration with the first use of a decompression habitat (2000) and culminating in the exploration of the cave by Apperley and Rick Stanton (UK - Cave Divers Group) to 177m in 2007 (Fig 2).
The author first dived the cave in 2007 with Apperley and has returned on 2 further occasions, pushing the cave slightly further in 2008 (see figure 4).

Figure 4. Section view of the Pearse Resurgence Cave at the end of the 2008 expedition.

The lower level at 182m depth, poses serious obstacles to further exploration. Using open circuit (traditional SCUBA) technology, the amount of gas required to perform a single dive to the bottom of the cave would be prohibitive; requiring vast amounts of helium, oxygen and SCUBA cylinders to be taken into the cave. The helicopter trips required would increase exponentially as would the expense and time required for gas preparation. The use of closed circuit rebreather technology allows the same dives to be performed with far smaller quantities of gas and also confers other benefits such as better heat retention and greater gas reserves in the event of an emergency.

However deep cold water diving on rebreathers is not without problems. Carbon dioxide retention is a particular hazard in this setting and a very conservative approach to CO2 scrubber management is required.
Figure 5. The Pearse Resurgence, birthplace of the Pearse Stream.

Goals
This expedition to the Pearse Resurgence was undertaken with several goals in mind:

1. To develop and utilise a deep mobile decompression habitat to allow ongoing exploration at depth.

2. To establish contacts with the New Zealand scientific community and to begin a sampling program of the cave's biota.

3. To continue a video and still photo survey of the cave.

4. To continue the exploration and mapping of the cave.

Participants
Six Australian cave divers, all qualified mixed gas rebreather divers, travelled to New Zealand and camped on site during the expedition. They were: David Bardi (Melbourne), Craig Challen (Perth), John Dalla-Zuanna (Melbourne), Richard Harris (Adelaide), John Vanderleest (Melbourne) and Sandy Varin (Melbourne). The team were assisted locally by Anthony and Elizabeth Honeybone (Christchurch), and John Patterson and Deb Cade (Nelson).
The Expedition
After shipping approximately 3 tonnes of diving and camping equipment from Australia to New Zealand in mid November 2009, the divers met up in Christchurch on January 5th.

Access to the resurgence is either by a 2-hour hike from the nearest road, or by helicopter if large amounts of equipment are to be taken in. On this occasion 9 helo trips were utilised to ferry in the large amount of equipment and the divers. The flight up the Pearse valley is spectacular and takes in the temperate rainforest and sheer sided gorges leading to the landing zone. With the final load delivered, the helicopter departed leaving the sudden silence of the bush and constant sounds of the nearby watercourse.

Figure 6. Packing the gear with the Honeybone family in Christchurch.

Figure 7. Syd Deaker in the helicopter prepares to collect a load of cylinders. Richard Harris readies the strop.
The relative warmth of summer was chosen for the dive program but even so, the area was prone to wildly variable weather. Warm sunny days with a gently flowing stream can suddenly develop torrential rain resulting in a flooding resurgence. From the time of our arrival the adjacent Eyles Creek changed from a dry riverbed to a flowing creek and back to dry again. The resurgence itself is similarly labile.

The steep sided valley precludes any communication with satellite or cellular phone systems, and the volunteer Mountain Radio HF radio service provides the only reliable means of communication with the outside world. Everything required for 9 days diving was taken in with the divers, the only predictable resource being the pristine crystal clear spring water flowing from the cave.

The cold spring water makes refrigeration of victuals a simple matter and so the divers were able to eat well during the trip. A large communal shelter for cooking, gear preparation and battery charging was established and individual dome tents erected for sleeping quarters.

![Figure 8. Home sweet home for 9 days.](image)

**Planning to Dive the Pearse Resurgence**
Over the last 10 years progress in the exploration of the cave has involved the use of a one cubic metre decompression habitat secured in the cave at 7m depth. Initially placed by David Apperley in 2000, the habitat allows the last extended shallow decompression stops to be performed in the relative warmth of a dry habitat whilst breathing 100% oxygen. This increases both diver comfort and the efficiency of decompression. On the author’s dive to 182m in 2008, he spent approximately 2.5 hours in this habitat during the ascent to the surface after diving for only 15 minutes to the maximum depth.
One of the primary goals of the 2010 expedition was to extend the time for exploration of new passage at 180+m to 25 minutes. This would require a total ascent (decompression) time of over 9 hours. The divers feel they can only comfortably spend between 2 and 3 hours immersed in the cold water of the Pearse, and so it was clear that a second habitat would be required at a greater depth. Ideally this would be mobile so that the exploration diver could enter the habitat at say 40m, and ride it up to 12m before exiting and transferring to the 7m habitat. In this way an actual immersion time of approximately 150 minutes could be performed.

