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Exploring the Harder Side of Caving



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Organisation

No matter how well equipped you are, you won't get far unless that gear and you are organised. The level of organisation you require depends on the cave and your group, but in general the more serious the trip the better organised you'll have to be.

Integrated systems

While vertical caving can be dealt with as a series of separate units such as Prusik Systems, Descent, Ascent, the units must be put together properly with other compatible units for them to work as a vertical caving system. It is no use setting up the hottest 3 Gibbs Ropewalking rig and then cursing at the first rebelay only ten metres up. From the choices available you must first decide how you intend to rig caves and then attach other units that fit.

Alpine rigging goes with thin rope, Frog prusik rigs, cowstails, bobbin descenders, bolts, staying dry at all costs and rope packs. IRT rigging goes with thick rope, Ropewalking, spare ascenders on a sling, racks, bowlines around boulders, wet suits and 'wagon wheels'. This is not to say that there is no room for compromise but simply that you cannot choose caving methods and equipment in isolation from each other.

Personal organisation

Each caver in the party must be physically fit and be organised to do the cave. It is important to be confident in your fitness and caving ability so that moving through the cave becomes second nature. This invariably means building up to hard trips by practice in continually more demanding caves to get an idea of your personal limits, whether physical or psychological.

Before starting down a cave, everything should be pre-arranged ready for use. Wear your prusik gear ready for action with footloops rolled up out of the way so they will not snag, or pack it into a small but secure sack and hang it from your belt. Never carry prusik gear in a rope sack, if the sack is left behind or swapped with someone else the gear could be left behind. Similarly, on the way up you should keep your descender on you in case you must redescend a pitch. Arrange personal equipment neatly. The more odds and ends hanging off the more they will get hung up.

Your seat maillon is the focal point that connects you to your equipment. It often has many things clipped into it, all of which must be in an orderly fashion so that they interfere minimally with each other.

From left to right they can be organised:

- Pack haul karabiner
- Cowstail
- Croll
- Descender on a locking karabiner
- Brake karabiner

The **pack haul karabiner** is easy to undo and its cord hangs against the left harness leg loop instead of more delicate objects. A pack haul karabiner also works well clipped into the left attachment eye of your harness.

The **Croll** moves up to the top of the seat maillon when in use, otherwise it drops out of the way to the left.

The **descender** also moves to the top when in use and you can remove it if prusiking any distance.

The **cowstail** is a minor problem. It also moves to the top when loaded but as well pulls to the left or right depending on the rebelay. When it pulls across your Croll on ascent it conflicts with the Croll. As best of a bad lot, it is better to have your cowstail push against the left of the Croll, than the right.

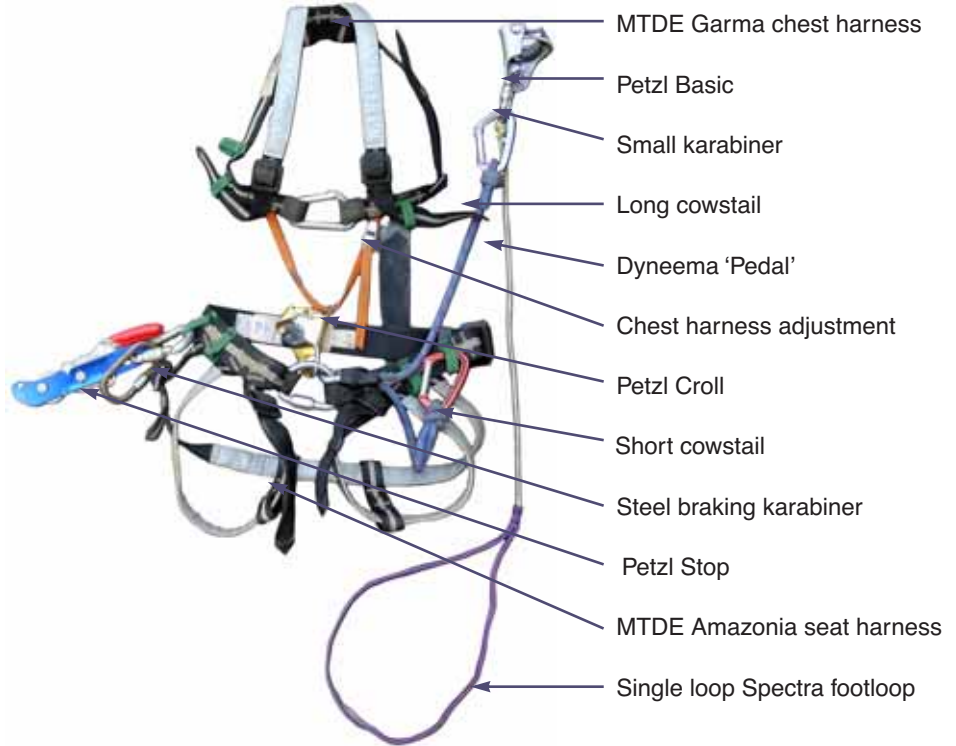
The **ascender safety cord** (if you wear one) is as far out of the way as possible on your extreme left. Don't clip it to the bottom of your seat maillon—if you weight it, the maillon will capsize and make other items difficult to reach.

It is rarely necessary to wear everything at once.

How I do it

I have all the gear. I have a cave rigged and ready to go. This is what I use to get down and back up.

The emphasis of my rig is simplicity and light weight, usability, efficiency and safety. It's not a rig for absolute speed up any one rope, however in a deep cave, simple, light, usable and efficient wins every time by saving me energy on the climbs and time passing obstacles. This in it's way improves my safety. There's a straight forward method for just about any rigging obstacle and I don't need to resort to gorilla acts to make up for shortcomings in my SRT rig.



Seat harness

I use an MTDE Amazonia. It's light, exceptionally comfortable and has a very low attachment point. Harnesses like the Petzl Superavanti are also good –just not as comfortable or as low. No doubt there are other nice harnesses out there. Provided the harness holds your main maillon flat against your abdomen, your rig will work, you'll just stand to lose efficiency and comfort. Whatever harness you get, wear it as tight as you can comfortably get it.



