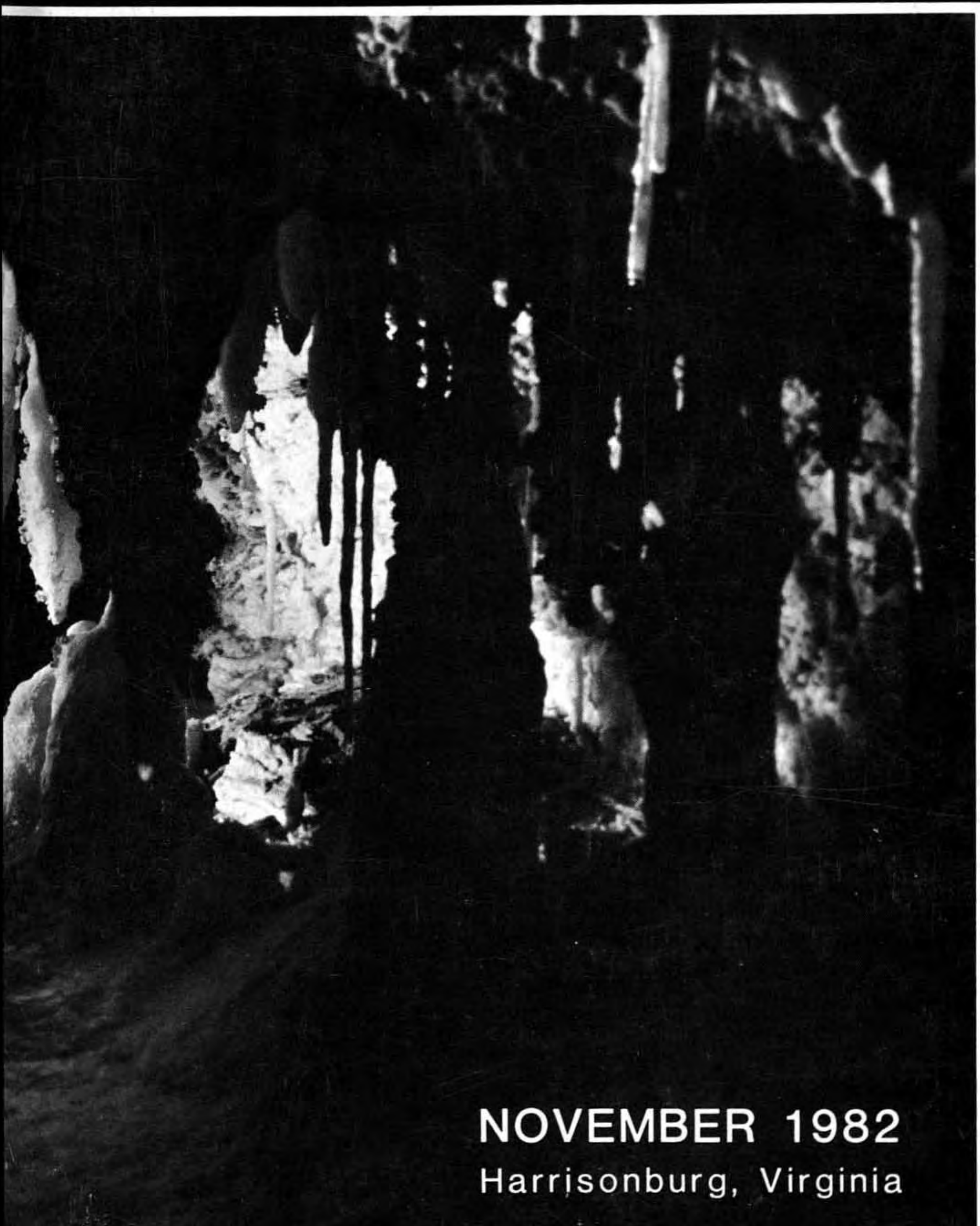

NATIONAL CAVE MANAGEMENT PROCEEDINGS

CAVE MANAGEMENT SYMPOSIA

PROCEEDINGS

Harrisonburg, Virginia

November 5-7, 1982

Sponsored by

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The Challenge and the Future

James P. Wiggins*

INTRODUCTION

It is indeed a pleasure for me to participate in the 1982 National Cave Management Symposium. It seems like yesterday when Mammoth Cave National Park hosted the 1980 Symposium. I have many fond memories of that Symposium and I hope those of you that were there - and there are many of you here today - also treasure the same memories. I am sure that this Symposium, as with the previous ones, will be equally rewarding and successful. In reviewing the agenda for this year's meeting, I find the subjects vital to sound cave management and the activities useful and exciting.

My special thanks to John Wilson, Roy Powers and their committees for organizing the Symposium. I know, by experience, the many endless hours that are devoted to an event such as this. Again, thank you.

If this is your first Symposium, bear in mind that some of the "best minds" in the caving community are here today. You will find them very friendly, composed of many disciplines, representing many organizations and agencies, both public and private. You can be assured the caving community wants to share their experience and talents with you. Please let them - and please become a member of the family. Your continued support and participation is essential to sound cave management.

Today, cave managers of public agencies are facing what many of the cave managers in the private sector have since their existence - survival. In fact, at our last Symposium, one of the panel discussions, chaired by the National Caves Association, covered many of the same concerns Government park managers are plagued with today. I am talking about severe fiscal constraints imposed on us by a troubled economy in a changing society.

CHANGING TIMES

For most of the last three decades, park managers have been in an era of growth and expansion and have been making decisions accordingly. Like the rest of society, they were accustomed to many non-essentials and their facilities and services were often second to none. As we all know, these conditions have been changed in recent years. Like the visitors we serve, our belts must also be tightened. We are now entering a time frame where we must stretch a shrinking budget to cover increasing costs in our services to the public. Every major expenditure must be justified as it will most certainly be questioned. I believe this trend will continue into the foreseeable future. Many budgets have already been severely severed and I fear many more reductions are to come. Managers will be making difficult decisions such as which programs are to be deleted or reduced and which employees are to be furloughed.

The image of parks as being a "free service" for many agencies will change and more emphasis will be placed on a "pay as you use" system. Public managers will adopt cost-efficient programs and become more self-sufficient and businesslike. They will tap other government entities and the private sector to see if they can provide services at reduced costs. No services will be immune and will include a wide range of activities such as maintenance, interpretation, resource management, law enforcement and various phases of administration. In the future, more emphasis will be placed on contract administration.

As cutbacks become imminent and managers examine the options, they should beware of false economics both now and over the long term. They should also beware of impacts their actions will have on the community and other agencies. Regardless of the fiscal constraints, managers

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should not jeopardize, under any circumstances, the unique and fragile cave resources. Social and economic pressures must not deteriorate the irreplaceable treasures. In these changing times when public support is crucial to our existence, it is imperative that all managers effectively communicate with the public the reasons for changes. Remember, cave appreciation and preservation are inseparable.

PRIVATE SECTOR INVOLVEMENT

It is the position of the administration that the Federal Government and the private sector share the responsibility for providing the resources needed to preserve the quality of life in our nation. It is Government policy to rely on the private sector to support Government functions by providing products or services.

Where commercial sources are available, it is sound management practice for Government officials to perform a cost comparison analysis to determine who can provide the product or service more economically - the Government or the private sector. A detailed management review is essential and should include a complete review of all and anything that contributes to the cost and efficiency of the operations including cost of equipment, supplies, and personnel. In essence, those products or services that can be accomplished more economically and efficiently by the private sector should be contracted out. Historically, it is maintenance activities such as janitorial and sanitation services that are most often contracted out by the National Park Service.

To organize and guide the strength and ingenuity that exist in both the Government and private sector, the President has established a special task force. With the creation of the task force comes the opportunity to increase the benefits from the private sector, especially in those programs and organizations already utilized by many Government entities.

To upgrade the quality of the parks and the services offered therein, the National Park Service is improving its relationship with concessioners. All areas of the Service are investigating the feasibility of concessioner-operated campgrounds, the possibility of sharing facilties and coordinating planning efforts. Under consideration are the development and expansion of the reservation system for overnight accommodations in park units and nearby communities. The Service and concessioner will be working closely with the U. S. travel industry representatives to improve both domestic and foreign information services.

Overall, there will be endless opportunities for increased concession involvement in federal agencies. The economic opportunity for the private sector to assist the Government in its mission has never been greater.

The role of non-profit groups will become increasingly important. The National Speleological Society, the Cave Research Foundation, and other non-profit groups have provided significant cost savings to many agencies and are aligned with many Government priorities and goals. At Mammoth Cave, the NSS has been assisting the rangers in the implementation of a recreational sports caving program. In addition, the CRF has supported scientific research related to caves and its environment, aided in many aspects of cave conservation, performed cave explorations that resulted in significant cave discoveries and assisted in interpretation of caves through education.

Volunteers

The volunteer program, common to many agencies, has been successful in the past and will certainly be relied on more in the future. In fact, for many federal, state, and local government units, the use of volunteers is essential for adequate resource protection, maintenance and visitor services.

The National Park Service Volunteers in Parks (VIP) Program is nearly twelve years old and has contributed almost four million hours of work. To expand the role of the Parks' VIP Program, the Service is offering the volunteer more of an opportunity to work in the many and varied activities within the Service. They can work in such fields as interpretation, living histoy, arts and crafts, history, archaeology, natural science, resourcement management, and maintenance. In essence, the volunteer can work in almost any work environment, as long as paid employees are not displaced.

The Volunteers in Parks Act (Public Law 91-357) authorized the National Park Service to "recruit, train and accept without regard to the Civil Service classification laws, rules or regulations the services of individuals without compensation as volunteers." The Act further authorized the Service to provide the volunteer "for incidental expenses such as transportation, uniforms, lodging and subsistence." Although the volunteer is not deemed a Federal employee, he is considerered one of them in the event of a work injury.

BACK TO THE BASICS

After many years of almost explosive growth, the National Park Service is stabilizing and is getting "back to the basics". Each unit within the Service has been directed to develop a basic mission package. The program was formulated to provide management at all levels of the Service with the information needed to make decisions concerning possible cutbacks and reallocations.

Only essential activities are to be addressed - that is, those activities needed for the protection and interpretation of the parks' primary resources. In directing the implementation of this program, the National Park Service Director, Russell Dickenson, stated:

> I would not ask that you carry out a program of this magnitude unless I felt it was extremely important. However, we are today at a critical point in our history. We have been challenged to document a cohesive Service-wide management program, define our goals and objectives, critically examine our operations in each NPS unit and make a careful distinction between those activities which we would like to be able to carry out versus those which are essential to perform, and develop and implement a rational process for distributing available resources so as to respond to our most critical needs before undertaking any other activity. I believe that the Core Mission process that we are undertaking represents the best way of responding to this challenge.

In the future, the basic operations will become the process for planning, programming, and budgeting.

STRATEGIC PLANNING

Changing economics and the increasing demand of our resources require realistic management strategies. In response to these changes, the NPS Southeast Regional Director has established a Strategic Planning Task Force. In essence, the task force members are consultants to the Regional Director on issues that affect the management and operations of the park.

The objectives of the task force are three-fold. They include:

(1) Identifying immediate issues, needs and problems through various methods including employee surveys, meetings, and discussions. In order to achieve this objective, assessments will be made in order to clarify issues and identify specific needs. Action strategies will be devloped to resolve issues and recommendations will be made to the Regional Director;

(2) Identifying short range (2-5 years); and

(3) Long range (5-10 years) concerns of the park areas of the Southeast Region are likely to encounter. The formulation of strategies, policies and directions for increasing the reliability of park management to meet future requirements is proposed.

Until the task force completes its work, the benefits arising from its undertaking cannot be evaluated. However, the potential for what the task force can accomplish in improving management's efficiency and cost effectiveness is great.

CONCLUSION

In conclusion, let me say a few words of caution. We have been entrusted with some of the most fragile and irreplaceable resources in the world. These unique resources are dependent on how we meet our challenge today and in the future. As we light up and enter the darkness of the unknown, our course of action should be carefully planned and if we err, let's hope it benefits the resources and is something our children's children will see. Remember, the breath-taking sight of a gypsum flower can and will wither and die if we become complacent. The challenge and the future is yours.

Thank you.

Meeting the Challenge

Lewis Cutliff*

INTRODUCTION

From the previous talk you have gained a general overview of the trends and some of the problems facing federal cave managers today. My purpose is to supplement Mr. Wiggin's talk with specifics of how we at Mammoth Cave are meeting the challenge of a troubled economy, changes in society and shrinking budgets. Although we have tightened our belts a bit, we are still alive and well and have hopes for the future.

SIGNS OF THE TIMES

For three decades, Mammoth Cave, like most other areas, experienced a tremendous boom in visitation. It surged in 1959 and rose rapidly until 1974. It was a period of rapid expansion when management struggled to accommodate every visitor, sometimes at the expense of the resource, for instance, a self-guided tour. Money was pretty easy to come by and resulted in the addition of specialty tours such as lantern, wild cave, handicap and the Great Onyx.

At the end of the seventies, warning signals began to appear as inflation soared and federal deficits ballooned. With the advent of a new administration, we changed from zero base budgeting to basic operations which, simply stated, is "Getting Back to the Basics." We can no longer assume that "historic funding patterns" will be followed or "base-funding levels will be maintained." Each unit of a federal agency must determine that "tasks that are essential to the central purpose of the unit and must be carried out," and "to establish the lowest level of resources adequate to carry out each such task at a minimum level of acceptability." We are not to consider those things which we like to do or activities we would like to have; only those programs necessary to the mission are considered.

The Enabling Act of 1916 and the Parks Enabling Legislation spells out our mission, and that is "to manage the resources in a way that will not only protect them but will also provide for the enjoyment by this and future generations. Since the cave is the primary resource of Mammoth Cave National Park, we are mandated to protect it as well as make it accessible to visitors in the most efficient and economical way possible We have accomplished this by re-shuffling priorities and more efficient use of manpower.

Other measures taken for cost savings:

- Delayed starting dates in spring and summer - one week
- Cut seasonal training - one week
- Adjusted seasonal hiring dates and eliminated lump sum leave costs
- Hired ten less seasonals
- Started participating in Student Aid Program
- Eliminated surface walks
- Eliminated wild cave tour

Even with those measures taken and cost reduced, we now offer as many tours as we once did. In fact, we have expanded tour offerings for Echo River. We accomplished this by arranging tour times so that personal could lead 3 and 4 tours rather than the traditional 2 and 3. We gained an additional half hour cave time per person which in a day's time amounts to approximately 15 more productive hours.

Delaying scheduled starting dates caused no great problems since visitor use patterns have shifted somewhat since the rise in gasoline

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prices and changes in the economy. Seasonal training, though shortened a week, has never been better. Throughout the summer, they are given re-enforcement by supervisors and an expert in the field of communication, Dr. Michael Cronin, Radford University, Virginia. Eliminating guided surface walks caused no comments from visitors. Their prime reason in coming to the park is to visit the cave. For those who wish to hike the surface, there are 36 miles of trails available throughout the park. Discontinuing the wild cave tour did cause consternation for some visitors, especially those who came back year after year to participate in it. True, it was a nice addition to our activities but not one that met the criteria of cost effectiveness.

Cost effective measures have been applied in other areas as well as visitor services. Resource management/visitor protection has reduced road, river and back country patrols, and reduced summer seasonal hires by 25%. Maintenance retro-fitted buildings with insulation and double pane glass and finished lighting the cave with flourescent lights, thereby reducing cost and saving energy to fulfill a mandate to reduce energy consumption 20% by 1985. We are meeting that deadline.

THREATS AND REMEDIES

As Jim stated earlier, we, like other cave managers, are fighting for survival. Not only from a monetary standpoint but threats to the resource as well. Most of you are familiar with the major threats to cave resources in Mammoth Cave National Park. Three of the most pressing are:

1. Great Onyx Job Corps Center

2. Groundwater pollution from towns on the Pennyroyal Plateau

3. P. C. B. transformers in the cave

Measures to alleviate these threats have been taken. As of October 20, the Jobs Corps Center was vacated. The 201 Facilities Study on a wastewater treatment plan is now in the design stage for the towns of Horse Cave and Cave City. Park City will be added later. A contract has been signed for removel of P. C. B. transformers in the cave. In addition, the park is cooperating with E. P. A. in installing an acid rain and air quality monitoring station.

We are surviving the challenges so far. Now!! What about our future?

DEALING IN FUTURES

I think basic operation programming will be with us for a long time to come and will be the major document in planning, programming, and budgeting. As I stated earlier, it directs that all expenditures and programs be based upon the primary resource as outlined in the enabling legislation. Managers of cave parks are faced with a dichotomy--managing resources to protect them and at the same time provide enjoyment for visitors. This is a difficult task but one which has helped us fare better than some parks whose primary resources are surface oriented. If visitors are to enjoy the primary resource in a cave park, such as Mammoth, they must be guided. In this, the guide also becomes the protector. Consequently, we fulfill our mission as stated above. For this reason, I believe our future cuts, if they come, will not be as severe as for other areas.

I foresee travel holding its own and rising between 1-1/2 to 3% per year. Mammoth Cave's inclusion on the World Heritage List will help in this area.

I see more organized groups and bus tour travel increasing, based upon our travel patterns in recent years and data from the tourism organizations. Cave tour schedules at Mammoth will be expanded with the re-opening of the new entrance. Interpretive quality will be enhanced by this addition since tour size can be reduced.

CONCLUSION

In conclusion, I look to the future at Mammoth Cave with optimism. There has never been a time in the history of this nation when the economy didn't bounce back. There never has been a time when good old "yankee ingenuity" didn't triumph over change. It will again. Through meetings such as this, we can help each other, even though we come from a diversity of backgrounds. We can learn from each other those things shared in a common interest that have benefited each of us in the past and will hopefully help us meet the challenge of the future.

Cave Conservation and Management Overview

Roger W. Brucker*

Abstract

While the lack of money may seem to be an obstacle to cave management and conservation, protection is a matter of the allocation of resources. The task is to increase the value of the cave over its protection cost, which can be achieved by establishing protection as the highest objective. A second problem is a lack of negotiating capability on cave related matters, such as entrance gating, cave purchase, and exploration agreements. It is proposed that the NSS investigate providing negotiators and training in negotiations. The problem of building communities of cave defenders is analyzed in light of experience with NSS conservation task forces. Successful strategies have included growing a sense of stewardship, gathering facts, careful planning, and the recognition of victories. Three case histories are given that illustrate these ideas.

INTRODUCTION

How can caves be conserved and managed so future visitors may enjoy them? Are we caught in the realities of increasingly frequent cave closings? Is the general alienation of individuals and the decline of neighborliness and community signs that cave owners will be tougher to deal with in years hence? Is it possible that while "us good folks" meet to discuss cave protection, the vandals will wreck the caves and will eventually make protection unnecessary?

We could pose a long list of questions by way of introduction to an overview of some of the problems that confront caves and those who care about them. It would be too easy to say that management is the magic answer that will solve all problems. Today we want to place these issues in perspective, to examine some of the problems critically, and to propose some remedies.

Privately owned caves, whether commercial or not, are the focus of this discussion. Some of the examples I use are government caves, but regardless of ownership, the problems apply to all caves.

Where do I think we will be in 1993, 10 years from now?

* I predict there will be 20% fewer caves open to cavers than now.

* I predict that most of the caves open to everyone will be thoroughly despoiled, stripped of speleothems, or polluted beyond endurance.

* I think the NSS and individual grottos will own and manage 20 caves, and will control access to these with vigorously enforced rules.

* I predict there will be a cave negotiation service that will deal more effectively with landowners than the average grotto can.

* I predict there will be a cave defense fund to finance litigation to preserve and protect caves.

So you can see where this talk is headed, I will be covering three major problems and will propose a course of action. First is the problem of money; second is the problem of negotiating cave agreements and purchases; third is the problem of building groups of cave defenders. We propose management as a solution to many of the present problems and threats.

I. The Problem of Money

America in November of 1982 is at the bottom of a recession in which more than one in ten work-

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ers is jobless. At the moment, the necessary signs to signal a recovery are either invisible, or they require a microscope or crystal ball to see.

This means that cave explorers have less money to spend, cave owners have a less secure future, the NSS has budget problems, and federal and state agencies that are charged with the mission of preserving caves have few or no resources. All of those preservation measures that require money are in peril or on hold.

Without money, won't the caves suffer? The answer is Yes. Perhaps the only bright side of the picture is that the casual users of wild caves -- those that cause much damage -- may be staying at home more.

I talked with James Wiggins, on the staff at Mammoth Cave National Park. Tell me your most serious cave management problem today, I asked him. He replied that it was tight budget funds. He pointed out some of the programs that must be curtailed because of the cuts: cave gating, a wild cave program, guide and ranger staffing cuts and a freeze on hiring, reduction or elimination of research projects, and so on. It was plain to see from the look on his face that Jim was feeling anguish.

A year ago I talked with an owner of a private wild cave. He regretted that we could no longer enter the cave on research projects as we had before. The owners had decided to try to sell the cave for a considerable sum of money, and our continuing use of the cave might interfere with purchase negotiations. To my knowledge, the cave has not been sold, nor is any developer with an ounce of business sense likely to buy it.

Common to these two instances is the central role of money and the subordinate role of the cave. In prosperous times, we would not have these problems.

What is the remedy? Fold our hands and wait until things get better? My answer is No.

A master salesman once told me there was a simple way to sell anything. All you have to do is to increase the value of whatever you are selling above the selling price. In other words, value is like beauty: very much in the eye of the beholder.

In terms of caves, most would agree that value is related both to natural features, and to potential use and the resulting satisfaction. A very valuable cave is one that appears pristine, where the marvels of nature appear to have been unmodified by man, where the cave blindfish and cave cricket roam. So far as man is concerned, cavers call a cave valuable when it presents a challenge and rewards exploration with joy and new experience. A cave owner may consider a cave valuable when it earns a profit. The ticket buyer may say a cave is valuable when it provides entertainment and education during a visit.

There is never enough money to protect every kind of value. This is true in all aspects of life, not just the world of caves. I believe, therefore, that the real question becomes not the amount of resources, but the allocation of resources. What will our spending priorities be? Should we spend the limited money on cleaning up a cave, or on buying a gate for it?

Cave protection is based on the fact that caves are fragile, easily damaged, and therefore vulnerable to irresponsible activities. Unless the caves are protected, none of the subsequent values are likely to follow. Nobody enjoys a trip through a graffiti-decorated sewer. Natural values are the primary core of the value system of caves.

When money is short, it should be allocated to the protection tasks first.

If the way to sell anything is to increase the value over the cost, then those who care about caves need to elevate the value of caves. Those who allocate the resources must be made to see that the cave is indeed very valuable, and that the protection of the cave's natural features is the most critical element.

How can we accomplish this? There is education. There is persuasion. There is coercion. All three tactics belong in the arsenal of those who want to preserve and protect caves. I had a speech professor who advanced the startling thesis that every change in this world was the result of either bribery or blackmail. As idealistic students, we challenged such a simplistic and cynical idea. Gradually, we saw that much human behavior can indeed be explained in motivation terms of reward and punishment.

Increasing the value of the cave over the cost of protecting it often requires education, persuasion, and coercion. Education, in particular, requires the presentation of facts about the relationships and processes of the cave. It may begin with an inventory of the cave's resources. There may be research, such as dye tracing that shows the origin of cave pollution. Education is aimed at producing informed citizens, who can make up their own minds on whether the values are real or not. As a tactic, education is central to cave preservation because it provides the basis for recruiting supporters. People who know the values of caves are less likely to fall to manipulative persuasion of the opponents of protection. And if coercion is a tactic of opponents, the informed citizen may make a personal decision to join the protectors.

Persuasion often uses emotional appeals as well as facts and objectivity. Americans share a common abhorence of "senseless violence". We are suspicious of any argument advanced for profits being the primary value in life. We resent being manipulated by "big money". Thus, when a coal company lobbyist tries to defeat acid runoff conservation measures in a state legislature, cave supporters may well describe in vivid terms what will result: "Senseless violence to rare and beautiful caves, motivated by greed for profits, advocated by silver-tongued spokesmen hired to manipulate your vote".

Coercion can take many forms. Probably the most effective is a healthy lawsuit when the cave spoilers are violating the law.

This is not a textbook on political action. Ideally, we would rather engage in positive action ahead of time to ward off the cave conservation crises. The way for this preventive medicine approach is by helping cave owners and managers set their objectives before trouble arises.

The Cave Research Foundation has found that most cave owners and managers of private and government caves are curious about their caves. It is an easy matter to satisfy this curiousity by making a cave inventory and providing factual information. We always stress the values of the natural features inventoried, because this is the first step in making sure that the owners and managers will see their caves as valuable.

Once the cave resources are known and valued, it is only logical that both informal and formal objectives be proposed to the managers for their consideration. "You say the speleothems are the only ones of their type known in North America? Then of course our first objective is to preserve them so they may be studied and enjoyed forever".

Objectives can be readily formulated and written down when the resources are known, understood, and valued. But managers do not write objectives instinctively. We have found that they welcome help. Private cave owners, when they realize the natural fragility of a cave, can readily accept the objective of controlling access with a gate when this alternative is pointed out.

It is CRF's experience that a short list of objectives in regard to caves will head off most cave threats early, if the manager is concerned and competent.

To summarize this section on money, the key is to understand that the problem is the allocation of money more than the amount of money. Money is likely to be allocated where the values are seen to be the highest. To sell conservation values requires education, persuasion, and sometimes coercion. The most efficient way to advance the priority of conservation values is to help the owner or manager set objectives, based on a factual knowledge of the cave.

II. Need For Negotiating Capability

Many kinds of cave conservation issues require negotiations between people. Cavers need to negotiate with landowners for permission to explore. A group may wish to arrange for installing a cave gate. The NSS or related group may wish to purchase a property with a cave.

We know that some people are more skilled at negotiating than others. Professional labor negotiators are in great demand. Some lawyers and real estate salesmen are effective negotiators.

Today there are several cave management plans that could be implemented if only negotiations to buy the cave had been successful. NSS grottos or special project groups did the research, set objectives and made plans, and even raised funds. But the outcome is in doubt because of some problem. In one instance, the project leaders thought they had an agreement with the owner to buy the land, only to discover that there were other owners who were either unsympathetic or unreachable. In another instance, the price of the land skyrocketed when the prospective seller became convinced that a government agency with unlimited resources would reward him handsomely if he held out.

These are not necessarily failures in negotiation, but the projects might have been accomplished successfully or brought to a stalemate with less anguish had there been a skillful negotiator.

