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Many of us remember the deaths of 4 young men from the northern beaches of Sydney. Last weekend we were reminded of their deaths as we sat in Seamans Hut and read the plaque to their memory. They died along the base of Etheridge Ridge which we walked past. The following is a very instructional article on that incident.

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THE DEADLY WHITE BLANKET

Ian Brown files a special report for Outdoor Australia on what went wrong when four men died in their snowcave on a stormy evening in August 1999, and crucially, he looks at what we can learn from their deaths.

"We'll be right. We're just going to dig a snow cave and sit it out." The four young men shouldered their large packs, snowboards attached, and turned away from the ticket booth towards the Thredbo chairlift. It was about 9.00 am on Saturday 7 August 1999. The ticket seller, a keen backcountry boarder himself, had just shown them the weather forecast. It was still fine in the valley, as expected, with bright sun shining on the snow-covered mountain ridges above.

The official forecast had been released at 5.30 am. It predicted a fine and mostly sunny day with moderate to fresh northeast to northwest winds and nil probability of snow overnight, but deteriorating weather from Sunday into Monday. The next bulletin at 4 pm forecast some precipitation on Sunday with fresh to strong and squally northwesterly winds. In fact, the storm arrived much sooner. By the middle of Saturday night the mountains were coping gale force winds and driving snow.

Dean Pincini (25), Timothy Friend (25) and brothers Scott Beardsmore (26) and Paul Beardsmore (24) had been planning their three-day snowboarding expedition into the backcountry of Kosciuszko National Park for weeks. This was the only chance for them to get time off work together and the prospect was exciting. Life-long friends, they’d enjoyed camping, hiking and snowboarding trips together in the past. Friend and Pincini had camped in the snow twice before, with Scott Beardsmore joining them on a 1998 expedition to the Lake Albina area. It was Paul Beardsmore’s first backcountry trip.
When they left Sydney on the Friday, Scott left a map and their intentions with his sister, saying that if she did not hear from him on the Monday she should notify authorities. The four planned to walk to a location between Lake Albina and Racecourse Gully; ten kilometres from the Thredbo chair; dig a snow cave and board the nearby slopes. But because of the storm they would not make even a third of the distance.

They travelled down to Jindabyne in two cars. On Saturday morning they picked up ski poles from a hire shop and left one vehicle outside the national park entrance at Bullocks Flat. Leaving the other car in the Thredbo carpark, they took the chairlift to the top of the mountain.

Just before 10 o'clock, a ski patroller returned to the top of the Thredbo chair from his morning check of the ski runs. He noticed the group of four snowboarders. "The wind was really starting to howl," he later reported. "It was getting towards whiteout on the Main Range, with snow blowing in and the cloud cover increasing...there was about a hundred metres visibility...worse as you went up the hill."

A short time later at about 10.30 am, a waiter from Eagles Nest restaurant saw the men outside at the ski shed. He was probably the last person to see them alive. "The missing persons were last seen setting out on foot into the weather," the police later reported. The weather raged for the next three days.

Scott Beardsmore's sister never got the call. She waited until about 9pm on Monday 9 August then lifted the phone and called Jindabyne police. They found the group's car at Thredbo and checked the local pubs and bars, then went back to organise a full search to start at 7.00am on Tuesday 10 August. Wednesday 11 August was the first day of good weather, and the search continued every day for most of the month. It was one of the largest searches ever conducted in the Snowy Mountains, covering 300 square kilometres and involving dozens of searchers from NSW and Victoria, oversnow vehicles and aircraft. Operations were often limited by storm conditions. The distraught parents watched as time passed and leads were discovered and dismissed. The most likely places along the group's intended route were combed over and over again. The search was progressively expanded to cover other possibilities. Still nothing was found.

Speculation and dismay grew, not only amongst those following the search in the media, but within the search team. How, in a wide open snow landscape, could four grown men disappear without trace? They couldn't all be injured. Had they gone down into the thick bush on the western fall of the range to escape the weather? Were they buried in an avalanche?
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Machinery was brought in to excavate debris from a massive cornice avalanche above Lake Cootapatamba. Special thermal equipment was deployed from aircraft in the hope of detecting human warmth in the bush or under the snow. The bush was so thick in places that searchers had to be inserted by helicopter to check heat sources. Wallabies and urine stains were examined. Clairvoyants even offered advice. Still nothing.