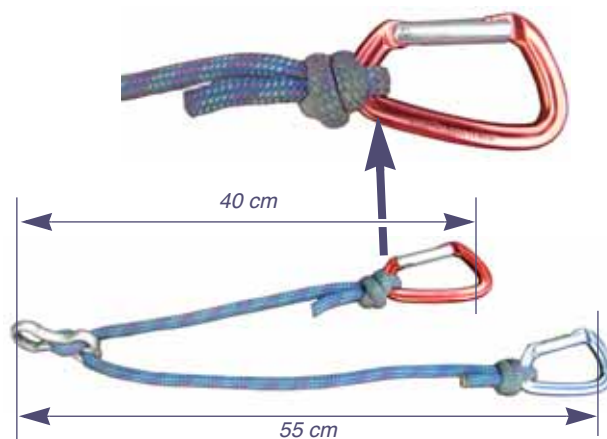
Chest harness

I use an MTDE Garma. It's a traditional [Climbing Chest Harness](#) with one important difference: it supports my Croll with an ingenious tape and bicycle toe-strap buckle arrangement. It's faster and easier to adjust than any other chest harness –by a long way. It also has handy attachment loops to hang your goodies from. Of course for the money and weight, you still can't beat a figure-8 harness with a fairly easy to release karabiner on the Croll.

Ascenders

A Petzl Croll on my chest is best. The Kong copy is almost as good, possibly wears better, but isn't quite as smooth to release or handle. For a hand ascender, I use a Petzl Basic for several reasons. It's small, compact, light, versatile and lasts well. I haven't used a handle ascender for years. They're much bigger and a little heavier. The handle is useless when climbing a vertical rope—but nice on slopes and handlines. When I push a handle ascender up the rope I tend to push the handle slightly to one side and this wears out the lower edge of the ascender's running surface. Looking at other people's handle ascenders from time to time, I don't think I'm alone with this action.

Cowstails – material



Made of 9 mm dynamic rope. I use a double one with a metal eye that I got from Expe at the bottom. It locks the rope without a knot so I don't have a bulky knot at my main maillon, or a knot that gets abraded. But the rope itself still gets abraded, which is one reason why I use rope instead of tape. When the sheath wears out I change it. With tape I just can't tell when it's

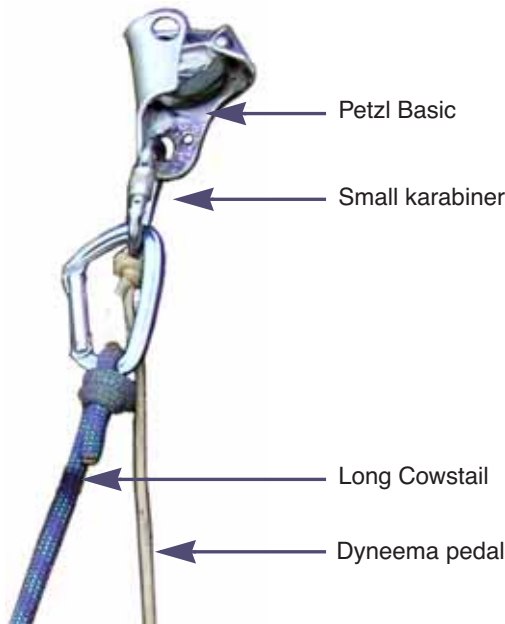
worn out. Tape isn't dynamic either and easily catches in ascenders. At the other end I attach my cowstail karabiners. I use good quality, straight gated non-locking D's—Petzl Spirit is good. Kong are even better: I can get them in red and blue so I can put a different colour on each cowstail. I attach the rope with a [Barrel noose](#)—half a double fisherman's knot (that's a half a double fisherman's knot, not a single fisherman's!). They're strong, neat and tighten onto the karabiner so I don't have to mess around with rubber bands or little metal bits to keep my cowstail tied to the correct end of it's krab.

Cowstails – lengths

My long cowstail also doubles as my safety for my hand ascender. It's long enough so that when I push up that hand ascender, I have just enough rope, but no spare—if I'm hanging from it, I still need to be able to reach it. My short cowstail has grown a little over recent years as rigging styles have changed. It's just long enough so that I can use it for crossing rebelay on the way up, while not too long to cross them on the way down. So, when I climb up to a rebelay and have both my ascenders as high as they'll go without jamming them into the knot, I can just clip my short cowstail into the rebelay karabiner. All that works out to an inside top of karabiner to maillon attachment eye distance of 55 cm for the long one and 40 cm for the short one.

I should point out here that it's the cowstails that hold the whole thing together and provide much of the safety for my SRT rig. I've long ago got rid of the extra safety cord to my top ascender—it only got in the way, got tangled around things and was more weight and bulk to carry. Whenever I used it, my long cowstail was just hanging there doing nothing anyway, so I replaced it with a 'removable' safety aka. long cowstail. This of course means that I have to take care to always use it and not unclip it at the wrong time or trust my Croll as my only attachment point. Yes, it is physically possible to prusik the rope with no cowstail and my top ascender not attached to me at all. Would I do or recommend it, even for a little pitch - no! Get in the habit of always doing it right. Treat every pitch as a 100 m pitch.

Footloop/Legloop/Pedal



Perhaps the French/Spanish 'pedal' is a better word for this thing. Mine is made of 5.5 mm Dyneema (also goes by the name 'Spectra'. Get it from MTDE or Expe), and is made specially for caving by Beal. It doesn't take a dye, so you buy it white and it becomes dirty white in no time. Its real advantage is that it wears and stretches like wire cable—that is, not at all. The lack of stretch makes for a more efficient stand motion. The lack of water absorption and bulk are unbeatable. Unlike wire cable though, it's soft to touch, flexible and light. For the footloop itself I prefer a single large loop about 40 cm in circumference so I can get both feet in to hold the rope, and pop one or the other foot out easily. Get a spectra sling of the length you like and tie an overhand loop around it with the end of the Dyneema. If you've got tough feet, just tie a loop in the end of the dyneema, or you can buy ready made pedals. Don't get an adjustable one, except perhaps for training people, just experiment a bit to get the length right.

At the top of the pedal, I use a [Barrel noose](#) to attach it to a small, locking, life support karabiner. My usual routine is to clip my pedal to the bottom of my hand ascender on the way down when I want to remove it easily and lock it to my harness for travelling. On the way up I normally clip my cowstail to my ascender, then my pedal to my cowstail karabiner. This way I can use the ascender and pedal together (normal use) or as separate items on traverses and slopes where I may not want the pedal getting in the way. If I meet a really difficult rebelay on my way down or up, I can clip just my pedal into the anchor and stand in it to pass.

Pedal length



Basic reaches to here when I'm standing on the ground

and



here when I'm hanging on the rope

My pedal is surprisingly short - 106 cm from the bottom of the footloop to the eye of my ascender. When I put both feet in the loop and stand up straight, the ascender barely makes it to the bottom of my Croll. However, once I'm hanging on a rope, my pedal is short enough that when I push my hand ascender up as far as I can reach, my feet can't come up any further anyway, and my cowstail is just about to pull tight. If I take out one foot, I can step higher and reach higher, but have less power climbing with one leg. When I stand as high as I can with both feet in the loop of the pedal my Croll almost hits my Basic. The bodies of the ascenders do overlap, but the wrap around sections don't actually hit. To get the your pedal length right, just shorten it bit by bit until your ascenders hit, then lengthen it a little.

