

# Official Report

## Castleguard Cave Diving Expedition 2010



By Martin Groves

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## Introduction

Less than twelve months since the previous expedition a joint Canadian and U.K. team returned to continue the exploration of the sump at the end of Boon's Blunder passage in Castleguard Cave. During the 2009 expedition a strong team, purely based on man-power, managed to explore the sump for a distance of just over 500m to a terminal depth of just 6m. The 2009 expedition is covered in detail in the Official Report for 2009. The progress made in 2009 was not limited by the diving equipment and gas safety margins but simply by the amount of diving line the team had. Conditions in the sump were actually a lot more pleasant than expected; most notably the temperature was measured to be about 4°C, not the anticipated 1°C. This makes for significantly more comfortable diving conditions and from a safety point of view the chances of regulator free-flow due to freezing is greatly reduced. The sump also contained a lot less sediment than anticipated and as a result visibility remained good throughout the dive which increased the speed at which the cave could be explored and surveyed.

One of the major problems encountered during the 2009 expedition was the melting ice-crawl. Physically crawling through slush for a couple of hundred meters either side of a diving trip takes it out of the body and exposes one to an elevated chance of getting a cold. The diver coming down with a cold would be a disaster as it significantly compromises the safety of any dive operations. On top of the safety issues there is also the logistical issues relating to drying wet clothes whilst living in sub zero conditions in the entrance camp. Straight after the 2009 expedition we looked at the dates of Easter for subsequent years and it became clear that a return would be needed in 2010 as Easter was exceptionally late in 2011 and this greatly increases the chances of meeting a melted ice-crawl.

The purpose of this document is to outline the details of the 2010 expedition and to provide an official record of the exploration conducted.

Dr M Groves

September 2010

## Logistics

### Dive Logistics

The 2009 expedition was an all round success and demonstrated what could be achieved by a committed and dedicated team. The diving equipment and configuration used had nowhere near reached its limits and this made planning for 2010 significantly easier.

The development of Castleguard Cave is strongly controlled by the dip of the beds. Boon's sumps had been explored from an initial depth of 20m to a terminal depth of 6m over a distance of 500m. This makes a dip angle of around  $1.6^\circ$  and extrapolating it is anticipated that the sump would surface after about 714m, again well within the range of the equipment used. The only real concern with this hypothesis was the fact that the water temperature in the sump was  $4^\circ\text{C}$ , not the anticipated  $1^\circ\text{C}$ , could this mean that there was some kind of deep circulation where the water is heated geothermally? Well the known geology of the region does not suggest that this is likely and it is more likely that the water is this warm because it remains as a static reservoir for much of the year and remains insulated from the icefield above. This did however prompt us to pursue the idea of placing temperature data loggers in the sump for at least a year to get some idea of how the water temperature fluctuates during the course of a year.

From a diving point of view it was decided that *all of the eggs were going to be put in one basket* and the sump would be tackled with the expectation that it would head for surface. The main diving cylinders were filled with 45% oxygen, this limits the safe depth to which one can dive to just over 20m before the possible onset of oxygen toxicity. Oxygen toxicity can occur when the pressure of oxygen breathed exceeds a pressure of 1.6 bar (1.4 bar is considered the safe working pressure for prolonged periods), it can cause sudden convulsions, loss of consciousness and the victim usually dies from drowning. Needless to say this physiological limit of the human body must be treated with the utmost respect and the rules rigidly respected. It may seem limiting to use such a mix but from a realistic view point if the sump did hit a deep phreatic loop then it is likely to be very deep and any exploration of it would be greatly limited without the use of special gas mixtures containing helium to combat one of the divers other enemies and that is nitrogen narcosis. There is no way you can effectively plan for such a dive without some idea of what is ahead, so the approach was taken if a deep phreatic loop was met it would have to be subject to investigation on another expedition; needless to say fingers were crossed that this would not be the case!

