Cave Photography: Getting Great Pictures in Nature's Darkroom

by Dave Bunnell

Shooting decent photos in caves can be a daunting task even for a professional photographer who is not used to working in that environment. Caves are one of the few places to be found where darkness is total once leaving the twilight of an opening to the surface. Photography in caves is thus unique in that ALL the lighting must be supplied by the photographer. While this increases the challenge, it also offers the photographer a blank palette on which he can "paint" with light. It is remarkable how the same scene in a cave can vary with small changes in the placement of the flash(es) used to illuminate it.

In show caves like Black Chasm, there is continual lighting provided, often in ways that look like they would lead to desirable photos. But to use that light for illuminating your pictures, you would need a tripod to produce a sufficiently sharp photo at the exposures required, usually over a second. Most show caves won't allow tripods, however, as they would slow up the group or produce a tripping hazard if set up on the trail. There's also a color balance problem when using show cave lighting, although with digital cameras one can probably adjust the white balance to match the cave lighting (incandescent, fluorescent, or LED).

Most of the time, therefore, if you want good pictures in show caves or undeveloped caves, your must supply your own lighting.

Basic Principles of Cave Photography

Most modern cameras are equipped with some sort of built-in flash, or at least a hotshoe or other means for connecting an external flash to the camera. Many cameras offer both choices.

The fundamental key to good photography in caves is simple: **move the flash away from the camera**. Cave photos shot with only a built-in flash, or an external one connected directly to the camera, tend to look somewhat flat and uninteresting, and often hazy. This is because very few shadows are created, and shadows help give a sense of depth to a two-dimensional image. Hazy pictures result because caves are naturally very high in humidity, and the water droplets in the air reflect light back towards the camera.

By moving the flash off the camera, more shadows are created, and fogginess is eliminated or reduced because the reflections from water drops are not in line with the camera.

If you haven't got an external flash, the first step is to acquire one or more, and the more powerful the better for working underground. Ideally you want it to synchronize with the camera, so that it fires just as the camera shutter opens, and there are three ways you could do this:

(1) Synch Cord: A really handy accessory is a long synch cord, so that you can hold your flash out at arm's length yet still have it firing with the camera. These can sometimes be ordered from your camera manufacturer or generic ones can be acquired from camera stores.

(2) Slave Unit: Also known as a remote sensor or a flash trigger, this is a small device that attaches to your flash which can electronically "sense" the light pulse from another flash. It can do this quickly enough that both flashes will be captured on the film or imaging device while the shutter is open. This is the method I use most often, using the small flash on my digital camera to trigger one, or more typically two or three different flash units, each aimed independently. More on slave units below.

(3) Manual firing: One of the old standby methods of cave photography is to put the camera on a long exposure or in "B" mode, and fire the flash(es) manually. Slaves may still be useful here for synching a second flash with the one which is manually fired. Because flash has such a short duration (1/1000 second or less), no tripod is needed. However, you will need one for best results if you want to manually fire several flashes in one frame. Some, but not all electronic flash units have the required manual flash switch that allows this—often it is labeled "test."

Equipment for cave photography

Cameras

Virtually any camera can be used underground, but if you are using external flash, your flexibility will be vastly increased by having some control over the aperture, and better yet, full manual control. Most "point and shoot" film cameras don't offer this, but more and more digital cameras seem to. Having control over the aperture allows you to get the proper exposure from your external flash, and affords control over your depth of field. Smaller apertures allow a broader range of things in focus.

Digitals are ideal for cave photography since working with flash and environments of variable reflectivity make for lots of uncertainty, and nothing beats that immediate feedback. This is even more important if using several flashes in one image, as often it is the balance of lighting rather than just the overall exposure that may need tweaking, or the placement of a flash. With film, you wouldn't know until you left the cave that what seemed like a small stalagmite had cast a very large shadow on to someone's face. With digital, you would know that you need to change the position of the flash to avoid making that shadow, or that is was too close to something and burned it out.