Pedal length isn't critical. Mine has two lengths some 5 cm different depending on how I clip my pedal to my ascender.

Descender



Petzl Stop. Zipping down a rope on a non-stop descender is like riding a bicycle without brakes... I attach my descender with a locking karabiner. No need for any fancy twist-lock, rapid on off mechanisms. I also always use a steel braking karabiner. Sure steel's heavy, but anything else wears out rapidly, even Russian titanium karabiners. I picked up two really nice steel ovals with smooth pin & slot latches on the gate, that makes them really user-friendly. Most steel krabs - if you can get them - have really nasty claw latches and there's just so much you can do with a file. If you can't get steel, or

titanium, or have enough aluminium karabiners to grind to dust, try to find a Raumer 'Handy', a special stainless karabiner-like 'brake-krab' that should last you forever. Very positive braking, a bit too positive at times. A karabiner is nicer and if it's a good one I can occasionally use it for something more serious like a tyrolean when I don't want to wear out a precious cowstail karabiner. As a rule my Stop is either on my seat maillon for descending or on my belt/harness loop in an easy to get position when I'm ascending. Just as my 'up' gear goes down a cave on me and ready to go, my Stop is always handy when I'm climbing and never in a pack that may get left behind or carried-off by someone else.

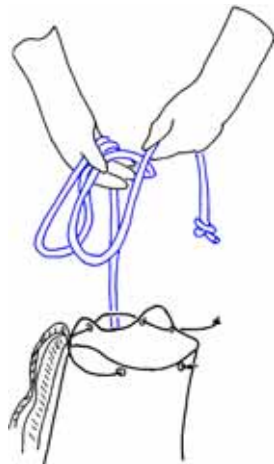
Foot ascenders/Pantin

Euro cavers have discovered the foot ascender. Ask any French caver and they'll tell you that the Pantin is "zee best". A Pantin pulls the rope tight for your Croll so you can effectively prusik up a tight rope and use a walking motion on slopes or on freehangs if you're a gorilla. It may also save you some energy and certainly makes you feel like you're climbing better, but there's a price. Your Croll will wear out perhaps twice as fast, and you have a third ascender to attach to the rope, that you usually have to put on a few metres up as they don't necessarily run right from the bottom. No need to wear your Pantin all the way down the cave. You don't 'need' it to climb.

This is how SRT works for me. Everyone is a different height, has different proportions and different flexibility, and so needs to set up their equipment slightly differently.



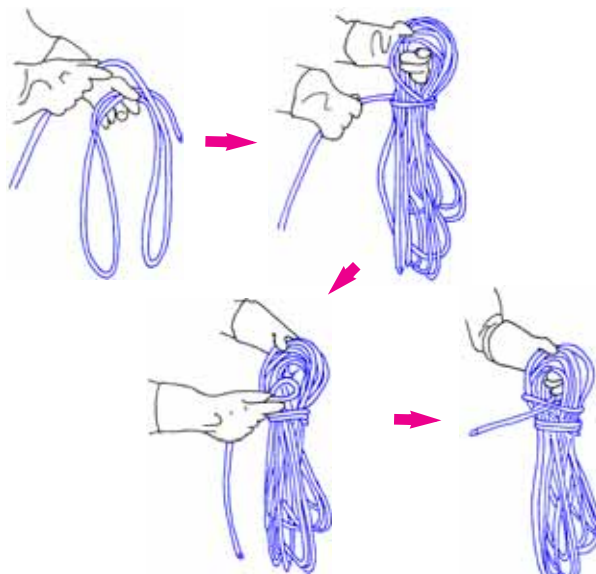
Gear management – rope



Stuffing a rope pack

Cavers spend a lot of time handling ropes and most would agree that the only place to carry one is in a rope sack.

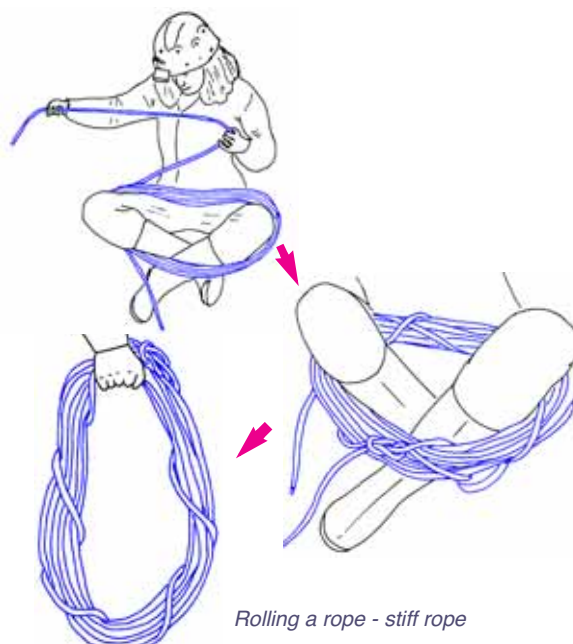
When you know the cave or cut a long rope to fit a pitch tie a stopper knot in the end and stuff the rope into the sack, ideally in handfuls that do not twist the rope. Tie consecutive ropes to each other either loosely if the pitches are not continuous or with a knot and safety loop ready to cross so that you won't have to do it while hanging in space. Descend pitches with the rope pulling out of a sack to reduce the danger of a falling rock damaging it or the rope becoming tangled as often happens when it is thrown down. I prefer to pull out a few metres of rope at a time, descend a little, then repeat the process. This way I can see that I still have rope. Even though you 'know' that the rope has a knot in the end, if for some reason it doesn't the end will be out of the pack and through your descender before you know it.



Rolling a rope - climber's style

When you don't know the cave, choose a suitable rope as you encounter each new pitch. Carry these as a selection of ropes, each rolled up separately, with the longest one stuffed into the bottom of your sack. The specific selection you carry depends on what you know about the cave or other caves in the area. As you empty a rope sack split the load more evenly between the party or leave the bag hanging from a belay for refilling on the way out.

Stiff thick ropes don't easily fit into rope sacks but you can roll them around your knees and tie them into 'wagon wheels' that you wear over your shoulder, hanging below on pitches or rolled along ahead of you in narrow passages.



Rolling a rope - stiff rope

Occasionally the rigging of a pitch requires delicate climbing that would be difficult with a heavy pack dangling below you. Instead, descend a loop of rope with a second paying out rope to the leader until the difficult anchor is rigged or the loose rock is passed or removed. When everything is secure the pack can be lowered or brought down by the second. Never clean a pitch of loose rocks with rope hanging down it.