In summary the diving equipment used consisted of two steel 80 cubic foot tanks filled with EAN45, a closed circuit cheat-mounted rebreather, together with a number of small oxygen bottles to drive the rebreather.

In anticipation of cold conditions and poor visibility thick 3mm dive line was used in 2009. One is really limited to the amount of this line that can be carried on a reel, typically 300m maximum before the reel becomes unfeasibly large. For the 2010 expedition a decision was made to use 1mm dive line, this allowed more than double the amount of line to be carried compared to the 2009 trip.

## **Personal**

A successful expedition to a remote site like Castleguard is only feasible with the help of a strong dedicated team for both surface and underground portorage. Again the largest proportion of the team consisted of Canadian cavers most of whom are members of the Alberta Speleological Society (A.S.S.) together with six U.K. cavers. Ian McKenzie took on the key roll of co-ordinating the Canadian side of things and also planned the schedule of events. I think it is important to emphasis how the diving trips to Castleguard are a win-win situation, especially the way Ian sorts out the logistics of having a number of overlapping teams. Each team has a specific roll corresponding to the diving operations, but either after or before this roll is carried out team members are free to enjoy other parts of the cave. This I feel is more important that just allowing people to do caving trips it is also keeping the knowledge base of Castleguard Cave alive for next generation of cavers. The schedule that was adopted is outlined in the following table.

### Castleguard 2010, Team Locations

	Mar 29	Mar 30	Mar 31	Apr 1	Apr 2	Apr 3	Apr 4	Apr 5	Apr 6	Apr 7	Apr 8
<i>Team 1</i>	Ski	Cave	Cave	Cave	Cave	Ski					
<i>Team 2</i>			Ski	Cave	Cave	Ski					
<i>Team 3</i>			Ski	Cave	Cave	Cave	Cave	Cave	Ski		
<i>Team 4</i>						Ski	Cave	Cave	Cave	Cave	Ski
<i>Team 5</i>											
<i># in camp that night</i>	6	6	(17)	(17)	(17)	(15)	(15)	(15)	5	5	0

Team One (six days): Claire Gougeon, Jesse Martin, Nick Vieira, Chris Chenier, Gael Herve, Chris Stenner.

Team Two (three days): Gavin Elsley, Andrea Corlett.

Team Three (seven days): Andre Whitehouse, (eight British cavers).

Team Four (six days): Kevin Abma, Chantelle Abma, Nate DeBock, Monique Castonguay, Randy Spahi.

Team Five (three days): vacant.

**NOTES:**

Maximum entrance camp allowed by Parks Canada is 15 at any one time.

Teams Two and Three will ski in together, but Two skis out with One. Generally speaking they will ski in heavy but ski out light.

Teams Four generally speaking will go in light but come out heavy.

Team Three will ski in heavy and ski out heavy.

In this schedule there is an allocation of one week for the dive operations at the cave. The time frame allows for possible complications such as poor weather conditions, equipment problems and so forth within reason.

The main purpose of the first team is to transport equipment to the cave. The second team will then bring the remaining items of equipment with the U.K. contingent staying at the cave for a week to conduct the diving. This year the second and third who skied in together were joined by Greg Horne and Jurgen Deagle from Parks Canada. The job of the fourth team is largely to assist in the de-rig of the cave and the ski out.

## **Safety Considerations**

An expedition to a remote place such as Castleguard clearly entails a certain element of risk and our job in the planning phase is to reduce this to an acceptable level and have a number of contingency plan in place should some thing unexpected happen.

A significant proportion of the team has first aid experience and are members of their respective cave rescue teams. A comprehensive first aid kit is transported to the cave along with a iridium satellite phone, kindly provided by Rigstar Communication Inc. The team planned to be self contained, in all but the worst situations, but notification of our trip was given to the British Columbia Cave Rescue team.

