Photographs as Cave Management Tools

Val Hildreth-Werker

Take nothing but conservation-wise photos.
Leave nothing but careful footprints on established trails.
Kill nothing but time.

Cave softly ... and erase your trace.

Photographs provide visual records that document, educate, and entertain. Cave pictures are made for various purposes—personal enjoyment, historic documentation, resource inventory, salon entry, restoration before-and-after, and so on. Any photographic image may someday become an important element in cave management decisions.

Photographs can have significant influence on cave conservation. We refine and change caving ethics as we learn more about the detrimental impacts humans cause in cave environments. Photos can support protection of critters, microbes, bones, minerals, speleothems, cultural remains, geologic features, and cave systems—photographers can create support materials for all sorts of cave resource conservation.

Photographers have the opportunity and responsibility to communicate updated stewardship standards—through our in-cave behavior and reflected in the resulting images. Photos that portray outdated modes should systematically include explanation statements describing improved ethics.

This chapter defines photodocumentation, photoinventory, and photomonitoring. Simplify and enhance cave project photography with formulas for effective photos, strategies for file organization, and systems for efficient archiving.

Photodocumentation, Photoinventory, and Photomonitoring

Three categories of cave photography support resource management decisions.

- **Photodocumentation** is the photographic recording of events, projects, procedures, expeditions, evidence, locations, or scientific examples. Photodocumentation includes organizing the photos to tell a coherent visual story. Documentation or inventory photos should always include an object or a person to indicate scale.

- **Photoinventory** is much like a picture inventory of valuable household items for insurance purposes. Photoinventory is an organized, labeled collection of pictures recording the valued resources and features of a cave or karst system.

- **Photomonitoring** is based on established photo stations that enable the same photographs to be accurately repeated over time. Photomonitoring sequences may document and detect visitor impact, vandalism, speleothem growth and decline, water level fluctuation, trail conditions, and other anthropogenic or natural impacts.
Photographs that record or document events, projects, procedures, expeditions, evidence, locations, and scientific data examples are called photodocumentation.

Most importantly, write the date and place the photo was made on every cave photograph. Immediately record the date and location on each slide mount, on the back of each print, or electronically file the information with each digital image.

Photodocumentation

Some cavers take a lot of pictures. We use images to record expeditions, projects, procedures, events, locations, evidence, and scientific samples. Picture collections become photodocumentation when the images are properly labeled, organized, and captioned to tell a coherent story. Photographs made for scientific documentation should include a measure or an object for scale reference.

Documenting Evidence or Stages of an Event

- Basic documentation is sometimes communicated in a single image. (See photo that shows before-and-after gypsum cleaning in one shot, page 420.)
- A series of two images can document before-and-after—the conditions before and results after an event, a project, or a time interval. (See Southwinds photo pair, page 207.)
- A series of three or more images can describe a process or tell a story. (See Lower Cave stalactite repair series, page 468.)

Rules of Three for Better Documentation Photos

- Shoot at least three images at each site:
  - Shoot from a distance or use a wide-angle lens to make long shots that record an overview of the area.
  - Move in (or zoom in) for medium shots and include people involved in activities.
  - Make close-up photos to record details.
  - Shoot three angles of each image area—move the camera to higher and lower positions and find interesting angles that best communicate information.
- Bracket exposures and make notes about the camera settings for later comparative analysis. Shoot at least three bracketed exposures on important documentation shots.
- Compose the image before you shoot. Improve your photos by using the rule of thirds (Figure 1). Mentally divide your frame into thirds (nine sections)—composition is often improved by placing the subject at one of the four points where the lines intersect.

Figure 1. Rule of Thirds (left). To enhance photographic composition, mentally divide the frame into nine equal portions. Place the subject at one of the four intersection points. (See Figures 3, 4, and 5, page 205.)

Figure 2. Bull’s Eye (below). Deliberately center the composition only when centering will enhance the visual impact of an image. (See Figures 6 and 7, page 205.)
Figure 3. The white helmet in this image is positioned on an imaginary intersection for rule of thirds composition. The trail in this image, though unmarked, is an obviously compacted pathway that carries the viewer’s eye down from the helmet, then back up into the passage.