The Cave Research Foundation officers have engaged in a variety of negotiations. They have negotiated agreements with federal agencies on the national, regional, and local level. They have negotiated agreements with other groups. They have negotiated leases and agreements with landowners. They have purchased land to protect caves. This experience has led them to the conclusion that negotiations can always benefit from professional expertise, and such expertise often seems unavailable.

I believe that everyone who has been involved in cave conservation negotiations has felt inadequate. When I was president of the Cave Research Foundation, I often wished that an expert had been available to conduct the negotiations -- or at least that the advice of an expert could have been made available to me.

I propose that the NSS undertake an investigation of cave negotiations. Could the NSS inventory its members to identify those who are skilled at negotiating agreements, making offers to buy land, or mediate conflicts? Could the NSS establish a Negotiations Committee of volunteer or paid practitioners who would be available to projects and groups? Could the NSS conduct a seminar or workshop on cave negotiations -- led by experts -- for the benefit of those who need to negotiate? Could the NSS publish a <u>Cave Negotiations Handbook</u> similar to its successful <u>Cave Gating Handbook</u>?

III. Toward A Community of Cave Defenders

The NSS, CRF, and other caving groups have had considerable success with local conservation task forces. Often a local group is close enough to a threatened cave to know the situation intimately; it can respond quickly, develop local media contacts, and can provide continual monitoring.

When threats become too severe for local groups to counter, the task force calls in friends and allies. The activities of such task forces can be analyzed for insight on what makes them effective. The following four elements of task forces have been identified from discussions with Beth Estes, Chairman of the NSS Mammoth Cave Conservation Task Force.

1. Growing a sense of stewardship. The first task in developing the task force was making a list of the caving and noncaving groups that might be expected to share a conservation ethic for Mammoth Cave. The common objective was preservation of natural features. In some cases, groups were identified that had an economic interest in preservation of natural features. For example, Mammoth Cave is the goose that lays golden eggs of tourist dollars; if you kill the goose by pollution, there will be no more tourists.

   Letters and conversations confirmed the common interest. By keeping groups posted on late-breaking developments, a rapport was built, leading to an informal partnership, and finally to a sense of stewardship toward the resources of the cave. On one occasion, the Superintendent of Mammoth Cave met with representatives of half a dozen organizations to discuss cave conservation problems.

   Stewardship means managing and keeping safe in a caring way. When participants in a task force know their concerns are being acted upon, they commit themselves and can be expected to pitch in as needed.

2. <u>Knowledge better than speculation.</u> A community implies shared experiences, knowledge, values, and neighborliness. One of the best ways to cement the community of cave defenders is to research the facts about the cave, so that actions of the group may be based on knowledge rather than on hunch or speculation. When such knowledge is shared, it can provide a basis for authoritative statements and reasoned recommendations.

   At Mammoth Cave, the task force had the benefit of nearly three decades of intensive research and publishing by Cave Research Foundation and other investigators. The longest cave is also the most studied cave. Consequently, the task force was able to tap this reservoir of knowledge, first to inform and educate friends and allies, and secondly, to work out its own positions.

Probably any conservation task force needs to address the issue of building its data base. Perhaps it can recruit investigators to survey and map. Experts are available to help make cave inventories. In any adversarial situation, such as cavers versus strip miners, the opponents to the cave conservation position are most likely to attack any lack of factual evidence. "Proof by assertion" isn't good enough. When the task force has the facts, it can also attack the opponent's position by challenging their unsupported assertions.

3. Planning heads off problems. A third element of successful conservation task force operation is careful planning. This planning cycle must always start with writing down the objectives. The reason is that planning is rather easy to do when objectives are stated, and takes forever when objectives are left behind.

   At Mammoth Cave, one objective was to let citizens of the region know what vile and loathsome acts were being committed upon or in the cave. The plan that followed was to find investigative reporters who were interested in a good story, and to obtain speaking engagements at local clubs and groups. Many objective stories have been written about the situations at Mammoth Cave; and, more local citizens know and care about the caves than ever before.

4. Recognize victories. The fourth element of successful task force management is acknowledgment of victories. Individual members of the task force need to be told when they have achieved a victory, and thanked for their perseverance. Cave conservation task forces are organized initially only when clear and present dangers are recognized. By this time, the chances for saving the cave may seem slim. Opponents may be well organized and well financed. Legislators may have been bought off. The bulldozers may be rolling.

   With such long odds against success and so many adversities, the task force planners need to establish goals along with their plans. A goal is a quantitative, measurable milestone. For example, the objective may be to recruit and interest news reporters. The plan is to identify and contact those in the area. The goal may be to get three local stories in the paper. When the third story appears, that is victory! It should be a time of celebration, bestowing of credit, and renewal.

   Great accomplishments are the result of little victories.

Some Real Problems Solved By Management

Are these ideas blue sky? Or are they really in the mainstream of cave conservation today? I believe they are practical, and the following case histories illustrate the principles in action.

A caving permit system at Mammoth Cave. Last year the staff at Mammoth Cave National Park wanted to open up some of the park's cave resources to organized spelunking. The park had been forced to cancel the popular Wild Cave Trip into Mammoth Cave because of budgetary limits. There was no question that this superlative interpretive experience was the highlight of a lifetime to many of the participants. But it was not cost-effective from the standpoint of guide usage. The staff had obtained copies of the caving permit system from Carlsbad Caverns.

When the NSS Mammoth Cave Conservation Task Force learned of this planning, they initiated contacts between NSS officials and Park Service officials. Since the NSS grottos were expected to be heavy users of the new permit system, it seemed reasonable to include the NSS viewpoint in the planning. To its credit, the Park Superintendent wholeheartedly welcomed the NSS committee and soon put it to work.

The NSS committee quickly saw that the preliminary planning had centered around logistical problems of how to administer the permit system. The problems of cave conservation, resource inventory, rescue and safety, and monitoring were largely unaddressed.

A set of management objectives was proposed by the NSS committee, and adopted by the Park staff. These objectives were entirely consistent with the National Park Service mission to preserve the resource for future generations, yet to encourage the widest enjoyment. With the objectives behind them, it was clear that a natural resource inventory and hazard assessment needed to be made of the proposed cave. The committee undertook to organize mapping and other studies. In the meantime, it became clear that a certain level of staffing would be required if the program was to meet its objectives. The Park Service was committed to providing staff support

Then the budget axe fell. There was no money to run the regular interpretive program, let alone something new. In the absence of objectives, planning, and study, another administration might have tried to "wing it", to mount a half-baked permit caving program. This did not happen at Mammoth Cave because the staff was conscientious and dedicated. They shelved the program rather than sacrifice a cave. You may ask, is this a victory?

To be sure, it was a disappointment. But it certainly was a victory for sound cave management. None of the planning has been lost. The objectives are still valid. If the value of the experience is later raised high enough, or if budget money is restored, money might still be allocated for the program.

In this instance, we see the interrelationship of money, of negotiating skill, and of a community of well-informed cave defenders who made themselves available to assist the staff in doing a good job.

Law of the land applies to caves. Now we turn to the subject of cave conservation hardball. For years the caving community has protested the locating of the Great Onyx Job Corps Center atop Flint Ridge in Mammoth Cave National Park. The Park Service and independent investigators found repeated instances of sewage pollution, cave vandalism, altering of natural conditions by diversion of surface springs for drinking water, and destruction of government property. The struggle to eliminate these outrages has continued for many years in many arenas.

After the last round of massive sewage leakage into the karst aquifer, the National Parks and Conservation Association and several others sued the Department of the Interior and the National Park Service to close the center and cease the adverse impacts. The suit led to a plan to relocate the center on land with no caves beneath but for various reasons the funds were not made available to finance the relocation. Plaintiffs in the case petitioned the court after more than a year of seeming inaction to issue an order requiring termination of the use of the site.

That order came in June of this year: If the Park Service had funds for the relocation project, then the present center must be vacated and restored to its natural state by October 1, 1983. If there were no funds available, then the site was to be vacated and restored by October 1, 1982.

On September 22, the Interior Department and National Park Service asked the judge to amend his order, to provide a delay in relocation until December, 1983. The judge denied the government's request without a hearing. Today the closing of the center is well under way, and the sewage lagoons are being drained. Thus, victory for cave conservation appears to be at hand.

Why was it necessary to resort to legal hardball? Couldn't those concerned about caves rely on the mission of the National Park Service and its stewardship? Perhaps if it had been left strictly to the professionals in the Park Service, stewardship might have prevailed. But the facts are that political hardball swept aside the mission of the Park Service in this instance. Political concern about the preservation of a visible project with its payroll had become "more valuable than its cost". The cave was about to pay the price. In this case, the caving community and its allies used the law of the land to increase the value of the caves, and to "sell" the idea that the National Park Service is subject to laws and not to men.

Value itself can protect. Let me close with a third case. Some cavers and geologists had long marveled at a significant karst feature, a large sinkhole or karst window. The gulf is on privately owned land. The cavers learned that the site was being considered as a possible pumping station for a municipal water works, and possibly other uses. The owner was approached, and asked if he would sell for preservation, to an organization such as The Nature Conservancy. He said yes, and eagerly followed the formal evaluation process that leads up to such a transaction.

When The Nature Conservancy was satisfied that the site was indeed significant, it asked the price. The owner had become so convinced of the large intrinsic value of his property that he quoted a price three to four times higher than prevaling local prices for the entire 300 acres. The deal fell through. Was this a victory?

The answer is yes. Even though the land did not pass into formal protection, the process had raised its value in the eyes of the owner so high that he would not sell it for ordinary consideration. The land remains unsold today, and is still protected by the land owner. Could more skillful negotiations have preserved the land forever? We do not know, but we do know that increasing the value of the natural feature over its "fair market price" has resulted in many years of protection.

Overview of Conservation and Management

Robert Stitt*

A BRIEF HISTORY OF CAVE MANAGEMENT

The cave conservation and management movement generally began in the early 1800's, with the opening of commercial or "show" caves, which allowed the public to visit caves under the supervision of the owners. Until the beginning of the twentieth century, cave management was primarily in private hands, but several National Parks and Monuments containing caves were formed in as early as 1906. Carlsbad Caverns became a National Monument shortly after its discovery in the late 1920's, and Mammoth Cave, which had been in private hands for most of the time it was known to the white man, passed into Federal hands in the early 1940's.

At about the same time, the National Speleological Society was founded, to bring together speleologists and sport cavers in pursuit of a common goal--the study of caves. By the 1950's, it became obvious to many NSS members that unless actions were taken, caves in the natural state would not long be with us, and the NSS Conservation Committee was formed. At first, the Committee mainly monitored cave management outside the Society, but by 1960, it was realized that one of the primary threats to caves was the caver. The NSS Conservation Policy, an ethical code aimed at encouraging cavers to regulate their own behavior to take better care of caves, was adopted by the NSS Board of Governors.

During the 1960's, there was increased conservation awareness and activism on the part of NSS members, many of whom worked with various agencies to promote better management of caves. There was much caver education within the NSS, and local and scattered activism. The Cave Research Foundation, which had been formed in the late 1950's primarily to engage in speleological studies within Mammoth Cave National Park, became an increasingly important force and gradually developed a good working relationship with the National Park Service.

The rise of the environmental movement in the early 1970's led to increased activity and interest on the part of NSS members and other cavers in more active management of cave resources. In an attempt to get more awareness and involvement on the part of Federal cave managers and private sector cave owners, the first National Cave Management Symposium was held in Albuquerque in 1975. The continuing series of symposia has continued to focus interest and involvement in cave management in spite of a reduced national leadership visibility within the NSS on cave conservation issues.

In summary, over the past almost two centuries there has been a movement from landowner (mis)-management of caves towards more knowledgeable and active management on the part of landowners and managers and more involvement of cave users--cavers and speleologists--in cave management.

PROBLEMS OF CAVE MANAGEMENT AND CONSERVATION

I see three major problems that plague the cave conservation and management field:

Because of the low public profile which the caving community has adopted, there is a lack of public interest in cave conservation and management. Although the low public profile has been founded on the assumption that if the public knew about and visited caves that they would destroy them, in fact, the policy appears to have had an ironic reverse effect: because the public does not care about caves, scarce government resources that could be used for management has been allocated to other areas that have more public awareness.

This has led to a lack of resources for cave management both on the part of the federal land management agencies and the caving community. Cavers have relied on hard work and scrounging

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to gate a few caves, and have often had to resort to secrecy (a tactic which only works for awhile) to keep people away from caves and thus defer their eventual discovery and destruction by the uninformed general public.

In fact, much of this lack of support for cave management has resulted from the sometimes almost violent divergence of opinion in the caving community. The subjects of cave gating and caver proliferation are but two of the issues which have resulted in a flurry of letters to the editor of caving publications, the generation of massive correspondence files, and in some cases, wild (usually never proven) accusations and character assassination. Although this dialogue may be a healthy sign that ideas are circulating and being considered, it has often appeared to managers in government and to some members of non-caving environmental organizations that the caving community does not really have an in interest in cave management or conservation, but instead is interested in cave politics.

CAVER CAVE MANAGEMENT

While all this debate has waxed and waned over the years, many cavers have quietly begun to start managing caves themselves. Some have turned caves into show caves (Cumberland Caverns is the best example of a show cave that was built up by cavers). Others have puchased cave properties and managed them as cave preserves (Friars Hole), research facilities (Butler, Perkins) or as sacrificial caves (Knox). The NSS obtained Shelta Cave as a scientific preserve in 1970, and McFails Cave has been maintained as a scientific and advanced sport caver preserve since it was given to the NSS in the last 1960's. At the present time (Fall 1982), the NSS is negotiating for several other cave properties. [Note: By the time this paper was written up in the Spring of 1983, Trout Rocks has been puchased, Pettibone has fallen through, and others seem to be in a state of limbo.]

Problems which have continued to varying degrees for NSS Cave managers as well as others have included liability, continuity of interest, local group interest, and obtaining knowledge of how to properly manage the caves.

CAVE MANAGEMENT TOOLS

A number of tools are available to cave managers. The NSS provides some of these, others are available from a variety of sources, ranging from the managers ingenuity to the adoption of management ideas from other resource fields.

Public Education -- One way to gain public support and to reduce unthinking actions on the part of non-cavers is public education. Eventually a change of attitudes is necessary or we will all live on a planet denuded of its natural heritage. Although there is always the Catch-22 risk in this course, there are ways to educate the public about the value of caves without encouraging visits to wild caves. One way, for example, would be to distribute educational materials at show caves. The NSS has several brochures available aimed at educating the public about cave values, and also has a Public Relations Committee which is working on public education. A new project, offering a reward for the conviction of cave vandals, also shows some promise in making the public aware that cave vandalism is a socially undesirable act.

Caver Education -- It is presumed (although perhaps not correctly) that cavers exposed to the right attitudes through association with NSS members will adopt proper conservation attitudes. Certainly self education and restraint on the part of the NSS Internal Organizations and members is important--but most cavers do not belong to the NSS. Those cavers can be reached through peer pressure in the caves. A successful cave register program in many areas has led either to recruitment of cavers into the NSS or to at least an understanding that there are organized cavers around. The NSS has many publications aimed at caver education, including the Caver Information Series (CIS) and the recently published book Basic Caving.

Cave Laws -- Many states have cave protection laws which provide varying degrees of protection. There has been a state and local emphasis in the movement to obtain cave protection legislation, and it has been a difficult political process in some areas. The low profile kept by cavers has not helped. Even when the laws are on the books, without pressure from the public, there usually is no enforcement. The NSS Conservation Committee has a subcommittee which provides information on cave protection laws, and local NSS cavers working with show cave owners have been a potent force for obtaining the passsage of cave protection laws.

Cave Gates -- The cave gate is an important means of controlling access to the cave, and thus making the users more accountable, but a gate is not always an appropriate management tool, and is certainly a controversial one. Cave gates, if not properly installed, can alter the cave environment and have an adverse effect upon the life in th cave. To promote knowledge of proper gating techniques, the NSS has published a book Cave Gating.

Cave Owner Involvement and Education -- This is an important tool to not only keep caves open and accessible to cavers, but contributes to the long term wise management of caves, since it is only with the owner's permission that any cave management can take place by cavers or others. To facilitate this, the NSS has a Land Owner Relations Committee, and published a brochure "Caving Courtesy" for the education of cavers about getting along with landowners.

Government Involvement -- It is likely that until there is a change in admiminstration government involvement in cave management will decrease reflecting a decrease in available funding and a seeming lack of interest on the part of the current administration in preservation of anything.

KEYS TO THE FUTURE

In order to assure more support for cave management, we need to take a higher public profile, educating the public about the value of caves while trying not to encourage them to visit wild caves.

We also need to develop alternate sources of funding for cave management and conservation projects. Certainly, a widespread public education program will not get far without money. Some of this money can come from the caving community, but we will increasingly have to turn to outside sources, including the wider environmental movement, for funding.

Finally, there will be an increasing trend towards caver control of caves. Cavers, both through the NSS and on their own, will increasingly manage caves both as show caves and as wild cave preserves.

These trends, coupled with an increasing self-awareness on the part of the caving community, can lead to better management of caves.

The Need for Cave Conservation

Paul Stevens[*] and Lee Stevens[**]

Abstract

One of the best arguments for cave conservation is to observe the contrast between beautifully decorated caves and caves which have been degraded by man. Perhaps if we can show others the best and the worst of caves, then they may sympathize with our concern for caves and the need to conserve them.

No Manuscript Received

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MANAGEMENT PHILOSOPHIES

An Overview of Cave Management and Cave Interpretation in Missouri State Parks

Scott W. Schulte*

Abstract

In Missouri's State Parks, there are numerous caves which are under the care and protection of the Division of Parks and Historic Preservation of the Department of Natural Resources. These caves vary from simple shelters to extensive systems. These resources are considered to be a valued aspect of the parks' natural resources and considerable thought and effort is given to their protection and interpretation.

Highlights of Missouri's State Park caves management and interpretation are: 1) A cave inventory of all state parks, showing locations, biological content, speleothems and providing management guidelines; 2) A cave permit system for use by cavers in the wild caves; 3) Management plans are being developed for the caves in the parks; 4) Naturalist led cave tours in several state parks. An adventure caving program at Rock Bridge Memorial State Park; 5) Concession-operated commercial cave operation at Onondaga Cave State Park. Interpretive guidelines and guide training is provided by State Park staff; 6) Cave rescue planning and preparation; 7) Endangered species management; 8) Cave pollution research and management; and, 9) Cave Resources Act.

No Manuscript Received

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Tennessee Valley Authority's Role in Cave Protection and Management

Patricia A. Fink*

Abstract

The TVA Regional Natural Heritage Project is working to identify and protect significant natural features occurring in the seven-state Tennessee Valley region. The Heritage Project maintains a data base which contains information on threatened and endangered plant and animal species, State and Federal managed areas, sensitive habitats, champion trees, and unique geological features, which includes caves. The data management system was developed by the Nature Conservancy, and includes cross-referenced map, manual, and computer files. The data is used for environmental assessment and to identify significant natural areas in need of preservation. Efforts are then made to protect these areas.

Environmental assessment carried out by the Heritage Project consists of reviewing proposed projects located within the Tennessee Valley that will affect TVA lands or rivers, or receive Federal funds. These proposals are reviewed to determine whether or not the project will conflict with a significant natural feature, such as a cave. This technique has prevented adverse impacts to caves by identifying conflicts prior to construction activities.

TVA became active in cave management by efforts to protect the Federally endangered Gray and Indiana bats. Three caves--Hambricks, Nickajack, and Norris Dam--have been gated in order to prevent disturbance of their bat populations. Ten other caves on TVA lands contain important bat colonies, but because of their inaccessibility are not as vulnerable to destruction and disturbance. Several other caves on TVA lands are being protected by designation as Small Wild Areas.

No Manuscript Received

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Cave Management:
The Bureau of Land Management Approach

J. B. "Buzz" Hummel *

Abstract

This paper deals with the Bureau of Land Management's philosophy and methods of managing cave resources on public lands in the United States. Our approach is basically conservation/preservation oriented, with the objective of managing cave resources in coordination with other natural resource programs as part of comprehensive land use plans.

Background

The Bureau of Land Management, also referred to by the less cumbersome title of BLM, is the United States' largest resource conservation agency. We have exclusive management responsibility for about 357 million acres or 56 percent of all federally administered lands. This land area is over twice the size of the state of Texas. BLM administered lands do not include National Parks or Forests, and are mainly located in eleven western states and Alaska.

BLM is a relatively young federal agency that was formed by Congress when the General Land Office and Grazing Service were combined in 1946. The General Land Office was formed in 1812, to dispose of public domain lands and enforce mineral laws, while the Grazing Service was created in 1934 to administer grazing on public lands.

Recent management direction was given to the Bureau through two acts of Congress, the Multiple Use Act of 1964 and the Federal Land Policy and Management Act of 1976. These congressional mandates changed Federal land management goals from a disposal policy to one of retention in public ownership.

A National commitment to seek energy self-sufficiency and increased fiscal constraints has resulted in decreased funding levels for the Bureau's recreation programs. The Bureau's recreation program is but one of many multiple use programs and consequently, when program emphasis changes from one resource to another, all programs must be reevaluated to ensure that resource needs are being met.

This past year, the Bureau reevaluated and developed a new policy for recreation management. The current emphasis is centered around the intensity and type of management required. Two types of management are recognized - intensive recreation management and extensive recreation management. The first type is to be applied to areas of public lands when recreation is defined and recognized as the principal management objective. Only in these areas, which comprise a small proportion of the public lands, is there a need to do detailed planning and set detailed objectives with respect to visitor and resource protection, and provide recreation opportunities consistent with public wishes.

The second type, extensive management, is where recreation is not the principal management objective but is an issue or concern of some significance in multiple-use management for an area. Management emphasis in these areas is focused on resolving existing management issues or concerns and detailed planning is not normally done.

Cave resources are currently being managed under both types of management in the Bureau. New Mexico's cave program is an example where intensive management is being applied.

Caves and other recreational resources were not considered to be a Bureau management responsibility until the mid-1960's. At this time, members of the caving community contacted the Roswell, New Mexico District office of BLM and

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informed them that a rancher, who leased Federal lands for grazing had denied them access to a cave located on his lease. This incident brought about an awareness by BLM of this unique resource. The Southwest Region of the National Speleological Society (N.S.S.) aided BLM in obtaining additional information which revealed the extent of cave resources on public lands, and that mining, vandalism and rock collecting were rapidly destroying many of these caves.

By 1969, through the devoted efforts of a Bureau employee, Don Sawyer, the framework for a national level cave management policy had been formulated. Although all of Don's recommendations were not implemented at the national level, he was successful in gaining recognition for cave resource values in the form of program funding and resource recreation values. Presently, BLM is actively managing caves in the four western states of Oregon, Wyoming, California and New Mexico.

Management Philosophy

There is no Bureauwide policy or guidelines specifically aimed at cave management and no federal statutes or regulations which address cave resource protection. For these reasons, localized BLM management efforts were developed using a "seat of the pants" approach.

BLM's recreation management philosophy is not to overdevelop recreation sites by filling every space with camp units, tables and toilets; nor is it to build them into existence by drawing in the public with lavish campgrounds. The recreation management philosophy is aimed at enhancing and protecting values which are presently being enjoyed by the recreationist. The manager accomplishes this goal by managing the natural resource setting, and the activities which occur within it. This general philosophy is also represented in BLM's cave resource management program. Developments made in the caves, such as trails and gates, are for the purpose of protecting visitors or cave resources, which also enhances visitor experiences. Full scale cave development or commercialization to benefit casual visitor or tourist is provided by the National Park Service or the private sector. Caving organizations including the N.S.S., Cave Research Foundation (C.R.F.) and others played an important part in developing this management approach.

Management Methods

Recreation program emphasis fluctuates due to changes in emphasis for a particular workload such as wilderness inventory. This program must also compete for funds with other higher priority commodity resource programs. As a result of this yearly variation in funding, managers are required to use innovative approaches in order to maintain cave program integrity.

We have dealt with this funding problem by sharing our stewardship with cave user-groups. By establishing close working relationships with these groups, we are able to draw on them for assistance with the on-the-ground management.

Strong public involvement and volunteer work has provided the Bureau with essential information and assistance. This has also been beneficial in providing grassroots support and served as an information outreach program.

Basic cave management is done on a case-by-case basis. Each cave requires a separate management evaluation based upon its intrinsic values. Cave management evaluation and management plans are developed in a four step process.

1. Identification/ownership of cave resource.

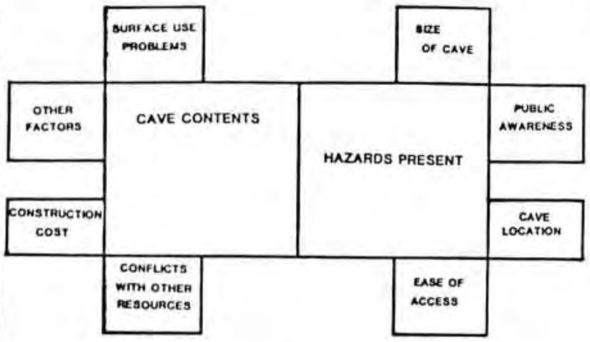
2. Cave inventory, classification and report.

3. Management evaluation and decisions completed.

4. Implementation of management decisions.

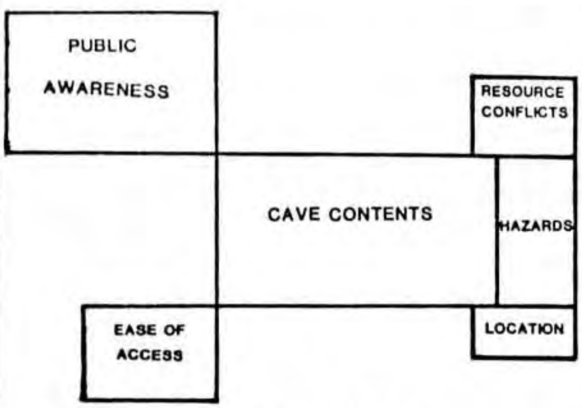
When a cave has been determined to be on federal land, an inventory of physical and biological resources is performed. These inventories are done to determine the hazards and resource contents which are present. This information is used to establish management classes and serve as a data base for management decisions. Management decisions and protective measures are based upon the fragility of physical or biological resources or the magnitude of hazards which are present. Implementation may involve both on-the-ground actions (gating) and administrative actions (permit requirements).

The intensity and complexity of management needed for any particular cave is based on the potential for man caused actions which may impact its integrity. This concept may better be explained graphically, using a management model.



