LEAVE NO TRACE

OUTDOOR SKILLS & ETHICS

Caving

LEAVE NO TRACE OUTDOOR ETHICS

Caving Ethics

Take only pictures, leave only carefully placed footsteps, kill nothing but time. The Caver's Creed

Cavers have advocated cave conservation for decades. Caves are full of beauty and mystery found nowhere else. They are also fragile. As growing numbers of people seek understanding and adventure underground, our mark on caves increases dramatically. In order to protect caves for future generations, we need to encourage a collective commitment to minimum-impact caving techniques and to cave conservation.

Caves generally do not recover from human impact, so most of our impacts are permanent. Over the years we have learned more about the incredible natural diversity in caves and how human presence alters cave environments. Our caving practices have changed accordingly. This booklet is part of a national educational program called Leave No Trace, the goal of which is to educate the general public, federal agency personnel, and commercial outfitters about minimum-impact outdoor recreation techniques. The principles and practices discussed here are based on an abiding respect for and appreciation of caves and their inhabitants. They are meant to be practiced with understanding and self-discipline, and to complement an ethic and practice of cave conservation.

We can continue to seek beauty, wonder and adventure underground, but in order to ensure the preservation of caves, we must take the responsibility to educate ourselves and to become equipped with skills and habits that enable us to Leave No Trace.

LEAVE NO TRACE
Outdoor Skills & Ethics

developed by the Natonal Outdoor Leadership School
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Caving

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We go underground because we value caves and the incredible and fragile natural diversity found inside them. Yet each time we visit a cave we change it, slightly or dramatically. As our understanding and our numbers grow, it is imperative that we learn ways to move through caves leaving the smallest possible impact. Toward this goal, caving-specific techniques are incorporated into the following Leave No Trace principles. These techniques have been developed through the collaborative efforts of cavers, land managers and the national Leave No Trace education program:

Principles of Leave No Trace

- **Plan Ahead and Prepare**
- **Camp and Travel on Durable Surfaces (Camp only above ground)**
- **Pack It In, Pack It Out**
- **Leave What You Find**
- **Minimize Use and Impact from Fires (Build fires only above ground)**

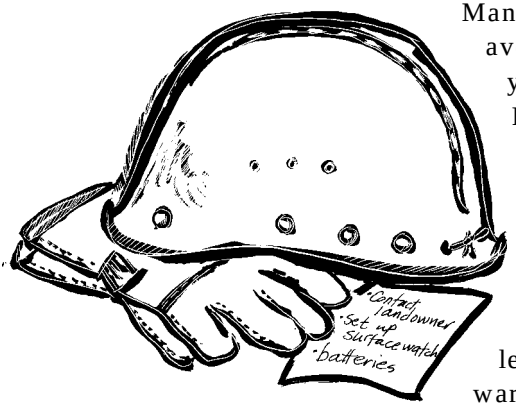
We have omitted the sixth Leave No Trace principle, "Properly dispose of what you can't pack out," from this booklet because it is not appropriate to dispose of anything within a cave.

Leave No Trace is inadequate as a set of rules and regulations. To be effective on a large scale, it requires that we understand the principles. It also requires that we have the judgment and self-discipline necessary to apply them to different cave environments. Consider the variables of each cave: current impact levels, inhabitants, water activity and geologic features, including speleothems.

If you are a novice caver, we recommend that you cave with an experienced, conservation-minded caver or with your local chapter of the National Speleological Society (NSS). These people can help you understand underground environments and develop the judgment you need to reduce your impact. If you are an experienced caver, make an effort to stay current in evolving minimum-impact methods and to share your understanding with others. Techniques are continually improving, and some techniques accepted in the past have been found to create significant impacts over time.

Your caving experience can be even more enjoyable when you minimize your impact on the cave, knowing you are leaving a legacy for future generations. This booklet is intended to support and complement landowner and agency guidelines.