Figure 4. The caver is positioned in an imagined rule of thirds intersection. The viewer’s eye is drawn from the silhouetted caver down the discolored path. The hole in the flowstone at the bottom of the trail creates more appeal by prompting the eye to move up through the image again.

Figure 5. Visualizing the rule of thirds, each caver is positioned on an opposing intersection point. The eye is drawn between the white circle on the foreground T-shirt and the caver sitting in the background. This interesting composition tends to hold the viewer’s attention.

Figure 6. A caver is centered in the old culvert entrance to Lechuguilla cave. The rings of the galvanized culvert give a literal bull’s eye impression to this image while the off-center flash adds interest to the composition.

Figure 7. The cave cricket is intentionally centered in the frame of white calcite. Note the slightly off-center nylon cap covering a photomonitoring station, adding visual interest to the image.

- Only use a bull’s eye or centered composition when you deliberately choose to center the subject, not because you forgot to compose the image. Mentally compose the image three other different ways before exposing a bull’s eye shot (Figure 2).

Document Participants in Action
- Make simple shots of human activity. Organize photo gear so action shots can be made quickly:
  - With a normal, mid-focal-length lens, shoot 2–3 meters (6–10 feet) from the participants.
  - Shoot two frames—the first candid, the second posed.
  - Add a slaved flash at the side only if convenient, conservation-wise, and quick.

Reference Scale for Scientific Documentation
- Photos made for scientific documentation should include a measure or an object for scale reference.
The International Federation of Rock Art Organizations (IFRAO) has designed a color scale for photographic documentation of archaeological resources (Bednarik 1991; Bednarik and Seshadri 1995). The IFRAO scale is an excellent tool for cave photographers (Figure 8). On this useful Web site, <http://www.cesmap.it/ifrao/scale.html>, a PDF file of the color scale can be downloaded and printed directly onto photograph-quality paper. The digital and archival benefits of color matching with the IFRAO scale are described by Bednarik on another Web site <http://www.cesmap.it/ifrao/scale.html>.

- A small nonreflective ruler is adequate for scale only.
- Or use a common object of recognizable scale to indicate the approximate dimensions of the subject matter.

**Photoinventory**

The term *photoinventory* describes the process of photographing specific cave features or passages using a simple, somewhat repeatable, stand-and-shoot method. The photographer stands in an easy-to-remember, obviously discernible trail location and shoots the speleothem, feature, or scene.

Usually, nothing is left in the cave to identify stand-and-shoot locations. Over time, stand-and-shoot spots are memorized with the aid of notes, or locations are matched to previous photos. This technique yields approximate repeat shots. Even if a location marker is placed in the cave, repetition of the shot will not be exact.

Like a picture inventory of valuable household items organized for insurance purposes, photoinventory images should provide simple, readily accessible information.

Photoinventory images should be individually labeled, organized, and archivally stored as a collection of pictures that record the valuable resources and features of a cave or karst system. Photoinventory collections can benefit and support resource management decisions.

**Tips for Photoinventory**

- Good lighting greatly enhances images that are to serve as visual records for identification and inventory. Use composition and lighting to emphasize the subject. A simple, repeatable lighting solution works well for photoinventory images:
  - Shoot with a camera-to-subject distance of 2–5 meters (6–15 feet).
  - Use two flashes. Fire one flash from the camera. Slave the second, off-camera flash. For consistency, the slaved flash can be held to one side at arm’s length.
Figure 11 (April 8, 1994) and Figure 12 (August 8, 1997). The entrance to Southwinds in Lechuguilla was very white and pristine on the day after it was discovered in 1994. Three years and about 150 cavers later, the entryway had become dusted to a dull, brown-colored appearance. Cavers should move gently through this area to avoid kicking the soft rock flour into airborne particles that discolor the features. (See page 6 of color section.)

- Choose camera position, image composition, and lighting techniques that can be approximately repeated if future comparative photographic analysis is necessary.