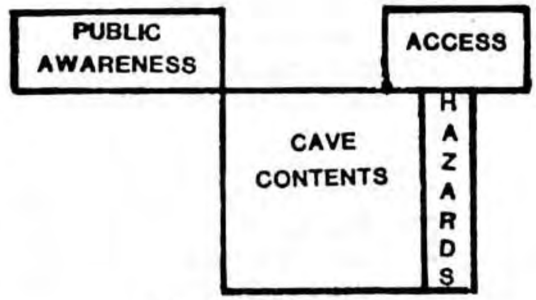
Example 1

Each of the above boxes represents a management consideration which may deal with a specific cave. The size of each box is indicative of its importance, (big problem-big box). The diversity or number of management considerations (boxes) is depicted by the configuration of the model. The main management considerations that are intrinsic to any cave consist of the contents and hazards present. These factors provide the core of the model while other management considerations, shown as extremities of the model, may be less important or nonexistent at a particular cave.



Example 2

Example 2 presents a cave with these management considerations: it has few hazards but has contents of some interest which deserve protection; the cave has been known by the public for a number of years and is readily accessible by an improved dirt road; oil and gas development is taking place in the same area as the cave.



Example 3

Example 3 represents a cave with the least complex management considerations: it has one room, a single passage and is small; it has no formations or animal life, but may be of archaeological interest; access is not difficult and the cave is known to the public.

As can be seen from the previous examples, each cave may require a different level of management. We are presently using a three-tiered approach which is listed in the order of management involvement:

1. Administrative measures;

2. Regulatory actions;

3. Physical controls.

Administrative measures involve the least stringent form of management. They could include signing, patrolling, public involvement, tours, cave talks, brochures, or other forms of public contact. This level is where public involvement and education is an important factor and can be built through administrative outreach programs.

Where administrative measures are insufficient to protect the resource or visitor, regulatory actions can be taken. These actions may involve the requirement for cave entrance permits, passage and enforcement of state or federal laws, legal closures and signing.

If administrative and regulatory actions fail or are not sufficient to meet management needs, then on-the-ground measures may be required. Physical controls may alter the natural setting, could impair some resources in the cave and should only be used when absolutely necessary. For example, installation of a gate to protect speleothems may inhibit the movement of a bat colony as well as having effects upon the cave's microclimate.

No cave management program will work without public support, which is the most important factor. BLM has achieved this support by sharing our stewardship with the public. We have a good working relationship with the organized caving community - their involvement and volunteer work has and continues to provide a foundation for our program.

The Virginia Cave Commission

Evelyn Bradshaw*

Virginia does not claim to be the state with the most caves, but we can assert some firsts in the legislative field. Our original Cave Protection Act of 1966 is believed to have been the first passed through efforts of the organized caving community, and we were the first--and to date the only, I believe--state to have an official Cave Commission.

Parenthetically, it is only fair to acknowledge that in some states such as Missouri there is a branch of state government that officially includes cave-related matters under its aegis, with active cavers involved in carrying out projects.

How did the Commission come about? After an abortive attempt to improve the Cave Protection Act in 1977, one Virginia caver living in Richmond observed that the legislative process in Virginia often worked best if a subject was first authorized for study, and results of that study then brought to the General Assembly for enactment into law. This was done, and in 1978, there was authorized the Virginia Commission on the Conservation of Caves (House Joint Resolution 10), with a mandate to study ways to provide for the conservation of caves.

The first eleven members of this Commission included ten members of the caving community, all relatively active in the National Speleological Society, and the owner of one of Virginia's fine commercial caves. At the end of the year, they recommended both an improved cave protection act along the lines of recent legislation in neighboring states and the establishment of a permanent Cave Commission.

All along, the General Assembly has proven very sympathetic to our cause. Apparently in the Old Dominion, caves rank right up there with motherhood as worthy of protection. Most bills have been passed with only token opposition or unanimously.

It would take too long to recite all of the accomplishments of the Commission since 1979. Annual printed reports are available for those interested. During the first year, a small appropriation enabled the Commission to purchase cave protection signs that can be installed to apprise the visitor of the provisions of the act, and to initiate computerization of Virginia cave data. This was negotiated by contract with the Virginia Speleological Survey, which has such data, and thus rockhounds cannot secure locations for all the caves with formations in X County under the Freedom of Information Act.

A newsletter for cave owners was initiated. These people have often known only a few local cavers, or unfortunately, only casual thoughtless visitors more likely to trepass and vandalize than to appreciate underground wilderness. We hope to enlist their support for protection and management of this resource.

The Commission also negotiated with the Highway Department to keep open but gated another significant cave whose entrance was on an interstate highway, rather than having it bulldozed completely shut and thus unavailable for study and observation.

Without state funding since 1980, the Commission has been able to secure modest financial support from cave-related oganizations. The Commissioners serve at their own expense.

A major undertaking during these first years has been the identification of some 250 caves in the Commonwealth as significant, based on a carefully selected set of criteria. A threat to two of these led to negotiations successfully altering the manner of erecting and maintaining a water facility in one county.

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*Secretary, Virginia Cave Commission, Alexandria, Virginia.

CAVE RESOURCES

Basic Cave Geology

F. Howard Campbell III*

A cave is defined by the U.S. Geological Survey as "a natural opening in the ground, extending beyond the zone of light and large enough to permit the entry of man".

Caves occur in a variety of rock types and are produced by different geologic processes. The major types of caves are sea caves, lava caves, glacier caves and solution caves. Of secondary interest are ice caves, eolian caves, tectonic caves and talus caves.

Sea caves are formed by the persistent action of waves attacking the weaker portions of rocks bordering the shore. Waves breaking on the shore exert enormous pressure in cracks in the rock and against less resistant parts of the rock. Gravel and sand carried by the waves exert a corrosive force eroding the rock, and solution by the sea water removes carbonate rock to form caverns, arches and intricately eroded pillars and outcrops along the shore. Slides illustrate the wave cut terrace, sea cliff and sea caves in chalk at Flamborough Head, Yorkshire, England, and wave cut arches and karst pillars on the South China Sea. Some sea caves are entered by boat and are illuminated by the reflection of light through the water. Illumination is likely to be blue or green tinted.

Lava caves are created by the differential cooling of a lava flow. As the surface of the flow cools and crystallizes, it forms the roof for the developing lava tubes which represent the last areas within the flow to contain streams of moving lava. As the flow subsides, the level of lava within the tubes lowers. Eventually all flow stops, the lava crystallizes and the lava cave remains. Access to these caves is through spatter vents in the roof or through areas of roof collapse. Slides from Craters of the Moon, Idaho and Lava Beds National Monument, California illustrate pahoehoe lava flows, gas pockets in the flows, roof collapse, spatter cones, lava stalactites, and interior views of the tubes. Many lava caves have wall ridges running the length of the passage. These represent the surface of subsequent flow levels within the tube after initial formation. Some lava caves have very smooth floors while others contain a ridge of lava extending the length of the passage. When these ridges are cracked lengthwise, they resemble a long loaf of bread. Lava ridges and "bread loaf" ridges represent the last movement of molten lava in the tubes.

Glacier caves are formed in the zone of ablation at the "downstream" end or "toe" of a glacier. Here the ice is melting and caves are formed by the melt water which enters cracks and crevasses in the ice and excavates drainage passages through or beneath the glacier. These passages form a three-dimensional network following fractures in the ice. Water is sometimes seen as a glacier surface stream entering a hole in the ice, to emerge later from caves along the bottom of the glacier or from the face of the glacier at varying heights forming waterfalls to the valley floor.

Ice caves are not associated with glaciers. Rather, they are usually solutional caves or lava tubes which contain ice for most if not all of the year. Slides illustrating an ice cave are of Merrill Ice Cave, a lava tube, in Lava Beds National Monument, California. During the winter, water freezes in the cave, and the ice persists through the summer because the cold air is not displaced by circulation and insulates the ice from warm summer air.

Solution caves are the most numerous and the largest type of cave. They form in carbonate rocks, i.e., limestone, dolomite and marble and in sulfate rocks, i.e., gypsum. These caves are created by slowly moving groundwater that dissolves the rock to form irregular passages, tunnels, and large caverns along joints, faults,

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bedding planes and other areas of weakness in the rock. The groundwater table is an important control of cave passage development. Three slides illustrate the progression of cavern development with reference to a lowering groundwater table. Passages developed above the water table, in the vadose zone, are called vadose passages and those developed below it, in the phreatic zone, are called phreatic.

The most widely accepted theory of cavern development is the two cycle theory, which involves hydraulic action below the water table in the first cycle, followed by cave passage modification and ornamentation in the second. Evidence for first cycle, phreatic, development is seen in blind galleries, ceiling pockets, three dimensional networks of passages and ungraded passage floors. The water table fluctuates seasonally and it is within this upper part of the phreatic zone that the rate of solution is most rapid and cave passages develop. As the water table lowers permanently in the region, air enters the cave passages and speleothems are able to grow. The second cycle consequently involves passage modification and ornamentation in the air-filled environment of the vadoze zone. Although there is some debate about the mechanisms which produce speleothems, the general process is well known. Rain water ralling through the atmosphere and soaking through the humus layer of the regolith "picks up" carbon dioxide and becomes a weak carbonic acid.

The major minerals in carbonate rocks, calcite and dolomite, react with the carbonic acid to produce a highly soluble salt, calcium bicarbonate. Calcium bicarbonate is about 30 times more soluble than calcite; consequently, limestone and dolomite rock exposed to carbonic acid readily goes into solution. This chemical weathering phenomenon, called carbonation, is responsible for the excavation of cave passages in the phreatic zone and for ornamentation in the vadose zone. The deposition of calcium carbonate, calcite, is accomplished by a reversal of the carbonation reaction in which carbon dioxide is released to the atmosphere of the air-filled cave, and calcite precipitates, creating speleothems. Three slides from Sennit-Thorn Mountain cave system in Pendleton County, West Virginia, illustrate various types of speleothem.

Orientation of cave passages is often determined by the attitude, strike and dip, of the rocks and by the pattern of joints or fractures in the rock. Where rocks are nearly horizontal, cave plans often show a great deal of joint control. Two slides illustrate this effect, showing the upper and lower surfaces of the passages determined by bedding and the walls controlled by joints. When the rocks dip substantially, the plan of the cave may be dominated by the strike of the rocks, and passage cross-sections may become triangular as illustrated by a slide of the big room in Sennit Cave. If the dip of the rocks is vertical, the bedding planes frequently become passage walls and the cave plan may again be dominated by the strike. Arguments have been made for dominant control of cave passages by bedding planes because of their great continuity. The world's longest caves, Holloch Cave in Switzerland and the great Kentucky caves, are largely bedding plane caves. Other caves are obviously dominated by joint control as is illustrated by slides of the Linville Quarry Caves in Rockingham County, Virginia. Many caves have scallops, current markings, on passage walls. These indentations, illustrated by a slide from a Kentucky cave, are solutional forms caused by flowing water in the pasage. The size of the scallops is an indication of the velocity of the water which created them. The distance between crests of the scallops is inversely proportional to flow velocity. Consequently, the slower the water flow, the larger the scallops.

Cave ornamentation is quite variable; however, some structures similar to speleothems are produced outside the cave environment. Slides of icicles and of stalactites attached to mortar joints of modern buildings illustrate some of the forms. External stalactites may form in carbonate rock, as illustrated in a slide showing a Mogote in the Cibao Formation on the island of Puerto Rico. The Mogote is itself a large residual hill of limestone resulting from karst erosion in regions of subtropical or tropical rainfall. A series of slides illustrate some of the surface features of karst erosion. Cross sections of sinkholes are seen in road cuts along I-80 in Pennsylvania and in Mammoth Cave National Park. Recurring sinkholes in Alabama persist in spite of periodic filling with quarry gravel. Pinnacled limestone varies, as seen in slides of construction sites in Virginia and quarry sites in Alabama. In some cases the erosion, aided by imagination, produces fanciful "critters" sculptured in the limestone. Differential weathering produces a highly irregular upper surface which can be seen in the oucrop pattern of carbonate rock. The irregularity becomes more apparent as illustrated by three slides of a quarry site in Alabama. Here the soil has been removed in preparation for quarrying, revealing the sometimes intricate sculpturing of the rock.

Eolian caves tend to be shallow but may be spectacular in size. They are created by wind blown silt and fine sand eroding softer areas of the rock. The process is essentially one of sand blasting and is active in arid regions. Even in the driest deserts, eolian caves are outnumbered by caves of other origins. Water is important in cave formation, even in arid regions, especially if the rock is a carbonate or if the sandstone has a calcareous cement. In our desert southwest, for example, most of the rock sculpturing is a result of water erosion during a past humid climatic period.

Wind caves are not eolian in origin; rather they are solution caves. The name wind cave is derived from the strong air currents that alternately blow in and out of the cave with changes in atmospheric pressure.

Tectonic caves may be formed in any rock type by earth movements causing fracturing and faulting. In zones of fracture and along some faults, openings in the broken rock may be large enough to explore. These passages may be ornamented by subsequent groundwater action.

Talus caves also form in any rock type. Talus is the name given to rock which has been mechanically eroded from bedrock. The term refers to one fragment of rock or may describe the landform produced by large masses of broken fragments. A talus cave is formed when the individual fragments are large and are so arranged as to create explorable passages through the mass between and around boulders.

Origin of Caverns

David A. Hubbard, Jr.*

Many millions of years after the limestone and dolomite beds of the Conococheague Formation were turned up on end, Grand Caverns began to form. The valley floor was higher than the top of Cave Hill and the water table was at a level well above the cavern location.

As water moved between the rock beds (nearly vertical) and along fractures transverse to bedding (joints), it dissolved some of the limestone and dolomite layers. Some of the layers, more resistant to solution, were left as partitions in Dante's Inferno and the Shield Room. Where fractures intersected, the increase in surface area and volume of water resulted in the solution of large rooms or great halls such as The Ball Room and Cathedral Hall.

As the cave enlarged by solution, the valley above was gradually widened and deepened by erosion. Clay and silt settled out of turbid groundwaters during floods and started filling in the cave. The groundwater level eventually became so low that the cave began to drain. Occasional floods still deposited clay and silt as their turbid waters receded.

Water seeping through the ceiling and walls deposited calcite as dripstone and flowstone. As seeping waters trickled through the cave, some deposits of clay and silt were reduced. Other deposits, containing residual limestone pebbles, were left.

As the valley deepened further, small cave streams washed more of the fills away, leaving flowstone bridges and false floors (near Persian Palace and the Senate Gallery). A large pool of water remained in a pit just past Lover's Lane. As this pool gradually subsided, calcite rims were left at numerous levels.

Water continued to drip and flow from ceilings, walls and floors depositing vast arrays of stalactites, stalagmites, draperies, shields and other calcite deposits (cave formations).

The clay fills, which everywhere covered the cavern's bedrock floor, continued to settle resulting in broken and tilted cave formations. A few of these cracked formations have since mended themselves with flowstone, leaving a scar-like welt.

Parts of the caverns have been blocked by cave formations which grew together. The growth of flowstone and dripstone deposits will cause the caverns to become smaller and shorter.

As the hill above erodes closer to the cave level, parts of the cavern will collapse, occasionally forming sinkholes on the surface. Eventually, the caverns and their once beautiful formations will be eroded away as the surface of Cave Hill reached them. However, beneath the valley, groundwater is at work dissolving limestone and dolomite along joints and beds of the Conococheague Formation.

SHIELD GENESIS

The most intriguing aspect of Grand Caverns is its shield formations. Pondering the origin of such impressive formations results in many more questions than answers.

Shields are composed of two parallel planar layers of plates separated by a thin space. Growth is radially concentric from a point of origin similar to a folding fan. Shields are normally inclined but the growth is not always downward from the point of origin. Growth may propagate from a wall outward with one side of

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the plates dipping toward the floor and the other side rising toward the ceiling.

The space between plates must remain thin enough for water to adhear to both plates as it migrates by capillary or hydrostatic pressure toward the outer growth ring of the formation. Capillary adhesion allows the growth to proceed in apparent defiance of gravity. Calcite is deposited along the margin of the plates as carbon dioxide is released from the water surface in contact with the cave air, which has a lower partial pressure of carbon dioxide.

Should the weight of the lower plate cause it to sag or fall away, growth of the shield stops. Increased flow of capillary water results in the expulsion of saturated waters which may develop draperies and other flowstone features on the lower plate.

The initiation of parallel plates is an intriguing question. Why does Grand Caverns have so many and other caves so few? What is so unique about Grand Caverns?

Introduction to Cave Paleontology

Fred Grady*

Abstract

For many years, paleontologists have described specimens of great scientific importance from caves. These range from the spectacular, such as saber toothed cats and giant bears to such animals as mice and bats. Cave owners, cave managers, and cavers should be aware of this resource and make sure it is protected and available for study by paleontologists.

Caves and paleontology are related in two ways. Fossils often occur in the limestones where the caves are formed and fossils may be deposited in caves during and after cave formation.

The fossils in the limestones are usually marine invertebrates and occasionally fish. They are often hundreds of millions of years old. From a cave management point of view, these fossils are seldom of concern, though there have been cases of vandalism. These kinds of fossils are frequently found more easily accessible outside of caves in road cuts and quarries.

The fossils deposited in caves are much younger, usually less than one million years old. These fossils have received more attention from paleontologists, as caves are one of the best sources for them. Most important are vertebrate remains, usually bones and teeth.

Ronald Wilson (1980), in particular, has discussed the nature of bone deposits in caves and the types of caves they are likely to be found in. Allen McCrady (1959) described some of the different types of bone deposits in caves. Vertical entrances and former entrances often have served as traps for unsuspecting animals. Cave entrances are sometimes favored as roosts for predatory birds which deposit remains of their meals in caves. Carnivores and woodrats aid in the accumulation of bones in caves. Floods also deposit vertebrate remains in caves. Finally, bats roosting in caves die and their remains become fossil deposits. Some sites derive from a combination of the sources described above (Grady and Garton, 1980).

Vertebrate remains in caves are often extremely fragile and collection should be under supervision of a paleontologist. Collection of one or more identifiable items such as a jaw will often allow a professional to make a determination of the scientific importance of a deposit (Wilson, 1980). Such specimens should be wrapped in tissue and placed in a hard container for removal from the cave. Large skeletons, particularly if fragile to the touch, should be photographed in place for evaluation.

Excavation of a paleontological site is often a time and labor consuming process. Some states and the federal government require permits for excavations on their lands. The excavation itself should be superintended by a paleontologist. If the decision is made not to excavate a site, it should be protected from vandalism. Cave owners, cave managers, and cavers should be aware of the paleontological resources in caves and contact a paleontologist upon the discovery of a potential site. A list of members of the National Speleological Society Vertebrate Paleontology study group is provided below.

Cavers have a long record of working with paleontologists, and it is important to acknowledge the debt of gratitude owed to cavers for the many hours of time and expertise they have put

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into the discovery and excavation of many important paleontological sites.

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Introduction to Cave Biology

Dr. John R. Holsinger*

Abstract

The basic principles of cave ecology and the evolution of cave organisms and ecosystems will be discussed, followed by a review of the diversity of animals found in North American caves.

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Cave Bats, Their Ecology, Identification and Distribution

Dr. Virginia M. Tipton*

The purpose of this paper is to acquaint the reader with various ecological aspects of cave bats necessary to promote the understanding upon which sound management is based. Thus, management is not specifically addressed. For information on management of cave bats, see the paper by John Brady in this volume and his 1978 paper; Mohr, 1972; Mohr, 1976a; Harvey et al., 1981; Poulson, 1976; Poulson and Kane, 1977; Tuttle, 1977; and Tuttle and Stevenson, 1978. Further specific management practices will be included in the Indiana Bat and Gray Bat Recovery Plans which should be available from the U.S. Fish and Wildlife Service sometime in 1983.

Bats are mammals, warm-blooded, fur-bearing animals that give birth to living young and nourish them with mother's milk. They are the only mammals capable of flying; "flying squirrels" merely glide through the air. Worldwide, bats have a tremendous diversity of lifestyles; some bats eat fruits and flower nectar, some eat insects, some even have a very specialized diet of blood. Bats roost in caves, cliff faces, trees and other vegetation, and even manmade buildings. Bats range in size from no bigger than the end of the thumb to about the size of an adult chihuahua. Some bats have huge eyes that enable them to navigate like owls in the night; other bats have less acute vision and rely much more heavily on echolocation. An "echolocating bat" emits ultrasonic instead of audible cries. These ultrasonic pulses bounce off objects in the environment and return to the bat's ears as echoes. The bat then uses this information to navigate in much the same way an airplane or submarine does when using radar and sonar. Our primary sensory information is gained through sight; that of the echolocating bat is hearing, and it is acute enough to allow the bat to detect and capture gnats and mosquitos flying through the underbrush.

The cave bats of the United States are all relatively small (no larger than the size of a fist). The majority of them have a diet of insects; a single bat may eat about one-third of its weight in insects during a night. Many of the bat species hibernate over the winter. Hibernation occurs when insect food is unavailable, and the bats must do something to survive. Therefore, they go into a state of almost suspended animation where bodily processes are slowed down to such an extent as to require very little food for survival. All the "food" necessary to endure this period of hibernation is stored as body fat which is slowly used as the winter progresses. A bat which is awakened too many times during the winter will thus die of starvation because it cannot replenish its food supply. If the bat survives this critical time in its life history, it emerges from hibernation, lean and hungry for insects in the spring.

Upon leaving the hibernacula in the spring, bats fly to their summer quarters. Very few species of bats are found in caves in the summer, the endangered gray bat being the most notable in the east and the Mexican free-tailed bat in the west. Many will remain above ground, locating themselves in tree hollows, under bark, in buildings, or such. Of those which do enter caves, the females of most species congregate together in nursery colonies. Birth and rearing of the young constitute another critical period in the lives of bats. Females readily abort or abandon their young if they are disturbed too much. This is important because bats have a very low reproductive rate, one or two young per year. A slight reduction in the birth rate could have a significant impact upon the population. The birth of a baby bat is fascinating. The mother turns head up (opposite her usual resting position) and forms a pouch with her tail (interfemoral) membrane to help catch the

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newborn bat who emerges feet first. The infant uses its hind feet to climb up the mother so it can finally grasp a nipple to nurse. The mother meanwhile is licking and cleaning the baby and will only leave it (hanging in the nursery) when she goes out to forage at night. Young bats are able to fly in three to five weeks. Depending upon the latitude and species of bat, the young will be out foraging with their mothers by late July or early August. This does not really give them much time to learn the habits for survival and put on the weight necessary for hibernation. Besides, shortly after learning to fly, they are making the trek to the winter hibernating grounds, anywhere from several miles for the long-eared bats to several hundred miles for the gray bats. So the yearlings are especially vulnerable during their first hibernating season.

Fall swarming may well be as important to the survival of bats as winter hibernation and summer birth and rearing of the young. It is not yet well understood, but this time period has been taken into account when restricting access to some "bat caves" for protection of the bats. The term, "swarming," was first introduced by Wayne Davis in 1964 (Fenton, 1969) to describe the late summer and early fall nocturnal flights into, out of, and around certain caves. The bats just seem to swarm around the cave entrances all night long. Davis and Hitchcock (1965) surmised that the swarming activity served to help bats locate hibernating sites. In addition, Fenton (1969) suggested that swarming functions in reuniting the sexes for mating since he observed mating activity at this time. Males and females generally roost separately during the summer. Courtship occurs mainly during the fall and also into the winter. Males have been found copulating with torpid females at hibernacula. In a remarkable departure from the usual mammalian sequence of reproductive events, the females do not immediately become pregnant. They store the sperm in their reproductive tracts until the spring, at which time an egg is released from the ovary. This egg will then be fertilized by the sperm, thus initiating development of the embryo. The pregnant females then migrate to their summer or nursery roosts.

The caves used by bats must be suitable for their specific requirements. For hibernation, it is not sufficient for a cave just to be dark and quiet to allow successful torpor (lowering of metabolic activities), the humidity must also be high enough and the temperature must be exactly right for each species. Too high a temperature will raise the metabolic rate and cause the bats to use too much energy; too low a temperature may result in "freezing to death." Summer caves must also have the correct (but higher) temperature. Humidity and quietude are also necessary for proper rearing of the young. Surprisingly, most caves do not qualify as either good hibernacula or nursery roosts. Therefore, when bats are disturbed and driven from a cave, they may very well not be able even to find another cave to which they might retreat. Or, if they remain within the same cave, the alternate roost site may not be satisfactory for long-term survival of the species.

List of Bats

Only the 48 contiguous states of the United States are considered. Of the 40 different species listed by Barbour and Davis (1969), 21 (or about half) can be found with some regularity in caves during some part of their life cycle. With some species, still not enough is known to make definitive statements about their habitat (so I made value judgements and categorized them on scanty information). Occasionally, "no-cave" (or "tree") bats will wander into caves and thus be found there. Myers (1960) found many dead tree bats of the genus Lasiurus in several Missouri caves.

Following is a list of the 21 "cave bats" with a brief description and notes on distribution, habitat, and mode of life. The list is sequenced according to taxonomic relationships. Species of bats can be grouped into genera (singular = genus) and genera can be grouped into families. The species has a two-part name which is demarcated from the rest of the text by italics or underlining. The genus is the first name of the species binomial, and it is capitalized. The scientific names were created not to make life difficult, but to resolve confusion caused by common names (e.g., there are several species of "long-eared" bats). So I will list the bats by scientific name but will include the common names. Sometimes a part of the scientific name becomes a common name; Myotis sodalis is sometimes called "sodalis" which is better than the commonly used "Indiana bat." The forearm measurement is given because it is one of the easier to recognize and more stable characteristics; the forearm is the largest wingbone seen when the bat is hanging at rest. The calcar is also used in descriptions; it is a small projection of one of the foot bones toward the tail, and it helps support the tail (interfemoral) membrane. Notice that some of the distinctions between species sound easy until you are actually confronted with the bats and discover that only the very experienced bat observer could actually tell the difference. Distribution information was obtained from Hall (1981).

FAMILY: PHYLLOSTOMATIDAE

Mormoops megalophyla

Common name: Leaf-chinned bat, leaf-chin bat, moustache bat.
Description: Forearm, 51-59 mm. A brownish bat with a flatish face that has leaf-like folds of skin in the chin region. One of the larger bats. Cannot be confused with any other species.
Distribution: Known only from a few records in southern Arizona and southern Texas. The northernmost extension of its range.
Habitat: Usually caves, mines, tunnels and rarely buildings at any time of the year.
Habits: Colonial, but not clustered in groups like other colonial bats. Apparently does not hibernate. Insectivorous.
Remarks: The presence of this bat in any given cave is quite unlikely.