The complicated part of any contingency plan clearly centres around a diving related incidents. The multiple redundancy approach which is central to all sensible cave diving together with a defensive approach to exploration are key to minimising the chances of an incident. By far the most complicated situation to handle is the non-return of the dive after an exploratory dive. Again we took the same approach as last year with a reserve diver in the team and a complete set of dive kit stored in Canmore which could be airlifted in the case of an emergency. Andre Whitehouse with his extensive cold water and cave diving experience agreed to take on this roll; it was certainly very reassuring to have such a capable dive on standby.

## The Trip

It was quite worrying in the weeks running up to the trip that British Airways cabin crew were planning a strike during the period that we were flying from the U.K. More worrying was the fact that the Heathrow to Calgary flight was cancelled throughout the week prior to our departure. It was not until the U.K. participants were in the air that we breathed a sigh of relief.

Upon arriving in Calgary throughout the day Ian McKenzie and Andre Whitehouse very generously transported us to Monique's house which was to act as expedition base whilst in Calgary. Within half an hour of regrouping at Monique's it was down to the business of banding up and preparing the dive bottles; which Andre had kindly sorted out for us before our arrival. Most of the team remained in Calgary, but Ian and I headed off late that night to Rampart Creek. The conditions were horrendous but we had to get the diving cylinders to the first team as they were skiing in the next morning.

The pre-dawn start at Rampart was quite painful, but it was good to catch up with the other guys. They set off from the Big Bend in horrendous conditions with very heavy sledges. It turns out that for much of the trip in they experienced white-out conditions, and it was some nifty map work from Nick that saw them arrive at the cave after a fifteen hour epic. What an introduction to Castleguard for Chris Chennier and Gael Herve who had travelled from Quebec for their first Castleguard trip.

Two days later the U.K. team headed in to the cave together with Greg Horne and Jurgen Deagle from Parks Canada along with Gavin Elsley, Andre Corlet and Andre Whitehouse. The team also had the support of a couple of Park's snowmobiles which would transport equipment at least to the base of the glacier. The snowmobile drivers, Greg Slatter and Al McKeeman, toiled for hours the day before clearing a route to avoid the river crossing near the Big Bend. The snowmobiles proved their worth and with the fine weather conditions they transported the equipment to the base of the moraine. With the various stages of loading and unloading the snowmobile sledges I do not think we got to the moraine much quicker than normal but the important point was we were fresh having done the majority of the climbing with very light loads. The party had a mixture of skiers and *snowshoers*. I believe that one of the *snowshoers* was the first person to make it to the cave! Personally, having done both, I believe that using snowshoes requires more effort but is less technically making sledge management and negotiating slopes easier. The party arrived at the cave after about seven hours, the only concern been that one of the U.K. team members, Ben who had been ill for a couple of days, was really feeling worse for wear.



**Snowmobiles on the glacier. Photo Martin Groves.**

That evening bags were packed ready for the set up trip to the sump and all were happy to hear that the ice-crawl was solid and wide open. A pleasant evening was spent at camp before getting off to sleep ready for the kit hauling the next day. During the night another U.K. team member, Chris, was stuck down by the bug which had hit Ben. He spent much of the night been sick and going to the toilet. At this point we were beginning to get worried that the whole trip may dissolve into a flop if the illness were to wipe us all out. Chris stayed in bed all day, we kept away from him. With all hands on deck it was a relatively painless but long task to haul the kit to the sump. The trip was broken up by numerous photographic opportunities. The distance to the sump seemed longer than I recall, from less than a year ago, but I think the mind is good at shutting out bad memories! It was good to see the site of the sump again with the turquoise water beckoning. Assembling and check the kit went without any hitches and we were soon on our way out to day light.