Other desirable features on a cave camera include a wide angle lens, and the ability to focus manually. Digitals typically have a maximum angle from 28mm to 38mm. Wider angles (e.g., 28 mm) allow more flexibility underground, because the nature of the cave often dictates how far away you can get from your subject (there may be a wall or a gaping abyss behind you). Manual focus is important because many cameras simply won't autofocus in the darkness of a cave. In show caves, though, the installed lighting may be enough to allow an autofocus camera to work.

The vast majority of images in this book were taken with a Nikon Coolpix 5000 (5 mp) digital camera, with a 28 mm lens, or with an adapter that allowed a 19mm equivalent. Complete manual control was used every time.

Flash units

Electronic flash units (strobes) are the bread-and-butter of cave photography. I typically carry four or more when shooting underground, ranging from very small to very powerful. The ideal flash unit is compact, powerful, has a manual fire switch, and capability to vary the output manually (i.e., to ½ power, ¼ power, etc.). Many flashes have both hotshoe and PC connections, one of which should work with your camera.

The lighting power of a flash is specified by its guide number (see sidebar). My favorite flashes, which meet all the above criteria, are the Vivitar 285, and the Sunpak 400 series, with a GN of about 80. By far the most versatile of flashes is the Sunpak 120J, which has a "bare-bulb" flash head with a reflector. Taking the reflector off gives a very broad range of illumination compared to the standard flashtube on most strobes.

Many flash units have automatic settings, that meter the reflected flash to meet a pre-set aperture. In my experience these are rarely useful underground except for relatively close-up shooting. The auto-sensor will base exposure on the first thing the flash hits, often resulting in a dark picture with some bright spots in the foreground.

To power electronic flashes, I recommend using rechargable Nickel-metal hydride (Nimh) batteries. Get them in as high an amp-hour rating as you can find (2000 or higher in AA size). Not only are they better for the environment and less costly if you do lots of shooting, they also allow the strobes to recharge much more quickly than do alkaline cells.

Flashbulbs are not made any more, but are very useful for cave photography because of their high power and ability to spread light out over a wide area. They can also be used underwater, as in the various shots of the lakes in this book. Bulbs and the units to fire them can still be readily obtained on ebay or www.flashbulbs.com. Unlike electronic flash, bulbs can only be used once.

Slave units

As mentioned above, slave units can be attached to external flash units and triggered by a small flash on the camera. These units range from about $20 to $80. Many of the cheaper units are rather insensitive, and will only work if fairly close to, and in direct line of sight of, the trigger flash. Better units can respond to even reflected flash, and at great distances. The Wein Ultra-slave is rated by the manufacturer to respond to a flash 1500 feet away! Two highly sensitive slaves are manufactured specifically for cave photography: The Firefly Slave and the Gibson Slave. You can find sources for these on the Internet.

Note that many digital cameras have a "pre-flash" that will fire a slave before the actual flash goes off. To address this, some manufacturers offer slaves which will trigger after seeing one or more flashes. Additionally, "red-eye" settings for on-camera flashes can trigger your slaves because they use a pre-flash to contract the pupil, so make sure your camera's flash is not in this mode when working with slaves.

Protecting your gear

If you only intend to shoot in show caves, gear protection involves little more than it does on the surface, such as a padded camera case. But shooting in undeveloped caves requires much more. They may be muddy and wet (as in the lower reaches of Black Chasm), and gear may have to be dragged through crawlways and pushed through small openings. I typically use waterproof plastic containers for my gear, such as the boxes made by Pelican and Otter. Less expensive options are Tupperware or other food containers. A bit of duct tape or stout rubber bands help ensure that the lid remains attached as they bounce around in a cave pack.

Putting it all together

Lighting principles

While we want some shadowing in our pictures, to provide a sense of depth, we don't want large, harsh shadows. A classic way to shoot a scene with two flashes is to have each at about 45 degrees to the camera. Each produces shadows, but harsh shadows are canceled out. Often one uses a powerful main or "key" flash, and a second, weaker one to reduce the harshness of the shadows. Backlighting (aiming the flash directly towards the camera) produces very dramatic effects, bringing out wall features such as scallops quite well (see photos below). Many cave formations are translucent, and backlighting can be used to emphasize this, as in the photos of the bacon on page 38.