**Photomonitoring**

*Photomonitoring* sequences yield time-based information for both qualitative and quantitative comparison of change, growth, and impact. Images are created from identical camera locations monthly, annually, or once every few years.

Photomonitoring systems can facilitate consistent documentation of human impacts and natural fluctuations in cave environments. Comparative images made from established photo stations provide monitoring data that pinpoint changes.

*Environmental photomonitoring* is a management and research tool for documenting, evaluating, and protecting resource values. Management decisions are supported with tangible, time-based evidence of changes in cave environments. Habitat fluctuation, visitor impact, natural growth and decline, water levels, trail conditions, cultural sites, paleontological remains, and other resource conditions should be photographed. Repeat photos can be made from the same point again and again, creating a time-lapse sequence that shows change or stability over time.

Photomonitoring images that are carefully labeled and archived become visual documentation tools for immediate, intermediate, and long-term cave management.

**Traditional Photomonitoring Methods**

Historic methods of environmental photomonitoring are labor-intensive and time-consuming. Tedium documentation is required to achieve rigorous duplication of tripod placements, heights, angles, and camera settings (Uhl 1981). The repetitious use of levels, plumb-lines, measurements, and compass readings further complicates traditional methods of cave photomonitoring, often renders inaccurate results, and increases impact to fragile resources.

**Streamlined Photomonitoring Installations**

During the 1990s, Werker and Hildreth-Werker (1994, 1996) began developing systems for permanent photomonitoring installations to ease the
time burden and redundant cave impact of traditional photomonitoring methods. Installing a permanent photomonitoring system enables quick, accurate, and repeatable images every time a photo station is used.

Stainless steel sleeves are installed in the floor, wall, or ceiling of a cave passage to achieve consistent image alignment, angle, and camera-to-subject distance. A specially designed mount accepts the camera and plugs into each sleeve. The same image area is reliably duplicated during subsequent photographic sessions—today, tomorrow, or 50 years from now.

With permanent photomonitoring installations and the specially tooled monorod, images made during subsequent photo sessions are readily compared on a light table, computer screen, or a projection system. Multiple projectors, multi-image dissolves, or digital comparisons can dynamically display temporal change and anthropogenic or natural impact.

Photomonitoring programs supply data for resource protection decisions and provide documentary photos for storytelling and interpretive activities.

Contemporary digital technology enables faster, more consistent photographic documentation. Advances in electronic imaging make it possible to compare visual data through layers, graphs, and statistical analyses. Innovative photographic technology and GIS applications will open future avenues for quantitative analysis of photomonitoring data.

**Tips for Photomonitoring**

- Selection criteria for a photomonitoring camera (digital or film-based) includes excellent lens quality, cave-friendly size and shape, adequate flash characteristics, sufficient exposure settings, and appropriate mounting positions.
- A camera with auto-focus, automatic settings, and in-camera flash makes photomonitoring sessions much easier, faster, and more consistently repeatable.
- Images exposed with only the camera flash make the most easily repeated type of photo-monitoring picture. Photograph subject matter located close to a photomonitoring station using only an in-camera flash (no additional external flashes). The in-camera flash yields a flat-looking image, but renders data that can be easily compared in multiple photos. However, multiple flashes are sometimes necessary to adequately light an image area.
- Choose identifiable positions for photo stations. Photopoints should be easily located during subsequent shooting sessions.

**Figure 13.** Traditional environmental photomonitoring techniques are cumbersome and time-consuming. With traditional systems it is difficult to avoid causing repetitive impacts to areas near the photo stations.

**Figure 14.** The streamlined photomonitoring system developed by Jim Werker and Val Hildreth-Werker is installed in caves throughout the western U.S.
In some caves, photopoints are installed at systematic intervals to enhance the monitoring objectives. In other caves, randomly located photopoints are more useful.

If there is no appropriate durable surface for installing a photomonitoring sleeve, choose a suitable stand-and-shoot location and include this shot to augment the chronological sequence of photomonitoring data. Stand-and-shoot photos are also useful for recording close-up details of subjects. For efficient identification, clearly labeled images indicate stand-and-shoot. (See photoinventory, page 206.)