Macrotus waterhousii

Common name: Leaf-nosed bat, California leaf-nosed bat.
Description: Forearm, 47-55 mm. A large gray, big-eared bat with a triangular leaf-like flap of skin that projects upward from the end of the nose. The nose leaf distinguishes this bat from other species with which it could be confused. Relatively large eyes.
Distribution: Extreme SW U.S.--California, Nevada, Arizona; the northernmost extension of its range.
Habitat: Abandoned mines and large caves of the lowland desert.
Habits: Colonial, but not clustered. These bats do not hibernate because they occur far enough south that food is available year-round. Insectivorous.

Choeronycteris mexicana

Common name: Hog-nosed bat; long-tongued bat.
Description: Forearm, 43-45 mm. A large brownish bat with a very long skinny nose and a prominent nose leaf. Large eyes. The tail extends about halfway to the end of the tail membrane (which is reduced). Small ears. Could be confused with either species of Leptonycteris which both lack a tail.
Distribution: Extreme SW U.S.--tips of California, Arizona/New Mexico, southernmost Texas; northernmost extension of is range.
Habitat: Caves and mines; sometimes buildings. Apparently not found in U.S. in the winter.
Habits: Colonial. One of the few non-insectivorous bats; they feed on nectar of flowers for which their slender noses and long tongues are adapted.
Remarks: These bats are extremely wary and easily disturbed.

Leptonycteris nivalis

Common name: Mexican long-tongued bat, long-nosed bat.
Description: Forearm, 55-60 mm. One of the larger bats, sooty brown in color, Very long slender nose with a triangular nose leaf. There is no tail and the tail membrane is reduced. Difficult to distinguish from L. sanborni which is only a little smaller in size and has shorter fur that is more reddish. Can be distinguished from C. mexicana which has a short tail.
Distribution: Big Bend area of Texas. Summer only. Quite rare.
Habitat: Caves above 5000 feet in elevation.
Habits: Colonial. Feeds on nectar and pollen.

Leptonycteris sanborni

Common name: Sanborn's long-tongued bat, long nosed bat.
Description: Forearm, 51-56 mm. One of the larger bats, gray to reddish brown in color. An erect triangular flap of skin (nose leaf) at the end of a long slender nose. There is no tail and the tail membrane is reduced. Very similar in appearance to L. nivalis which is slightly larger and does not have the reddish fur. Can be distinguished from C. mexicana which has a short tail.
Distribution: Southern Arizona, extreme SW tip of New Mexico; northernmost extension of its range. Apparently migrates to Mexico where food would be more plentiful for the winter.
Habitat: Caves and mines in lowland desert scrub.
Habits: Colonial. Eats pollen, nectar, fruit,

and insects. Does not hibernate.
Remarks: One of the 3 cave species with a plant diet.

FAMILY: VESPERTILIONIDAE

Myotis lucifugus

Common name: Little brown bat, lucifugus.
Description: Forearm, 34-41 mm. Dorsal fur is bicolor (dark at bases) glossy brown, light ventral fur. Long hairs extend beyond tips of claws. Ears, 14-16 mm. In the eastern U.S., this species can be distinguished from M. keenii by its shorter ears; distinguished from M. sodalis by the long toe hairs and lack of a keeled calcar; distinguished from M. leibii by its larger foot and larger size; distinguished from M. grisescens by its smaller size and bicolored dorsal fur; distinguished from M. austroriparius which has dull, wooly fur. In the western U.S., can be distinguished from M. yamanensis which has dull fur and is usually smaller; M. velifer is usually larger with nonglossy fur; M. leibii is smaller; M. keenii has longer ears; M. thysanodes has a fringe of hairs along the edge of the tail (interfemoral) membrane. This comparison of lucifugus with other species with which it could be confused is limited to the cave bats. There are other species of Myotis which I have not included with cave bats that could be confused with lucifugus.
Distribution: This is probably the most abundant bat in the U.S. It is found in every state except Louisiana, most of Texas, most of Florida, most of Nebraska, and the western half of Kansas. its range extends south somewhat into Mexico and north across Canada and into Alaska.
Habitat: Caves, mines, and buildings. Caves and mines in the winter only. It is exceptional to find this species in caves in the summer in the East; summer nursery colonies may be found in caves in the West.
Habits: Colonial. Hibernates in caves and mines either singly or in loose clusters (compared to the tight clusters of the Indiana bat). The colonies may be anywhere from a few individuals in a cave to many thousand bats. They seem to prefer hibernating temperatures of 30 to 55 degrees F (average 46 degrees) with humidities of 85 to 100 percent (average 89). They may be covered with water droplets while in hibernation, a dramatic sight!

Myotis yumanensis

Common name: Yuma myotis.
Description: Forearm, 32-38 mm. Dull fur, light tan to dark brown. Calcar not keeled. Confusing species: M. lucifugus--see lucifugus description; M. leibii has keeled calcar; M. velifer is larger.
Distribution: All of Arizona, California, Oregon, Washington; most of Idaho, extreme western Montana and Nevada, SE Utah, Northern New Mexico, southern and extreme western Colorado.
Habitat: Caves, mines, buildings, under bridges in the summer in arid regions. Whereabouts basically unknown in the winter.
Habits: Insectivorous. Colonial--summer nurseries.

Myotis austroriparius

Common name: Southeastern bat, southeastern myotis, Mississippi myotis, austroriparius.
Description: Forearm, 36-41 mm. A medium sized Myotis with wooly, dull yellowish-brown hair on back; ventral hair is lighter. Long toe hairs. Calcar not keeled. Can be distinguished from similar species by its wooly fur. Ears are shorter than M. keenii.
Distribution: Southeastern U.S. over to extreme eastern Texas and Oklahoma. Range extends up the Mississippi River into the Ohio River drainage in southern Illinois/Indiana.
Habitat: Caves, mines, hollow trees, buildings, culverts, beneath bridges.
Habits: Large maternity colonies in caves in Florida, but they do not frequent the Florida caves in the winter because they seem to be too warm for hibernation. In other states hibernate in caves. Colonial.

Myotis grisescens

Common name: Gray bat, cave bat, Howell's bat.
Description: Forearm, 40-46 mm. A large, big-footed Myotis. Calcar not keeled. Dull, grayish-brown dorsal fur that is the same color from base to tip. Can be distinguished from confusing species by its unicolor fur and unique attachment of wing membrane (at upper part of ankle rather than at lower part at the base of the toe as in other bats).
Distribution: Missouri, Tennessee, Kentucky, Alabama and the fringes of their adjacent states.
Habitat: Caves, summer and winter. This species is virtually unknown outside of caves.
Habits: · Extremely colonial. Females form large maternity colonies, numbering in the thousands. Nearly the entire species hibernates in only 5 caves! The bats form dense clusters (sometimes layered) of up to several thousand individuals.
Remarks: This species is on the Federal Endangered Species list. Since it aggregates in only a few caves, it is especially vulnerable to

local catastrophes and human disturbance. Summer maternity colonies are particularly sensitive. Merely shining a light on them will cause large numbers of young to be dropped to the floor, resulting in high mortality (Tuttle, 1976).

Myotis velifer

Common name: Cave bat, Mexican brown bat.
Description: Forearm, 37-47 mm. Dull brown fur. Calcar not keeled. In the eastern part of the range (Kansas, Oklahoma, central Texas), it's larger than other species of Myotis which are also more scarce. In the western part of its range, there are more species of Myotis. M. thysanodes has longer ears and a fringed interfemoral membrane. M. yumanensis and M. leibii are smaller.
Distribution: Southern Arizona and new Mexico, southwestern Texas extending north through central Oklahoma and into southcentral Kansas.
Habitat: Mainly caves and mines; sometimes buildings. At lower elevations.
Habits: Highly colonial. Nursery colonies are mainly in caves, sometimes buildings. Winter clusters are quite large.
Remarks: This is the most common bat found in caves in its range in Texas, Oklahoma, and Kansas; found year-round. It is frequently found clustering with the freetail bat.

Myotis keenii

Common name: Keen's bat, keenii, Acadian bat.
Description: Forearm, 32-39 mm. A medium-sized Myotis with long ears (17-19 mm). Brown fur, not glossy. Calcar not keeled. Could be confused with M. thysanodes which has a fringed interfemoral membrane. M. lucifugus has shorter ears (14-16 mm).
Distribution: There are 2 disjunct populations. One extends down the coast from Canada into northwestern Washinton. The other is more extensive, ranging across the eastern U.S. from western Montana to northern Florida.
Habitat: Caves and mines in the winter.
Habits: This species uses caves for winter hibernation. the bats are never abundant in any one cave and are usually found singly where they frequently tuck themselves into cracks. In summer, they can be found in caves at night, where they may rest after or during feeding sessions. They were noted swarming in scores around a cave entrance in Pennsylvania in August, 1931 (Mohr, 1933).

Myotis thysanodes

Common name: Fringed bat.
Description: Forearm, 39-46 mm. a rather large brownish Myotis with a conspicuous fringe of hair along the free edge of the tail membrane. It is the only Myotis with this trait.
Distribution: Western U.S. to Colorado and New Mexico. A disjunct population is found in western South Dakota and nebraska.
Habitat: Caves and buildings in the summer.
Habits: Colonial. Winter range unknown.

Myotis sodalis

Common name: Indiana bat, social bat, sodalis.
Description: Forearm, 35-41 mm. Keeled calcar. Hairs on foot short and inconspicuous. Dorsal hair brownish. To distinguish from confusing species, M. lucifugus has long toe hairs and no keel on the calcar, M. keenii has longer ears; and M. leibii is smaller.
Distribution: Eastern U.S. from southern Wisconsin and Michigan to northern Florida, west to eastern Oklahoma.
Habitat: Caves in the winter.
Habits: Not found in caves in the summer. Extremely colonial in the winter, clustering so tightly that all one sees are wrists and faces. The clusters contain 500 to 1000 (sometimes as many as 5000) bats. Usually, no droplets of water form on these bats.
Remarks: This is a Federally Endangered Species because of its tendency to concentrate the hibernating population in only a few caves. During the winter months, 94 percent of the known population of around 500,000 is found in 13 caves in 5 states. Drastic declines in the population have been documented (see the Indiana Bat Recovery Plan).

Myotis leibii

Common name: Small-footed myotis, least brown bat, masked bat, leibii.
Description: Forearm, 30-36 mm. A small brownish bat with black ears, a distinct black facial mask, and dark wing and tail membranes. Calcar keeled. The size and presence of the dark mask are distinguishing.
Distribution: A disjunct population, half of which is in the west from just inland from the Pacific coast to middle Dakotas, Nebraska, Kansas, and Oklahoma. The eastern population extends from the New England states completely

through West Virginia, Kentucky, Tennessee and on into western Oklahoma with the edge of this range extending some into the adjacent states. It is not found in the deep south or upper mid-west.

Habitat: Caves in the winter.

Habits: Does not spend summer days in caves, but may use them as night roosts. One of the few bats known to hibernate in caves in the west. Solitary, with hibernating habits similar to the big brown bat in choosing very cold and drafty hibernating sites.

Pipistrellus hesperus

Common name: Western pipistrelle, canyon bat.

Description: Forearm, 27-33 mm. Keeled calcar. Membranes dark, contrasting with light yellowish to brownish fur. The smallest bat in the U.S. Small size and light coloration are distinguishing.

Distribution: The deserts and lowlands of southwestern U.S. northward to southern Washington. As far east as western Oklahoma in the south and into western Colorado further north.

Habitat: Caves in the winter.

Habits: Hibernate singly, never numerous in any single location. May be active during the winter over part of its range.

Pipistrellus subflavus

Common name: eastern pipistrelle, pipistrelle, pip, pygmy bat.

Description: Forearm, 31-35 mm. A small bat with unique tricolored fur, each hair has a light band in the middle. Pale, reddish forearms contrasting with dark wing membranes. Anterior third of tail membrane furred. Usually fur is yellowish.

Distribution: Widespread across the eastern U.S. from the eastern edge of Nebraska, back westerly through Oklahoma across to the Atlantic coast. Absent from Michigan.

Habitat: Caves for hibernation.

Habits: Only found in caves in the summer at night being used as nighttime roosts. Solitary hibernator. Seem to prefer warmer hibernating sites. Frequently covered with droplets of water.

Remarks: No one cave ever contains thousands of these bats, but just about every cave has at least one or two of them.

Eptesicus fuscus

Common name: Big brown bat, barn bat, house bat.

Description: Forearm, 42-51 mm. Keeled calcar. A large brown bat with glossy fur and a broad nose. This bat is larger than species with which it might be confused.

Two big brown bats stuffed into a crack in the cave wall. These bats commonly hang solitary or in pairs and are frequently found in cracks.

Distribution: Throughout all of the U.S.

Habitat: Caves and buildings.

Habits: Seldom found in in caves in the summer. Hibernate singly or in small groups within caves near the entrances. They never become beaded with moisture like little brown bats and pipistrelles.

Pipistrellus subflavus (pipistrelle) with human thumb for scale. These tiny bats hang solitary rather than in clusters.

Plecotus townsendii

Common name: Long-eared bat, big-eared bat, Western big-eared bat, Townsend's big-eared bat, lump-mosed bat.

Description: Forearm, 39-48 mm. A medium-sized brown bat with 2 large lumps on the nose. Short toe hairs. Tan underparts. Huge ears, measuring more than an inch in length. Can be distinguished from P. rafinesquii which has long toe hairs and whitish ventral fur. Antrozous pallidus lacks the nose lumps. Macrotus waterhousii has a nose leaf.

Distribution: There are 4 subspecies (or races) of this species and their ranges are dispersed across the U.S. P.t. townsendii and P.t. pallescens have a range that extends from middle Kansas westward. P.t. ingens, the Ozark big-eared bat, is found only in northwestern and northcentral Arkansas, southwestern Missouri, and eastern Oklahoma. P.t. virginianus, the Virginia big-eared bat, is limited to western West Virginia, eastern Virginia, and extreme notheastern Kentucky.

Habitat: Caves only, summer and winter in the east. In the west, may also be found in buildings and mines.

Habits: May be colonial, forming tight clusters or solitary; additionally, in the west, may occur singly or in small groups.

Remarks: The Ozark and Virginia big-eared bats are on the Federal Endangered Species list. This is because their numbers are extremely low to begin with and are declining, and they are extremely intolerant to disturbance. In fact, a characteristic of all the individuals of the entire species is that they are very easily disturbed an can readily be caused to abandon their roosts. Wildlife biologist Mark Perkins has shown from some of his surveys in Oregon that many caves previously inhabited by long-eared bats have been abandoned. Apparently, there are no longer any nursery colonies in caves in California either. Some biologists think the whole species should be considered endangered or at least threatened because of the bats' exceptional susceptibility to disturbance.

Plecotus rafinesquii

Common name: Rafinesque's big-eared bat, eastern big-eared bat; southeastern big-eared bat; eastern lump-nosed bat; long-eared bat.

Description: Forearm, 40-46 mm. A medium-sized grayish brown bat with 2 large lumps on the nose and huge ears more than an inch in length. Underparts whitish. Long toe hairs. Can only be confused with P. townsendii--see above description.

Distribution: Southeast, east to extreme eastern Texas and north to southern Indiana and southern West Virginia.

Habitat: Caves in only part of its range.

Habits: This is not a common bat anywhere in its range. Has been found in caves in both summer and winter, but records of such findings are few.

Antrozous pallidus

Common name: Desert pallid bat, pallid bat.

Description: Forearm, 48-60 mm. A large pale yellowish bat with ears over one inch long and large eyes. The ears are widely separated whereas the ears of Plecotus are closer at the bases. M. waterhousii has a nose leaf.

Distribution: The Far West. The eastern border extends from western Washington and Oregon, into western Nevada, across middle Nevada into middle Colorado and into western Texas, with a small population on the border of central Kansas/Oklahoma.

Habitat: Caves summer and winter.

Habits: More commonly found in rock crevices and buildings in the summer. As with most of the western bats, scarce in the winter; their whereabouts are mostly unknown, but some have been found hibernating in caves.

FAMILY: MOLOSSIDAE

Tadarida brasiliensis

Common name: Mexican free-tailed bat, Brazilian free-tailed bat, guano bat, free-tailed bat.

Description: Forearm, 36-46 mm. A rather small dark-brown bat. The distinguishing trait is the lower half of the tail extending beyond the free border of the tail membrane. Hairs as long as the foot extend beyond the toes. The ears almost meet in the midline but do not actually join one another.

Distribution: The whole southern U.S. north to southern Washington, northern Colorado, southern Nebraska, middle Arkansas, northern Mississippi, northern Georgia, northern South Carolina. there are 2 disjunct records in NE Illimois and southern Ohio.

Habitat: Caves in the summer.

Habits: This species is unusual in that huge maternity colonies (many thousands of individual bats per colony) are found in caves in most of the western states and large (up to several thousand) maternity colonies are found in buildings (but not in caves) in the Southeast and

California. Most of the bats migrate south for the winter, as much as 800 miles into Mexico. Some remain in the more northerly areas but are not found in caves.

Rabies

I just want to emphasize that we have a tendency not to keep bats and rabies in perspective. Bats can carry and transmit rabies, which is a serious disease. But we should be very fearful of the automobile which kills far more humans each year, yet we manage to keep that in perspective. I think the statement by Dr. Robert Martin (1975) at the University of Main sums it up, "Although radies is found in bats, my calculations indicate that your chances of being killed by being run over a blue-painted Mack pulp truck driven by a pipe-smoking 65-year old woman who owns six beagles are greater than your changes of dying from rabies contracted from a bat." There is an excellent publication by Dr. Merlin Tuttle and Stephen J. Kern entitled "Bats and Public Health" (1982) that can tell you everything you ever wanted to know about bats and rabies and its list of references is extensive. It can be obtained from the Milwaukee Public Museum for $2.00.

Recommended Books

For further reading on bats, the following general works are recommended (full information is found in the References): Barbour and Davis, 1969; Mohr, 19976b; Griffin, 1958; Nivock and Leen, 1969; Yalden and Morris, 1975. Sloane (1977) has a chapter by Charles Mohr on two of the federally endangered bats. For more technical reading (although Barbour an Davis and Griffin would also fit into this category): Wimsatt, 1970 (Vols. I and II) and 1977 (Vol. III; Baker et al., 1976 (Part I), 1977 (Part II), and 1979 (Part III).

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Identification and Significance of Common Archaeological Remains From Cave Deposits

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No Manuscript Received

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A Brief Survey of the Role Played by the Cave in the Work of Art and Literature

Rosemary Balister*

The cave has played its part in world art and literature since earliest times. It was with this idea in mind that I spent a period of absence from the world of gainful employment reading books both from my own collection and those of local libraries looking specifically for references to caves. I'm sure that they are far from complete and I would be glad to learn of any references particularly from American literature.

Most people are aware of the prehistoric uses of caves as basic dwelling places for man from which our modern homes have evolved. Some of us have also been privileged to see the beautiful paintings on the walls of caves in France and Spain made before the birth of Christ and still preserved to this very day. Other primitive peoples such as the American Indian and the Australian aborigine have also left their art on walls and rock shelters.

Caves play an important part in Greek and Roman mythology. Zeus is hidden by Rhea, his mother, in a cave on the island of Crete as a child and later lived with a star maiden in a cave on Mount Cyllene by whom he had a child Hermes who was born and brought up in a cave. The cave theme also runs right through the labours of Hercules and serves as a home for Hydra, the many-headed monster, and Cacus, the fire-breathing troll. The entrance to the Underworld is said to be the great cave of Taenarum and the famous labyrinth at Crete has its center a cavern. In Roman literature, the cave serves as setting for Hades, entered at Avernus according to the Dido and Aeneas legend. Also, the worship of Mithras, practiced at garrisons of the Roman Army, is said to have taken place in artificial caves.

Caves are mentioned both in the Old and New Testaments. In Samuel, we read that "when the men of Israel were in a strait, they hid themselves in caves" and in Kings that "the prophets of the Lord cut off by Jezebel were hidden by Obadiah in a cave and lodged there." Of Elijah we read the "came hither unto a cave and lodged there." Many depictions of the birth of Christ show the stable of Bethlehem as a cave and in Hebrews we read of those "of whom the world was not worthy, who wandered in deserts, and in mountains and in dens and caves of the earth." The persecuted Christians in Rome hid away in catacombs which are a form of artificial cave.

Various manuscripts of medieval literature mention caves including Chaucer "the legend of good women" "and to a kaave pryvyly him spedde" and much of the Tristan and Isolde lgend is set in a cave. There are speleo references throughout Shakespeare in Cymbeline, The Rape of Lucretia, Julius Caesar and picturesquely in Venus and Adonis.

> 'Or, as the snail, whose tender horns
> being hit
> Struck back into his shelly cave with
> pain.'

The Romantic movement in literature brought with it a great awareness of nature-mountains, lakes and of course grottoes and caves. There are numerous references in French, German and English literature of this period. Wordsworth wrote a whole poem about Fingal's Cave on the island of Staffa off the coast of Scotland. The cave theme runs throughout Coleridge's poem Kubla Khan and the poem Endymion by Keats has many references to caves. In German poetry, Goethe's poem Mignon tells of caves as the dwelling places of dragons - the cave salamander perhaps, and of seven references in French poetry I found one by Theophile Gautier the most charming.

> 'Et la stalactite qui tomee
> Larme blanche de l'antre noir'

In American poetry Thoreau writes of "caves rabbitted" and in a delightful poem "Mind" by Richard Wilbur the workings of the human brain are compared to a cave bat. "That beats about

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in caverns all alone". Perhaps this is a venture into a new field of speleo-psychiatry.

There are a lot of references to caves in novels both in the classics and in works of general fiction. Two of the novels of Jules Verne "Journey to the Center of the Earth" and "The Mysterious Island" have long passages in them with vivid descriptions of caves. Few people know that the British novelist Thomas Hardy wrote a delightful book for children "Our Exploits in West Poley" in which the entire action was set in a cave in the West of England. In American literature, the book "The Adventures of Tom Sawyer" by Mark Twain and the part played by a cave in Missouri is almost too well-known to mention. I did, however, also find reference to a book "Cudjo's Cave" by J. R. Trowbridge published in 1864 and set in Tennessee at the outbreak of the Civil War. In works of general fiction, the cave is mentioned as a place of refuge from the world, in association with the supernatural or for the adventure of exploration. The cave trip itself is seen as a test of character for those taking part.

We have dealt with cave art and primitive man, but the cave also has a role in classical art. Part of the inspiration for the background of Leonard da Vinci's "Madonna of the Rocks" was a visit when the artist was young to the Grotto di Fiumeletti. Paintings and enravings of the Nativity of Christ are often set in a rocky cave and perhaps the most famous painting of an actual cave is in the National Gallery in D. C., the lovely "Grotte de la Loue" by Courbet, a painting of a cave entrance with water flowing into it. Recently, I also saw at a special exhibition in the National Gallery an unusual painting "The Grotto" by Paul Delvaux. We can also read about caves in our daily newspapers. the state of groundwater in Virginia is of constant concern. In addition to cave accidents which always make the headlines, there are reports of archaeological finds in caves and even a cave hold-up. They have been in the news recently as storage places for cheese being distributed to the poor and also of interest is their possible use for the disposal of radioactive waste.

Last year, the 8th International Congress of Speleology was held at Bowling Green, Kentucky. This was the first time outside Europe and to publicize the event it was hoped to persuade the Post Office to issue a special stamp or set of stamps, depicting scenes from America's very lovely caves. Efforts were, however, in vain. For what man refused to do in the way of publicity, nature took upon herself, and in Florida a large sinkhole obligingly opened up, swallowing houses, cars, etc. In Albemarle County, closer to home in Virginia, a sinkhole collapsed in a farmer's field and in Charlottesville, a photograph of a pedestrian walking under an underpass in the rain giving the appearance of stalactites made the front page of the local paper and the Washinton Post.

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RESOURCE MANAGEMENT

Prescriptions for Cave Management

Robert Stitt* **and James Nieland****

Abstract

The Gifford Pinchot National Forest is developing management plans to guide its resource management. A committee of concerned cavers from the Northwest Caving Association of the NSS is developing a set of "prescriptions" for cave management which can be used as a basis for caver input to this planning effort. This paper includes a discussion of how cavers can contribute to the planning effort and presents a number of the "prescriptions" being prepared. These "prescriptions" go beyond the usual management guidelines which address only cave inventory and assessment and are guidelines for the ongoing management of caves within the overall Forest management scheme, in accord with the goal of protecting the cave resources while allowing other uses of the Forest.

The administration of the Gifford Pinchot National Forest in southwestern Washington State is developing two management plans for the Forest: an overall Forest Management Plan, and a plan for the specific management of Mt. St. Helens National Geologic Monument. This planning process involves development of a proposed plan, obtaining public inputs, and eventually, after several years of both public and private discussion, environmental impact analysis, and public hearings, the plans will be adopted. An early stage of the planning process involves discussion and inputs with interested user groups.

In the summer of 1982, following the NSS Convention at Bend, Oregon, cavers from the Northwest Caving Association (an NSS Region) met at Dead Horse Cave in southern Washington for a post-convention trip. During the discussion around the campfire one night, the subject of cave management naturally came up. Various problems of cave management in southern Washington on both the part of cavers and management agencies were discussed. It was eventually decided that what was really needed was for the cavers to get their act together and prepare a list of specific management tools that could be used to manage caves in the area. Coincidentally, it was learned that the U.S. Forest Service was seeking inputs for its own management planning process. It was decided to combine the two projects--the cavers would prepare a list of recommendations for management that could be used by the Forest Service in the development of its own management plans.

A group of concerned cavers met at the Yale School on August 14, 1982. First, we reviewed the current state of cave management planning in the Forest Service.

There has been a considerable local planning effort in the Gifford Pinchot National Forest; it has been the subject of several papers presented at previous National and regional Cave Management Symposia (1)(2). In the last few years, the Forest Service Manual (3), which could be characterized as the "bible" of Forest Service management, has had a supplement on cave management added (at least for Region 5 which, unfortunately, does not include the Gifford Pinchot National Forest). This supplement is fairly comprehensive with respect to two aspects of cave management: Inventory and Classification. However, the supplement does not include guidelines for carrying on with the day-to-day management of the caves once they have been inventoried and classified. It was decided by the group that the next step should be taken: managers should be given a set of guidelines for dealing specifically with the problems that they

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would face in dealing with the caves and in placing caves into the overall management perspective of the entire forest.

This approach fits quite nicely with the approach currently being taken by the Forest Service: the development of a series of management "prescriptions" for carrying out management goals. The remainder of this paper will consist of those "prescriptions" that were developed.