Plan Ahead and Prepare



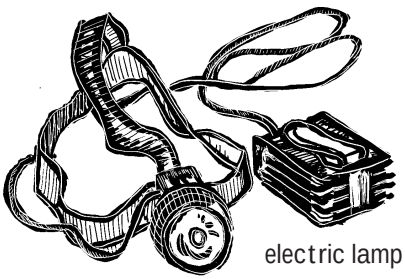
Many common impacts to caves can be avoided by carefully preparing for your cave trip and by caving safely. For example, if you do not bring enough clothes, you may become hypothermic, clumsy, and more likely to damage features. If your lack of coordination leads you to have an accident, requiring extrication from the cave, the rescue could lead to further damage. A prepared, warm and well fed caver will be better able to move carefully and react to hazards. There are many things you can do before you reach the cave entrance that will help you minimize your impact inside the cave.

Ask permission before entering a cave. Whenever you visit a cave, check with the private land owners, Bureau of Land Management, Fish and Wildlife Service, Forest Service, Park Service, State Park or local NSS chapter for permission, regulations and advice. Good relationships between cavers and private landowners or public cave managers enable us to work together to protect caves. Most land owners or cave managers do not charge entry fees, but many require liability waivers or permits. Respect gates and seek entry by obtaining a permit and getting keys or combinations to locked gates. Also respect periods of closure. Caves are sometimes closed for part of the year to protect maternity or hibernating bat colonies, for conservation projects, or because of flooding danger. Ask if there are areas within the cave that are restricted for restoration or preservation purposes.

Know the cave and what to expect. Before entering a cave for the first time, learn about it from land owners, managers or other cavers. Cave environments vary tremendously, and every cave presents its own unique set of challenges and hazards. Choose a cave that is appropriate for your experience level. Find out the temperature, trip length, known hazards and impact

concerns in the cave. Research the nature of necessary vertical work. By investigating this information prior to going caving, you can be better prepared in your expectations and equipment choices. One good option is to cave with someone who has previously been to the cave and knows of delicate, restricted or hazardous areas. Untraveled passages should be left to experienced cavers who have the knowledge and experience to judge which passages are safe and durable enough to travel. All cavers, whether on survey, restoration, exploration or recreational trips, benefit from preparation.

Select appropriate equipment. Proper equipment and clothing helps you Leave No Trace and cave safely. Equipment needs and impact concerns vary in different caves. For instance, a wet suit is a valuable piece of clothing for long, cold and wet cave trips; but in a hot, dry and highly decorated cave, the same wet suit will be a hindrance. Keeping your equipment to a minimum in any cave, without compromising safety, will help you move smoothly and carefully through delicate areas.


electric lamp

Cave lights: Every caver should always carry three light sources. Your primary light source should be mounted on your helmet so you can use you hands to move smoothly and deliberately. At least one of your back-up lights should be reliable and bright enough that you could use it to follow the safest and least impactful way out of the cave. You should also carry extra carbide, bulbs or batteries, and a repair kit for your primary light.


carbide lamp

Cave lights generally come in two forms: carbide or electric (battery powered). Whichever you use, each has its own impact concerns that need to be considered. The biggest potential impacts from carbide are soot marks on cave walls and the toxic effects of spilled carbide. If you use carbide, be very careful not to spill it.

To catch accidental spillage, change your charges directly over an open plastic bag. Finish each charge before replacing it, and close it loosely but securely in a plastic bag to prevent carbide dump explosions. Never allow a carbide flame to come close to a cave wall. It will leave a soot deposit, also known as "carbide graffiti". On the surface, carbide can be safely disposed of in a trash receptacle after it is fully spent.

The biggest environmental concerns of electric lights are battery production and disposal, which create significant ecological impacts. Lessen these impacts by using rechargeable batteries and efficient lamps. You can also recycle rechargeable and non-rechargeable batteries in some places. Batteries are corrosive and toxic, and should never be left in any cave. When using any kind of cave light, keep it running well. Lights that are functioning efficiently use less energy, use less of your caving time, and can help you to prevent accidents and impacts.

Clothing: To prevent the introduction of foreign material into the cave, wear clean clothes that are in good condition. Clothes that are thread-bare leave shreds of fabric behind, adding unnatural substances to the biological system of the cave. Lint can cause deterioration of cave formations and can feed introduced microorganisms, harming the microbial balance within the cave. Synthetic fibers are preferred because, unlike cotton, they don't feed microbes, don't shred as easily, and still provide insulation when wet.