Flash placed underwater (pages x,y,z) can emphasize the blue-green nature of cave water. Otherwise, water often acts as a "light sponge," because it absorbs rather than reflects light, and can look very dark in relation to the rest of the scene.

Shooting in show caves

Unless you are photographing a particularly attractive cave formation, usually as a close-up, most cave photos tend to be more interesting with people in them. They give a sense of scale to the image, and if in motion, a sense of something happening in the image. If on a tour, I typically use one external flash with a synch cord that I can hold away from the camera, and if someone is on the tour with me, they can hold a second external flash with a slave. Good pictures can be taken fairly quickly this way, but keep in mind that other people's flashes will also trigger your slave.

Even if your camera has no control over apertures you may still use an external, slaved flash with it. Generally, these simpler cameras operate with their lenses fully open, so one must calculate guide numbers based on that maximum aperture.

Undeveloped caves

Without the constraints of a tour, you have much more flexibility when shooting in undeveloped caves. Indeed, the chief constraints are your equipment, the patience of those assisting you, and the need to protect the cave. The importance of the latter cannot be over emphasized. When shooting in delicate areas, utmost care must be taken not to damage the cave. Stepping on a basin of crystals or putting a muddy boot onto clean flowstone are never justified, no matter how important it is to get the flash in "just the right spot." But there are many tricks that can be used, such as putting the flash on a monopod and holding it where you need it, or bouncing the light into the scene.

The ideal photo team has at least four people: one to act as a model, and two to man flash units, whether fired manually or by slave. The latter can help you compose your scene by shining their lights from the flash positions. With fewer people, you can use tricks such as setting the extra flashes on rocks or ledges, or on tripods.

Remember to reward those who help you with copies of your best photos, since they have put in their time for YOUR photos.

Further reading

There is far too much to say about cave photography than can be said here. But there are two excellent books on the subject available through the National Speleological Society's bookstore (www.caves.org). These are *Images Below*, by Chris Howes, and *On Caves and Camera*, published by the Society with contributions from many authors, including several chapters written by me.

Working with flash: guide numbers

If you'll be reckoning your flash exposures by brute mathematical force, you'll need to know the power of your strobe. Look on your flash or in its instructions for a guide number, sometimes abbreviated GN. The guide number describes the strength of your strobe at full power, generally rated for ASA 100 film. For a proper exposure, the GN should be related to the flash-to-subject distance (usually in feet) and lens aperture as follows: guide number/distance = f-number

Thus, if your flash has a GN of 90 and your flash is 20 feet from your subject, you could figure on an f-stop of 90/20 = 4.5 using 100-speed film. (Note that it is the **flash-to-subject** distance that counts, not camera-to-subject!)

Don't see a GN on your flash? Work backwards and derive it from the strobe's distance and f-stop recommendations on the unit.

In caves, guide numbers must be corrected by an appropriate Cave Light Sucking Factor (CLSF). Caves can be voracious light suckers, like wet highways swallowing up headlights on a moonless night. For general purposes, use a CLSF of 0.7, like so: GN x 0.7 = in-cave GN.

Don't be afraid to modify your final f-stop as the subject matter requires. If your subject is lightly colored, close down your aperture a stop or two. If it's darkly colored, open it up one or two stops. When in doubt, a good rule of thumb is to "bracket" a stop above and a stop below the recommended exposure. In other words, try three separate takes on the cave photos you really don't want to screw up. Of course, if you're shooting digital you won't need to bracket so much as just make corrections based on what your screen shows.

To get more power out of your flash, you can use a higher film speed or set the sensitivity higher on your digital camera. To correct for faster film speeds, multiply your guide number by 1.4 for every doubling of the film's ASA. Using 400 speed film and a strobe with a GN=90, we would thus calculate the working, in-cave guide number at 90 x 0.7 (CLSF) x 1.4 x 1.4 = 124.

Conversely, if you use film with an ASA lower than 100, or flash settings below maximum power, divide your guide number by 1.4 for each halving of the film speed or flash power.

Here are two pictures I took in a lava tube cave from the exact same spot. The photo on the left was taken with just a single, off camera flash to the left of the camera. I then added a second flash behind the caver, aimed right towards the camera. The addition of this flash brings out the textured surface of the wall.