While the bulk of your load will be rope there are several other items that you will need.

Anchors

Pre-clip bolt hangers to their karabiner or maillon and link them in chains of ten for convenience. When you split the chains between rope sacks to spread the load clip them to the drawcord or rope so they cannot be lost. While you are rigging pitches it is a simple matter to hang one chain of karabiners or maillons with hangers, and another without, from your belt ready for use. In dirty caves keep the hangers in a small sack to keep the bolt threads clean.

Avoid carrying hangers or small metal items loose in a cave sack, as they are adept at finding their way to the side or bottom and eating their way out. Pegs and nuts carry well on metal peg rings or short lengths of knotted cord. Knot slings loosely to make them easier to handle and clip a number to a karabiner to keep them together. Wind wire traces into a 15 cm diameter ring and join the two ends with a maillon to keep them from unraveling.

When you know the cave well or have a good tackle list attach the rigging gear for each pitch to the top of its rope. This avoids the need to rummage in a tackle bag at each belay point and saves time.

Bolt kit



Bolt kit

Pack everything you need for bolting into a pouch that doubles as a hammer holster that can hang at your side when in use. When closed, the pouch should keep the contents of the kit from escaping and trap the hammer head inside to stop it damaging your gear sack. Tie the hammer and cone pocket to the pouch with cords and fit the driver with a wrist loop if it does not already have one. You can also throw in a sky hook to help keep you in position when placing difficult bolts.

Before packing the anchors check their threads and only take a few more than you think you will need on the trip or they will only become wet, dirty and difficult to thread next time around.

Many cavers regard a spanner as a necessary piece of personal gear. The ideal is a 13 mm spanner for spits or a size that suits your bolts, with a ring spanner at one end and open at the other. Carry it separately from the bolt kit as you may need one for rigging to existing bolts

or adjusting rigging during exploration. Attach it to a string and mini-karabiner and hang it from your harness or put it on a car tyre tube armband. When you are derigging without a spanner, use the oval attachment eye on Petzl bobbins as a spanner to save abandoning a hanger.

When exploring previously bolted caves add an anchor cleaning tool made from a sharpened wire.

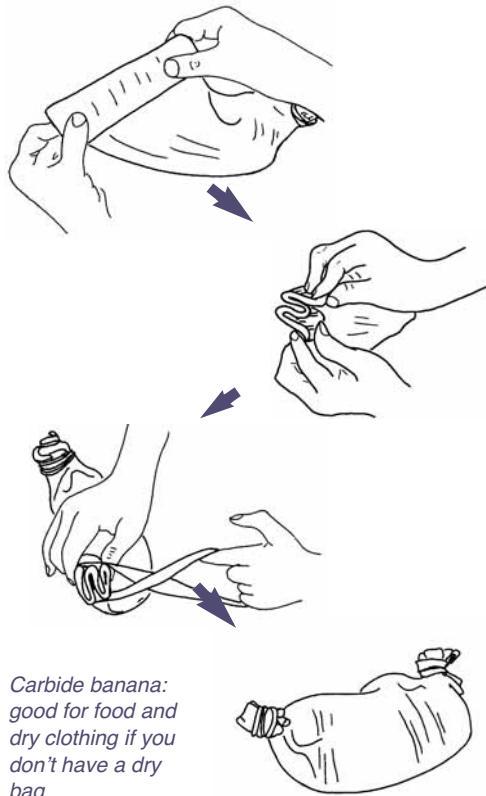
Spare clothing

Dry clothing is an absolute joy to put on if you are trapped by floodwater or moving too slowly to keep warm. A silk balaclava fits easily in your top pocket or helmet. A spare thermal top, wrapped in a garbage bag to keep it dry, has the added advantage that you can climb inside the garbage bag for extra warmth.

Spare batteries

For short trips, the batteries in your main light and backup light should be adequate. For longer trips take spare batteries in a robust, waterproof container. With your food or spare clothing works well. With such a wide variety of LED lights now available either carry your own spares, or take care that group batteries suit everyone's light.

Carbide



*Carbide banana:
good for food and
dry clothing if you
don't have a dry
bag*

Carry larger chunks and quantities of carbide in lengths of small diameter car tyre tubes with the ends closed by rubber bands to make 'bananas'. They are robust, waterproof, malleable and unlike plastic bottles they get smaller as the carbide is used. One third of a tyre tube filled with carbide is the maximum anyone would want to carry and it is usually more convenient to take several smaller ones rather than one big one for longer trips. Don't carry waste carbide in a banana. The waste usually continues producing acetylene and the banana will inflate until it bursts. Carry carbide waste in an unsealed plastic bag protected in a nylon sack. Often the carbide hasn't completely reacted and will produce a lot more acetylene if it gets wet. Take care in swims and especially in tight, wet sections where a gas leak can produce an impressive explosion.

Calculate the quantity of carbide you carry as for a cave diver's air - one third to get in, one third to get out and a third for spare. Though, because the consequences of running out are less drastic for carbide than for air you can cut down on the spare third for most trips.

Gear sacks



The ideal gear sack depends on the nature of the cave. Long thin sacks for nasty narrow caves and fatter, more comfortable ones for caves that give you a chance to wear them. No matter how much gear a cave requires there is no point putting it in a sack that is so big that you must unpack it to fit through every tight spot.

Pack hard items such as hammers and karabiners in the centre of the sack to keep them from damaging the sack fabric or your back. Carry odd items like food or rigging gear in a light nylon sack within the gear

sack so that you can easily remove them to get at the rope below. If you know the cave, prepack every item in the reverse order of when you will need it.

A pack that looks reasonable on the surface could become an impossible monster underground. Anything heavier than 15 kg and larger than 35 L is too big for most people. Carry more smaller packs rather than fewer large ones, you'll have a better chance of not injuring yourself.

Tackle lists

When planning a trip down a known cave do as much research as possible to find out exactly what is in store. The two most valuable pieces of information are a tackle list and a map. Encase a copy of each in 'contact' plastic or a clear plastic bag and carry them through the cave for ready reference.