The author constructed a collapsible “deep” habitat in the style of a large lift bag. When filled with air it would inflate and take on a rigid form so allowing a diver
to sit inside with only the legs and buttocks immersed. The plan was to anchor this deep in the cave and using climbing descending devices, allow the habitat to move up through the required decompression stops from deep to shallow water. The habitat was tested on a local shipwreck in South Australian waters before the expedition. A known complication was that the cave shaft where the habitat was to be deployed is sloped from the vertical, and hence a system to move the habitat sideways using pulleys and winches was also devised.

Figure 10. An inverted image of the deep habitat in the author’s back yard, showing how it would be rigged underwater.
In addition to the deep habitat, several new systems were to be trialled in the cave. A communications system from the habitats to the surface constructed by Australian caver Joe Sydney was to be tested. A new 12v heated undergarment devised by John Dalla-Zuanna would also be trialled following successful testing in some 15-degree Australian caves. Various combinations of glove systems and dry suit undergarments would also be assessed.

The author would record many of the diving activities on HDV, and 4 of the divers (RH, SV, DB, CC) would be preparing themselves to do the deep exploration dives if all the systems operated as hoped.
Expedition Outcomes
For all the divers except the author, this was the first expedition to the Pearse Resurgence and the first opportunity to perform extended dive times in water below 11 degrees C. The combined conditions of cold water, dark grey marble (which absorbs dive lights), great depth and high flow require some psychological adjustment and the first few days involved a degree of acclimatisation.

The dives generally commenced shallow and worked deeper during the 9-day period. After rigging the 7m habitat and installing the surface supplied oxygen and comms unit, work commenced on the rigging of the deep habitat. Successful installation of this habitat was a prerequisite to further exploration at the 180m level of the cave. The first priority was to reassess the topography of the main shaft between the depths of 40 and 12m. This revealed a significant slope especially between 40 and 24m, which would prove to be a major obstacle to the divers’ efforts. The first part of rigging the habitat needed the installation of anchors strong enough to restrain the 700kg of lift generated by the habitat. Failure of these primary anchors would see the decompressing diver ascend in an uncontrolled manner to the shallow part of cave with inevitably fatal consequences as they missed a very large decompression obligation. So the anchors had to be strong and reliable!
Builder's props (Acroprops) were installed as a first anchor between 2 rock ledges. Eyelet bolts were also inserted into the marble after drilling 12mm holes. This required the use of pneumatic drills and diamond tip hole saws...a very lengthy and laborious process in such hard rock. A single hole at 40m depth would take 2-4 dives and consume over 4 full cylinders of drive gas. The days started to tick by and the team began to fall behind schedule due to the slow progress with the bolting. Finally the primary anchors were complete and the habitat could be deployed and its path up the shaft studied. Re-direction anchors were then needed further up the slope and the process was repeated in shallower water. As the habitat rose in the water column, it was winched sideways towards the redirection point. From there, it was captured by a fixed line, and the process repeated up to the next rebelay. By the time the habitat cleared the third and final rebelay and was free to rise into clear water, only 3 days of dive time remained.
Several things remained to be done before the exploration dives could begin. A full test run with the push diver in the habitat was required, and further deep build-up dives needed to be performed. The final decision to proceed or abandon the deep exploration was made when the author’s rebreather electronics malfunctioned and hence the deep exploration was abandoned.
Once over this disappointment, the team rallied to make the best of the remaining time. For those who hadn’t been to the site before, dives to 125m were made and the beauty of the cave enjoyed. A number of smaller side passages in the first 60m were explored and several missing connections on the existing map were made. A test run in the deep habitat was made by the author with the assistance of the other divers, and a number of modifications were planned for the next visit in 12 months time.

Numerous dives were videoed and large areas of the cave were imaged; to be reviewed later by a karst geologist. A short documentary will be compiled documenting the efforts of the team.

During the course of the diving activities, a number of cave-adapted invertebrates were noted in different areas of the cave. 4 specimens of a 3mm white amphipod (Fig 19) and a 5mm white flat worm were captured and given to Graham Fenwick, an invertebrate systematist at the National Institute of Water and Atmospheric Research (NIWA) in Christchurch. Planning is already underway for a more comprehensive assessment of the cave’s biota on the next trip. A collaborative research project between the cave diving team and NIWA is being discussed.

![Figure 19. A new species of amphipod? Image by Nelson Boustead, NIWA.](image)

Acknowledgements

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