Brush off your clothes before entering the cave to avoid bringing in any seeds, plant material, or insects that might have attached themselves to you on your hike to the cave, and may disrupt the fragile ecosystem inside. Wear gloves to keep oils from your skin off the cave walls and to protect your hands. Long pants and long sleeves also minimize oils and organic material left from skin. There is research that shows cavers can introduce bacteria from one cave to another. Washing your caving gear between trips in different caves or regions minimizes this concern.

Footwear: Sturdy, lightweight boots support your ankles and provide good traction, yet allow enough flexibility for precise footing. Wearing non-marking boots prevents black scuff marks

on cave floors. If you have doubts about your soles, scuff your boots on a light surface like concrete to test them. In some areas it is necessary to change into a clean pair of shoes or aqua socks to prevent tracking muddy boot prints over clean flowstone.

Helmets: Prevent a head injury and a possible cave-damaging rescue by always wearing a well-fitted helmet with a chin strap when you cave.

Other items that might make your trip safer and reduce the risk of a rescue are a simple first aid kit, a large trash bag to wear as an emergency shelter, water and food. Bring extra plastic bags or containers to remove trash, spent carbide and human waste. If you bring food into the cave, consider bringing foods that don't leave crumbs behind. Many cavers organize these items in a small cave pack or sealable pockets to prevent dropping them in the cave.

Do not underestimate the detrimental effects of dehydration, hypothermia and fatigue on your impact and safety. In addition to having proper equipment, the best prevention method is to get a good night's sleep and eat and drink plenty of food and water the day before you go caving.

Cave Safely. A cave rescue almost always damages the cave. Underground accidents present many challenges for rescuers, and the time involved to complete a cave rescue can vary from hours to days. Rescues can require clumsy equipment and large numbers of people. A patient's safe recovery becomes more important than protection of the cave.

Prevent rescues by caving safely. Keep your cave trip well within the training and experience of your group. Necessary training may include wilderness first aid, rescue skills, vertical skills and vertical rescue skills. On any trip, you should have a rough contingency plan for responding to accidents or illnesses. Be prepared to deal with accidents and

administer basic first aid until you can get help or get your party out of the cave. Each caver in your party should know to stay put and stay warm if he or she is separated from the group. You can reduce the need for major rescues if your group is self-sufficient and able to perform self-rescues.

Four-person parties allow one person to stay with an injured caver while two people go for help so that no one has to travel alone. Recognize that if you have fewer cavers, you will have fewer resources in an emergency and you should be more conservative in your decisions. Some cave owners or managers require a minimum group size of three. Some also require a maximum of about six people, since larger groups are harder to manage safely and with minimum impact.

Set up a surface watch. Tell someone where you plan to go caving and when you plan to be out. If you are not out on time, they can set a rescue in motion. Incidents like getting lost can become much more serious when a group is exposed to cold, hunger and dehydration over time. Both the cave and the cavers will benefit from an early rescue.

Many rescuers recount situations where it was possible to retrace a series of seemingly minor errors (e.g., starting late, improperly functioning lights, exhaustion or a breakdown in communication) that caused a domino effect and led to the accident. It is important to stay alert to the potential hazards, know your personal limits, and stay within the limitations of the group by not exceeding the abilities of the weakest member.

To protect the cave environment from the damage of a rescue, be conservative and be prepared. The further you get from the entrance, and the more fragile the cave, the greater your responsibility to take extra precautions to avoid accidents.