Table 8:1

Creek Cave - tackle list

Pitch	Length (m)	Rope (m)	Rope taken	Anchors
1	12	20	30	nat + b, b-6
2	3	6	15	pr + b
3	90	100	120	2nat, nat-20, b-30, ledge b-50, 2b-60, b-70
4	20	25	28	nat + b
5	30	35	40	b, b-5
6	30	30	32	nat + b
7	45	50	50	b + nat, nat-15
8	2C	6	8	climb up/ ladder
9	30	35	37	nat, r-5, r-20

nat = natural belay b = bolt
 r = redirection (deviation) pr = previous rope

If a tackle list is not available you can usually draw one up from the cave description or map. In it include information for each pitch: pitch length, rope length required, nature and location of anchors, special characteristics such as water, pendulums, etc. Even an incomplete list is better than nothing. When rope lengths are not indicated calculate them roughly by counting each knot (of any type) as using one metre of rope and each rebelay as using two metres. With the help of the map make extra allowance for long tiebacks, traverses, stepwise pitches or large natural belays, all of which require more rope. If in doubt take too much and pack a few five to ten metre ropes as spares if the information is lacking.

Arrange the ropes so as to use the lighter and better fitting ropes at the bottom of the cave and save the ones that are too long or heavy for the top. When it is all decided lay everything out side by side, check it against the tackle list and note down each rope on the list, then stuff them into the rope sacks in order from the bottom of the cave up.

Split rigging gear between the sacks so that there is an appropriate amount to rig each load of rope or concentrate it to make one small but heavy rig pack. Put food, carbide and spare clothing into the packs that are lighter to even up the loads and later transfer it to the first empty sack so it will not have to be unpacked each time you need a rope. When there are a large number of sacks it may be worth marking each one with a number or tag so as not to get them confused.

New caves - prospecting

When surface prospecting it is best to walk the area first with minimal gear, perhaps a torch and short handline at the most. Once you find some reasonable holes you can return with light caving gear to check them more thoroughly.

Try to be systematic when prospecting an area. Mark the entrance of each hole with a spot or cross to indicate it has been looked at and goes nowhere or with a number and perhaps letter code for any significant holes. If possible, note the location of each hole on a surface map, take a GPS fix and take notes as to what each numbered cave is like.

Depth estimation

Before descending any shaft it is useful to know how deep it is. Estimate small pitches by shining a spot light down them to see if the rope is long enough. Once a pitch is longer than about 20 m or rounds over at the top the most convenient estimation is by sounding with a falling rock.

Drop a solid, fist-sized rock down the pitch taking care to give it no initial downward velocity, although a light outwards toss may be necessary to make it fall down the centre of the shaft. Count fall time to the nearest half second using a watch. Use this to calculate a rough estimate with the formula:

$$D = 5 \times T^2$$

D = depth in metres, **T** = time in seconds.

ie. A three second drop would give:

$$5 \times 9 = 45 \text{ metres}$$

In most cases this will give an exaggerated figure that at least encourages you to take too much rope rather than too little.

Once the rock bounces, accurate estimation is not possible though it still gives some indication as to whether the hole is 'big' or 'small'. [Table 8:2](#) shows time versus depth more accurately for anyone wishing to write it on the lid of their cave pack.

Table 8:2

Depth estimates

Time (sec)	Rough depth $5 \times T^2$ (m)	Actual depth* (m)
2	20	19
2.5	30	29
3	45	41
3.5	60	55
4	80	71
4.5	100	88
5	125	108
6	180	151
7	245	210
8	320	257
9	405	319
10	500	386

* Using $D = 340 \times T + 11784(1 - \sqrt{1 + 0.0577 \times T})$ (Hoffman, 1985)

What to take

In most karst areas the majority of surface shafts are blind, so make your initial descent with this in mind. Take only the lightest of personal equipment and carry no more than two or three ropes, one 30 m to 40 m long and two shorter ones are usually sufficient. Rig the most suitable length down the entrance drop and carry another if it looks hopeful.

Eleven millimetre ropes and IRT rigging will save a lot of time and effort if there are a number of holes to look at, but on the balance side, you have to carry more rope up the hill. Confirmed Alpine cavers or those who only have thin rope also need a bolt kit, some slings, perhaps a few pegs and nuts and some rope protectors to cut corners without cutting the rope on the initial descent.

Exploration rigging

For the first descent of an entrance shaft you can rig the rope roughly and quickly, though always safely, just to see if the hole 'goes'. Make heavy use of natural anchors and don't fuss too much about comfort or ease. Should the cave go, it is not much trouble to rerig one pitch and if it doesn't go, you will save time and effort. A slight exception is for bolts. If you are forced to spend the time placing one, do it properly so that it can be used again if necessary.

Once the cave is going and looks as if it will continue to do so rig it properly the first time. All too often cavers rush on down in the excitement of a new discovery and leave behind a trail of shaky anchors, half drilled bolts and chopped ropes. It may get them down a little faster but apart from being dangerous it is a thankless task having to completely rerig a section of cave before breaking new ground.

The amount of rope and rig gear you carry underground varies with what you expect to find. Take a lot and find the cave ends or a little and run short. On average a competent team could expect to rig 100 m to 200 m of rope and place up to ten bolts by hand—more with a power drill, in a days' exploration of a cave that goes with no major complications. When you carry a selection of different length ropes there is a good chance that several will be the wrong length but it is not too difficult for the following day's party to change them for more suitable lengths and carry the unsuitable lengths along to rig the next new section. So long as the anchors are properly placed, changing the ropes will be a minor exercise.

General organisation - party size

Modern lightweight caving works best with small groups. Parties from one up to four are reasonable, depending on experience. Beyond four it is preferable to split into sub-groups that are more manageable and can move faster. All rigging is slow and as there can only ever be one person in front at a time there is no point having the rest of the party shivering along behind.

When rigging, the ideal is two, one to do the rigging and the other to help when needed. A fast rigging descent rate for a known cave is around 100 m per hour and with this in mind a group of six can split into three twos and stagger their entry times so as to arrive at the limit of rigging just as their ropes are required. An alternative strategy is to split into a rig and derig team so that the riggers can reach the bottom and exit with minimal loads of excess gear and rope. The deriggers can arrive after the riggers leave the bottom and immediately begin the derig.

Trip duration

While you can estimate the descent rates for 'average' known caves, the actual rate will depend on the nature and state of rigging in the cave and the competence of the cavers involved. A pre-rigged cave could bring descent rates of 200 m to 300 m an hour while a vast amount of complex rigging or re-rigging could slow things down considerably. When researching information about a cave there is usually some indication as to trip duration.

For most people a trip of five hours would be no problem, five to ten hours would be reasonable and ten to twenty hours becoming serious. Beyond twenty to thirty hours people start considering bivouacs. While this is reasonable on expeditions when several trips of this duration may be necessary, one-off sport trips can, with training, the right attitude and acceptance of the extra risk, go for longer - thirty, forty or more hours without sleeping.