In addition to thorough written descriptions of each photo station, note the camera settings and flash techniques. Augment documentation with a photograph of each station area clearly showing the photopoint location and flash positions in relation to other features at the site.

Tie photo stations to the existing cave survey and add the photomonitoring stations to maps of the cave.

If using station markers in a cave environment, the recommended materials are stainless steel, nylon, or Mylar®. (See survey markers, page 185 and page 189; also see cave-safe materials, page 167.)

Photographic transparencies (35-millimeter slides) combined with digital images work best for photomonitoring projects. Fine grain films, typically ISO 100 or slower allow for enhanced resolution of small details but often require more flash power for proper exposure in caves. Kodachrome® films, when properly processed by approved labs and stored correctly, promise archival stability for several decades.

Kodak® E-100S, a professional transparency film that records accurate colors with flash photography, is this author’s first choice for

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Figure 15 (1995) and Figure 16 (2003, trail flagging added). These two photomonitoring images graphically show the success of management strategies to minimize new impacts along a trail leading to the New Mexico Room in Carlsbad Cavern.
Permanent Photomonitoring Installations
Val Hildreth-Werker and Jim C. Werker

Permanent photomonitoring systems can streamline environmental documentation processes. Designed by Jim Werker and Val Hildreth-Werker for cave installations, the streamlined system is efficient for any environmental photomonitoring application. A small stainless steel sleeve is installed at each station. Each sleeve is covered with an unobtrusive nylon cap to prevent debris from entering. The camera is mounted on a specially designed monorod that fits the sleeves to assure accurate alignment and efficient operation. The systems include simple methods for archiving and retrieving both analogue and digital photographic data (Werker and Hildreth-Werker 1994, 1996).

Both Jim and Val are long-time cavers and have backgrounds in research and development. Val has been photographing caves since the late 1970s and brings professional experience in medical and commercial photography, animation, multi-image, and video production. The tedious, time-consuming, and redundant cave impact inherent in traditional photomonitoring led to the development of the streamlined method. The idea of installing permanent photomonitoring systems in caves simmered until photomonitoring film. For slide developing, use Kodak “Q” Lab® services (photo labs that are inspected and certified for quality control in film processing). With archival processing and proper storage, Kodak E-100S retains color balance and quality.

- Proper processing and storage enhance the archival potential of any film.
- Prints (black-and-white or color) should not be used a the only media for photomonitoring because processing and printing variations for negatives can be extreme.

Video photomonitoring has not proved successful because it is more efficient to compare individual, high-resolution images.

For increased archival protection, scan photomonitoring images, (transparencies or negatives) and store the files on digital media. Some CD-ROM manufacturers claim 100-year storage stability. Ideally, archive digital images with at least 2,500 pixels on the long axis. In terms of common digital camera formats, a five megapixel file is adequate (note that a five megapixel camera file will make an 18 megabyte TIFF file). However, storage in JPEG format compressed to no less than 10 percent of the original file size is adequate for archival purposes (10:1 compression). Many software packages offer some degree of control over the level of JPEG compression—always choose the lowest degree of compression to achieve the least loss in original image data. Even this will result in substantially smaller file size than a TIFF. In the digital world bigger is always better, and larger image files will give better capability to resolve small details (Dave Bunnell, personal communication 2003).

- Immediately after processing or downloading, record the date and location on all photographs.
- Label all slides and place in archival, polypropylene sleeves for preservation. Polypropylene slide pages work well. (Plyvinyl pages are not recommended because they emit gases that rapidly deteriorate photographic emulsions.) Sequential slides or digital images from each photo station are paged or filed to facilitate easy retrieval, viewing, and comparison.
- Store complete photo sets in at least two separate locations. Update all sets with future photographs. If photomonitoring images are digital, then archive high-quality prints separately. Store electronic files on CD-ROM, DVD-ROM or other commonly accessible media.
- Photos typically grow more valuable over the decades and centuries. Long-term archiving and retrievability are important factors. Ideally, store photomonitoring images in public archiving institutions that accept cave photos. Find archiving facilities through cave societies, libraries, museums, and other public institutions.