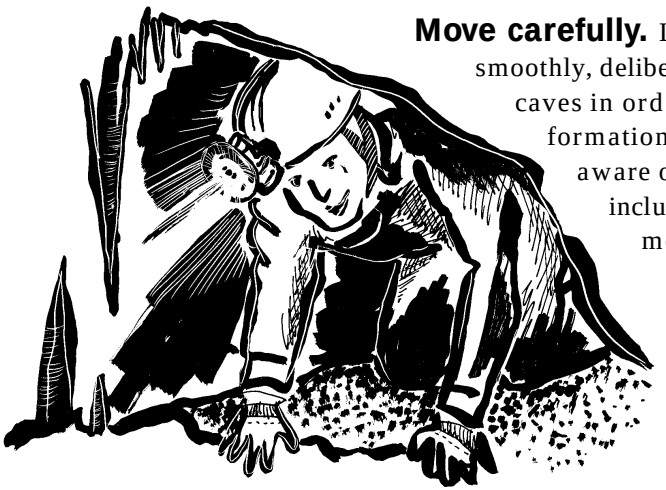
Camp and Travel on Durable Surfaces

Some impacts in caves are immediate and dramatic, like the breaking and removal of large stalactites. Others occur gradually over years, with no perceptible change attributable to any one trip. For example, careless travel can cause a small footpath to slowly spread out and become a very large impacted area. We always create some impact, no matter how small, when we visit

caves. You can minimize your impact while caving by recognizing and avoiding features that are easily impacted and by staying as much as possible in areas that have already been damaged.

It may be obvious that some areas, like a narrow crawl with soda straws dangling from the ceiling, are easily damaged. But some fragile areas are not as obvious. A flat, sandy-floored room may seem resistant to impact, but it may be prime cricket egg-laying habitat. If you do not know how to differentiate which features in a cave are easily damaged, cave with someone who does. If you are caving with beginners, be sure to teach them along the way.

Don't camp underground. Camping underground is generally not recommended. A group of cavers spending a night in a cave concentrates tremendous impacts in that one area. Carrying in all the support gear needed for an overnight trip also increases the impacts to the cave. Camping in caves is used for occasional scientific and exploratory expeditions and is done only in extensive caves that have remote areas.

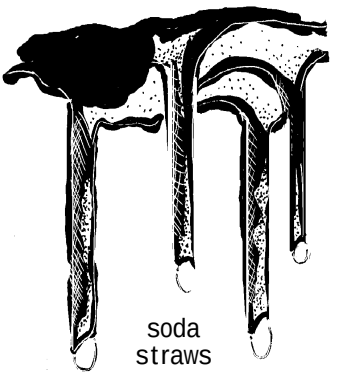


Move carefully. Learn how to move smoothly, deliberately and slowly in caves in order to avoid delicate formations and creatures. Be aware of your entire body, including your head, helmet, pack and other gear. Don't run, jump or move carelessly in a way that might inadvertently damage the cave.

Create a climate where people help each other by lending a hand and pointing out where to be careful. Speak up when someone else's back or head may be getting too close to fragile surfaces. This is especially important if you are caving with beginners who aren't used to moving in caves. Check in with your group regularly and assess fatigue levels. A tired caver

doesn't have the awareness and coordination of a well-rested and more alert caver. To stay alert on a long trip, be proactive about taking breaks, eating snacks and drinking water before you need them. Give yourselves ample time to return to the entrance before you get tired.

Avoid damaging cave features. Many caves contain features which can be easily broken or altered forever. For example, mud cracks can be preserved for hundreds of years in dry caves and can be obliterated by a single caver if crawled on. Learn to recognize the difference between easily damaged features and more durable features like bedrock and worn trails.



Speleothems are deposited after a cave is formed when minerals dissolve out of rock and are redeposited on cave ceilings, walls or floors. Speleothems include stalagmites, stalactites, flowstone and other beautiful secondary formations. Avoid touching or walking on speleothems. Often they are quite fragile and easily broken. This damage is considered permanent because regrowth, if it occurs at all, is very slow. A few cave decorations are so inconspicuous and delicate that the breeze of a passing caver can break them. The oils and dirt from our hands can change the permeability and color of speleothems, and can disrupt the way that water moves over them. This can alter or even stop their growth, so wear gloves and avoid getting mud and other dirt on otherwise clean speleothems. Some impact is caused by dust, kicked up and re-deposited on pristine speleothems. In especially dusty and pristine caves, move slowly and carefully to not stir up dust clouds.

In well traveled caves stay on established trails (even vague ones) to minimize the impact on the more pristine parts of the cave passage. Caving slowly allows you to be more careful and see more. Caving in a small group makes it easier to travel and see the cave as well as to minimize impact. When taking a break, find a spot where the cave is already damaged and can

handle more concentrated use, such as the trail itself. Be sure to keep your equipment and movement well within the damaged area to avoid enlarging it.

