DIGGING: GUIDELINES FOR CAVERS AND RESOURCE MANAGERS

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Abstract

Most cave entrances occur by natural happenstance rather than as an intricate part of the formation of the cave itself and the vast majority of caves have no entrance enterable by man. In the geologic lifetime of a cave any number of entrances may have opened and closed through natural processes. A surprising number of caves in the U.S. were discovered using some form of excavation or "digging" by cavers. Pursuing obvious "digs" is the next logical step in the process of searching for and inventorying caves. A variety of excavation techniques are employed ranging from removing soil and rolling a few rocks out of the way to "rock shaving" using micro-blasting techniques to using heavy equipment such as a backhoe. Digging for new caves and the techniques used for the excavation must be compatible with the overall land use regulations for the specific area. The techniques used for digging on highly protected lands such as wilderness areas should cause minimal disturbance to the surface zone and within the cave. The creation of a new entrance may reveal a significant resource not previously known and increase the natural value of the area. However, digging also may create negative impacts to the cave ecosystem and affect mineral growth by changing airflow patterns in the cave. Alterations to the surface zone immediately surrounding the new entrance may impact drainage, sedimentation, and energy inputs to the cave.

We cannot protect a resource that we have not identified, but we don't want to unnecessarily damage the resource in the process of discovery. In most cases, digging to search for a "new" cave or to reopen an old entrance is appropriate, but we must remain aware of possible environmental impacts and dig softly.

Introduction

Cave entrances provide links from the surface to the subsurface. Entrances provide points of air and energy exchange as well as routes for animals (including people) to enter and exit the cave. Most cave entrances occur through natural happenstance rather than as an intricate part of the formation of the cave itself (White 2005). The vast majority of caves have no entrance enterable by man (Curl 1958). In the geologic lifetime of a cave, any number of entrances may have opened and closed through natural processes.

As cavers continue to search for "new" caves and passages, a range of excavation or "digging" techniques are being employed. A surprising number of caves in the U.S. have been discovered by some form of digging by cavers. Digging may well account for the majority of current discoveries in the more popular caving regions. Pursuing obvious digs is the next logical step in the process of searching for and inventorying caves. Discoveries made

possible as a result of digging have certainly increased our knowledge of the cave resources of the world. Many well known commercial caves have artificial entrances and sometimes tunnels connecting different sections of natural passages. Examples of caves with dug entrances include Carlsbad Caverns, Flint Ridge, and Lechuguilla. Most commercial caves have undergone considerable modification of the entrance and passages to make the caves accessible to tourists.

The opening (or closing) of a cave entrance may cause changes in the circulation of air or energy and sometimes alter hydrologic characteristics within the cave. In most cases, the changes to the cave environment will be minimal, but careful observation of the conditions in the cave may suggest deterioration in the condition of mineral formations or a loss of habitat. Cavers and resource managers need to be aware of these potential changes caused by the creation of an entrance and sometimes do remedial work around the entrance to control potential damage to the cave resource. The purpose of this paper is to present the pros and cons of excavating new cave entrances and suggest ways to minimize the impacts to the cave environment.

Digging Methods

The methods employed to open or enlarge an entrance or cave passage may range from simply moving a few rocks out of the way to a major excavation using heavy equipment (Davis 2005). An online journal containing detailed discussions of digging techniques may be found at http://www.cavediggers.com. A general list of digging techniques includes:

- Moving rocks or sediments by hand
- Hammer and chisel
- Rock shaving with soda-straw explosives
- Blasting
- Heavy equipment — backhoes
- Heavy drilling to intercept cave passage

The first three of these techniques are generally low-impact methods and create a very controlled excavation. The soda straw technique does not cause a true "shock wave" explosion or blast but works by pistol powder expanding in a propagating fashion to create enough pressure to split the rock (Figure 1). Cave diggers tend to be very inventive and a variety of techniques may be employed at any given site (Passerby 2002).

Rarely, more intensive techniques including "hydro-mining" using high pressure jets of water and vacuuming sediments using a commercial sewer cleaning service may be employed. The scene on the surface at some cave digs using heavy equipment resembles a mining operation while the work is in progress (Figure 2). These more costly activities are normally conducted by a land owner willing to bear the expense to locate or develop his cave, possibly as a commercial operation. Reclamation of these sites may take several years, but given time the cave environment and animal populations should recover.