Organizing and Archiving Cave Photographs

Cave photographs should be organized for efficient retrieval. Otherwise, photographic information is of little benefit to resource managers. Conservation management decisions and law enforcement cases are frequently supported with photographic documentation, but a cave manager has to be able to access the photos.

Changes in cave environments; habitat fluctuations; water levels and conditions; effects of moisture variations; trail maintenance status; progress of survey, construction, or restoration projects; growth and decline of speleothems; documentation of geologic features; condition of cultural materials or paleontological sites; visitor impact; vandalism; gate status; entrance vegetation; and other resource information should be photographi-
Label Photographs
The date is the most overlooked detail on many photographic images. If necessary, other information can be reconstructed from an accurate date through comparison with field notes, journals, datasheets, or other photographs.

When photos come back from the processing lab, immediately write a tiny date on slide mounts or in a corner of prints. When downloading digital images, include (at least) the date and cave name with the file. When time permits, make complete labels that include the following information:

- Date the image was photographed
- Name of the cave (or code if name information is especially sensitive)
- Location in the cave (or name of the passage or survey station)
- Name of the photographer (and assistants)
- Address, phone, e-mail, contact information for photographer
- Names of the people appearing in a photograph
- Name of the landowner or managing agency
- Caption explaining the photo
- File number for personal image retrieval system
- Copyright (optional)
- Request for photo credit

Copyrighting photographic work is optional. Copyrighted material may complicate future use of simple documentation photos. Copyrights may make photographs less serviceable to the managing agency, organization, or landowner. Regardless of copyright decision, request for photo byline or photo credit may be included on the label.

Organizing and Archiving—Tools That Work
Streamline labeling and retrieval systems and minimize organizational time with the following suggestions:

- The ink in most Pilot® ball point pens will not smear on plastic slide mounts and resin-coated photographic papers.
- Ink-jet or laser printer labels work well and look great, but when time is short, write directly on the slide mount or photo print (front border or back corner) and save tedious label making for later.
- A photographic loupe aids in quickly viewing images on a light table.
- All photographs should be labeled and archivally sleeved for preservation in polypropylene slide or print pages. Avoid pages made of other materials—PVC, polyvinyl, vinyl, sticky pages, and so on—these products emit gases that rapidly deteriorate photographic materials. Today, most archival pages are made of polypropylene and the packaging will indicate archival quality.
- For prints, choose a photo-safe, archival album with slots for the negatives

Val described the concept to Jim. He designed and created hardware.

Jim, a mechanical engineer for Sandia National Laboratories since the 1960s, brings decades of professional experience in tooling design, engineering, and fabrication. For 30 years, he worked at the National Labs and the Underground Nuclear Test Site in Nevada.

Jim and Val collaborated to develop the complete photomonitoring system. Installation of their first system began in 1993. From designing the prototype through the evolutionary adjustments of fabricating, archiving, and digitizing, they created an easily repeatable means for chronological environmental documentation with photographs.

The couple also developed a specialized system using infrared photographic technology for monitoring the Mexican free-tailed bat population at Carlsbad Caverns National Park. They photomonitor the colony annually and collected population data during a 10-year study (Route and others 1999, 2005).

The Werkers have installed permanent photomonitoring systems in several caves of the western U.S.; caves in the Guadalupe Mountain region of New Mexico; caves of Arizona, Texas, Utah, Nevada, and Oregon; caves managed by the National Park Service, the Bureau of Land Management, the USDA Forest Service; and caves managed by private land owners. Patent is pending.
unless you already have a well-established negative filing system.
- For slide storage, archival clam-shell boxes made of polypropylene with ring binders inside work well for keeping dust away from slide pages. Archival slide pages and ring binder boxes are worth the investment—purchase through large photographic suppliers. These products greatly facilitate image organization and retrieval.

**Photography Can Promote Cave Stewardship**

“She’s a photographer ... she can do anything she wants.” That’s what some people believe. On several occasions, I’ve overheard people say that about me. But, when it comes to caves, I wholeheartedly disagree with this sentiment. Wielding an official-looking camera rig does not give license for go-anywhere-do-anything ethics in caves.