Finally, after searching the entire area six to ten times, police reached a grim conclusion: "the only real option is that the missing persons are under the snow or in thickly vegetated areas and not emitting a heat signature (deceased)." On 25 August the difficult decision was made to scale down the operation. Regular searching ceased on 29 August. The wide slopes of the Main Range, smoothed in deep snow, were returned to natural quiet. Everyone waited for the snow to give up its secrets in the spring.

By November the melt was well underway. Occasional searches by air were commenced. On Tuesday 16 November, Tony Reyne of HMAS Albatross was piloting a naval helicopter over the Main Range, combining a training operation with search assistance. He spotted a black hole in the side of a snowdrift and landed nearby. It was one of the few remaining patches of snow in the area. At 11.50 am he walked over the alpine grass towards the hole. He saw ski poles protruding from the snow, and as he got closer, a body inside the snow hole. He walked back to the chopper and radioed in.

The missing men were all found in the cave, which was largely intact and had not collapsed. It lay at an elevation of 1980 metres below the eastern slope of Etheridge Ridge, 2.3 kilometres south-east of the summit of Mt Kosciuszko and 2.2 kilometres south of Seamans Hut; close to the very top of the Snowy River. Sergeant Warren Denham of Jindabyne police was the field leader of the search. He is certain that he and other teams passed directly over the site or very close by several times during the first few days of the operation. So much snow must have collected during the storm that all sign of the cave was buried, including the ski poles standing outside.

The four sleeping bags lay crumpled amidst the bodies and other gear. Three of the bodies were close together in the main cave. Timothy Friend’s legs were bent as if he’d been in a sitting position. He was almost fully clothed but his overpants were not fully pulled up and undone at the waist. He was wearing socks but only one boot. Dean Pincini was clothed with his ski pants also undone at the waist. His boots were nearby as if he was putting them on and his legs were also bent as if sitting. Scott Beardsmore was lying in a curled position, clothed and without boots. His right hand was grasping a metal pot-holder.

Paul Beardsmore was found slightly downhill of the others, in what was probably the entranceway of the snow cave. He was lying on his right side on two snowboards and an insulation mat. His left hand was holding the end of the
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snowboard. There was a layer of ice five centimetres thick on the undersurface of the snow above where he was lying.

A considerable amount of food was found in the dead mens' packs, including cooked sausages, sandwiches and hard-boiled eggs. There were empty snack bar wrappers, a spaghetti tin and pasta sauce packet. One of their two stoves had been used.

The autopsies shed some light on why they died, but not enough. Many expected the culprit to be carbon monoxide (CO) poisoning, until toxicology tests ruled that out. Normal blood CO levels are up to 10%, the toxic range is 20% to 30% and the lethal dose is higher still. The level in all four bodies was 1% or less. No blood alcohol was detected in any of the victims.

The pathologist concluded the four deaths were the result of 'accidental suffocation' with 'possible hypothermia' (two victims), 'consistent with hypothermia' and 'combined effects of hypothermia and accidental suffocation'. Clinical signs of hypothermia were minimal or absent, and asphyxiation due to lack of oxygen also rarely leaves evidence, so these conclusions were based mainly on elimination of other possibilities and the circumstances of death.

Well-known adventurer Tim Macartney-Snape was called in to provide expert advice for the coronial report. Apart from his extensive mountaineering background, Macartney-Snape has been skiing the Snowy Mountains since 1974 and has built about twenty snow caves. In one snow cave high in the Himalaya, he and his climbing mates began feeling more breathless than usual. When their candle fluttered and died they got out fast! Macartney-Snape also happened to be out in the mountains on the same weekend the snowboarders died. After viewing photographs and video of their cave site, he drew some conclusions: ‘...on Saturday night any cave dug into that snow-bank, no matter what shape or design, would have been deeply covered over by freshly drifting snow. If the occupants were unaware of the need to keep at least a vent open to the outside and at most to clear the entrance every few hours, it would only have been a matter of four to five hours before they would have become dangerously sealed in.’

A video taken by Dean Pincini on the 1998 snowboarding trip showed them starting their cave with an excavated trench parallel to the slope. The cave was then dug into the side of the trench. There is no certainty about 1999, but Warren Denham suspects they worked the same way because of where gear was found outside the cave. Such a trench would quickly fill up and seal the entrance, by trapping snow that was blowing and rolling down the slope.