In pristine caves choose the path that least impacts the cave. Pristine caves are close to their original appearance. These caves are not heavily traveled and there is no obvious trail. It is imperative in these caves that you pay close attention to where you are going. Choose the best path that creates the least impact and travel single-file. You may literally need to follow in each other's footsteps. In caves that flood with running water, it may be appropriate to travel below the floodline as much as possible.

In places where you need to use your hands, take care where you place dirty gloves. If the wall or rock has already been touched by dirty gloves, place your hands only on the same spots the previous person used. Sometimes you can use the backs of your hands for balance, since they are usually cleaner than the palms. In an unaffected pristine area, change into a pair of clean gloves reserved in your cave pack for such places.

In areas that are too delicate, protect the cave by turning back. Particularly fragile cave passages are sometimes flagged off or have signs posted, restricting entry. Respect these signs because they are designed to protect the cave. If you are exploring an untraveled passage, be even more careful in choosing your route. You are choosing the route that future visitors will also follow. Look for ways to bypass sensitive areas.

Minimize your impact at the cave entrance. Just like deep in the cave, wildlife and vegetation in entrance zones are adapted to this environment and can be ecologically rare. Some cave entrances receive heavy repeated impact. When you stand, sit, load and unload gear outside these caves, concentrate your movements in durable areas like rock or bare ground to avoid damaging vegetation. Avoid trampling places where impact is just beginning. Urinate well away from the entrance to avoid concentrating odors. To prevent polluting water sources and to distribute impact, walk at least 200 feet from entrance areas and water to defecate. Do not defecate directly uphill from cave entrances. Use an outhouse when possible. When an outhouse is

not available, bury feces in catholes, six to eight inches deep. Pack out toilet paper in a plastic bag. Pick up any surface litter as well as anything you brought to the site.

Minimize your impact above ground when camping and hiking. Cavers can create significant impacts in the areas surrounding cave entrances. Appropriate minimum-impact practices above ground differ depending on the level of use the area receives. In order to minimize impact, concentrate your use in popular areas and spread out your use in remote areas. Basic guidelines for each are discussed below. Avoid places where impact is just beginning because, unlike underground, these sites can regenerate if given time. For a more thorough discussion of above ground minimum-impact practices, read the Leave No Trace Skills and Ethics booklet for your region.

Camping. If you are camping before or after your cave trip, camp away from water, trails and cave entrances. By doing this you will help disperse impact, protect water sources from contamination, and minimize impact at cave entrances. Since required distances may vary, make it a practice to camp at least 200 feet away from these features. Choose an established campsite when

available. These sites are usually "hardened"-they've lost their vegetative cover- and careful use causes little additional impact. Choose a site that is big enough for your group, including sleeping and kitchen areas, to avoid enlarging the disturbed area. Leaving your site clean will invite others to use it in the future.

In pristine areas where an established campsite is not available, select durable ground for your campsite and kitchen area. The most durable surfaces are rock, sand or gravel. Leaf litter, pine needles or dry grasses are also fairly durable. To avoid long-term damage to pristine areas, it is best to camp in small groups (up to five people). In larger groups, spread out tents and avoid repetitive traffic routes. When you break camp, naturalize the site by covering scuffed up areas with native materials (such as leaf litter or pine needles) and raking matted grass with a stick. This extra effort will help the site recover and make it less obvious as a campsite. Future campers will be less likely to camp in the same spot and the site will have more time to regenerate.

In bear country, both in popular and remote areas, be sure to research appropriate precautions that protect both yourself and the bears.

Hiking to cave entrances. When hiking to a cave entrance, take the time to seek out and walk on established trails. Staying on trails minimizes damage to soil, vegetation and wildlife and maintains the natural character of the area. Shortcutting switchbacks saves little time and causes erosion. Stay on the trail as much as possible, and try to clean any mud and vegetation from your boots and clothes before entering the cave. Do not mark trails with flagging tape; it often eventually becomes litter.

If a trail to a cave does not exist, do not inadvertently create one. It may draw casual hikers to the cave who are not prepared for caving. To avoid creating new paths, travel on durable ground, such as rock, gravel or dry grass. Avoid fragile vegetation and steep hillsides if possible. Instead of traveling single-file, spread out. Minimizing the number of footfalls in any one place helps prevent new trails from forming.