The longing to get a shot should never overpower the importance of reducing impact to the cave. Before acting, first think about protecting the resources—the cave should come first.

**Conservation Ethics for Cave Photographers**

Promote leave-no-trace attitudes by staying on trails and adopting caver minimum-impact ethics. If there are no marked trails, look for the most impacted path and choose to stay on it.

Always appoint an assistant to be in charge of spotting the photographer. It is easy for cave photographers to get preoccupied and forget to watch out for their feet, backs, elbows, helmets, lenses, and equipment. Assign a conservation-minded caver who will speak up when the photographer needs caution or correction.

Check with cave managers and speleologists for proper protocol before entering sensitive areas. Preplan restoration gear and erase your trace as you move through the cave. Become aware of state-of-the-art conservation ethics and insist that models, cavers, and assistants cave softly. Shoot for no new impact. (See the minimum impact code for cave photographers, page 215—remember to eat over a zippie bag, use nonmarring boots, wear lint-free clothes, and pack clean flowstone shoes.)

**Erase Your Trace**

For decades, cavers promoted a follow-the- footsteps-of-others ethic by placing feet inside the first set of footprints to avoid causing new impact. But, more people are caving, and ethics are changing. Pathways of single footprints have expanded into multiple scars across cave floors.

Today, rather than retracing former impact, cavers are developing gentle ways to prevent and erase impacts. Even the traditional caver motto has changed—*Take nothing but pictures. Leave nothing but footprints. Kill nothing but time.* Many are now augmenting the adage to reflect new ethics—*Take nothing but conservation-wise photos. Leave nothing but careful footprints on established trails. Kill nothing but time. Cave softly ... and erase your trace.*

If trails are not marked, choose routes across durable surfaces. Avoid creating new footprints and causing new damage to cave passages.

Immediately remove or restore any inadvertent foot or hand imprints if the restoration activities will not cause additional harm. Erase left-over footprints so they cannot tempt others to follow.

In the spirit of leave-no-trace ethics, cave photographers are developing ways to restore along the way. Some cave photo teams now carry a little restoration kit with simple tools. Use only clean, contaminant-free equipment. When feasible, get water from the immediate cave passage for restoration tasks. Use supplies in a single area to avoid cross-contamina-

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tion. With just a few lightweight tools, many types of restoration and repair can be accomplished (Hildreth-Werker and Werker 1997, 1999; also see chapters in the restoration sections of this volume):

- Small nylon-bristled brush or a new, soft toothbrush for muddy prints
- Packable spray bottle for water
- Absorbent sponge to blot up gunk
- Two or three clean zip-closure plastic bags
- Stainless steel or plastic tweezers to remove small debris
- Nonlatex, powder-free surgical gloves
- Light flowstone shoes

If setting up a shot is going to be extremely time-consuming, some photo assistants and models might be willing to work on restoring a small area while the rest of the team participates in shot preparation. By planning and appointing an experienced restoration team leader, simple tasks—certain trail maintenance, flowstone cleanup, or small speleothem repairs—can be quickly accomplished.

Photos Can Help Protect, Preserve, and Perpetuate

Photographs document our journey through the history of cave exploration and conservation. Each image freezes a single moment in speleological time. Pictures become silent mirrors, chronicling subterranean systems, human ethics, and environmental impacts.

Cave photographs should illustrate good caving practices. People tend to repeat or emulate what is seen in pictures—blunders, as well as new techniques, can make bold statements in photographs. Photographers can create images that focus other cavers toward low-impact methods and thoughtful resource stewardship. Any cave photographer can support and promote conservation ethics through their images.

Those who make and show photographic work of caves have an intense responsibility to communicate the best possible conservation messages.

Any published photograph, exhibition image, or salon entry that depicts outmoded caving practices should include a disclaimer, warning, or explanation. Insist that a statement describing better practice is boldly displayed or printed with any photograph that illustrates questionable behaviors (Figure 17).