"We estimate that a couple of metres of snow fell on the cave, being on the lee side of a cornice," Denham said. Snow is never deposited evenly over the ground, but concentrates into calmer areas. A steep downwind slope will typically build outwards during windblown snowfall at a much faster rate than snow is
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deposited on a flat surface nearby, due to the eddy effect in the 'wind-shadow' (see diagram). The top of such a slope is often indicated by a vertical or overhanging cornice.

After receiving the police report and consulting with the victims' parents, coroner John Abernethy issued a brief statement on 6 October 2000: 'They had built a snow cave but became snowed in on the night of 7 August 1999. It is very likely that they had died before police were notified of the need to search for them. Accordingly, I have this day dispensed with the holding of an inquest into the deaths.'

The coroner made two recommendations on police search and rescue procedures, but nothing on snow safety. In a later response to an inquiry from a ski club member, he expanded a little on the issues: '...the manner and cause of death...were clear. Whilst there is a particular interest by persons such as you and your club members, who may from time to time utilise snow caves, I cannot say that the issue is one of substantial public interest. The time, expense and further anguish for the parents, were an inquest to be conducted, was not, in my opinion warranted in this case. 'I cannot briefly explain to you the precise manner of the boys' death but on the night they retired to their snow cave there was an unusually heavy dump of snow and they appeared to have neglected to ensure there was continuing ventilation. It appears that at least three of them went to sleep. I can only say that it would be prudent for snow cavers to always ensure that some type of aperture to the open air is kept, even if this means maintaining a "watch" throughout the night.'

At 9.00 am on Saturday 7 August, just as the four friends were setting out, the Bureau of Meteorology's automatic weather station above Thredbo (altitude 1957 metres), recorded a temperature of minus 0.3°C and wind from the north-west at 39 km/hr. The temperature rose to zero by 3.00 pm, when they were probably digging their cave, then hovered between zero and minus 1°C right through until late on the Sunday night. Throughout Monday it was slightly colder; between minus 2°C and minus 3°C.

The wind blew strongly and persistently from the north-west the whole time, peaking at nearly 90 km/hr. Precipitation arrived with peak winds during the very early hours of Sunday, and persisted as 'moderate intermittent rain' (snow at that altitude) until the end of Monday when the storm began to clear. The total precipitation of 25.8 mm over this period, falling as snow, would correspond to a snow depth of about 25 cm.

It was an ordinary nor-west storm. No better, no worse. The sort of blizzard that occurs often on the Main Range at the height of winter; very windy and unpleasant but with mild temperatures and moderate snowfall. But millimetres of precipitation tell only part of the story. Anyone who's been in a blizzard
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knows that a small amount of falling snow can be insignificant compared with the particles blasting across the ground and through the air.

The 40 km/hr wind into which the group walked was more than strong enough to produce drifting snow, and the strengthening winds would have brought even more. In a nor-wester, places closer to the crest of the range; such as the snow cave site; would also receive more snowfall than the downwind weather station at the top of Thredbo.

Tim Macartney-Snape was ski-touring with friends on the Main Range up above Guthega that weekend. On Saturday night they camped below the treeline as heavy wet snow set in. When they left on Monday morning they had to plough through a 30 cm depth of fresh snow. In his police statement, Macartney-Snape said that 'The weekend...had excellent snowdrift building conditions.' A group of scouts and adult leaders were camped just over a kilometre from the snowboarders, and suffered the same heavy snow accumulation. One camper, alone in a tent being gradually buried, feared for his colleagues in a nearby snow cave. In the middle of the night he got up and dug them out. They kept a watch from then on.

On the Sunday night, Sergeant Denham was in a snowmobile near Seamans Hut, searching for another missing party. "It was absolutely bucketing down snow," he said later, reporting low visibility, gale force winds and 15-20 centimetres of snow building up in 40 minutes. When they turned to go home their outward tracks were already covered.

After leaving the Thredbo chair, Pincini, Friend and the Beardsmore brothers followed the poles of the Lakes Walk towards Mt Kosciuszko. The track was buried in snow and they did not have skis or snowshoes. Even with the aid of ski poles, the walk would have been increasingly difficult through soft and deepening drifts, into a strong headwind. And the weather was only getting worse. It seems that after about two kilometres they'd had enough. Taking the prudent decision to dig in early, they selected a snowbank about 500 metres off the track. They took a single photo which shows them about to start digging, looking comfortable and in good spirits with snow shovels in hand. It was not snowing at the time and the site was apparently pleasant and sheltered from the wind, consistent with being in the shelter of a cornice. When the cave was big enough they moved in, leaving much of their gear outside, including eight ski poles.