It should be remembered in the discussion that follows that the caves of the Gifford Pinchot National Forest are lava tubes. "Prescriptions" developed for limestone caves or even in other geographical areas may be different because of different environmental conditions and different management concerns.

CAVES: GENERAL DIRECTION

Caves are a resource having unique scientific, recreational, educational, cultural, and scenic values. These values can be endangered by resource management activities or, in some instances, by uncontrolled visitation. When caves are encountered in project areas, they will be preserved in as nearly as possible an undisturbed condition until an inventory of their values is completed and a plan for their management written. The inventory and plan should be written by a person or persons knowledgeable in speleology.

A management plan should address the goal of preserving and protecting the cave and its environment while permitting compatible uses.

The following elements will be considered when an inventory is conducted.

1. Resource inventory of a cave should commence with inquiries to local caving organizations and cave scientists and a search for any relevent information in published literature.

2. Inventory takers should consider all possible values of a cave, whether scientific (including geology, biology, archaeology, etc.), recreational, or other.

3. Some aspects of a cave's value may be seasonal in nature (e.g., ice speleothems or seasonal fauna such as bats); therefore, where possible, inventory should include visits at more than one time of year.

4. Biological inventory must recognize that small and inconspicuous invertebrate animals contribute a large part of a cave's biological importance, and should also consider the often unusual plant communities in cave entrances.

5. Inventory must consider a cave's interaction with its surface and subsurface surroundings.

TIMBER

Cave roofs can be thin and present a hazard to equipment and operators. This may restrict the logging methods and techniques used over caves and the methods of slash disposal.

Cave entrances should not be used as disposal sites for slash, refuse, spoils, etc.

Alterations to cave entrances will be avoided as a part of timber harvest activities.

Cave sedimentation and nutrient flow into cave ecosystems can be affected by surface modifications to lands above cave passages or near cave entrances, including timber harvest and slash disposal. Generally, slash should not be burnt or the ground surface significantly disturbed within the runoff area draining into cave entrances.

Slash burning that has the potential of sterilizing thin soils above cave passages should carefully be considered before the project is undertaken to determine its effects.

In some instances, it may be necessary to leave vegetative buffer areas around cave entrances to protect their micro-environments, and/or over cave passages to protect the cave's biota.

In cases where it is permissible to cut timber adjacent to or within entrance areas, the timber should be directionally felled away from the entrances and slash disposed of by hand methods.

ROADS

Generally, roads should be routed away from cave entrances and avoid crossing over the caves' course. No alterations to cave entrances will be made.

1. Road construction will not interfere with the natural hydrology. Surface drainage shall not be diverted into caves.

2. Cave roofs can be structurally unstable and may in some cases be unable to support roads.

3. By locating roads away from cave entrances increased visitation and resulting adverse impacts can be reduced.

WILDLIFE

Some caves within the Gifford Pinchot National Forest contain unique and fragile biologic communities which need to be protected. The following considerations will help preserve these values:

1. Maintain the integrity of the caves and their surroundings;

2. Preserve vegetation at entrances and over the course of the cave where needed;

3. Protect water quality;

4. Sensitive wildlife (e.g., bats) should be protected by minimizing human visitation as needed;

5. The use of pesticides, herbicides, fertilizers, and chemicals could cause adverse impacts to cave life and should be avoided in the hydrologic setting;

6. Human impacts can be minimized through public education in appropriate behavior and use of caves.

RECREATION

Caves can provide many aspects of recreation, but not all caves are suitable for recreational uses. Caves generally are not overly hazardous but exceptions do exist for ill prepared individuals. In some instances, hazards do exist in the form of unstable breakdown or pits.

Certain caves, cave entrances, or vicinities may be suitable for more than one type of recreation or recreation development. When conflicts arise, consideration should be given to the highest form of recreation and to protection of cave values.

The following caves may not be appropriate for unrestricted or directed recreational use:

1. Caves under scientific study where recreational use could be detrimental to the project.

2. Caves which contain sensitive or endangered species.

3. Caves containing delicate geologic features which can easily be damaged.

4. Caves requiring specialized technical equipment or skills.

Would-be cave explorers should be educated in cave safety and conservation and, where possible, directed to appropriate caving organizations for the training.

DEVELOPED SITES

Caves should be developed for public use only when they can be properly interpreted and protected and should be utilized as an educational resource. Development should be considered when such development would be benficial to protecting the resource.

When development takes place, care should be taken to minimize impact on the cave. Cave development will be carried out using established cave management techniques. Some of the impacts to be considered include the following:

1. Parking lot and road construction and location;

2. Sewage disposal;

3. Visual quality;

4. Trail placement and design;

5. Lighting design;

6. Protection of delicate features;

7. Carrying capacity;

8. Control of the public;

9. Design of interpretive programs;

10. Litter clean up and control.

DISPERSED RECREATION

The thrill of discovering and exploring wild caves is a vital recreational experience. The following will help maintain this value:

1. Limit the publication of cave locations on maps and brochures to developed sites;

2. References to wild caves and wild cave locations should generally be omitted from publications prepared for widespread public attention to wild caves;

3. Trail and road signs should not direct public attention to wild caves;

4. By locating trails away from cave entrances, increased visitation and its impacts can be reduced.

MINING

Mining is inappropriate in or around caves when a cave's values will be affected. Removal of speleothems, rock slabs, sand, or other geological features shall not be permitted. Development of borrow pits, quarries, or other excavations shall be done in such a manner as to prevent runoff or sediment from entering caves.

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A Cave Inventory System III

J. B. "Buzz" Hummel *

Abstract

In order to manage a cave and protect its values as well as the visitor, some type of management plan must be devised. Since plans are based on information, eventually some type of inventory or pool of knowledge on a cave's contents must be compiled and put down in a standard format. This paper deals with the standardization of inventory systems, classification and the compiling of cave files.

INTRODUCTION

Information extrapolated from raw data is the most important tool of the cave manager. In order to make intelligent decisions, the decision maker must have as much information on the resource as possible. This knowledge will hopefully enable the manager to weigh alternatives and determine which actions are in the best interest of the resource and the public.

Cave managers usually compile their data bases from some type of cave inventory, literature and record search and by word of mouth. This data is then pooled and used to construct a cave file based upon a resource report.

What is needed in the field of cave management is some type of standard or similar cave inventory and classification system. With managers using a standard inventory system and writing reports in standard or similar formats, ideas, knowledge, and management methods can more easily be exchanged.

CAVE INVENTORY SYSTEM III

This paper essentially deals with an expansion and updating of the cave classification and inventory system developed by Jerry Trout for the Lincoln National Forest. This initial system was presented in a paper at the Third Cave Management Symposium held in Big Sky, Montana.

A modified version of this system was again presented in three parts: a work shop; a field trip; and then, a critique was held. Useful input from this critique was then incorporated into the cave inventory system.

Present needs of the Bureau of Land Management, in the field of cave management, call for detailed information on cave biologic, mineralogic and geologic resources. This information is needed to both provide management information and to rank caves by their contents. This latest inventory system is divided into three parts: a General Cave Inventory and Classification System; a Cave Biologic segment; and a Cave Mineralogic and Geologic Feature segment.

The two new segments can be utilized when more information on cave biota or cave mineral and geologic features is needed or becomes available. These two expanded inventories will assist in ranking caves and in identifying diversity among cave systems.

This Inventory/Classification System is composed of five items:

1. Field Inventory Forms

This is composed of a comprehensive check list of items which may be inventoried for.

2. Cave Card File

A 5 x 8 inch card maintained for each cave. This is essentially a reduced copy of the field inventory form.

3. Coding Key For Cave Inventory Card File & Field Inventory Form (see appendices)

*Outdoor Planner/Cave Specialist, US Department of the Interior, Bureau of Land Management, Roswell District, Roswell, New Mexico.

4. Format For Cave Inventory Report

Data from field inventory form and field studies is detailed in a report which forms the bulk of your data base, from which information is drawn to be used in making management decisions.

A. General Inventory and Cave Classification

1. County - New Mexico

BE	Bernalillo	MO	Mora
CA	Catron	OT	Otero
CH	Chaves	QU	Quay
CO	Colfax	RA	Rio Arriba
CU	Curry	RO	Roosevelt
DB	DeBaca	SD	San Doval
DA	Dona Ana	SJ	San Juan
ED	Eddy	SM	San Miguel
GR	Grant	SF	Santa Fe
GU	Guadalupe	SI	Sierra
HA	Harding	SO	Socorro
HI	Hidalgo	TA	Taos
LE	Lea	TO	Torrance
LI	Lincoln	UN	Union
LO	Los Alamos	VA	Valencia
LU	Luna		
MC	McKinley		

2. Cave Number and Ownership

a. Agency initials, or "P" for privately owned.

b. State (use U. S. Post Office abbreviations).

c. District number.

d. Cave number, starting with 001.

(1) A BLM cave located in the Roswell District would be numbered: BLM-NM-060-001.

3. Cave Name:

Assign name. Make sure name is unused. Some caves are already known by several names. In this case, the following is suggested for final name assigning:

a. Historic name or name given by first person discovering cave.

b. If "A" is underterminable, then use the name that is most descriptive of the cave.

c. List all other names on separate cards, with a reference to the final assigned cave name.

(1) List all other names under "Remarks" on cave card.

(2) List all other names in the Master Cave File.

4. Legal Location:

State, County, Township, Range, Section, 1/4 of 1/4 of 1/4, USGS quad and series.

5. Photo Number:

List the number of aerial photo that the cave is pin-pointed on.

6. Overlay:

Cave location indicated on master planning unit overlays: Y - Yes N - No

7. Map:

Cave map available: Y - Yes N - No

8. Geologic Formation:

Start with the formation the cave entrance is located in, and then, the progressive formations encountered as one would move further into the cave entrance.

9. Altitude/Elevation of Entrance

a. Altimeter reading of 4,723 feet - A4723.

b. Estimated reading of 4,723 feet - E4723.

10. Type of Cave:

R - rock shelter
L - lava tube or lava cave feature
T - talus
S - solutional
F - fissure or tectonic type
P - pit only
C - pit with cave
H - sink hole

A - littoral or sea cave
O - other

11. Number of Levels:

a, 2, 3, etc.

12. Dominant Rock Types:

CO - conglomerate
DO - dolomite
GY - gypsum
HA - halite
IX - igneous
TR - travertine
LS - limestone
MX - other metamorphic
SH - shale
SO - soil
SS - sandstone
MA - marble
IL - igneous lava
OO - other (snow, shale, etc.)

13. Type of Entrance:

Code as many as apply, starting with the "Main" entrance.

Q - Quarry or road cut gives access
B - Side or bottom or sinkhole
H - Horizontal (give size)
V - Vertical (give size and depth)
O - Other

14. Number of Entrances:

1, 2, 3, 4, etc.

15. Trend of Cave From Entrance

Bearing: T264 True North
M264 Magnetic North

16. Aspect of Cave Entrance:

NW - Northwest
SO - Due South

17. Length of All Known Passages:

S1250 - Surveyed 1,250 feet
A1400 - Approximately 1,400 feet

18. Vertical Relief of Cave From Entrance:

+ 368 S - Surveyed 368' above entrance
- 368 A - Approximately 368' below entrance

19. Pattern of Cave:

S - single passage/room only
P - pit only/no passages or rooms
R - rectilinear pattern
D - dendritic pattern, bifurcating
M - maze, boneyard, solution, anastomosed network
T - trellis/joint control maze
C - pit with cave passage
A - alcove or rock shelter
O - other

20. Water Elements:

A - arid, no water
D - dripping water
F - flooded
I - intermittently flooded
L - lakes present (100 sq. ft. of surface. avg. of at least 6" deep).
M - moist earth
U - mud floor
P - pool present (less than lake)
S - stream or river system in cave
W - overall wet and muddy cave
O - other

21. Hazards Present:

Code as many as apply.

C - confusing passageways
S - long passageways
D - disease present
G - gases present
L - loose rock/ice or cave in hazard
V - vertical drops
E - slippery ice or rock
W - water with no alternate route
P - poisonous insects and/or reptiles
F - flooding
I - intermittent flooding
T - low temperature
H - high temperature
O - other
N - none

22. Specialized Skills Required:

C - technical climbing
D - diving (scuba or air hose)
R - rapelling, prisiking, cable ladder, ascending - rope work

W - swimming required wet or dry suit
S - swimming
P - good physical condition
O - other
N - none

23. Special Equipment Needed:

Y - Yes N - No

24. Cave Contacts:

Code as many as apply.

A - archaeological (artifacts)
H - historical
B - biological (organisms)
G - geological (structural, hydrological, genetic, etc)
P - paleontological (fossils)
S - speleothems
O - other
N - none, no special attraction or significance

25. Type of Protection Recommended:

A - entrance hidden
G - gate
L - location not divulged
H - sign concerning hazards
F - fence
S - sign concerning protection
P - permanent closure (dynamite etc.)
C - road closed or locked
R - remote monitoring
E - public education
O - other
P - patrolled
N - none

26. Type of Protection Provided:

G - gate
L - location not made public
H - sign concerning hazards
S - sign concerning protection
P - permanent closure (dynamite, etc.)
F - fence
C - road closure
R - remote monitoring
E - public education
T - patrolled
O - other
N - none

27. Cave Marked With Brass Cap or Sign At Entrance

Y - Yes N - No

28. Background/History Compiled:

Y - Yes N - No

29. Carrying Capacity:

Give # and location ______________________

____

30. Card File:

Y - Yes N - No

31. Dual Classification Coding:

Content - A, B, C, D, E, or F
Hazard - I, II, II, IV, V or VI

This is a general classification system used for management purposes. The system consists of a two-part rating: one part for resource values; and, a second part for hazards. More detailed classification and inventorying systems for Cave Biotic Communities and Geophysical Cave Types are contained in parts B and C.

a. Content Ratings

(1) Class "A" Caves

Caves which contain few or no items of scenic or scientific value. If any such items are present within the cave, they are of the type which cannot, without great effort, be destroyed or removed from the cave. Basically, a cave in which frequent visitation by any and all types of cavers will cause little or no change within the cave.

(2) Class "B" Caves

Caves which contain secondary deposit-type formations of the ordinary type, such as stalagmites, stalactites, columns, flowstone, draperies, and rimstone dams, which are either of such size or are so positioned within the cave that they are not easily damaged and vandalized; or any items of scientific value which are of the type which cavers could not seriously disturb or destroy.

(3) Class "C" Caves

Caves which contain secondary deposit-type formations of the ordinary type, such as stalagmites, stalactites, columns, flowstone, draperies, and rimstone dams which are either of such size, or so positioned within the cave that they are quite susceptible to breakage and vandalism; or any items of scientific value which are of the type which cavers could seriously disturb or destroy.

(4) Class "D" Caves

Caves which contain formations that are of unusual quality or are very delicate and susceptible to breakage, even by well-trained and very careful cavers; or any items of scientific value which are of the type which cavers could seriously disturb or destroy. Examples of Class "D" Cave formations would be selenite needles, gypsum flowers, epsonite formations or crystals, cave helictites, etc.

(5) Class "E" Caves

Caves which contain items of scientific value which could be seriously disturbed or destroyed by frequent visits, or by visits of uninformed cavers as to the item or items of scientific value, i.e., a biological species which has a delicate habitat, or is in danger of extinction in the area or within the particular cave. The items of scientific value could be either archaeological, biological, or paleontological in nature, or rare cave formations.

(6) Class "F" Caves

To be assigned.

b. Hazard Ratings

(1) Class "I" Caves

The Class "I" cave offers the least hazard to the caver. Experience indicates that exploration should be conducted by no less than three cavers, who observe caving safety rules, and use the following basic equipment: hard hats, three light sources per person, boots with nonskid soles, and protective clothing.

The following are general characteristics of Class "I" caves.

(a) Single, well defined main passageway, with no lateral passages.

(b) No passageways less than 1 meter in diameter.

(c) No step-type drops over 1 meter.

(d) Stable ceiling rocks.

(e) Stable floor material.

(2) Class "II" Caves

The Class "II" cave contains moderate hazards, and is mostly horizontal in structure. Experience indicates that exploration should be conducted by no less than three cavers, one of which is experiened, who observes caving safety rules, and uses the following basic equipment: hard hats, three light sources per person, boots with nonskid soles, and protective clothing.

The following are general characteristics of Class "II" caves.

(a) Well defined main passageways, with only dead-end lateral passages.

(b) Crawlways less than 60 centimeters (24 inches).

(c) No step-type drops over 3 meters (10 feet).

(d) Stable ceiling rocks.

(e) Stable floor material.

(3) Class "III" Caves

The Class "III" cave contains structural hazards not found in Class I and II caves. Experience indicates that exploration should be conducted by no less than three cavers, two of whom have moderate caving experience (including vertical descent and climbing), who observe caving and vertical safety rules, and use the following basic equipment: hard hats, three light sources per person, boots with nonskid soles, vertical descent and climbing gear, and protective clothing with no loose or protruding attachments which might become entangled while doing vertical work. Each caver should have a complete set of climbing equipment. (Note: Vertical equipment may not be needed in some Class "III" caves.)

The following are general characteristics of Class "III" caves.

(a) Multiple passageways, with straight connecting passages.

(b) Crawlways less than 60 centimeters (24 inches).

(c) Vertical drops up to 15 meters (50 feet).

(d) Unstable rocks on ceilings over 2 meters in height. Stable rocks on passages less than 2 meters in height.

(4) Class "IV" Caves

Class "IV" caves are the most hazardous from the structural standpoint. Experience indicates that exploration should be conducted by no less than four cavers, all of whom have considerable caving experience (including vertical descent and climbing), who observe caving and vertical safety rules, and use the following basic equipment: hard hats, three light sources per person, boots with nonskid soles, protective clothing with no loose or protruding attachments which might become entangled while doing vertical work. Each caver should have a complete set of vertical equipment.

The following are general characteristics of Class "IV" caves.

(a) "Maze-type" passageways.

(b) Vertical drops over 15 meters.

(c) Unstable ceiling rocks on crawlways under 2 meters.

(5) Class "V" Caves

Class "V" caves are extremely hazardous due to characteristics such as poisonous insects and/or reptiles, airborne diseases, dangerous gases, flooding, passages requiring cave diving, or any other hazard which requires special equipment to protect the caver. Class "V" caves should only be entered by qualified cavers, with special equipment, and only if there is a real necessity for information which is deemed valuable in relation to the risk involved. The minimum party should consist of six cavers, with two remaining in a supporting position in the event of an emergency. Extra precautions should be taken, and special communications and rescue capabilities available.

(6) Class "VI" Caves

To be assigned.

B. Inventory and Classification System for Cave Biotic Communities

32. Bat Roost:

Y - Yes
N - No
U - Unknown
R - Roost in past/presently not used.

33. Roost Type:

H - Hibernaculum
N - Nursery
S - Summer Roost
O - Occasional Use
R - Night Roost
U - Unknown
T - Transitory

34. Species and Population Estimates of Bats

Species/# ______________________
Species/# ______________________

MV - Myotis velifer
ML - Myotis lucifugus
MA - Myotis auriculus
ME - Myotis evotis
MT - Myotis thysanades
MO - Myotis volans
MC - Myotis californicus
MI - Myotis leibii
MY - Myotis yumansis
LN - Lasionycteris noctivagans
PH - Pysistrellus hesperus
EF - Eptstcus fuscus
LC - Lasiurus cinereus

LB - Lasiurus borealis
LE - Lasiurus ega
EM - Euderma maculatum
PP - Plecotus phyllotis
PT - Plecotus townsendii
AP - Antrogous pallidus
EP - Eumops perotis
TF - Tadarida femorosacca
TM - Tadarida macrotis
TB - Tadarida brasiliensia
IP - Idionycteris phyllotis
EP - Eumops perotis

35. Bat Population

I - increasing
D - decreasing
C - constant
U - unknown

36. Bat Species Status:

FE - Federal Endangered Species
FT - Federal Threatened
SE - State Endangered Species, Group I
ST - State Endangered Species, Group II
BL - BLM Sensitive Species
O - Other

37. Relative Threat Destruction/Disruption:

A - No present threat
B - Slight threat
C - Medium threat
D - High threat
E - Presently being impacted
F - Headed for destruction

39. Bat Roost Classification:

A, B, C, D, E, F.

A - Minor transitory roost of little importance. No management or protection needed.

B - Bat roosting site in a remote location where man and his activities should not impact roost.

C - Major roost of common bats which have the low potential of being disrupted by man.

D - Major roost (Hibernaculum/Nursery) which contains common bats which have a high potential of being disrupted by man.

E - Roost of bats which are on the state or federal T&E list.

F - Unique or rare roost.

40. RESERVED

II. Cave Climate & Substrate

41. Cave Relative Humidity

A - Fluctuating humidity (__ to __ %)
B - Near constant humidity of (__ to __ %)
C - Unknown

42. Cave Temperature

A - Fluctuating temperature (__ to __ F/C degrees)
B - Near constant temperature (__ to __ F/C degrees)
C - Unknown

42. Reserved

44. Aquatic Substrate

A - Periodic perched pools from flooding by surface waters
B - Perched water-pools from dripping ceiling
C - Periodic flooding and perched pools from raising ground waters
D - Pools/water from periodic spring/streams
E - Pools/water from perennial spring/streams
F - Perennial lakes/streams/rivers from moving groundwaters
G - Other

45. Terrestrial

A - Dry cave floor on non-organic matter
B - Dry cave floor with organic matter
C - Moist to mud cave floor without organic matter
D - Moist to mud cave floor with organic matter
E - Cave floor also with sand/gravel

F - Cave floor also with large rocks
G - Reserved
H - Reserved

46. Energy Input for Cave Communities

Boitic Input

A - Organic matter carried in by animals
B - Organic matter from animal carcasses
C - Guano from mammals and birds and crickets
D - Tree and plant roots
E - Bat guano

Abiotic Input

F - Diffuse input from percolating water
G - Concentrated input from water transport
H - Organic matter blown in by the wind
I - Other

47. Cave Adapted Biota Potential

A - Climate and substrate and a lack of organic matter provide low potential
B - Climate, substrate and presence of organic matter provide a medium potential for cave life
C - Cave climate and high presence of organic matter provide high potential for cave adapted life
D - Cave adapted biota has been collected from this cave
E - Unknown

48. Inventory or collection has identified the following invertebrates to inhibit the cave. After two digit species code, place adaptation code AD-TB-TP-TX-UN

UN - Unknown Amphipods
UC - Unknown Copepods
UI - Unknown Isopods

UB - Unknown Beetle
RB - Rhadine Beetle
FB - Round Fugus Beetle
SB - Scavenger Beetle
DB - Darking Beetle
EB - Eleodes Beetle
OB - Rove Beetle
EB - Embacphion Beetle
IB - Diving Beetle
GB - Ground Beetle
LB - Flat Back Beetle
UB - Unknown Cricket
CL - Ceuthophilus Longipes
CA - Ceuthophilus Carsbadensis
CO - Ceuthophilus Conicaudus

MP - Millipedes
CP - Centipedes

SP - Springtails
DI - Diplurons
FL - Flies
FE - Fleas
BF - Bat Flys
LI - Lice
AT - Ants
BT - Bristletails
CE - Collemboa

UA - Unknown Arachnid
HA - Harvestmen
SR - Spiders
MI - Mites
SC - Scorpions
TI - Ticks
PS - Pseudoscorpions
SI - Spiders

MO - Moths

FW - Flat Worms
UW - Unknown Worms
TW - Tubeifax Worms

UL - Unknown larva
AD - "Accidentals". Mammals, birds, reptiles, invertebrates, etc., which are washed or fall into caves. These animals are not able to live and reproduce in the cave environment.
TB - "Troglobites". Animals that live in caves and nowhere else. They must complete their whole life cycle in a cave.
TP - "Troglophiles". Can live and complete its life cycle in caves and other suitable environments outside the cave.
TX - "Trogloxene". Animals which live in caves but which must return to

the surface for certain needs, i.e., food. Bats are trogloxenes.

UN - Unknown Adaptation

Example of species/adaptation readout.

/Species code/Adaptation code
line 48. UB/UN, MP/TB,

Line 48 reads: Cave contains an unknown species of beetle which is of unknown adaptation and a millipede which is troglobitic.

49. Relative Threat Destruction/ Disruption of Cave Biotic Community

A - No present threat
B - Slight threat
C - Medium threat
D - High threat
E - Presently being impacted
F - Headed for destruction

50. Cave Biotic Community Classification

A - Cave with no known troglobitic biota and with a low potential to support a biotic community.
B - Cave which has potential to support a biotic community but with no known species present.
C - Cave with a low population and diversity among its cave biota and which is not being impacted by man.
D - Cave with high populations and diversity among its cave community. Subject to man's impact.
E - Cave with state or federal rare, threatened or endangered species.
F - Cave with unique, rare or diverse species which are of high research value.
G - Reserved

C. Cave Mineralogic and Geologic Features

51. Speleothems/Petromophs

Cave deposits will receive a three digit code. The first digit will tell the source of the deposit while the last two will tell what form the speleothem is taking.

Source

A - Aragonite
B - Calcite
C - Epsomite
D - Gypsum
E - Halite
F - Hydromagnesite
G - Ice
H - Lava
I - Limonite
J - Mirabilite
K - Mud
L - Re-solutioned
M - Selenite
N - Sulfate
O - Other
P - Reserved

Form

XA - Balloons/Bubbles
XB - Bacon Rind
XC - Bell Canopy
XD - Boxwork
XE - Canopy
XF - Cave Pearls
XG - Cave Cotton
XH - Cave Hair
XI - Coating/Crust
XJ - Coralloids
XK - Draperies
XL - Flowers
XM - Flowstone
XN - Focia
XO - Gours
XP - Heligmites
XQ - Helictites
XR - Moonmilk
XS - Needles
XT - Popcorn
XU - Rafts
XV - Rimstone Dams
XW - Shelfstone/Tables
XX - Shields
XY - Stalactites
XZ - Stalagmites
YA - Trees
YB - Reserved
YC - Other

Unique Features

ZAA - Cave Velvet
ZAB - Calcite Roses (Blades)
ZAC - Dogtooth Spar
ZAD - Endellite
ZAE - Nitrates/Niter
ZAF - Nailhead Spar
ZAG - Quartz Euhedral Crystals
ZAH - Spathites

ZAI - Tabular Gypsum
ZAJ - Reserved
ZAK - Other

52. Speleogens

AA - Anastomoses
BB - Boxwork
CC - Bridges
DD - Dome
EE - Dome pit
FF - Floor slot
GG - Flutes
HH - Joint cavities
II - Meander niche
JJ - Meander
KK - Pillar
LL - Rills
MM - Scallops
NN - Spongework
OO - Tepee
PP - Vugs

53. Speleothem Status

A - No growth, dry cave, some deterioration of speleothems
B - No growth, but no apparent deterioration of speleothems
C - Isolated areas in cave showing speleothem growth
D - More than 40% of cave with speleothem growth
E - More than 70% of cave with active growth taking place.