**Martin Groves in the Ice-Crawl. Photo Jules Carter.**

Several other members of the team came down with the mystery illness that night and the diver had to go in to 'quarantine' to try and avoid catching it. Judgment day was soon upon us and the team made a steady trip to the sump. Gareth and Andre took on the lead role of helping to kit the diver whilst others passed essential pieces of equipment and Jules and Ben took photos. All went well and all too soon a very apprehensive diver was lowered into the sump pool. It was a huge relief to be weightless and descending down the pot. The first few minutes of the dive are very slow and calculating with numerous checks made to ensure that all of the equipment is functions and configured correctly. The forty minute swim to the current limit of exploration was pleasant but seemed very slow, it was physiologically comforting to tick off various 'land marks' on route, the metal reel from the 1985 expedition, the knot joining the line join on the second dive in 2009 and finally the large white line reel which was suspended in the water from the final dive in 2010. The new thinner line was quickly joined to the previous line using a larks foot and cautious progress was made into the unknown. The passage continued in much the same vain, with the depth gradually decreasing exactly as predicted.

At just under seven hundred meters from base and at a depth of less than two meters a strange double layering was encountered. To the left (heading upstream) there was a very muddy bedding plane in which the top layer of water was very murky and with a distinct transition the lower level was crystal clear. The main way on continued large so this bedding was not investigated. At around 720m the magical mirror image of an air surface appeared. The heart began to race, the sump had been passed. Surfacing a 1.5m wide by 3m high out of depth canal was entered. Swimming along it was hoped that a nice land spot would be reached. The elation rapidly turned to disappointment when after 30m the only

way on was muddy hole some 8m up that would require aid climbing. Dipping the head underwater it looked as if the sump was going to plummet down into the depths. Was this the elbow of a deep phreatic loop, would I regret using such a rich oxygen mixture? There was only one way to find out. The line was belayed and dumping air from the dry suit I submerged. Luckily the passage levelled out into a wide bedding at a depth of 2m. The bedding was about 1m high and around 5m wide with a significant change in character the floor was very silted with very few belays. The passage continued in the same vein and after 100m or so I emerged into a muddy lake chamber. Crawling with my knees buried in the mud, getting bashed by the odd submerged rock I worked my way to the shore line. Firstly before getting excited I secured the dive line, but could not resist the urge to howl out, the echo reverberated down the tunnel ahead. I removed the mask and could see a Subway like tunnel disappearing into the distance. What a feeling. I started to remove my kit, I paused the seventy minute dive in had not been without incident one hand was numb as my dry glove had leaked one of my two oxygen meters had started to give strange results. I thought of the support team who must have been freezing. I knew a return would have to be made with two divers and an almost cold calculating logic told me that it would not be worth the delay of at least another hour to go for a wonder down the new passage. Several minutes were spent draining the dry glove and warming up the hand, the bottle I removed was clipped back on and one last longing look was made into the new extension before replacing the dive mask and starting the long cold process of surveying the new passage. Within a few minutes of starting the dive out the suspect oxygen meter crashed out and to edge on the side of caution I switched to diving the rebreather semi-closed; which means just the 40% mixture was injected and no oxygen and gas is then vented every ten breaths or so. This mode protects the diver to be exposed to high levels of oxygen if there is any doubt over the oxygen content of the breathing gas. The surveying went well but I was certainly a little chilled by the time the white image of the 2009 line reel came into view. It was a relief to stow the slate away and up the speed for the five hundred meter swim home. The rest of the dive went by in a bit of a blur and it was nice to wriggle beneath the rock arch and have the ascent straight up to the surface. I stopped for a couple minutes at 6m and saw the temperature data logger that Greg had placed in the sump. The excitement was almost overwhelming as I surfaced, the rebreather mouthpiece was closed and as I started to speak, I sank slightly almost drowning on the mouthful of water I was trying desperately to cough out. The guys laughed, but got the idea that the sump had been passed. The total dive time was just over two and a half hours. Andre and Gareth did the honours of fishing me out of the sump pool; again with a flooded dry glove my hand was desperately cold. I was soon passed a magical cup of hot chocolate and recounted the dive to the guys as the kit was removed.