Snow caves are always quiet. Even with a storm raging outside, it is calm and secure cocooned within the thick white blanket. Unlike tents, snow caves don't blow away or break. Wind and blasting snow belong to another world, and even rain can take a long time to penetrate. Due to trapped body heat it is warmer than outside. There is a special satisfaction in winning such perfect protection from the environment itself.
As darkness grew they used a candle, a chemical light and a torch with the top removed for lighting. They cooked a meal on a gas stove then turned it off. There was no accumulation of deadly carbon monoxide; an open entrance or a ventilation hole or both must have provided enough air exchange. They lay down in their bags to sleep, waiting for daylight and an end to the storm so they could resume their journey to some of the best slopes in the mountains. Outside, snow particles were blowing down the slope with a soft hiss, beginning to drift up the entrance and seal the cave completely. The storm was growing in intensity, accumulating more snow. But the snowboarders were probably feeling secure and comfortable, unaware of the mortal danger wrapping around them. It was already too late.

THE AIR WE BREATHE; SURVIVING SNOW SHELTERS

Getting out of the cold and wind to rest is a key to survival in the mountains. But that very isolation from fresh air is also a hazard. Suffocation and carbon monoxide poisoning are very real risks for anyone occupying tents or snow shelters.

Suffocation in snow caves is rare. Jed Williamson, who manages the Accidents in North American Mountaineering database, knows of only two cases; both involving single occupants dug into skifield carparks! In 1960 a woman died when heavy rain caused the snow to settle slowly over her. She'd covered her sleeping bag in a poncho to keep dry. Then two years ago in Vermont a sleeper was buried by a snowplough.

In 1987 on Mt Hood, seven students and two teachers died. Some were inside a small cave and others were outside. But hypothermia was the primary cause, with suffocation possibly contributing to the deaths in the cave. Impervious fabric and the difficulty of escape can turn a tent buried by heavy snowfall into a death trap. Peter Hackett MD, President of the International Society for Mountain Medicine, quotes a recent disaster in Nepal when the dean of the Washington University medical school, his family and all their Sherpas were killed. "They suffocated in a huge snow storm that buried their tents. No avalanche, just heavy snow."

Hackett says that carbon monoxide is the more likely threat in both tents and snow caves. CO is an odourless gas produced by combustion. Camping stoves are often the culprit, even when operating efficiently and especially in confined, poorly ventilated spaces. CO kills red blood cells, progressively reducing the ability of the blood to deliver oxygen to vital tissues. Symptoms are similar to altitude hypoxia (oxygen deficiency) and dehydration, so may go unnoticed. It is possible to die while sleeping.
A well-documented CO incident occurred on Denali (Mt McKinley) in Alaska in 1986. Two Swiss climbers died while cooking in their tightly-sealed tent at 4400 metres. Autopsies revealed blood CO levels of 65.6% and 56.9%. CO poisoning can be cumulative and recovery slow due to the time needed to replenish the blood cells. Even low-level poisoning will retard acclimatisation to altitude (a process of building more red blood cells) and increase the risk of altitude sickness.

After this tragedy, Dr Hackett and colleagues carried out measurements of CO accumulation in tents, snow caves and igloos on Denali, and made some important findings (Carbon Monoxide Exposure in Mountaineers on Denali, Turner, et.al., Alaska Medicine, May, June 1988). They reported that typical mountaineering stoves burning white gasoline can produce toxic CO levels in just 30 minutes inside a tent or snow shelter. Less efficient stoves will produce CO faster.

Tents sometimes offer greater safety because of wind-aided ventilation which is not usually available in snow shelters. But adequate venting is still vital. In caves, the size of the ventilation hole is crucial. The researchers recommend a minimum of 50 square centimetres; about the size of ski pole basket. The hole should be located as high as possible and close to the operating stove. This is equally good advice for avoiding suffocation. A sleeping adult uses about a quarter of a litre of oxygen per minute. In an unventilated snow cave (eg. blocked entrance and no vent hole), the amount of oxygen available will be limited by the size of the cavity, plus any that transfers through the snowpack. A burning stove or candle will consume additional oxygen and more occupants in a given space will limit the volume available to each person. The lower atmospheric oxygen levels at altitude will add to the problem. Even an elevation of 2000 metres can be significant, and people who have travelled directly from sea level with no acclimatisation will be more vulnerable. Australian glaciologist and very experienced snow-caver Harry Black says that new-fallen dry snow has an air content of around 90%. 'Ripening' changes begin immediately, but even after three weeks a typical air content would be 70%. He estimates that the snowpack that killed the four snowboarders would have held about 60% air.