54. Relative Threat of Destruction/Damage to Cave Features

A - No threat, presently
B - Potential threat from surface activities or cave visitors
C - High potential for damage, resulting from surface activities or cave resources very delicate which could be easily destroyed by visitors
D - Cave features presently being destroyed by vandals or surface activities
E - Cave features destroyed, little left of original speleothem

55. Cave Mineralogic and Geologic Feature Classification

A - Cave with features of few or no features of scenic or scientific value.
B - Cave contains some features with some diversity. Medium scenic value and/or low scientific value.
C - Cave contains many features with a high diversity of forms. High scenic value and/or medium scientific values.
D - Cave contains a remarkable amount of features with a high amount of diversity in their form, and/or a very high scientific value.
E - Cave contains either rare, unique, or features of very high scientific value.

Appendix 1

FORMAT FOR CAVE INVENTORY REPORT

CAVE NAME

CAVE NUMBER:

COUNTY, STATE:

LEGAL LOCATION:

LOCATION: Description in road log format, walking distance and time.

HISTORICAL BACKGROUND: When found, by whom, how located, historical values, etc.

DESCRIPTION: Detailed description of the cave. Include major features formations, passages and brief description of biological, hydrological, and geological, etc. findings.

CAVE CONTENTS: Detailed description of cave's contents by scientific field.

A. Archaeological (artifacts).

B. Biological (organisms).

C. Geological (structural, hydrological, genetic, etc.)

D. Paleontological (fossils).

E. Speleothems.

F. Other.

Appendix 2

CAVE INVENTORY AND CLASSIFICATION SYSTEMS....Field inventory and computer coding form.

Cave Name: __________ Section: __________ To section __________ Date of Observations __________

A. GENERAL CAVE INVENTORY, CLASSIFICATION AND MANAGEMENT PROFILE.

(1) County: __________ (2) Cave number/ownership: __________ (3*) Cave name(s): __________

(4*) Legal location/USGS quad: __________ (5*) Air photo # __________ (6) Overlay: Y N

(7) Map: H L N S U (8) Geologic formation: __________ (9) Altitude of entrance: __________

(10) Type of cave: R L T S F P C H A O (11) Number of levels: __________ (12) Dominant rock type: CO DO GY HA IX TR LS MX SH SO SS MA IL OO

(13) Type of entrance: Q B H V O (14) Number of entrances: __________ (15) Trend of cave: __________

(16) Aspect of cave entrance: __________ (17) Length of passages: __________ (18) Vert. relief of cave from entrance: __________

(19) Pattern of cave: S P R D M T C A O (20) Water element: A B D F H I L M U P S W O (21) Hazards present: C F S D G L M V E W P I K T H O N

(22) Specialized skills required: C D R W S P O N (23) Special equipment needed: Y N (24) Cave contents: A H B G P S O N

(25) Type of protection recommended: A G L H F S P C R E O T N (26) Type of protection provided: G L H S P F C R E T O N (27) Cave marked with

(27) cont. cap or sign: Y N (28) Background his: __________ (29) Carrying capacity: __________

(30) Surface Estate Status: __________ (31) Mineral Estate Ownership __________

(32) Mineral Estate Segregations: __________ (33) Mineral Estate Status: __________

(34) Surface Estate Restrictions: __________ (35) Access: __________ (36) Card File: Y N

(37) Dual classification coding system-----Content A B C D E F Hazard I II III IV V VI (38) Specific Resource designation: __________

(38) General Recreation potential: __________ (40) Reserved: __________ (41) Reserved: __________

(42) Section "A" from Section __________ to Section __________ (43) Inventoried by: __________ date __________

COMMENTS

Remarks: __________

Remarks: __________

____

____

Remarks: __________

Remarks: __________

____

B. CAVE BIOLOGIC RESOURCES

(44) Bat roost: Y N U R D (45) Roost type: H N S O R U T G M (46) Species and population: __________

(47) Bat population status: I D C U W V S F (48) Bat species status: FA FP FB FC FE FT SE ST BL ON NO UO (49) Relative threat: A B C D E F G

(50) Bat guano deposits: A B C D E F O (51) Other Observed Vertebrates __________

(52)Bat roost classification: A B C D E F G (53) Cave rel humidity: A B C (54) Cave temp: A B C D (55) Reserved __________

(56) Aquatic substrate: A B C D E F O U N (57) Terrestrial: A B C D E F G H S I O M (58) Energy input for cave systems A B C D E F G H I J

(59) Cave biota potential: A B C D E F (60) Cave invertebrates __________ (61) Relative threat: A B C D E F G

(62) Cave biotic classification: A B C D E F G H (63) Status of Cave Fauna: FP FA FC FB FE FT SE ST BL O N U (64) Reserved __________

(65) Reserved __________ (66) Inventoried by __________ Date __________

(67) Section "B" inventory from Section __________ to Section __________

C. CAVE MINERALOGIC AND GEOLOGIC FEATURES

(68) Speleothems/petromorphs: __________

(69) Speleogens: __________ (70) Speleothems status: A B C D E F (71) Relative threat A B C D E F

(72) Cave mineral/geologic classification: A B C D E F (73) Types of Fossils __________

(74) Reserved: __________ (75) Reserved: __________ (76) Reserved: __________

(77) Reserved: __________ (78) Reserved: __________

PART "A" GENERAL CAVE INVENTORY AND CLASSIFICATION SYSTEMS.
PART "B" CAVE BIOLOGIC RESOURCES.
PART "C" CAVE MINERALOGIC AND GEOLOGIC FEATURES.

NOTE: "X" in any entry indicates - does not apply. "+" in any entry indicates see description under remarks.
"*" in any entry indicates - that this cave location is not to be given out except by the managing agency or owner.

COMMENTS

79 Remarks: __________

80 Remarks: __________

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Remarks: __________

Remarks: __________

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A Simple, Low Cost Computer Data Management Technique for Missouri's Cave Fauna Inventory

Elizabeth A. Cook*

Abstract

Management and analysis of large data sets are major concerns of any researcher. Traditional methods such as keeping handwritten catalogs or index cards offer limited flexibility, besides being time-consuming to maintain and interpret. More and more, researchers of all disciplines are turning to computers to "simplify" these tasks. However, with little familiarity of programming languages and computer hardware, this can potentially be a frustrating venture.

In the past decade, several computer systems for data analysis have been developed and marketed by commercial firms. In one easy-to-use system, these software packages provide all the tools needed for data storage, sorting, modification, statistical analysis, and report writing. The analyst does not need a high degree of computer sophistication to become a competent user of these systems.

In 1978, a joint effort was undertaken by the Mark Twain National Forest, North Central Forest Experiment Station-Columbia, Missouri, Missouri Department of Conservation, and Missouri Department of Natural Resources to inventory the fauna and physical characteristics of caves occurring on their lands. At the onset, less than 300 caves were known to exist; a total of 387 have been inventoried to date. Nearly 4,000 specimens of invertebrates have been collected, in addition to records of over 1,000 vertebrate observations. These data, as well as geographic and physical information about each cave, form one of the most comprehensive cavernicolous data sets for any region of the world.

Three separate data sets (invetebrates, vertebrates, and caves) generated from Missouri's cave inventory are being managed as computer files using the data analysis package called SAS (Statistical Analysis System). Although it was developed primarily as a statistical tool, SAS serves many other computing needs and is quite useful for mainipulating work data. The invertebrate information was organized into a SAS computer file by specimen collection number, with the complete set of associated data included (genus, species, cave name, habitat notes, etc.). Vertebrate observations were similarly described. Information for each cave consists of cave name, legal description, county and area where located, length of cave in meters, cave entry restriction notes, cave map availability, and extraneous comments such as "partly water filled."

SAS procedures allow data to be sorted, grouped, modified, and printed out in nearly any format the user desires with relatively few computer program statements. For example, SAS has been used to sort these data

*Resources Planner, Missouri Department of Conservation, Jefferson City, Missouri.

by genera, by U.S. Forest Service management districts, and by cave zones and habitat associations. Any one of these analyses done by hand sorting would be very tedious. The average cost of one sort and print job for the 4,000 line invertebrate data set is $10.00.

No Manuscript Received

Results of a Cooperative Cave Inventory in Missouri

James E. Gardner*

Abstract

A comprehensive cave inventory involving most of Missouri's public lands began in October, 1980. The cooperative study included caves managed by Mark Twain National Forest, Missouri Department of Conservation and Missouri Department of Natural Resources. The primary objective of the study was to collect and compile data from their caves and use the data to develop recommendations for a responsible cave management program.

After four years of study, 387 caves were successfully inventoried. A total of 139 caves (or 36%) of the 387 caves studied were new, previously unrecorded caves for Missouri. These caves account for more than nine percent of the over 4,200 known caves in Missouri and represent a very significant portion of the state's diverse cave resources.

A cave classification and management system based on resource content and hazards was developed to insure proper stewardship of the caves. As a result of this system, 104 caves (or 27%) received a restricted classification. Only 10 caves (or 2%) are closed to recreational caving. The remaining 273 caves (or 71%) continue to be unrestricted.

Primary emphasis of the study was on gathering biological data. Over 3,300 specimens of cave invertebrates were collected. In excess of 386 species were identified from these specimens by over 40 cooperating taxonomists world-wide. These specimens also represent 22 new species to science (undescribed).

A total of 68 species of vertebrates were observed and identified from study caves. Several of these records are of federally listed threatened and endangered species and Missouri listed rare and endangered species.

With the continuation of study on Missouri Department of Conservation lands and the inclusion of selected caves within Ozark National Scenic Riverways (National Park Service), significant additional cave resources are expected to be discovered.

No Manuscript Received

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*Wildlife Biologist, Missouri Department of Conservation, Natural History Section, Jefferson City, Missouri.

Volunteerism for Cave Management

Harry B. Mahoney*

Abstract

Volunteerism provides an opportunity for individuals and organizations to participate in conservation and management of caves on National Forest lands and to stretch budgets to make real progress toward cave management objectives.

Forest Service Volunteers are working on every National Forest in practically every aspect of protection and management of National Forest resources. Although volunteers receive no compensation, volunteer agreements may provide for payment of incidental expenses such as transportation, lodging, and subsistence. In addition, the volunteer is protected under provisions of the Tort Claim Act and Federal Employees Compensation Act while working within the scope of the agreement. This paper will discuss the opportunities, benefits and procedures for this approach to National Forest cave management.

In 1972, Congress passed, and the President signed, Public Law 92-300 which stated in part that the Forest Service of the U.S. Department of Agriculture

> "is authorized to recruit, train, and accept without regard to the Civil Service classification laws, rules, or regulations the services of individuals to serve without compensation as volunteers."

These volunteers are authorized to assist in any Forest Service program or activity.

What could be more fair that that? Here is an opportunity for an individual to help out in anything the Forest Service does without having to put up with all the hassle and embarrassment of being paid for it. In 1981, 16,445 people took advantage of this opportunity and an estimated 30,000 got on the bandwagon this past year. It is projected that some 36,000 people will be doing it, as the bumper stickers say, on National Forests all over the country in 1983. I doubt that Congress really anticipated this response when it passed the "Volunteers in the National Forests Act" ten years ago.

WHO ARE THESE VOLUNTEERS?

The average age of 315 sampled 1981 volunteeers was 26, but about 50% were over 45 years of age and 16% were over 66. They averaged 14 years of education and about 17% had more than a bachelor's degree, but 38% had 12 years or less of schooling. A third of the sample had family income of less than $10,000 and only 15% had incomes over $30,000.

These figures do not represent a good statistical survey but are indicative of one important aspect of the program - volunteers do not fit any particular sociological model. The basic requirement is that the individual be motivated to volunteer his or her services and to believe he or she has something to offer.

The specific motivations may be as varied as the number of volunteers, but surveys indicate that they are usually related to expectation of some desirable type of experience. Frequently, these are expressed as being able to "enjoy scenic beauty", "enjoy sights and sounds of nature", etc., but other reasons such as an opportunity to "meet new people", "apply my skills and knowledge", "challenge myself", "do things with

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*Forester, Monogahela National Forest, Elkins, West Virginia.

the family" (or "get away from my family") are also voiced and even such things as "to help accomplish the mission of the Forest Service" and "to help reduce government expenses" have been listed as very or extremely important by 30-40% of volunteers.

WHAT DO VOLUNTEERS DO?

- They build and maintain trails.
- They do historical research.
- They serve as hosts at National Forest campgrounds.
- They conduct interpretive programs.
- They build structures.
- They perform surveys of wildlife habitat and populations.
- They take photographs.
- They control erosion.

The possibilities are limited only by the willingness, interest and ability of the volunteer and the agreement that a given job will benefit Forest Service programs and that the volunteer is qualified to do it.

Volunteers could even contribute to a program of National Forest Cave management.

HOW?

Cave management, in all its interpretations ranging from a simple inventory to intensive development and operation, falls within the scope of Forest Service activities somewhere and sometime.

However, for a great variety of reasons, management of National Forest cave resources has received relatively little attention and consequently relatively few funds have been budgeted for cave management in the past, with some notable exceptions. Despite a growing recognition of the importance of some aspects of the values of cave resources, it would not be realistic to anticipate any significant increase in budgets in the foreseeable future.

The caving community encompasses a considerable number of interested people and specialized expertise that could contribute greatly to the conservation and management of National Forest cave resources. In most cases, even a modest contribution by a few individuals would represent a huge accomplishment in proportion to what has been done in the past. In many cases, such a contribution would represent a critical and necessary first step. In others, it might supplement an ongoing program or might maintain a program that would otherwise die.

The possible opportunities are as varied as the scope of the term "cave management" and the expertise and interests of those interested in the cave resource.

We can see a role for volunteers in a long list of activities related to management and conservation of caves including, but not necessarily limited to, the following:

- Cave location and preliminary inventory
- Specialized resource inventory (biological, historical, recreational)
- Survey and mapping
- Classification and Planning
- Design and installation of gates
- Cave tour guiding and interpretation
- Cave resource restoration
- Photography
- Monitoring of use
- Public information
- Access trail construction and signing (or obliteration)

The list could be extended.

SO, HOW DOES ONE BECOME A VOLUNTEER?

Like getting married, the actual process is pretty simple, but the courtship rituals may have their frustrations. One officially becomes a volunteer merely by entering into a one page agreement signed by the volunteer and the Forest Officer such as a District Ranger. A copy of the agreement form is attached. The description of duties may be extremely brief and informal, or may be supplemented by making attachments. The details of such an agreement are subject to infinite variation and may be revised or modified.

There are undoubtedly many people who would be interested, willing, and able to perform voluntary work related to management of National Forest caves. I know there are already many cavers providing services and information without the formality of a signed agreement.

There are also District Rangers, Forest Supervisors and Staff personnel who recognize the need to manage these resources better than they have in the past, or at least to find out whether special management is warranted. There are also lots of Forest Service officials who would welcome the assistance of volunteers if they were convinced that there was a need.

The trick is to get the prospective volunteer and the appropriate resource manager together.

There are three approaches to accomplishing this:

1. The Forest Service may issue an invitation through local media or other means for people to participate in the Volunteer Program. A list of specific openings and opportunities for participation may be provided and such a list could even include an opportunity related to some aspect of cave management. But I wouldn't bet on it.

2. John Q. Caver of a local, statewide, or national organization may approach the Forest Service with some sort of proposal. This proposal could address any aspect of cave management the individual or organization feels would be worthwhile. If the ranger agrees, it could be a simple step to a signed agreement.

   However, there may also be frustrations before an agreement can be finalized. The Ranger may not be convinced that the volunteer's proposal will meet a management need or that the volunteer is qualified to perform the service. He may decide that an Environmental Assessment is needed where there is risk of an undesirable impact on the environment, or he may feel that the proposal should be reviewed with staff specialists before an agreement is signed. Such delays do not necessarily represent a lack of empathy or bureaucratic red type. We have learned by experience that taking a little time to evaluate any project proposal is usually worth it in the long run. The secret is obviously to allow enough lead time for this type of consideration.

3. The prospective volunteer may submit an application.

a. Form 1800-17 "Prospective Volunteer Application" (a copy is attached) may be submitted to the appropriate Forest Service Office (such as a National Forest Supervisor's Office) listing special skills or interests which may be matched to an available job or stimulate creation of a job to utilize available skills.

b. The Forest Service also maintains a roster of prospective volunteers with special skills for use by National Forests or Regions. As an example, a paleontologist willing to volunteer his/her skills might be matched with a specific management need anywhere in the country.

WHY GO TO ALL THIS TROUBLE?

Many reasonable projects which would contribute to National Forest cave management programs could be (and have been) done by volunteers without any written agreement, environmental assessments, or official reviews. There must be some reason to take the trouble to enter into even this relatively simple agreement.

The agreement actually offers several possible advantages to the volunteer depending on the details of the work to be performed and the conditions in the area, and the individual volunteer.

1. Legal Status of Volunteers - Although volunteers are not federal employees in regard to recruitment, employment, compensation, and benefits, they are considered employees in relation to tort claims and workmen's compensation. In other words, they will have the same degree of protection if they cause damage or injury to a private citizen or are injured themselves, while acting within the scope of their agreement.

2. Incidental Volunteer Expenses - Although volunteers receive no salary from the Forest Service, they may receive reimbursement or allowances for incidental expenses such as transportation, uniforms, lodging, subsistence, and miscellaneous expenses. Notice the verb "may". An individual agreement may cover all, some, or none of these in whole or in part as determined on a case by case basis, tailored to the individual, the job being accomplished, available budgets, and agency priorities.

3. Possible Requirements for Authorization - Some actions, such as erecting a gate, constructing a trail, cutting trees, or entering a closed area require some form or authorization. Volunteers, acting within the terms of an agreement, may be authorized to do such things. It should also be noted that most

structures require some sort of design with appropriate approval.

4. Other Possible Benefits - (Again these may or may not be provided).

a. A government driver's license and vehicle or other transportation may be provided.

b. Training, office space, equipment, etc., may be provided.

c. Quarters, if available, or a campsite may be provided without charge.

d. A uniform, volunteer vest or jacket, or identification may be provided.

5. Creditable Work or Education Experience - Volunteer service can be used as creditable work experience toward formal employment and may frequently be used to satisfy college requirements or obtain college credits.

6. Good Management Practice - This may not appear to be of particular value to the volunteer at first glance, but in reality, it may be the most important benefit. If we assume that one major motivation for the volunteer is to promote and accomplish conservation and sound resource management, development of a volunteer agreement represents a commitment by both the volunteer and the Forest Service to work toward some common objective. It provides both parties an opportunity to be assured that the work is consistent with overall resource management objectives and policies.

WHAT OPPORTUNITIES IN CAVE RESOURCE MANAGEMENT ARE AVAILABLE FOR VOLUNTEERS?

I can only speak for the National Forests of the Eastern Region of the Forest Service (from Missouri to Maine), but I suspect that our situation is quite typical except for a few isolated cases.

At least four of the 14 National Forests in the Eastern Region have at least some caves. I'll briefly summarize the cave management situation on each of these.

1. The Mark Twain National Forest (Missouri)

Since 1978, 226 caves with about 10 miles of passage have been located and inventoried; 54 have been located but not yet inventoried; and 59 more have been reported but not found. At present, 222 of the caves are open to the public without restriction; 3 have been gated but may be entered on a permit basis; and 1 has been physically blocked to prevent entrapment by flash floods.

2. The Shawnee National Forest (Illinois)

At least 7 caves are known to occur on National Forest land on the basis of the Illinois Department of National Resources "Natural Areas Inventory". All are open to the public.

3. The Wayne-Hoosier National Forest (Indiana-Ohio)

There are 24 identified caves on the Forest. They are open to the public, but use is neither encouraged nor discouraged, and they receive little official attention.

4. The Monogahela National Forest (West Virginia)

About 80 caves are known on National Forest lands ranging in length from less than 100 feet to about four miles of passage. Endangered bats are known to use four of these caves at least for parts of the year and two of these are gated during critical periods. There has been no attempts to inventory or classify these caves systematically, although a continuing survey of bat habitat and populations has been conducted.

This very brief overview of the present status of cave management on the National Forests in the Eastern Region suggests that there could be plenty of opportunity for volunteer involvement in such aspects as basic inventory, mapping, specialized inventory, and classification.

It is unlikely that we will be able to accomplish more than a modest level of management of cave resources with available or anticipated funding and employment levels, except where considerations of critical habitat or other special management concerns dictate special attention. In many cases, no management may be the best management, but in general, some level of inventory and classification is needed as a minimum to support such a decision.

Volunteerism can help to fill the gap between that which is realistically probable and that which might be desirable. It represents an opportunity both for the Forest Service and for the caving community. The National Forests Volunteer Program provides a vehicle for accomplishing mutually desirable objectives but, it will take a sincere effort both on the part of the potential volunteers and on the part of Forest Service managers.

I would suggest that anyone interested in exploring this idea further contact a Forest Service office, either at the District, Forest, or Regional level to see what opportunities there might be to match your interests and skills with cave management needs. You may have to sell your idea or yourself, but there's nothing wrong with that if you think the need is there.

In closing, several speakers here today have emphasized that volunteer contributions will be necessary if much effective cave management is to be accomplished. The opportunities for volunteer participation are not limited to National Forests. Both the National Park Service and the Bureau of Land Management have similar volunteer programs and a number of state land management agencies will welcome volunteer assistance.

Appendix 1

U.S.D.A. — FOREST SERVICE

AGREEMENT FOR SPONSORED VOLUNTARY SERVICES

(Act of May 18, 1972, P. L. 92-300)

NAME OF SPONSOR ORGANIZATION (Print)

ADDRESS (Street, city, state, Zip code)

We desire to make available the volunteer services of the following person(s) to assist with Forest Service work:

(If more space is needed, use reverse)

1. Description of work to be performed:

2. The above-described work will be contributed to the Forest Service. Except as provided below, the work performed by the participants will not confer on them or on our employees, or officers the status of federal employees.

3. We will provide the Forest Service with a listing of participants and man-hours or man-days contributed to accomplish the work in item 1 above.

4. We will obtain parental or guardian consent for each individual under 18 years of age and will comply with child labor laws.

5. ______________________________ is hereby designated to serve as our liaison with the Forest Service in day-to-day operations under this agreement.

6. We understand that either the Forest Service, or we, may cancel this agreement at any time by notifying the other party.

SIGNATURE	DATE

ACCEPTANCE FOR THE FOREST SERVICE

The Forest Service agrees, while this agreement is in effect, to:

1. Provide such materials, equipment, and facilities as are available and needed in performing the work described above.

2. Finance necessary incidental expenses of sponsored participants to the extent such expenses cannot be borned by the sponsor, and to the extent Forest Service funds are available. The maximum Forest Service funding of such incidental expenses shall be set forth in an accompanying financial plan for each fiscal year or portion of a fiscal year.

3. Consider sponsored participants as federal employees for the purpose of tort claims and compensation for work injuries, to the extent not covered by the sponsor.

4. Authorize sponsored participants to operate federal motor vehicles when necessary; provided the individual qualifies for, and is issued, a U.S. Government Operator's Identification Card.

SIGNATURE	TITLE	UNIT	DATE

TERMINATION OF AGREEMENT

Agreement Terminated on ______________
Month, Day, Year

____
Signature of Forest Service Officer

Remarks:

GPO 863-677

1800-8 (7/73)

Appendix 2

USDA - FOREST SERVICE

PROSPECTIVE VOLUNTEER APPLICATION

NAME (PRINT - Last, First, Middle Initial)	DATE OF BIRTH	TELEPHONE NO.

ADDRESS (Street, City, State, Zip Code)

IF UNDER 18 YEARS OF AGE, GIVE NAME OF PARENT OR GUARDIAN	TELEPHONE NO. (Including code)

ADDRESS (Street, City, State, Zip Code)

CIRCLE HIGHEST LEVEL OF EDUCATION COMPLETED:

ELEMENTARY SCHOOL: 1 2 3 4 5 6 7 8 HIGH SCHOOL: 9 10 11 12 COLLEGE: 1 2 3 4 5 6

LIST SPECIAL QUALIFICATIONS IN AGRICULTURE, HORTICULTURE, ENGINEERING, HISTORICAL, ETC., AND ANY SKILLS IN TRADES OR OCCUPATION

LIST ALL TRAINING RECEIVED, IF ANY, INCLUDING HOURS.

BRIEFLY DESCRIBE PAST AND PRESENT EMPLOYMENT.

LIST INTERESTS AND HOBBIES.

LIST ANY PREVIOUS VOLUNTEER SERVICES, INCLUDING DATES AND/OR COMMENTS.

LIST VOLUNTEER WORK INTERESTS.

SHOW AREA OF AVAILABILITY (*National Forest, State, etc.*)	DATE OF AVAILABILITY

CIRCLE DAY(S) OF WEEK OF AVAILABILITY AND SHOW HOURS.

DAYS	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
HOURS	____	____	____	____	____	____	____

SIGNATURE	DATE

Previous Edition is obsolete

FS-1800-17 (1/82)
GPO 886-921

The Use of the Significant Cave List as a Cave Conservation Tool

Bob Custard,* Dr. John R. Holsinger**

and Phillip C. Lucas***

Abstract

In 1980, the Virginia Cave Commission completed compilation of a comprehensive listing of Virginia's significant cave resources. The list was designed to assist land use planners and reviewers of environmental impact statements in identifying and protecting those caves and karst areas which provide the best remaining examples of Virginia's spelean wilderness. Approximately ten percent of Virginia's 2500 caves were identified as significant on the basis of their length, depth, biology, geology, hydrology, paleontology, archaeology, historical significance, recreational use, economic value, or aesthetic value. Since completion of the list, several organizations involved in the conservation of cave resources have used the list to help them establish priorities for various conservation projects. Also, designation of several caves as significant has assisted in making a case for their protection when they have been threatened by development. Limited and selective distribution of the significant cave list has avoided stimulating additional caving pressure on the designated caves.

No Manuscript Received

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**Professor of Biological Sciences, Old Dominion University, Norfolk, Virginia.