It was soon back to reality and we need to make a decision about the best course of action for the rest of the trip. With no solo surveying equipment (maybe an oversight, but

hindsight is a wonderful thing!) passing the sump again did not seem worthwhile. So it was decided to remove the rebreather from the cave but to leave the large open-circuit scuba tanks to allow a dive to investigate the possible downstream continuation of the sump in a couple of days time. With just two side mounted cylinders the diver would be much more streamline and able to pass through smaller places. There was also the added advantage of spreading the kit haul out of the cave over more days. The way things turned out meant that a couple of small oxygen bottles and 5kg of sofnolime were carried to the cave and not used but there is no way we could have anticipated this.

Spirits were high in the camp that evening, despite several more people becoming ill. The next day several people went caving but the U.K. decided to have a day off and take a trip down towards the Big Springs; where we were humbled by find bear prints in the snow!

It was back to business again the following day for the downstream dive. It was amazing how effortless and rapid it seemed to kit up with just two side-mount cylinders. Jules helped me kit up and I was soon descending the now familiar shot line again down to the arch. The visibility had not cleared from two days ago but a line was attached and all possibilities were investigated. There was one tiny hole which is too small to enter which takes a small amount of water but otherwise there is not major downstream passage as had been postulated.

The downstream end of the sump is effectively a lifting chimney, like the pitch near the entrance. This series of dive seem to have cleared up a few points to do with the sump. In winter I believe that the sump is effectively a static reservoir, with a tiny inlet where the murky water layer was met and a small out let at the base of the pot. During winter this water is insulated by the bedrock and remains at 4°C. When the spring and summer melts occur I believe that the level in the sump begins to rise as the newly discovered passage begins to flow, the temperature in the sump should then drop as the cold water infiltrates the system. I believe that the rising of the sump must be a fairly smooth process as the dive lines stay in tact; it then overflows over the lip of the pot and causes the entrance series to flood. What will be interesting is to get the results of the data loggers and see if this anticipated temperature fluctuation does indeed occur. It would also be interesting to data log the water level in the sump to see how that responds throughout the year.

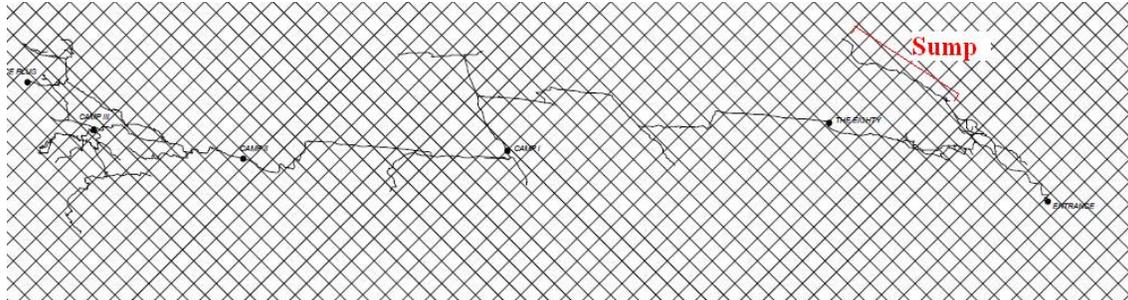
The dive kit was efficiently removed over the next few days and the various teams excited from the cave over a three day period as well as team 4 arriving to help with the de-rig. In addition to the diving Chris lead a few trips to survey passage in and around Boon's Blunder, some of the U.K. team got interested in a draughty dig at the end of the Next Scene and few teams attempted to get to the ice-plug, luckily they did not make it so they will have to come back next time!