Once a trip goes overnight, you must make allowance for your body's slowing down during normal sleeping hours and the increased accident risk that it entails. The turn around time for most cavers is about 10.00 pm to midnight, and anyone still working their way into a cave in the early hours of the morning should not take it lightly. Reduce or avoid the problem

entirely by getting an early start so that you do as much caving as possible during normal waking hours. This does not mean setting an alarm for an 'alpine start' but merely getting going quickly and efficiently after waking and not spending most of the day sorting equipment or mending gear when it should have been done the day before. Contrary to popular belief "Gentlemen **do** go caving before noon".

Bivouacs and camps

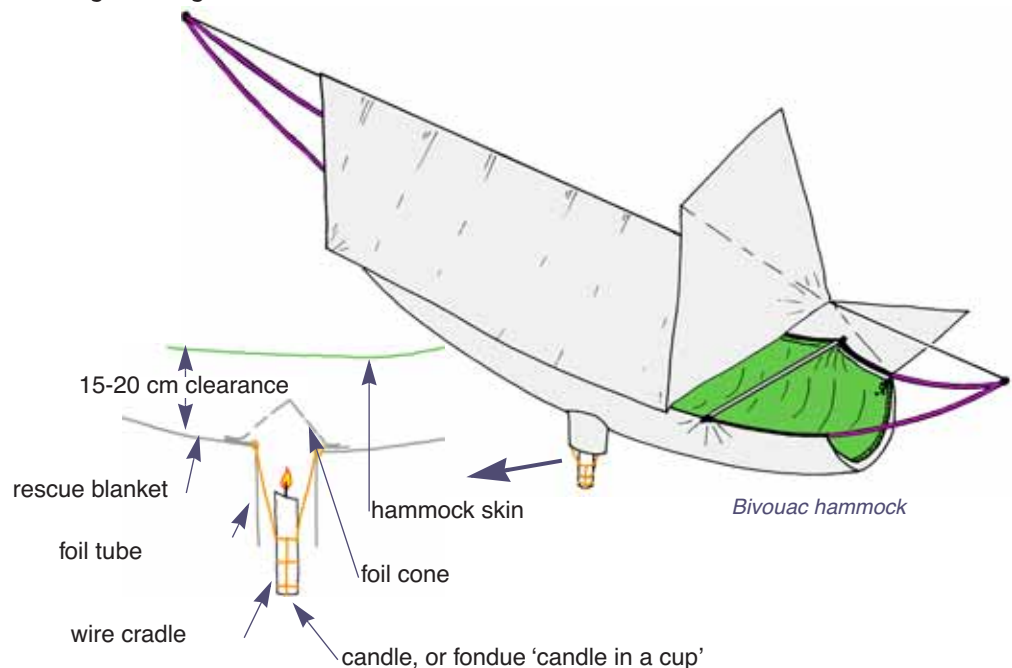
The need to place an underground camp or not is often a matter of caving style rather than an absolute "It-is-not-possible-to-go-further-without-a-camp". Many cave camps are a waste of time and effort. The same result may well be achievable from the surface with less expenditure of time and manpower. The effort involved in carrying in camping equipment, food and extra clothing often ties up several people for a few days when the same effort could be put toward exploring the cave. Granted, camps may be set up by those who take on a support team role, so that other cavers can put a greater effort into the exploration, though this is hardly reasonable justification for unnecessary camps.

Underground camping has a devastating effect on the cave environment. I seriously doubt that there has ever been a cave camp that has not left its mark on the cave, be it a rubbish heap, human waste dump, abandoned gear or rearrangement of the cave to build kitchens and beds.

If camping truly is the only solution, make it as light and short as possible. Long duration camps inevitably waste a lot of time with people sitting around on rest days eating valuable food. Cut everything to a minimum. Specifically designed gear helps reduce the load. Sleeping bags should be synthetic so that they still insulate when damp and of a narrow mummy shape to keep their bulk down. Pack everything as small as possible and take a minimum in hard containers that pack badly and once you've used the contents, be it food or carbide, they still take up the same volume empty as they did full.

Hammocks

Light, heated hammocks cut weight even further as they provide a bed and shelter and do not require a sleeping bag in warmer caves and a less bulky bag than would otherwise be needed in a cold cave. Hammocks also allow you to camp in truly inhospitable locations where there is no flat ground or water below. The heat source is a solid fuel burner, long burning candle or carbide lamp. Bivouac hammocks are commercially available but you can improvise using a light nylon hammock, three rescue blankets or light plastic sheeting and adhesive tape. Your heated hammocks will be much more comfortable if you run a stove under it to dry it out and warm it before you go to bed. The candle then keeps the hammock relatively warm and dry. Hammocks are best reserved for short, hard bivouacs when you can arrange nothing better.



Camps



Ozto Ocotol/J2, Mexico

For longer camps in better campsites a lightweight tent to trap your body and cooking heat makes a huge difference. A traditional 'A' tent with short walls made of the lightest possible synthetic fabric is ideal. A 2 m by 3 m tent holds 6 covers in comfort and weighs around 500 g if you choose the correct fabric, and saves everybody carrying the extra clothing they'd need to survive 'outside' in the cold. They heat trap effect is even more noticeable if the cave has a breeze. In caves where the roof leaks it may be necessary to add a roof from light plastic sheeting.

Camp food

The key to efficiency is to plan everything. For a one or two night bivouac it's easy to plan each meal and carry the precise amount of fuel to cook it. Longer trips require considerably more planning and the planning task gets even bigger once there are covers moving between camps.

Table 8:3 Ten cave/day theoretical food pack

Food	Amount	kJ	...reality
rice/pasta/couscous/instant potato/etc.	2.5 kg	40 000	
porridge	500 g	7500	
cheese	1 kg	20 000	
salami	1 kg	20 000	
bacon/jerky/dried meat	500 g	10 000	
chocolate/bars	1 kg	20 000	
sugar	400 g	6 400	
tea	30 bags	-	
olive oil	200 mL	6000	
nuts	500 g	12000	
dried fruit	500 g	5 000	
powdered milk	300 g	6500	
candles	2		
lighter	1		
toilet paper	1 roll		
flavourings (chilli, tomato paste, garlic, salt)			
stove fuel	1L		
~10 kg pack	~1kg/person/day	~16 000 kJ/person/day	<p>Photo: Enrique Ogando</p>

An approach that works is to make 10 caver/day packs that contain the food and fuel. With waterproofing in a drybag and padded with thin foam it should fit into a 30-35 L sack and weigh 10-12 kg, with just enough room on top for a little personal gear—your spare batteries and dry top. Everything is communal, the tent, plastic floor, sleeping bags, mats (that came down padding the food), and cooking gear so when you move between camps you are not already half loaded with clothes and camp gear.