Keep vehicles on designated roads and trails. Driving your vehicle off the road in a pristine spot leaves a path that may tempt others to do the same. Always use established roads and parking sites instead.

Pack It In, Pack It Out

Trash and litter have no place in caves and can permanently alter underground environments. Discarded food crumbs, lint from clothing or even flakes of skin can affect underground nutrient budgets and fragile but important microbial populations. While it is impossible to pack out every micro-thread or flake of skin, commit to packing out all that you bring in. As good stewards of caves, we can also carry out the litter that others have left.

Stream caves and caves that flood seasonally by running water are regularly flushed out. Still, pack out all your garbage and waste from these caves since water merely moves it to another part of the cave or to another natural environment.

Pack out all garbage and dispose of it in a garbage receptacle after returning to the surface. Materials such as food particles, wrappers and other litter are unsightly and can disrupt the natural balance of the cave. Avoid dropping food crumbs when eating. Eat in a place where you can easily pick up crumbs or put down a ground cloth to make cleanup easy. Eat your sandwich straight out of (or over) the bag you packed it in. Better yet, carry foods like energy bars that tend not to produce crumbs. If you find it necessary to use flagging tape, reflective markers, or rock cairns to aid in route-finding, remove them all as you exit the cave. "Biodegradable" flagging tape can be eaten by and is toxic to cave organisms. Pick up old flagging tape if it is obviously litter. If you are not sure, leave it in place and tell the cave manager about it. Be careful, sometimes flagging tape or other markers are used to mark permanent trails, delicate areas or survey stations. If you find other trash that someone else left behind, pack it out as well.

Pack out all human waste. Packing out human waste is important to avoid the contamination of underground water sources, and to preserve biological communities and an aesthetic experience for other cavers. Here is one good method for removing your solid human waste from the cave:

1. Carry two extra plastic bags and durable plastic wrap for packing it out. Sturdy plastic bags that you can tie, such as the ones sold for roasting turkeys, work better than resealable bags: slightly larger than one gallon is a good size. Layer several pieces of plastic wrap between inexpensive paper towels. (Inexpensive towels create less lint.) You can also use the towels for toilet paper. Before it is used, the plastic wrap, towels and one plastic bag all rolled within the second bag take up little space in your cave pack.

2. When you are ready to use your bags, lay a piece of plastic wrap on the floor and open a bag above it. Deposit your waste and toilet paper in the plastic bag and tie securely.

3. Wrap this package tightly in several layers of plastic wrap and double-bag. The plastic wrap will reduce odors and prevent leaking. Ask your local waste management department or public land manager how to properly dispose of this package.

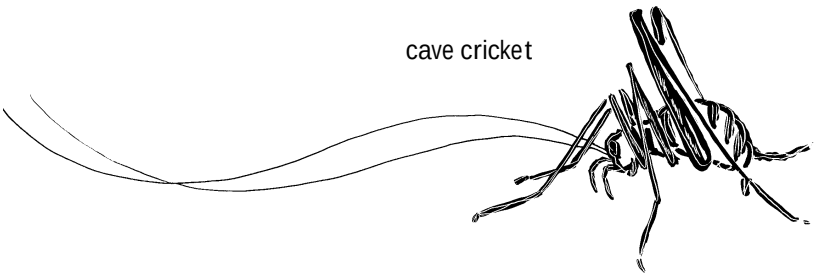
Urine can also disrupt aquatic ecosystems and microbial populations. In drier caves the odor from the urine can be unpleasant. The easiest method for dealing with urine underground, both in wet and dry caves, is to carry an extra water bottle or similar storage container and carry urine out. Some women find large-mouth bottles or funnels helpful. Many cavers prefer to make their "pee bottle" distinctly different from their water bottle to minimize the possibility of confusion. Use either of these disposal systems to carry out vomit or spit as well.

Leave What You Find

People come to caves to experience them in their natural state. Objects in underground environments can remain intact for centuries if undisturbed, and cave features and living populations grow slowly or are no longer growing at all. Things taken from caves are irreplaceable. We all share the responsibility to preserve

caves in their natural state so that future generations can learn from and experience them.