**The long slog home. Photo Martin Groves.**

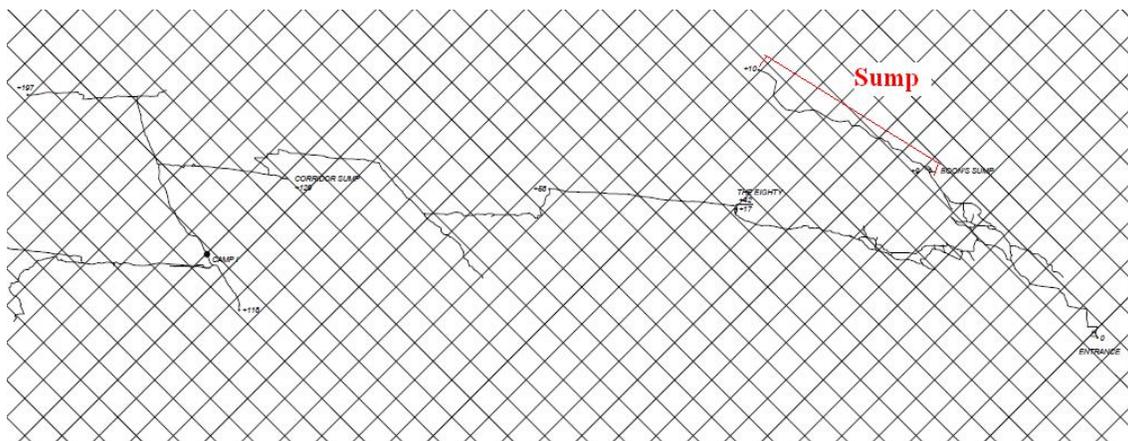
# Survey

The upstream extensions of the sump were surveyed so that it could be included in the overall line survey of the cave. The results were kindly analysed by Dan Green.



**Boon's Sump relative to the whole cave. Survey plotted by Dan Green.**

Relative to the surface the sump is heading directly beneath the Castleguard Meadows and as a result will pick up drainage directly from beneath the Icefield. Of significant interest is also the fact that the drainage from Terrace Mountain is also expected to intersect the drainage channel in the new extensions and hence it is anticipated that a number of significant inlets will come in from a easterly direction. The North line being the leftward slanting diagonal line.



**Zoomed in on Boon's Sump. Survey plotted by Dan Green.**

# Outlook

The last two expeditions have demonstrated what can be achieved by a dedicated team. Boon's Sump has been passed after a dive of 845m in the upstream direction and the downstream part of the sump has been written off as a non-starter. Given the general nature of the limestone bedding in which Castleguard Cave system resides it is a fair assumption that the new unexplored passage beyond Boon's Sump will lead to a major new extension which should at least mirror, and given the extra drainage from Terrace Mountain, possibly exceed the already known system. The potential exploration of such a system opens up a whole series of exciting challenges if they are to mirror the exploration of the known cave as far as the ice plugs!

The team plans to return in the Easter of 2013 with the initial aim of getting two divers through the sump to enable an accurate survey of the new extensions to be made as well as enhancing safety. We are currently working on smaller rebreathers which can be used primarily as gas extension tools to enable a person to pass the sump but by using far less gas than by diving using open-circuit. These rebreathers are much smaller than the one used in the exploration of the sump and so this should counter some of the extra weight which must be transported to allow two divers to enter the sump. The real issue again will be the transportation of four large scuba tanks to the sump, but given that we know the profile of the sump then the gas margins can be scaled down somewhat.

It will also be interesting to retrieve and download the results of the data logger experiment and to see exactly how the temperature does fluctuate through the seasons. If anything maybe two seasons worth of data will be more interesting than one so it may well be a good idea to leave them in the sump until 2013.

Castleguard Cave is slowly revealing her inner most secrets but as one is uncovered hints of more tantalising ones are exposed; however one thing is for certain there are exciting times ahead in this magnificent cave system.

# Acknowledgments

The exploration of Boon's Sump would have been impossible without the support of a large number of people and organisation. Even though the lead diver is the one in the 'lime light' he is the first to point out that a dive would have only been a distant dream without the help and commitment of all involved. To all of these people and organisations we are truly thankful.

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British Airways for not cancelling our flight during the strike action!