Neither list has freeze dried food on it. If you read the nutritional information on a freeze dried packet you will see that they contain very little energy in such a bulky packet. On an energy for cost basis, they are even worse, and I won't even consider the question as to whether they are food or not.

Take the lightest available liquid fuel, canned gas or solid fuel stove. The best stove depends on the type of camp: liquid fuel for longer stays and heavy usage and to avoid carrying out a lot of cans and expense; canned gas for convenience and lighter, cheaper stoves for short stays, and solid fuel for lightest weight bivouacs.

Once you have installed and inhabited the camp use it as efficiently as possible and waste it on nothing other than its intended purpose - to explore the cave.

Communications



Nicola cave 'radio'



'Michie Phone' single wire phone

Communications are hardly a problem for shorter trips. The worst that can happen is that you have to wait until one team emerges before the next team knows what to take in. Once you have more than one group working or living in the cave the confusion increases exponentially. Sending messages usually results in a speleo version of a game of 'Chinese Whispers'. Even written messages are often out of date by the time they reach the surface. At some point you may just have to take the plunge and set up an in-cave communications system. They are of two basic types:

- Wireless. Like the Nicola system as used by French Cave rescue
- Wire telephones. Preferably purpose-built single wire phones

Each has advantages and disadvantages. A Nicola fits in a lunchbox sized Pelican case plus antenna. You set up the antenna, preferably in a damp spot, then call the base. On the downside, the battery consumption is high enough that you can't just leave a Nicola running and wait for a call, the two stations are best more or less one above the other and within 700 m, and they are expensive.

A single wire 'Michie' phone is a mobile phone sized handset that can talk to any other handset on the line. A Michie phone runs for at least a month on a single small battery, and they are cheap. They have a range of 30 or more km. Unfortunately, they require you to lay a phone line down the cave. This is neither trivial or cheap.

With good communications between anywhere in the cave and the surface, the next team entering can know exactly what they need to bring and start down the cave much earlier. For caves where there is a

chance of becoming trapped by flooding, complex logistics, or in an emergency, good communications become more important.

Derigging

On sport trips everyone wants to get to the bottom and they usually end up there at the same time, looking at each other and trying to put off what comes next.

In order to derig efficiently each caver should ascend slowly and wait at a predetermined spot one rope sack-full apart to take their turn at derigging or to collect a load. As last person up you begin pulling the ropes. As you ascend you should dismantle belays and undo knots and loops so as to reduce the chances of a rope snagging when you pull it up. Any knot left in the rope will also grind against the rock on its way up and cause unnecessary rope wear. On long pitches with ledges you may find it necessary to haul the rope up to each ledge and re-stack it so that when you haul it up the next section it pulls from the top of the pile.

When a pack is full, either take it to the surface or pass it on to someone who does. Anyone with a full load gets priority so as to get the gear moving as fast as possible. Move singly or at the most in pairs with the last two staying together to help each other with difficult derigs, long ropes and packing the sacks. A group derigging a cave from the top should organise themselves so that each person descends to a pre-determined point and hauls out a sackfull of rope. Stagger your entry times such that as you fill your sack and begin to head out, the next person arrives to take over without waiting.

If you intend to leave a cave rigged from one season to the next it may be desirable to 'stage derig', especially in flood prone caves. All this means is that you pull up the ropes and stack them every few hundred metres in a safe dry location to save them from being destroyed. Derigging whereby cavers haul sacks part of the way out and then leave them for a later derig trip while they exit empty-handed is highly inefficient.

Gear hauling

Hauling gear up pitches on the end of a rope is not compatible with lightweight caving. It is hard work, causes unnecessary wear on gear and will not work at all with rebelays. The biggest risk however, is of the rope not being replaced correctly after the haul—a rope snagged because it wasn't thrown down correctly can easily trap a party below. Makes for good campfire stories, but it's not much fun at the time. Flying foxes (ziplines) and pulley lifts are a thing of the past, any caver who needs them should rethink their approach to **lightweight** caving.

The most efficient way to move gear is for each caver to carry their own load. A full 30 L cave sack is enough in tough caves although more can be carried in easier caves. When loads exceed this for any distance two trips are more efficient than gear hauling sessions. Rarely will there be a section of cave that is so nasty that it requires an extra pair of hands to pass sacks through. Long chains of cavers passing packs take a lot of time to set up and gain little distance. You should only consider it in very difficult passages or when you have a lot of bags to move. Efficient vertical cavers are self-sufficient.

Weather

Many caves are little more than stormwater drains in wet weather. As part of any pre-trip organisation it is important to get some idea of the local weather patterns and choose a stable period or season to visit. This will vary greatly from waiting a few days for unsettled weather to pass to visiting an area in the dry season. In tropical areas this may actually be the 'least wet' (euphemistically called the "dry") season and it may be necessary to modify caving schedules to suit - if it rains most afternoons, caving is safest at night/early morning with everyone out of danger areas before the rain begins.

In alpine areas the worst times are during snowmelt or when there is heavy rain on a light snowcover, and far less predictably from thunder storms. After waiting out bad weather it may not be wise to start down a cave on the first good day, the water will still be high and the ground will be soaked so that any more rain will run off into the caves immediately instead of being absorbed at least a little by the soil.

Food


Nita Cho, Mexico

The main requirement for cave food is edible, followed by high energy. Suitable energy foods are sugars of any description, dried fruits, sweets and chocolate. This can be pre-mixed to make a 'scroggin' and save having to pack each item separately. Starchy foods such as fruit cake and biscuits give longer lasting energy than sweets and are more filling.

Most caving trips are too short for fats, oils and proteins to be essential, nevertheless nuts, cheese and salami are filling and help you feel well nourished, which is half the battle. Numerous light snacks, such as sweets in your pocket so you can nibble them while waiting for rope free calls or during a short stop provide a constant supply of quick energy and a valuable psychological boost. Most cavers on extended trips soon tire of a diet of sweets and more traditional meals like sandwiches are often appreciated so long as you keep them intact.

Carry your food in plastic bags and on rough trips in wet caves it will probably get wet. Wide mouthed plastic bottles and lunch boxes keep food in better shape and keep it dry. In wet caves you can keep food dry in plastic bags inside tyre tubes like you would use for carbide or use a dry bag.

Even minor dehydration can cause a severe fall-off in performance, it is therefore essential to drink enough to maintain your body's needs. When exercising heavily, thirst is an inadequate indication of water need and it may be necessary to drink more than your thirst indicates. In many areas this entails taking water purification chemicals and a small water container for long trips.