Never remove natural features from a cave. Natural objects of beauty, including cave organisms, rocks, minerals and speleothems, should be left for others to discover and enjoy. Even broken cave formations should not be removed. Caves are protected by the Federal Cave Resources Protection Act and by laws in many states. It is illegal to harm or collect natural features or animals in caves found on federal and many state lands. Objects removed from a cave lose the beauty bestowed by their original environment.



Avoid disturbing or killing cave inhabitants. Life in caves has evolved to exist in subsurface habitats, and most inhabitants depend on specific environmental conditions and survive on very limited nutrients. Some cave creatures, like the cave salamander, are very sensitive and can be killed by a human touch. Because cave populations are often small, individual deaths can affect the whole cave ecosystem. Many cave inhabitants are rare or endangered, and it is possible that uninformed cavers could unknowingly kill off an entire species. The chances of harming underground organisms are greatly reduced when we take care to avoid and not handle them.

The cave environment can also contain many valuable biological resources for scientific research. For instance, cave actinomycetes, a mold-like bacteria, have been studied as a possible source of antibiotics. Other subterranean microorganisms have been studied as possible treatments for cancer. In warmer caves, stop and examine pools for creatures or sub-aqueous speleothems before plunging in. Avoid jumping into pools altogether unless

they are the most heavily traveled route through the cave. Isolated pools within unexplored passages may contain populations of invertebrates and microbes undisturbed for centuries.

Some caves or areas within caves are closed to protect bat nurseries or hibernation colonies. Disturbing maternity roosts generally causes a higher infant mortality rate. Bats that are disturbed while in hibernation lose much of their stored energy and might not have enough to survive through the hibernating months. During late fall to spring, avoid disturbing all bats: do not stay long in hibernation areas, talk quietly around bats, and avoid shining or flashing lights directly on them when passing through.

Preserve historical artifacts. Since many caves have a stable environment with constant temperature and humidity and little physical disturbance, records of the past have been well preserved. Objects that are over 50 years old are considered historic. 100 year old objects are considered archeological. Let the land owner or manager decide whether to remove historic or archeological artifacts even if they seem like litter to you. Many artifacts are very well preserved in the static climates of caves. In recent history, some early cave explorers left significant evidence, which should not be removed, of their exploration. While graffiti and discarded gear are no longer acceptable, historic signatures and equipment are now part of our history and the history of cave conservation ethics. If you think there is any question about the age of something, leave it in place but note the location on your map and tell the land manager about it.

Archeological & paleontological artifacts. Fossils, prehistoric skeletons, petroglyphs, pictographs, ancient artifacts of human habitation, and other traces of the past can all be preserved in caves. These resources are key pages in the local or even global history book and can be lost forever due to unintentional damage by an uneducated visitor. Artifacts should not be disturbed or removed because they are a more complete record when left in place. Archaeological and historic artifacts are also protected by the Archaeological Resources Protection Act of 1979 and the National Historic Protection Act of 1966. It is illegal to excavate, disturb or remove these resources from any public lands. Report discoveries of archaeological remains or acts of vandalism to cave managers or landowners. Some caves are closed to recreation to protect archaeological or paleontological resources. Please respect these closures. Help protect caves by reporting vandalism to cave owners or managers.

Photograph carefully and conservatively. While "taking only pictures" is a good idea, getting a good photograph does not justify damage to the cave. Just as you would if you were not taking pictures, stay on the trail or on other previously impacted areas. Keep your flash units on trails or durable surfaces as well. Keep in mind that if the people in your photos are demonstrating good caving ethics, it will encourage and educate others to do the same. A photo showing damaging practices will lend approval to that behavior and confuse novice cavers. Pack out all film and spent flashbulbs. If left behind, film can be especially toxic to the cave environment. Minimize your photography of bats because repeated flashing can disturb them. Do not photograph roosting or hibernating bats or maternity colonies.