Use captions to educate. If photos showing cave damage are used for
Use captions to educate. Any published photograph, exhibition image, or salon entry that depicts outmoded caving practices should include a disclaimer, warning, or explanation.

Cited References

Figure 18.Photographers, flashes, and assistants remain within the trails in Lake Louise, Lechuguilla Cave, New Mexico.
Minimum-Impact Code of Ethics for Cave Photographers

Val Hildreth-Werker and Jim C. Werker

The goal of this code of ethics is to encourage cave photographers to minimize human impacts to caves. As we learn more about cave environments, we are in a continuing process of evaluating and redefining caver ethics.

These guidelines for low-impact cave photography come from the experiences and thoughtful contributions of many cavers. Think safety—take care of yourself and your team.

Think stewardship—avoid impacting cave resources. Take care of aesthetic, cultural, paleontological, geological, hydrological, mineralogical, meteorological, biological, as well as microbial resources.

Move gently and photograph softly.

- Packs, vertical gear, boots, aqua socks, gloves, helmets, and lint-free clothing should be freshly washed to avoid transfer of mud, dust, and microbes from other environments. Photo gear and tripods should also be cleaned before each cave trip.
- Use only nonmarring/nonmarking soles. Whether light or dark colored, many boot soles will leave marks on calcite and other cave surfaces—test by striking soles across untreated limestone or concrete. No heavy waffle stompers. Traditional black lug soles will leave marks on cave surfaces. Be careful with blond rubber soles—chunks from soft soles tend to break off and leave debris in cave passages.
- Use padded camera cases rather than hard-edged boxes when feasible.
- Minimize photo gear—smaller, lighter, more compact.
- Always ask to be spotted when photographing fragile areas. Spot the feet, too.
- Instruct models to refuse if the photographer suggests a move that is too close to delicate speleothems. The model usually has the best vantage point. Appoint an assistant to spot each model.
- Avoid disturbing bats and other cave-dwelling creatures.
- Take nothing from caves. Removal of natural or historical objects is unethical and illegal unless you have a collection permit for authorized research. (Contemporary trash usually should be removed.)
- Wear gloves. Rather than grabbing handholds along the trail, use a gloved knuckle for balance where possible.
- Pack in clean gloves for use in gloves-off areas and in pristine passages. Powder-free, nonlatex surgical gloves are recommended. Fresh surgical gloves also help keep photo gear cleaner.
- Carry clean flowstone shoes—lightweight, lint-free, and nonmarking. Use water-sports booties, smooth-soled athletic shoes, aqua socks, or nylon slippers. Include a plastic bag to contain dirty boots. Do not use bare feet or socks—lint, skin flakes, blood, and body oils should not be left on cave surfaces.
- Insist that all team members change to clean garments when entering pristine areas to make photographs.
- Avoid contamination. Know which special-attention areas require clean clothes, shoes, and gear. Do not enter restricted areas wearing general caving attire. Keep these areas pristine.
- Avoid isolated pools. Tens of thousands of skin flakes and fragments
Photographers are not exempt—they should adopt minimum-impact ethics.

- Don't comb or brush hair in caves. Try to avoid scratching.
- Don't smoke or use tobacco in caves. Smoke and fumes can kill bats, invertebrates, and other cave-dwelling animals.
- Remove all human wastes. Contain and carry urine, feces, spit, and vomit out of caves.
- Eat over a plastic bag. Carry out all crumbs and debris. Don't eat on the move.
- Stay on established trails. Sit within the pathway and be careful not to set packs outside the trail. Keep tripods within the trail. Always look for and use the most impacted areas whether traveling or stopping. Where trails are not obvious, stay within the most compacted or durable zones.
- Don't lean on walls, ceilings, or speleothems. Don't sit on formations. Avoid trampling floor deposits. When traveling through the cave, use small points of contact for balance instead of dirty open palms.
- Rather than retracing footprints and handprints, gently erase and restore.
- Photographers are not exempt—adopt minimum-impact ethics. Stay on trails. Stay away from sensitive or off-limits areas. Look carefully, move gently, don't kick up dust, and avoid anything you don't have to touch.