Cavers in cold caves often carry stoves to make cups of tea and soup but they give little extra energy. The psychological boost they give is more than counteracted by the time spent sitting around in the cold waiting for them to cook-up, as well as the weight of carrying them. Snacks instead of meals help keep cavers from becoming cold and avoids the lethargy most of us usually feel after a good meal. The only time you need a stove is for bivouacs, long trips such as when climbing, and more importantly in the case of an accident when any psychological boost to the patient is worthwhile.

Just as important as what you eat in the cave is what you eat before the trip. As in other endurance sports, eat as much complex carbohydrate, especially pasta, as you can tolerate before the trip so that you enter the cave with a maximum of energy reserves already in your body. On returning to the surface it is good to have something 'nice' to eat at the entrance so as not to starve on the walk back to camp or while cooking dinner.

Due out messages

Before going underground it is advisable to leave word with somebody on the surface as to when you expect to be out. This can be on a casual basis such as someone in the group who is not going caving but knows when to expect you out, or it can be more formal such as filling in an intentions book in a caving hut and being obliged to call back before a stated time.

Most of the time however, cavers simply rely on a friend or relative noticing that they have not come home from a weekends caving. This could leave them stuck underground for two to three days. Better alternatives are to leave a message as to when help is wanted with someone who knows exactly who to call should you exceed the deadline or leave written emergency instructions with some responsible person.

Pre-trip research should include the call-out numbers for the local cave rescue if there is one or the police or fire brigade if not. Expeditions to remote areas do not enjoy such luxury, they must be self-sufficient.

Calls and signals

Some cavers fuss over the need for good whistle signals or communication between cavers at the top, bottom or middle of pitches, while in practise there is rarely a need to say much at all. Perhaps it is a hangover from the days of ladders when belayer and climber had to communicate up and down pitches. SRT cavers are largely independent of one another and it is only necessary to give a simple call such as “OK”, “Rope Free” or “Off Rope” when each caver has left the top or bottom of a pitch or has passed a rebelay. If you carry a whistle, keep it simple:

1 blast - going down

2 blasts - going up

3 blasts - rope free

Long, urgent blasts HELP!

If there is loose rock, water or some other reason why the next person should not follow close behind, withhold the call, preferably by pre-arrangement, until it is safe for the next caver to proceed.

It is good practice to always give a call if there is any chance the following caver is within earshot, that way they will know the rope is free before they even reach it and not wait for a call that may never come. Similarly, in Alpine rigging, it is usually possible to see the rig point ahead but this is no reason to not call because you think your companion has seen you pass it.

When you knock a rock free any urgent call such as “**Below!**”, “**Rock!**” will elicit the appropriate response though it is better for cavers waiting at the bottom of pitches to stay under shelter whenever possible. If there is any chance of rockfall it is safer to give some advance warning rather than wait until something actually falls.

Conservation

It is a sad fact that the world’s caves are slowly filling up with rubbish and it is the job of every caver to take out all that he takes in and whenever possible a little bit more to make up for lazy cavers who have left things behind.

Carbide is a particular problem. The calcium hydroxide waste is strongly alkaline and harms cave life. Always remove it from the cave system and then dispose of it correctly. Do not go to the effort of packing the waste into old carbide containers or plastic bags and then leave it in the cave. Hopefully the advent of LED lights won’t result in little piles of AA cells appearing in out caves.

Throwaway rigging is another irresponsible and unnecessary habit. While anyone can appreciate that things may be accidentally left behind or even abandoned in times of stress, there is absolutely no excuse for cavers who deliberately take along old or low quality rope with the express intention of abandoning it in the cave simply because they are too lazy to derig. eg. In September 1986 a group of cavers rigged Reseau Jean Bernard down to 600 m almost entirely on new but poor quality 8 mm rope. ‘Derigging’ was done by removing the bolt hangers and karabiners and leaving the rope in a heap at the top of each pitch! This unfortunately, is no isolated case. 20 years on and you can visit the deepest caves in Mexico and find ropes left there because “the project is not finished”, even though there is no plan to return.

On a smaller scale, the everyday rubbish like chocolate wrappers weigh very little and take a negligible amount of effort to carry out, yet in many caves you find them in vast numbers.

At least rubbish is removable with a little effort. Other things such as bolts are not. It is up to the first riggers to place bolts well enough so that future visitors will not be tempted to put in alternative rigs. Bad bolts, both in terms of position and the anchor itself only leads to bolt farms, new anchors popping up like mushrooms with each season, whereas good bolts will be used by everyone. Part of this is psychological. Many caves are well bolted, though not overbolted until a large pitch, then there is a bolt farm with most of the bolts safely back from the edge where they are useless and perhaps one or two well located so they are useful.

When doing a known cave it is worth being a bit tolerant of weird rigging provided it is safe. Save time and the cave by taking along something to clean out clogged bolts rather than just putting in new ones beside the old. A small piece of stiff wire with a curved point at one end

is light, simple and cheap. With some work you can make rusty or mud-choked bolts usable again and more than once I have wished I had an 8 mm tap with me.

When a bolt is unquestionably bad some cavers bash it to a mangled mess to render it safely unusable. This attitude and that of filling anchors with glue or mud may only serve to compound pollution problems. When a bolt is no good disable it **neatly** with a wooden or plastic plug, leave it alone or better still, remove it.

A simple bolt puller made from a steel plate with three 8 mm threaded holes through it and three long 8 mm bolts through the holes will remove many loose, half drilled or otherwise bad bolts provided they have usable threads.

Some bolts can be difficult to locate. This is both good and bad. A bolt that you cannot find is effectively not there but also increases the chance of a superfluous bolt being placed. Mark obscure bolts with flagging or 'Scotchlite' tape, or leave hangers on them, but not giant carbide arrows and spray paint. Bolt caps made of nylon pegs help keep the anchor clean in dirty conditions, while marker tags and a thread or fishing line set in with the anchor so they are not lost make the bolts easy to find and stops them filling up with debris. Also effective as a marking device is to set a short length of track marking tape in with the bolt. Often, practice and a few minutes searching in likely areas will locate a lost bolt - a better solution than placing a new bolt, both time and conservation wise.

Training

Caving is not competitive enough to require a rigid training schedule as do other sports. Nevertheless being fit is a big help and any stamina building exercise like cycling, swimming or bushwalking is worthwhile. Try to be fit as a part of everyday life rather than a crash get fit campaign for the few weeks before a big trip.

A large part of being fit for caving is being able to move through a cave without wasting energy and this comes with practice. Train on cliffs or in trees until you are completely familiar with vertical gear and rigging that in turn will lead to increased confidence underground. Even so, no amount of simulated practice can replace the training gained from caving itself. On expeditions one or two 'acclimatisation' trips can be worthwhile to get familiar with the cave before doing more committing trips.



Madre de Dios, Chile



Madre de Dios, Chile