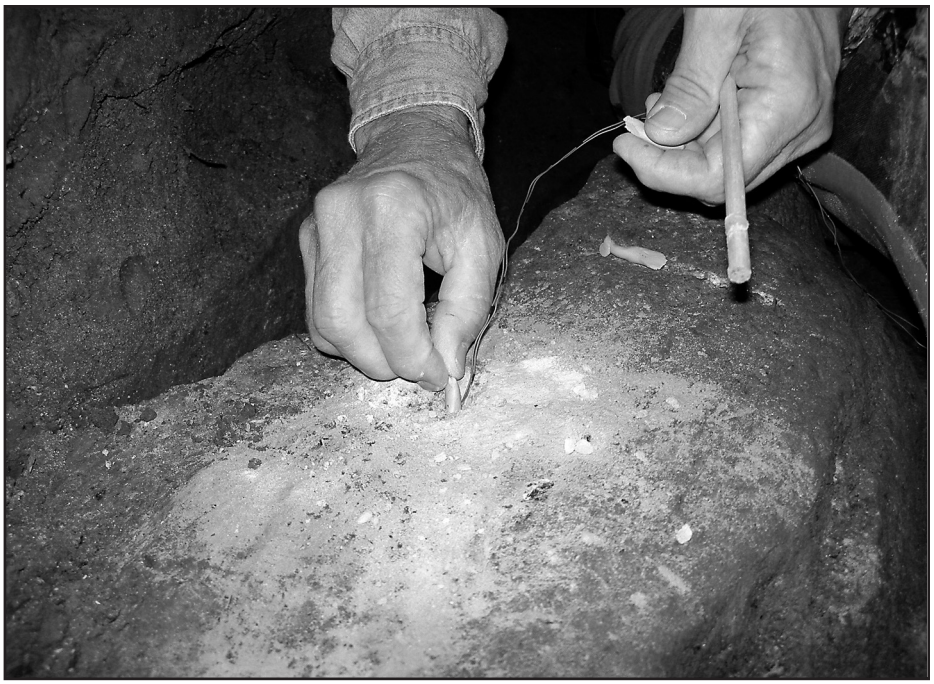

Figure 1. Rock shaving techniques using soda straws filled with pistol powder and inserted into a drilled hole in the rock create a very controlled splitting or shaving of the rock without the potential damage associated with more traditional explosives. Photo by W.K. Jones

Figure 2. An example of a cave entrance excavated using a trackhoe. This site is adjacent to an industrial park that overlies most of the cave. It will take a few years for the entrance zone area to regain a pre-dig condition, but it was felt that the benefits of gaining access to the cave for environmental monitoring and resource inventory outweighed the disturbance caused by employing heavy equipment at this far from pristine site. Photo by W.K. Jones.

Although all of these digging techniques may have a place or be appropriate at certain sites, the more invasive techniques will certainly have the greater impact on the animals living in the cave and in altering the entrance-zone environment. The digging techniques used at a site should always be the least destructive means of opening the entrance. In the case of highly protected public lands, the digging techniques must be in reasonable compliance with overall regulations on land-use at the site.

Pros and Cons of Creating a New Entrance

The most obvious benefit of digging is the discovery of previously unknown resources. This creates an increased knowledge of the geology, hydrology, and ecology of the area. This should lead to improved protection of caves due to increased awareness of the subsurface resources. We cannot protect something we don't know exists. A new entrance may also create easier and safer access to parts of the cave for environmental monitoring, resource inventorying, or possible rescues.

The creation of a new entrance will almost always cause some change in the cave environment. These changes may often be of little significance or even beneficial to certain animals living in the cave.

The potential downsides to digging include:

- Alteration of the natural appearance of the entrance or landscape
- Changes to the patterns of air circulation within the cave and the accompanying impacts to the ecosystem and mineral growth
- Cave microclimate disruption may cause an increase drying, especially during the winter
- Changes around the entrance zone may alter drainage characteristics and patterns of sediment transport within the cave
- Possible creation of an unstable passage with an increased danger of rockfall
- Potential increase in the number of visitors to the cave

These changes may occur anytime an entrance opens (or closes), whether due to natural causes or the activities of man.

The disruption of the surface area around the entrance may, at least temporarily, cause the most potential damage to the cave ecosystem. Most cave communities depend on food input coming through the entrances. Destruction of vegetation around the entrance zone may reduce cricket populations dependent on foraging in this entrance zone for food. Remediation of any surface disruption should be a standard part of any dig.

Guidelines for Diggers and Resource Managers

In most cases, the benefits of discovering previously unknown resources far outweigh the environmental costs associated with a dig. This is especially true if the digging techniques are low impact and the resulting disturbance to the entrance area is kept to a minimum. Resource managers should

consider digging as an extension of field cave inventory methods if it is conducted in a way that minimizes impacts to the surface zone and passages. The digging techniques must be in harmony with overall land-use regulations for the area.

Protection and monitoring plans for the newly discovered resources should be prepared. Newly opened entrances often require some sort of cover or "lid" if the management objective is to leave the cave in the condition in which it was found. This means if the site of the dig was loose rubble and large rocks with air flowing into the cave prior to the dig, then any modification for an entrance ought to allow for air flow. Similarly, if there was no air flow and the new entrance causes air flow, the entrance ought to be arranged to stop the air flow. A pipe/culvert with a lid (Figure 3) is a time-tested technique to accomplish this and help prevent cold, dry air from altering the cave environment in the winter. In a few cases, airlocks or specialized gates may need to be installed to mitigate the effects of altered air flow. In any event, the resource manager should be able to control most of the good and/or bad effects from the newly created entrance to maintain management goals.

Cavers should plan digs for places with a good potential for success. Old, currently obstructed entrances or places where mapped cave passage is near the surface are obvious sites. Geophysical techniques may also help identify areas where cave passages are near the surface. It must be noted however, that some digs initiated at sites with little obvious potential have yielded highly significant caves such as Helictite Cave in Virginia. The digging techniques should be appropriate to the site and the surrounding area. Clean up and do reclamation work around the entrance zone after the dig is completed. In most cases, try to leave the cave in the condition in which it was found. Make certain that the excavated passages are stable and do not pose a safety hazard. Identify important resources within the cave. Photo document and plan a protection strategy for these resources (Seiser 2002). Work with the resource manager or land owner and share all discoveries promptly. In summary, dig carefully and dig softly.

Figure 3. Dug entrances may be stabilized using culvert pipe. A lid may be fitted to control air flow and temperature fluctuations. In most cases, the management objective at the new entrance will be to maintain the cave in the same condition as before the new entrance was opened. In this example surface disturbance and visual impact are minimal. Photo by P.C. Lucas.

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