Little research has been done on gas transfer through snow, but recent avalanche survival studies give some guidance. Hackett stresses that lack of oxygen is not the issue. "The problem is not so much being unable to draw air through the snow, but getting rid of the carbon dioxide that is exhaled. You can breathe through snow for a while, but carbon dioxide displaces the oxygen and eventually you die of suffocation. If you can get rid of the carbon dioxide you can breathe for hours."
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This is because carbon dioxide seems to transfer through snow more slowly than oxygen. Special breathing devices based on this principle have recently been developed to aid avalanche survival.

Carbon dioxide is also heavier than oxygen so it tends to fill up the lower levels of snow shelters first; the 'foul air' phenomenon well known to cavers. Carbon dioxide drainage is one reason for building a snow cave with an entrance below the floor of the living area. If trapped in a suffocating snow cave, it may be better to stand up and break through the roof, rather than descend into the even worse oxygen deficiency of a blocked entrance.

Impervious icy layers in the snowpack may also slow down the release of air. Glazing of surfaces inside a snow cave is a common experience, but Hackett reckons this usually takes at least a couple of days. Many avalanche deaths result from the formation of an 'ice-mask' around the face. In Australian snow-caving conditions, human activity and heat from cooking often raise the temperature well above freezing, partially melting the inside surfaces. This can create a waterlogged, less permeable layer which freezes when the temperature falls due a reduction in activity (such as sleep) or abandonment of the cave.

Under normal circumstances, as the oxygen level falls a sleeping person will become distressed and wake up. Anything which inhibits physical capacity; such as drugs, alcohol, illness, hypothermia or exhaustion; may delay this response and make it harder to react quickly. If caught in such a situation, you may have only a minute or two or less before unconsciousness.

**TENT, SNOW CAVE OR IGLOO?**

Snow offers more options for comfortable and secure shelter than most outdoor environments, but which is the best? The answer depends on your situation.

**TENTS**
- are heavy to carry but are always at hand
- provide quick shelter just about anywhere
- even the best have limitations, so it is important to be familiar with your own
- are vulnerable to strong winds, especially in exposed situations
- can sometimes be protected with snowblock walls
- heavy snowfall can break poles or suffocate occupants (such big dumps are uncommon in Australia)
- a snow shovel is a very useful accessory (sloping sites can be levelled and wind-break snow-block walls can be built)
- can be noisy (in the wind) and have condensation problems
- can be warmer (in calm conditions) than the outside temperature
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- must be well ventilated when cooking
- are good for camps on the move.

Snow caves
- are quiet and very secure in wind, snowfall, light thaws and sometimes rain
- usually maintain an internal temperature of just above freezing when occupied
- must be well located and constructed
- require shovels (and keep the shovel inside with you!)
- need the right conditions, which are not always available (such as early season with patchy snow cover)
- must be well ventilated
- are often damp, making sleeping bags progressively soggier; a synthetic bag or waterproof/breathable cover (bivvy bag) helps
- require time for construction; allow at least two hours per person for a comfortable home, one hour each for a survival hole
- digging is hard work and risks damp clothes and hypothermia; unsafe for a cold and tired group
- are rarely worth the effort for one night, but make good base camps.

Igloos
- have similar qualities to snow caves, but require more time and skill to build
- practice is essential and a saw (plus a shovel) is an advantage
- the right sort of firm snow can sometimes be hard to find in Australian conditions
- sag, melt and erode in thawing temperatures and rain.

Emergency shelters include snow trenches and snow mounds. They are inadequate for planned camps and should be practised before they are needed.

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Ian Brown is a regular contributor to Outdoor Australia and has spent a lot of time camped in the snow, including 60 consecutive nights during the first Australian walk to the South Pole in 1998. He has snow-caved extensively in Australia and New Zealand. Extreme South, his book on the South Pole expedition, is published by Australian Geographic.