Minimize rigging impacts. When rigging caves for vertical rope work, use natural anchors whenever possible. Don't place bolts if there is another route that leads to the bottom of the drop. Check with the managing agency or land owner for regulations if you think you need to place bolts to ensure the safety of the caver. If you place a bolt, make sure it is well placed and secure. This will avoid both user injury and having to replace it with another bolt nearby. Stainless steel bolts that are the equivalent of 3/8 inches in diameter and 2.5 to 3 inches in length are recommended for their durability and security in limestone.

Search out places to rig your ropes away from delicate formations. Avoid damaging cave features by being careful when you are throwing ropes, descending and ascending. Rope marks on mud slopes, trees and other features can sometimes be avoided with padding.

Minimize Use and Impacts of Fires

Building fires is unacceptable in caves. Fires blacken cave walls and ceilings, increase carbon dioxide levels, and leave ashes and pieces of wood. As air moves through caves, smoke and fumes can be carried to other sections of the cave and affect cave life throughout the cave. The heat from fires can also alter the constant climate in a cave and kill biological organisms. Smoking in caves is a smaller version of building fires. Smokers leave behind ashes and toxic fumes, harming the fragile cave environment. Torches are also harmful and should not be used to provide light in caves.

Minimize impact of campfires above ground if you camp before or after a cave trip. The natural appearance of many

areas has been compromised by the careless use of fires and the ever-increasing demand for firewood. Built properly, campfires can still be an enjoyable part of camping, but the decision to build a fire should never be made arbitrarily. Regulations, ecological conditions, weather, skill, use levels and firewood availability all should be considered in deciding whether or not to build a fire. To minimize the impacts of your fires, consider using a camp stove instead of a fire for cooking. Stoves consume no wood, leave no scars, and rarely get out of control.

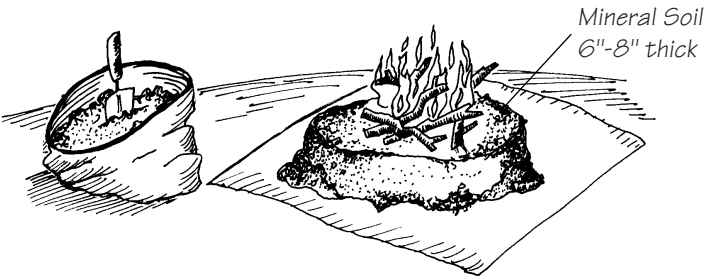
If you do choose to build a fire, use appropriate Leave No Trace fire techniques. Build all fires at least 200 feet from cave entrances. Campfires should only be built where firewood is abundant. Use only dead and downed wood. To avoid visual impact, never break branches off trees, living or dead. Collect your wood from the ground over a wide area, away from camps, trails and cave entrances to disperse impact. If firewood is scarce, you can bring wood from home.

Use firewood that is no larger than an adult's wrist. This size of wood burns easily down to ash or very small coals. Burning a fire down to ash requires some extra time and effort, but it is a significant step toward minimizing impact. Once the fire is completely out, feel the coals with your hand to be sure they are cooled. Crush the smaller coals to ash. The ashes should be scattered widely over vegetated ground, where they will mimic the remnants of a naturally occurring forest fire.

In high-use areas, use existing fire rings. In remote areas, it is possible to enjoy a fire and Leave No Trace that it was ever there. Take care to select a durable site that will withstand the impact of people moving around it, and use either a portable fire pan or a mound fire.

Fire pans. Fire pans are metal trays with sides high enough to contain wood and ashes (about three inches). Metal oil drain pans and backyard barbecue grills make effective and inexpensive fire pans. Raise the pan off the ground with rocks to protect the surface underneath from the heat.

Mound fires. To build a mound fire, collect sand or mineral soil from a place like a stream bank or beneath an uprooted tree. Build a circular, flat-topped fire platform, six to eight inches thick and about two feet across. A tarp laid down beneath the soil will facilitate clean-up. Once the fire is out and cold, the leftover ashes can be scattered and the mineral soil returned to its source.



Remember, caves are highly subject to the cumulative impacts of our visitation. Let us each do our best to respect cave environments and cave life by caving responsibly and Leaving No Trace. Caves are also threatened by water pollution, mining, overgrazing and other surface activities. For more information on caves, caving and how to be involved in cave conservation, contact:

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