***Virginia Electric and Power Company, Charlottesville, Virginia.

General Cave Gate Considerations

Roy D. Powers, Jr.*

Abstract

The requirements for effective cave gate designs that let the bats and other cave creatures in and out of the cave but keep unwanted people out, are listed and explained. The psychological factors in cave gates are explained in ways that would help one prevent attempts to reach the gate. Features that make cave gates difficult to circumvent will be demonstrated. The trade-offs of weak links versus medium strength weak links and the no true weak links methods will be compared, as well as other alternatives such as supervision, fencing and other barriers. Cave protection situations where fences would be more desirable than gates, situations where no barriers are needed and situations where gate supervision may be required, are all weighed from a cost-effectiveness point of view.

INTRODUCTION

A cave should be gated only as a last resort and when other methods of protection will not suffice. Once it is determined that a cave must be gated, a careful determination must be made as to the type of gate to be selected.

Cave gates exist in three general categories, which are listed and defined below:

Type 1 -- The token protection gate. Gates in this category provide little or no resistance to breaching. This type of gate may be violated with little effort, requiring no tools to effect entry. An example of this type is the fence gate.

Type 2 -- The minimum protection gate. Gates in this category require tools and greater effort to breach than the Type 1 gate. This type of gate may be breached with boltcutters, hacksaw, sissor jack, and possibly sledge hammers.

Type 3 -- Maximum protection gates. This type of gate requires a maximum of effort and specialized tools to effect breaching. This type of gate is engineered to defeat the most persistent type of vandal. It may have a reinforced concrete foundation integrated with a massive sill plate, and a heavy steel framework tied to the top, bottom, and sides of the passageway. The locking device and hinge pins are protected. All exposed edges of the steel framework, which might be attacked by hacksaws are hardened. Special tools such as cutting torches are required to defeat this type of gate.

DESIGN CONSIDERATIONS

The cave should determine the design of the gate. Most caves do not fall in the category of being "bat caves". This is not to say, however, that in the future bats will not elect to use them if they are available. It is suggested that all caves which have the possibility of future bat occupation be gated as if they were bat caves. The difference in construction cost and effort required to install a gate which is acceptable to bats is small. As population in caving areas increase, the traffic in the caves will increase, and it is conceivable that only a previously gated cave is acceptable to a displaced bat population.

EXPENSE

Cost is one factor which has, too often in the past, played a major role in determining the type of gates installed in caves.

A cave gate should be well thought out and properly designed before expense should enter into

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the design considerations. There are many engineering and cost trade offs that can be made, but these trade offs should have major considerations only at the last stage of design. Financing exists now from many sources. Several organizations exist which make funding for gates available. Among these are the Nature Conservancy, Cave Conservancy of the Virginias, the Fish and Wildlife Commission, and other state agencies. In some instances, the property owner himself is willing to share all or some of the cost. The materials for Madison and Fountain Caves (Augusta Co., Va.) were purchased by the owners. Large and small comppanies alike are willing to donate material. Southern Railroad, for example, has recently donated 300' of railroad steel to the Cave Conservancy of the Virginias to be used for gating projects. Individual donations are also a possibility. The steel for the Unthanks gate (Lee Co., Va.) was donated by an individual. Another source is the caving community itself. Fund raising projects by grottos and regions of the N.S.S. are distinct possibilities.

LOCATION

Location of the gate is determined by the geometry of the cave and the location of the features that are to be protected. There is no set rule to the location of the gate. There are advantages and disadvantages to any location. A gate at or near the entrance makes it easier to construct, maintain, and patrol. It also exposes the gate to many people who visit the front part of the cave and in some cases, visitors who would not normally visit the cave. A gate located in or near the entrance also exposes bats who are using the cave to predation by limiting their speed and maneuverability. A gate located a distance from the entrance has the disadvantage of more difficult construction and maintenance. It is more difficult to patrol and also gives a measure of privacy to the vandal intent on forced entry. It does, however, have the advantage of discouraging predatation of bats and limits the exposure of the gate to a smaller population of persons entering the cave.

Cross-sectional area of the passageway is also a factor governing gate location. It is obvious that the larger the cross-sectional area, the greater the cost and effort required to construct the gate.

It has been standard practice in the past to gate the smallest cross-sectional area for the reasons given above. In addition to these reasons, the rational has been that this gives the vandal less room in which to work. This rational may be correct, but it should not be a design consideration. A small work area makes it very difficult to properly construct a gate. The location should be chosen to facilitate proper construction as much as possible.

If the features to be protected are remote or if they are contained in a discrete section of the cave, then the location of the gate should be chosen to keep as much of the cave open as possible. There is much opposition to gating from members of the caving community and from sport cavers alike. A gate should serve only to protect some feature or animal. Many gates that have been installed, restrict traffic through large areas and in some cases, whole caves, unnecessarily. This is very bad public relations and can be avoided in many cases.

The final factor governing the location of the cave gate is air flow. Air flow must not be restricted in any way. One way of minimizing the effect of the gate on the air flow is to choose a location which lies between two cross-sectional areas that have greater restrictions than the gate. An example is the General Davis gate in Greenbrier Co., West Virginia.

GATE GEOMETRY

The size of the openings in the gate have been very well defined. A gate should have openings with a minimum vertical height of 6" and a minimum horizontal width of 24" (Tuttle 1976). This is the accepted minimum size opening that will permit bats to enter and exit flying. It is fortunate that the 6" dimension will effectively limit passage of the majority of the human population. Vertical bars have a greater disturbing effect on bats than horizontal bars. It is, therefore, desirable to have as few vertical bars as possible. The distance between vertical bars is governed by the strength and rigidity of the gate material.

AIR FLOW

There are many factors governing air flow in a cave system. Among these are volume, cross-sectional area and shape, elevation differences between entrances, outside barometric pressure, and entrance size.

Temperatures within a cave are governed, in part, by the air flow in and out of the cave. Bats choose a particular cave for a variety of reasons but the main reason appears to be the temperature. If the air flow is altered, the temperature within is altered. Air flow also governs humidity, which not only affects the biota, but formations. For these reasons, it is of major importance that the air flow be unaltered.

Air flow is poorly understood by gate designers, gate builders, and speleologists. The greatest misconception is that air flow is proportional to cross-sectional area. This is not true of low to medium air velocity.

It is not yet determined how much restriction versus air velocity is permitted before air flow is seriously affected. It is conceivable that at low to medium velocities 20% is feasable and perhaps up to 40% at low velocities is acceptable.

The easiest way to address the air flow restriction problem is to design the gate so that air flow is not restricted but simply redirected. A design of this type is shown in Figure 1.

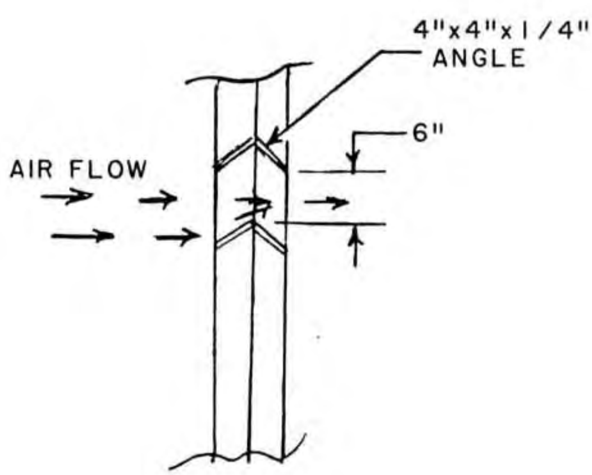

Figure 1

The air approaching the front of the gate is deflected upwards instead of being blocked, as it would be if the air encountered a flat plate normal to the air flow. This type of design would work well at even high velocities. The cross-sectional area of the gate is effectively the sum of the area of the edges of the individual plates.

The use of angle iron permits greater spans, reducing the number of columns required. The square columns in this type design are rotated so that they deflect rather than restrict the air flow. One word of caution on using this type of design is that on 6" vertical spacing, the maximum size of angle iron should not exceed 4" on the back leg. If this dimension is exceeded, the air at high velocities may strike the back leg normal to the surface.

Using a design of this type along with careful location choice should solve all but the most severe air flow problems.

OTHER DESIGN CONSIDERATIONS

Water is the enemy of the gate. Water can cause locks to fail, hinges to freeze and the gate material to rust. The completed gate should be protected by paint or other preservative. Locks and hinges should be protected from direct moisture. Maintenance for any gate should be performed on a regular basis.

THE ACTIVE GATE

With the advent of inexpensive solid state low power electronics, a fourth type of gate is now feasable. The active gate is one which actually becomes active when the presence of people at the gate is detected or if a violation of the gate is attempted. Such a gate could deliver a harmless shock, sound a remote alarm or photograph the vandals. A gate could be designed to remain open until approached and then shut. Unlimited possibilities exist, depending only on the imagination and skill of the designer.

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MANAGEMENT

PROJECTS

Cave Conservation in the Klamath Mountains

Mike Sims*

Abstract

The Klamath Mountains Conservation Task Force was organized in 1973 with the objective of "preventive conservation," i.e., applying the concept of a task force to promote cave conservation in a relatively unknown area before a crisis situation arises. Toward this objective, the KMCTF has located and assessed little-known or previously unknown caves within the Klamath Mountains and actively sought liaison with the government agencies possessing the caves. The KMCTF also sought to increase the awareness of the government agencies toward management of their cave resources.

The concept of National Speleological Society Conservation Task Forces (CTF) was established under Act 50-238 of the NSS Board of Governors on March 31, 1971. This act states: "The Conservation Committee should actively seek out conservation problems throughout the counry and establish task forces under the Conservation Committee to seek out the facts in each case and publicize the problem through the NSS News and other publications." This concept is fairly typical of the cave conservation efforts of the NSS. In other words, wait until a cave or caving area is suffering acutely or is in imminent danger and solve the problem by jumping in with great outcry and publicity, but with the obvious danger of the effort being too little, too late.

Other factors may come into the picture when the "crisis" method of conservation task forces is used. For example, it usually is the case that when a cave becomes well known and well used by cavers, especially the locals, it becomes very difficult, if not impossible, to change the patterns of use of the cave. People react strongly and perhaps irrationally when deprived of what they consider to be their rights and freedom of access. It has proven to be very difficult to keep a gate intact on a relatively well-known cave. Also, all too often the conservation effort is undertaken by one group to the exclusion, perceived or actual, of others. There are many examples of cavers establishing control over a cave by use permit, mining claim, or just by constructing a gate. Then, the cave becomes a playground for one group to the exclusion of all others, either by design or by clash of caver personalities.

If the foregoing generalizations are correct, it would seem that the ideal conservation situation would be a cave unknown locally, under the ownership of a person or agency receptive to management development, and which is in original condition. In other words, the ideal situation is a newly discovered cave, found by conservation-oriented cavers. Conservation could then be carried out before a problem developed -- i.e., preventitive conservation.

These ideas developed through a series of campfire discussions over a period of some years. There were ample examples of the shortcomings of crisis-oriented cave conservation efforts and even more examples of failure of the "conservation by exclusion" efforts. Therefore, to pursue the concept of preventive conservation, Steve Knutson, Lynne Sims and I formed the Klamath Mountains Conservation Task Force. Our basic mission, as formulated in our discussion, was to find new caves, and then go to the owning person or agency and impress upon them the need for cave management and conservation (whether they like it or not). Our major selling point was to be the value of the cave as a resource. Beside the obvious scientific values, caves are a true wilderness. One need not go very far into a cave to gain a wilderness experience equivalent

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to many miles of surface wilderness. The concept of "underground wilderness" was just gaining currency in the NSS and our ideas were doubtless influenced by this.

The Klamath Mountains Physiographic Province is an area of complex geology with scattered marble deposits. It is a lens-shaped area with the points north and south. It runs from just west of Red Bluff in Northern California to just south of Roseburg in Oregon. In 1973, there were only a few caves known in the area and, due to its isolation from population centers and from organized caving, it seemed to be an ideal place to find the caves required for our preventive conservation. It was also apparent that the caves which had seen use by the locals were badly vandalized, seeming to strengthen one of our basic assumptions.

In the autumn of 1973, we began to search for caves and cave leads in Northern California. Our first coordination with a cave-owning agency was with the Big Bar Ranger District of Trinity National Forest. Locals, including Forest Service personnel, had discovered a cave only a few years before. We contacted the Forest Service, were guided to the cave, and proceeded to map and inventory the cave. This cave was a substantial discovery in California at the time, and it spurred on our search for new caves.

We found several other small caves, and convinced of the potential of the Klamath Mountains as a caving area, we applied to the NSS Conservation Committee for status as the Klamath Mountains Conservation Task Force. Our request was approved by the NSS Board of Governors on April 2, 1974 and we set out to implement some of our ideas.

In the summer of 1974, we were rewarded in the extreme. In the Marble Mountains Wilderness, we found an alpine karst area which was to become one of the major caving areas of the Far West. This area has yielded over 45 caves, with over fifteen miles of mapped cave, including Bigfoot Cave System which, with a depth of 1,205 feet and nine and one quarter miles of mapped passage, was from 1977 to 1980, the deepest cave in the continental U.S. and the longest cave west of the Continental Divide. The great majority of these caves had not previously seen the passage of man.

It was apparent quite early on that we were on to something good. Assembling the data from our first summer in the Marble Mountains, we found our largest cave was already the third longest in California and the fifth deepest in the U.S. Fighting off the alternate urges to "keep it secret -- just for us!" and to go for the big ego trip with wide publicity, we began to realize that here was a near ideal situation to further develop our ideas of preventive conservation. We contacted the responsible Forest Service District of Klamath National Forest, arranged a meeting and showed them our slides and maps. The rangers were politely impressed, but really didn't know what to do with us. This we expected and assured them that it would all work out.

Now, it is some nine years later and the original three cavers of the KMCTF have become several dozen cavers, with participation from California, Oregon, Washington, Nevada, and elsewhere. We continue to explore, map, inventory hazards and contents of the caves, and aid students and others in pursuing speleological studies. We have, for the most part, been successful in avoiding the controversies that have often surrounded CTF and other conservation efforts modeled on the "crisis" and exclusion concepts.

How was this accomplished? From the time we first contacted the Forest Service, we emphasized that the caves were unique resources possessing recreational, wilderness, and scientific values. We emphasized the unique features: formations, biological species, and physical factors of length, depth, and size -- any unusual nature of the specific caves. We also set out to educate the Forest Service personnel. We deluged them with conservation articles, copies of proceedings from the various cave management symposia, and information on what other agencies were doing. We enlisted and infiltrated agency staff whenever possible. We provided bones to their archaeologists. We got their hydrologists interested in cave hydrology. We related the caves and karst features to Forest Service activities, e.g., karst hydrology related to herbicide spraying and logging activities. We constantly (but gently) reminded them that conservation of natural resources was a primary mission of the Forest Service. And finally, we did not go away. We had personal and telephone contact. We prepared and presented annual reports of our efforts and findings and conducted annual meetings.

Over time, these efforts began to pay off. Presumably, we were reinforcing an emerging awareness in the government of the potential values of natural resources for scientific and recreational uses. Finally, we were able to get management-level personnel from both the Klamath National Forest and from Region 5 Headquarters to attend a National Cave Management Symposium (at Mountain View, Arkansas in 1976). It turned out that this was the ideal symposium for them to attend. They were exposed to the cave management plans being put into effect in New Mexico's Guadalupe and Lincoln National Forests and at the Buffalo National River in Arkansas. Also, the symposium included a tour of Blanchard Springs Cavern, the crown jewel of the Forest Service's show caves.

This resulted in a request from the Forest Service for the KMCTF to submit a proposal for a cooperative agreement concerning inventory and investigation of the caves of the Marble Mountains in Klamath National Forest. The cooperative agreement was signed in April 1977. A further result was the development of a cave management plan for all National Forests in Region 5 of the Forest Service. This plan was drafted and circulated to caver groups for comment before implementation. In July 1980, the cave management guidelines were implemented as a supplement to the Forest Service Manual for Region 5.

The Region 5 Cave Management Plan is based upon the "New Mexico" plans which rate caves according to their contents and hazards. A further feature of the Region 5 plan is management guidelines tied to the contents and hazards ratings. The plan also provides for limited recreational use of caves by various options ranging from open caves to guided trips by either volunteers or Forest Service employees.

In summary, we believe that our efforts in preventive conservation have proven successful. The cooperation we have received from the Forest Service and the National Park Service has been outstanding. And, within the NSS, other conservation task forces have been modeled after the KMCTF -- to us the sincerest form of flattery.

The main point to be made, though, is not the glorious caves we were lucky enough to find, nor the flattery of our task force serving as a model for others. The point is that we have achieved our goal. We feel that this is due to two factors: First, the Marble Mountains is in an ideal management situation; 1) no locals have a claim to the caves; 2) the caves are isolated within a surface wilderness; 3) the cavers of the region are willing to see the cave area managed; 4) the governing agency has been made aware and is interested in management of the cave resource; 5) due to the low key nature of the effort, when the caves inventory is complete, the cave resource will be in essentially original condition.

The second factor in a successful preventive conservation project is the effort and style of the cavers in dealing with the responsible government agency. I suggest the following as hints on "how to do it": 1) be friendly and open; 2) show your enthusiasm; 3) provide the agency with the things they need: share your data, maps, pictures, articles, and significant information on the caves; 4) conduct the inventory using the format and techniques required by the agency; 5) don't be condescending; your job is to educate the agency personnel, not to impress them with your knowledge; 6) accept your responsibilities and gently insist that the agency accept theirs; 7) above all, be persistent; don't go away; and let the agency know that you will be there as long as necessary to accomplish the goal.

The Formation of the Trout Rock Conservation Task Force of the National Speleological Society

Fred Grady*

Abstract

The closing of the caves of Trout Rock stimulated the formation of the Trout Rock Conservation Task Force, whose goals are to obtain the caves by purchase and donate them to the National Speleological Society. The caves are significant historically, recreationally and especially paleontologically.

During April of 1981, the owners of the caves at Trout Rock, Trout, New Trout, and Hamilton decided to enforce the closure of the caves. This halted surveys and other scientific work at the caves and diverted sport cavers to other caves. The property consists of approximately 42 acres of steeply forested hillside and the owners were anxious to sell it. While it had been on the market for several years, there had been no serious interest due to the unrealistically high price.

A group of cavers from West Virginia and the Washington, D.C. area discussed the possibility of buying the property and approached the National Speleological Society (NSS) for assistance and support. The result was the formation of the Trout Rock Conservation Task Force of the NSS. Negotiations with the agents of the landowners were opened and proceeded over a number of months. A brochure was put together and circulated at various gatherings of cavers. The brochure included maps of the property and the caves, as well as information on the significance of the caves recreationally, historically, and paleontologically.

By the time of the 1982 National Cave Conservation and Management Symposium, 5-7 November, 1982, about 2/3 of the necessary funds had been donated or pledged. Thus, it appeared that the Trout Rock Conservation Task Force was close to achieving its stated goal, the purchase of the caves at Trout Rock.

POSTSCRIPT

On January 26, 1983, initial papers were signed transferring the Trout Rock Cave property to the National Speleological Society. Using several loans from cavers and the NSS Save the Caves Fund, final payment was made on March 16. The final selling price was $40,000 (Garton et. al., NSS News, April, 1983, p. 128). At this time, it was decided to name the property the John Guilday Cave Preserve in memory of the late John Guilday, a caver and paleontologist. The Trout Rock Conservation Task Force then became the management committee of the NSS for the John Guilday Cave Preserve. One of the first acts of the committee was to declare the caves open to all qualified cavers.

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Cave Management for the Endangered Indiana Bat (Myotis sodalis) and Gray Bat (Myotis grisescens)

John T. Brady*

Abstract

The Indiana/Gray Bat Recovery Team has been preparing recovery plans for the Indiana and Gray Bats. The plans will determine criteria for protecting caves for these species as well as prioritize which caves are more important. Management options such as public acquisition of caves, posting of warning signs and erection of fences and gates to exclude human entry are discussed.

INTRODUCTION

The Indiana bat and gray bat both have been designated as endangered species by the U.S. Fish and Wildlife Service and are protected under the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service, 1978). The Indiana/Gray Bat Recovery Team was appointed by the U.S. Fish and Wildlife Service to prepare a recovery plan for the gray bat and revise the recovery plan that was prepared for the Indiana Bat in 1976 (Engel, et al., 1976).

DISTRIBUTION

The Indiana bat is found in the midwestern and eastern United States, from extreme northern Florida north to Vermont, Michigan, Wisconsin, west to Iowa, Arkansas and eastern Oklahoma. The winter range is primarily Missouri, Indiana, Kentucky, and Tennessee.

Gray bat populations are found mainly in Alabama, northern Arkansas, Kentucky, Missouri and Tennessee, but a few occur in northwestern Florida, western Georgia, southeastern Kansas, southernmost Indiana, southern and southwestern Illinois, northeastern Oklahoma, northeastern Mississippi, western Virginia and possibly western North Carolina (Hall, 1981; Tuttle, 1979).

HABITAT REQUIREMENTS

1. Indiana Bat. Depending on local weather conditions, Indiana bats are in hibernation from October to April with some arriving at the hibernacula as early as early September (LaVal, et al., 1977). Indiana bats have specific requirements for hibernation, generally choosing roost sites within caves or mines which have stable temperatures of 4-8 degrees C allowing the bats to maintain a low metabolism and conserve fat reserves until spring (Humphrey, 1978). The bats usually hibernate in large, dense clusters of about 300 bats per square foot (Hall, 1962; Engel, et al., 1976; Clawson, et al., 1980).

   Current studies indicate that females form nursery colonies mostly in riparian and flood plain areas of small to medium sized streams, (Humphrey, et al., 1977; Cope, et al., 1978; Sparling, et al., 1979; Gardner and Gardner, 1980). Riparian habitat was found to be occupied from mid-May until mid-September (Humphrey, et al., 1977).

2. Gray Bat. The gray bat is, perhaps, the most restricted to cave habitats of any U.S. mammal (Hall and Wilson, 1966, Barbour and Daves, 1969; Tuttle, 1976a). With rare exceptions (Hays and Bingham, 1964), it roosts in caves year-round. Because of highly specific roost and habitat requirements, fewer than 5 percent of available caves are suitable for occupation by gray bats (Tuttle, 1979). Colonies move seasonally between unusually warm (14-25 degrees C) and cold (6-11 degrees C) caves (See Figure 1).

   Most winter caves are deep and vertical; all provide large volume below the lowest en-

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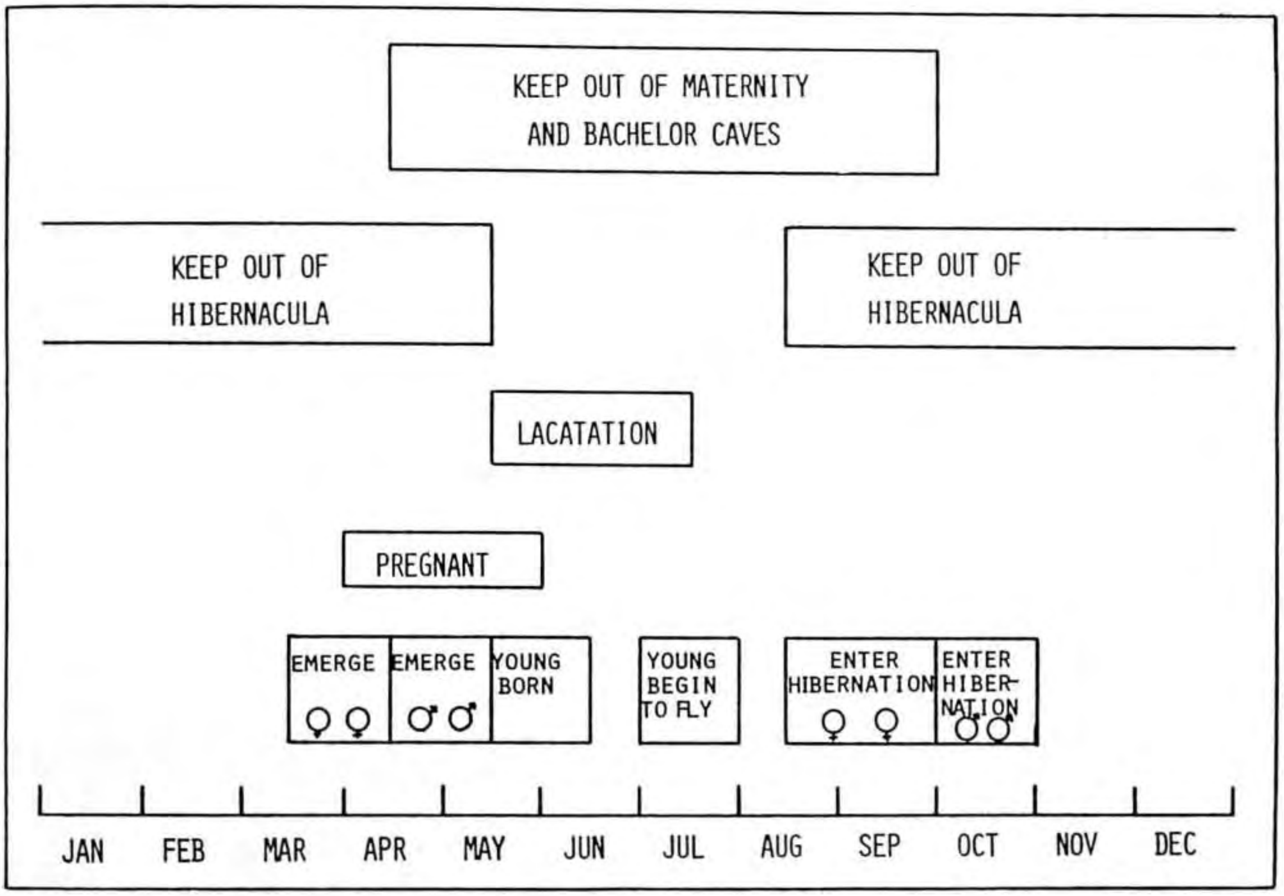

FIGURE 1. Annual chronology of the gray bat (*Myotis grisescens*), showing seasons when caves should not be visited. Some maternity and bachelor colonies naturally leave their caves as early as 1 August annually, and at such locations entry is permissable thereafter.

trance and act as cold air traps. A much wider variety of cave types are used during spring and fall transient periods. In summer, maternity colonies prefer caves that act as warm air traps or that provide restricted rooms or domed ceilings that are capable of trapping the combined body heat from thousands of clustered individuals (Tuttle, 1975; Tuttle and Stevenson, 1978). At all seasons, males and yearling females seem less restricted to specific caves and roost types (Tuttle, 1976a).

Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer of rivers or reservoirs (rarely more than 4 km) over which the bats feed (Tuttle, 1976b).

REASONS FOR DECLINE

Human disturbance is the most serious cause of population decline for both species. Hibernating Indiana and gray bats are vulnerable and can lose as much as 10 to 30 days of fat supply per disturbance (Tuttle, pers. comm.). Gray bats are also vulnerable at maternity caves when flightless young are on roosts and thousands may die from a single disturbance. Most human disturbance is the result of people who don't know any better, but there are also cases of deliberate vandalism against both species.

Other reasons for population declines are flooding, ceiling collapse, especially in abandoned mines, careless handling of bats by biologists, commercialization of caves, exclusion of bats by poorly designed gates, changes in cave microclimate by opening of additional entrances or blocking air flow by poorly designed gates; flooding of caves by reservoirs, clearing of forests, and pesticide poisoning.

CAVE MANAGEMENT

Signs, fences, and gates may be required to reduce or eliminate human disturbance at Indiana and gray bat caves. Generally, Indiana bat hibernacula should be closed to human entry between 1 September and 30 April. Figure 1 shows when the different types of gray bat caves should be closed.

1. Signs. At a cave which is infrequently visited, or easily observed by its owner, a sign alone may be adequate to prevent disturbance. Under certain circumstances, a sign might call unnecessary attention to a cave, in which case the management agency might opt for placement of the sign inside

FIGURE 2. Warning sign used on a gray bat maternity cave by the Missouri Department of Conservation.

the cave. Signs must be of durable construction and fixed solidly in place to minimize vandalism, and should not be placed where bat movement or air flow might be impeded. They must be located where potential violators can see them, and should be placed just behind the gate or fence if such a structure has been erected.

Wording will vary from cave to cave, depending on the history of use of the cave by both bats and people. If law enforcement officials are to have a strong case against violators, the sign must contain a warning message similar to that of the upper half of the signs shown in Figures 2 and 3. All signs should include an interpretive message, as exemplified by the one shown on the lower half of the sign in Figures 2 and 3. The sign in Figure 2 is used at gray bat summer caves in Missouri, and is especially suitable for maternity caves; Figure 3 is used at Indiana bat hibernacula. The interpretive message has been modified for certain other types of gray bat caves as follows: (1) for gray bat hibernacula - "The gray bat, an endangered species that hibernates in this cave, must survive the winter on stored fat. When disturbed, they arouse, using up this fat. Bats that have been aroused two or three times may die before insects on which they feed are again available in spring." (2) caves in year-round use by gray bats - "The gray bat, a highly beneficial endangered species that occurs in this cave throughout the year, is intolerant of disturbance. In the summer, baby bats may fall to their deaths if disturbed. In the winter, bats may arouse from hibernation, using up the stored fat they need to survive until spring."

FIGURE 3. Warning sign used on an Indiana bat hibernaculum by the Missouri Department of Conservation.

At some caves, visitor entry can be permitted during seasons when bats are not present. A smaller sign containing that message, plus information on how to obtain a key to a gated cave or other pertinent details, might encourage the cooperation of spelunkers.

In cases where a cave is located in a public use area, the management agency may wish to use a more detailed interpretive message. For example, a sign with the following wording was posted at Blowing Wind Cave, National Gray Bat Sanctuary in northern Alabama:

BLOWING WIND CAVE
Wildlife Sanctuary-Unauthorized Entry Prohibited

"This cave is critical habitat for endangered Gray and Indiana Bats as well as for threatened Eastern Big-eared Bats and the Tennessee Cave Salamander. As a result of human disturbance, all of these species have decreased dramatically in numbers, requiring protection from unauthorized entry. When this cave was purchased by the U.S. Fish and Wildlife Service in 1979, populations of all but the Gray Bat were nearly extinct here, and even this species had been reduced to less than half of former numbers.

Gray Bats have declined by more than 54 percent throughout much of their range in the last six years alone. Due to this cave's unique structure and strong, seasonally reversing air flow patterns, it is the most important summer cave known for gray bats. It contains roughly a quarter of all known gray bats and the colony here is the largest anywhere. With careful protection it is hoped that this colony will soon recover to former numbers (between 250,000 and 500,000).

These bats are very beneficial and deserving of human understanding and protection. Individuals often eat 3000 or more insects in a single night, including many harmful kinds such as mosquitos. Insects, eaten nightly by the whole colony number roughly a billion and weigh more than a ton!

Since thousands of these bats sometimes die from a single ill-timed disturbance of their roost, human entry into this cave must be carefully controlled. Please help us protect them. You are welcome to quietly watch the emergence and return of these bats at dusk and dawn each day from April through September (flights are especially impressive in July and August); however, penalties for unauthorized entry beyond this gate or other molestation of endangered species, range up to fines of $10,000 and/or imprisonment. Also, it is illegal to damage Federal property. For further information you may contact the Wheeler National Wildlife Refuge, P.O. Box 1643, Decatur, AL 35602."

2. Fences. Although fences may not afford the same level of protection as steel gates, the presence of a fence makes it clear that unauthorized entry is illegal. Fences may be less expensive than gates, but are easier

FIGURE 4. Fence erected at Norris Dam Cave, Tennessee by Tennessee Valley Authority. (Photo credit, Robert Currie)

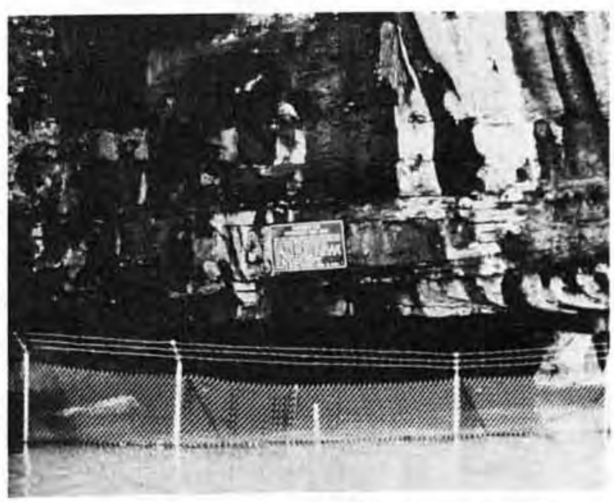

FIGURE 5. Fence erected at Hambrick Cave, Alabama by Tennessee Valley Authority. Fence is located approximately 30 feet from cave entrance. (Photo credit, Tennessee Valley Authority)

to climb or cut. Nevertheless, some caves are impractical to gate, due to size or configuration of entrances, or because gating would result in probable abandonment of the cave by bats. Chainlink, barbed-wire-topped fences (Figure 4), with posts set in concrete are best. Barbed-wire should not extend into flight space required by bats. Several fences have proven highly effective in reducing human disturbance, permitting gray bat maternity colonies to increase greatly in size. Fences also have been used successfully to protect caves with flooded entrances adjacent to reservoirs (Figure 5).

3. Gates. Gates must be used only with extreme care to avoid detrimental effects. They should not be used at gray bats summer caves unless free flight space can be provided above. They should not be horizontal or used in entrances smaller than 6 feet in diameter. Gates in small entrances are most likely to restrict air flow or increase bat vulnerability to predation (Tuttle, 1977; Tuttle and Stevenson, 1978), leading to abandonment by the bats. The U.S. Fish and Wildlife Service is currently conducting a study on the effects of gates on bats. This study is scheduled for completion in 1984.

Welded steel bar gates provide the most secure means of preventing human entry into a cave. Even the best-designed and well-built gate can be vandalized. Routine inspections will identify damage so that repairs can be made promptly.

Each gate must be designed specifically for the cave to be protected, considering numbers of bats, type of colony, air flow, and entrance size and shape. In spite of the number of variables involved, certain generalizations about gate design can be made.

Gates should be constructed of steel bars of sufficient size to be invulnerable to bolt cutters. Steel bars 3/4-inch to 1-inch in diameter (ASTM* A 242) are recommended. All welds should be made carefully, using arc welding equipment.

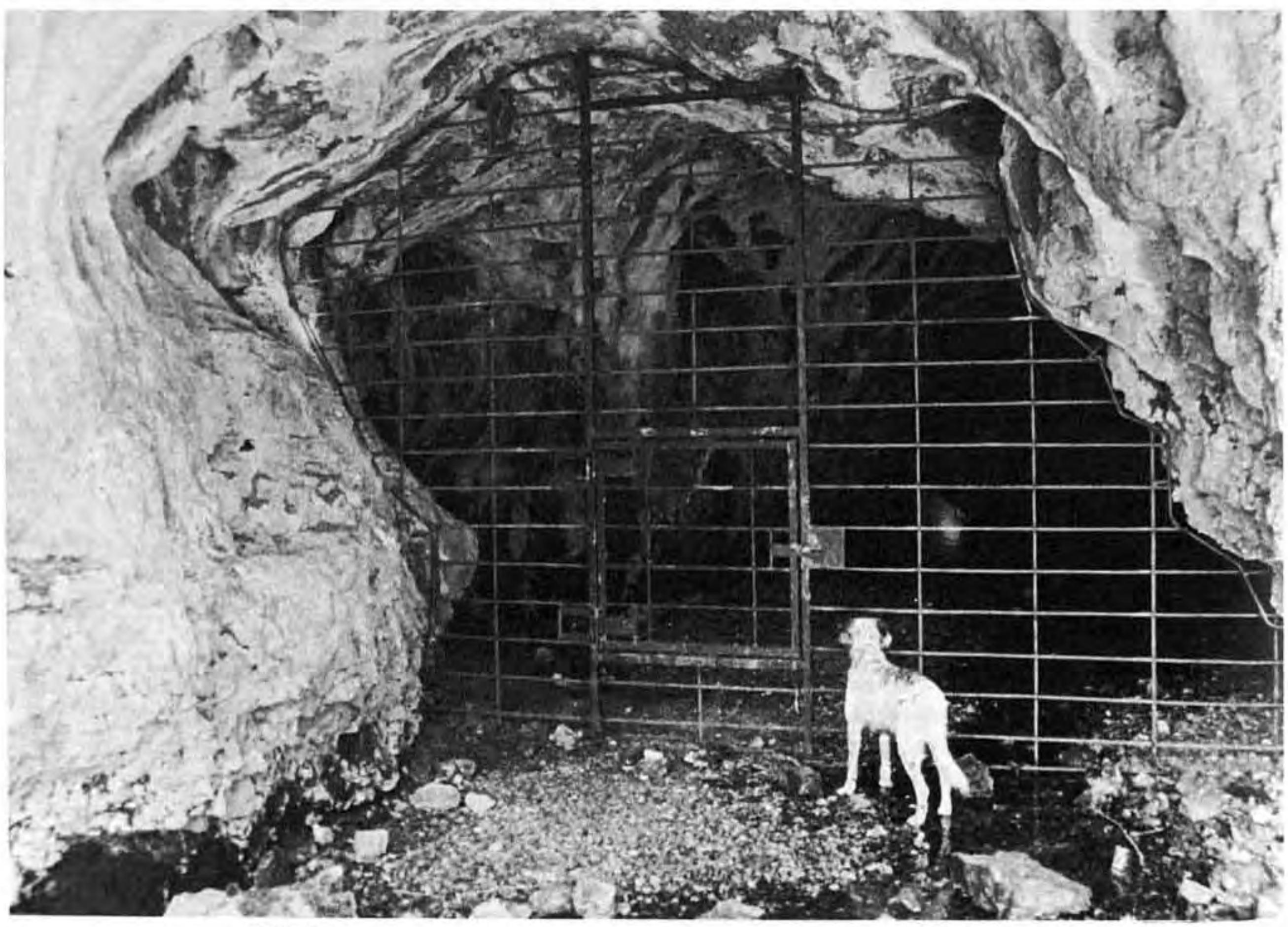

FIGURE 6. Great Scott Cave gate erected by the Missouri Department of Conservation. (Photo Credit, Rick Clawson)

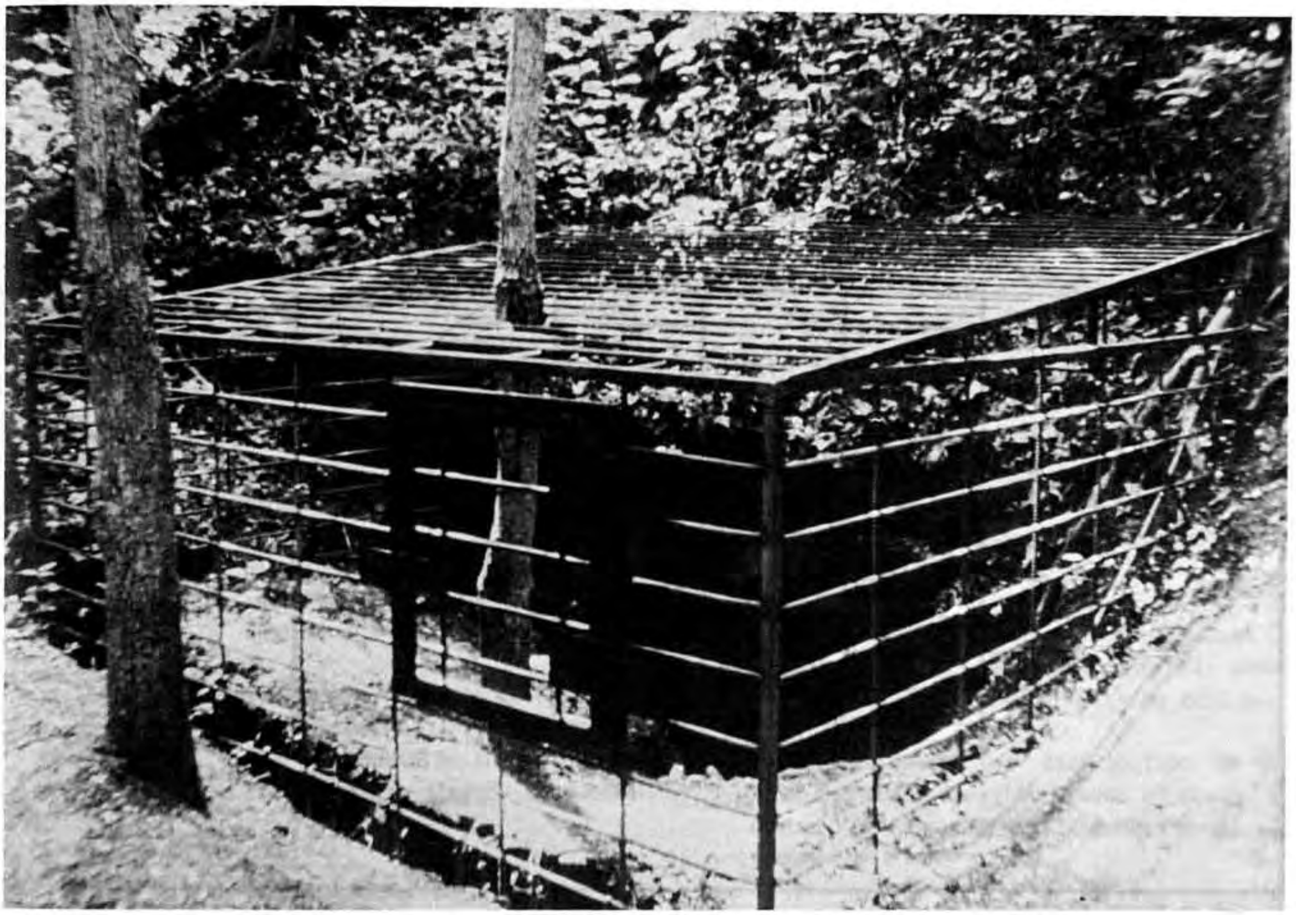

FIGURE 7. Bear Cave gate (a "cage" gate) erected by the Missouri Department of Conservation. (Photo credit, Rick Clawsen).

Access openings in gates should be constructed to the same standards, with the most durable hinges, hasps, and locks. In a situation where vandalism seems likely, weak-link design may be employed. The lock, hasp, or some other easily replaceable portion of the gate should be relatively weak so that vandals will not try to breach the main body of the gate. Locks should be chosen with care, as many common types are extremely easy to force open.

Free ends of all bars should be grouted into solid rock. In some caves, it may be necessary to pour a concrete footing (although it should not rise above original ground level), or to dig through a deep clay or gravel fill to reach the underlying floor.

Openings in gates through which bats are expected to fly should be approximately 6 inches vertically and at least 24 inches horizontally. Lengths greater than 24 inches between vertical bars increase the probability that the bars can be spread by use of hydraulic jacks.

Unfortunately, a simple vertical gate (Figure 6) seldom can be constructed at a cave with a sinkhole entrance. Horizontal gates have two serious drawbacks: (1) Bats are reluctant to fly up through such a gate; and (2) A horizontal gate may become blocked with debris, preventing entry and exit by bats, as well as blocking normal air flow. A solution is provided by a "cage" gate, similar to that shown in Figure 7.

Although gates that cover entire entrances may provide maximum security, their use should be restricted. Pregnant gray bat females and females with young apparently will not fly through them. Until a full gate can be designed that proves acceptable to gray bats using maternity caves, such caves must be "half-gated." A half-gate is practical only in a large cave entrance, where it extends from the floor part way to the ceiling. It should allow adequate space through which bats may fly (at least 3 feet of space and preferably more, depending on entrance width and colony size). It is relatively easy to climb over a half-gate unless the

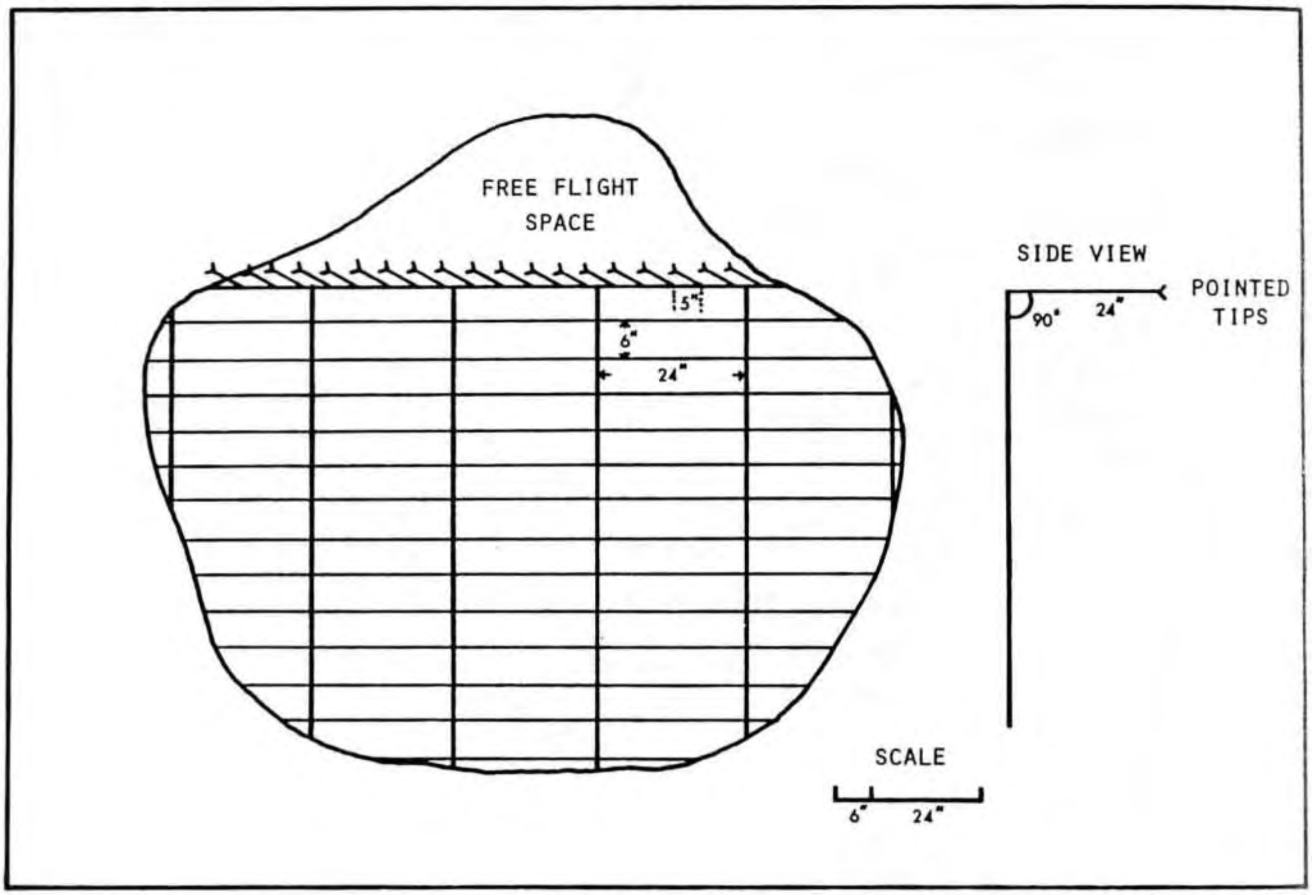

FIGURE 8. Drawing of a gate with free flight space, adapted from Blackwell Cave Gate, U. S. Army Corps of Engineers, Kansas City District.

top is designed to make the climb difficult (Figure 8).

Full gates have one additional limitation which cannot be overcome by the half-gate design. Gray bats are apparently very sensitive to any gate or other structure placed across a small entrance (less than 6 feet in diameter). One such cave, when gated, was promptly abandoned by a bachelor colony of 40,000 bats that had been present the previous year.

4. Restrict Approach to Cave. Few people find caves without the aid of trails and roads. Obliteration of jeep and foot trails may greatly reduce human traffic to the caves. The Tennessee Valley Authority has blocked boat approaches to two of its caves, preventing access. Other opportunities for restricting approach may present themselves at specific cave sites.

5. Levees. The Kansas City District, Corps of Engineers have successfuly used an earthen levee to protect a gray bat cave from flooding at Harry S. Truman Lake in Missouri. Care must be taken to prevent water from backing up into the cave, behind the levee.

6. Resource Groups and Agencies. No modification should be made to either an Indiana bat or gray bat cave without consulting the appropriate Regional Director of the U.S. Fish and Wildlife Service.

The following groups and agencies have had the most experience with bat cave management, and can be consulted for advice when management actions are being planned:

(1) The Recovery Team;

(2) U.S. Fish and Wildlife Service, Region 4;

(3) Missouri Department of Conservation;

(4) Tennessee Valley Authority, Office of Natural Resources; and

(5) U.S. Army Corps of Engineers, St. Louis and Kansas City Districts.

Recovery Efforts

1. Indiana Bat. An agency review draft Indiana Bat Recovery Plan was distributed on 10 August 1982. A final plan should be available in 1983. The most important way to protect this species is to protect their hibernating caves. The following cave protection priorities were developed:

   Priority 1 - Hibernacula with recorded population greater than 30,000 since 1960.

   Priority 2 - Hibernacula with recorded population greater than 1,000 but less than 30,000 since 1960.

   Table 1 displays the distribution of Indiana bats and their important hibernacula by state. As can be seen from this table, a number of these caves are already in public ownership.

2. Gray Bat. The final Gray Bat Recovery Plan was approved by the Director of the U.S. Fish and Wildlife Service on 8 July 1982.

   Cave protection is also the key in protecting this species. In addition to the important hibernacula, the critical maturity caves must also be protected. The following cave protection priorities were developed for gray bat caves:

   Priority 1- Major hibernacula and their most important maturity colonies.

   Priority 2- Caves containing fewer bats that are important for geographic or other reasons.

   Priority 3- Caves that require further investigation.

   Priority 4- All remaining caves, most of which are of marginal consequence and require no action.

   Table 2 displays the distribution of gray bats and their important caves by state. The number of caves in public ownership is also shown.

*American Society of Testing Material

TABLE 1
INDIANA BAT POPULATION AND RECOVERY STATUS

State	Priority 1 Hibernacula	Priority 2 Hibernacula	Population*
Missouri	3 (1)	8 (5)	281,700
Indiana	2 (2)	4 (1)	167,600
Kentucky	3 (2)	13 (3)	110,400
Tennessee	0	4 (2)	22,500
Arkansas	0	3 (1)	6,200
New York	0	2 (0)	1,700
Pennsylvania	0	1 (1)	200
Virginia	0	1 (0)	600
West Virginia	0	1 (0)	1,500
TOTAL	8 (5)	37 (13)	592,400

( ) Number of caves that have been purchased, leased, or have a cooperative agreement with a public or private conservation agency.

*The most recent population census was used. In most cases this was taken in 1981-82.

TABLE 2
GRAY BAT POPULATION AND RECOVERY STATUS

State	Priority 1 Hibernacula	Priority 2 Hibernacula	Population of Major Hibernacula (Estimate)*
Alabama	7 (5)	13 (2)	700,000
Arkansas	3 (1)	26 (10)	250,000
Florida	4 (1)	3	
Illinois	1	0	
Kansas	0	1 (1)	
Kentucky	1	15 (1)	25,000
Missouri	11 (6)	54 (14)	300,000
Oklahoma	1	3	
Tennessee	9 (2)	26 (5)	300,000
Virginia	0	1	
TOTAL	37 (15)	142 (31)	1,575,000

( ) Number of caves that have been purchased, leased, or have a cooperative agreement with a public or private conservation agency.

*Estimates are only displayed for major populations.

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CAVE HISTORY

A Brief History of Grand Caverns

Bob Custard*

Grand Caverns was discovered in 1804 and opened as a commercial attraction under the name of Weyer's Cave in 1808. It rapidly eclipsed nearby Madison's Cave in popularity and became a nationally known tourist attraction. It is the oldest commercial cave in operation in the United States.

Throughout the early 1800's, Weyer's Cave enjoyed considerable success as an enterprise, especially during the summer tourist season. Square dances were held in the cave's Ballroom. During the Civil War, armies from both sides camped near and visited Weyer's Cave (and probably the other caves on Cave Hill). Most notably, Stonewall Jackson camped his troops here following the battles of Cross Keys and Port Republic at the end of his famous Valley Campaign in 1862. Jackson's Hall in the cave is named for him.

After the Civil War, Weyer's Cave resumed commercial operation. In 1874, a railroad was built through Grottoes and tourists began coming to the cave by train rather than stagecoach. The Western Electric Company installed electric lighting in the cave in 1889. In the Depression of 1893, the company which owned the cave went bankrupt and the cave passed back into private ownership.

In 1926, the stone lodge on the caverns property was built and the cave's name was changed to Grand Caverns. In 1974, Grand Caverns was acquired by the Upper Valley Regional Park Authority. Since then, development of the property by the Park Authority has transformed the park into a complete recreational facility which includes a swimming pool, tennis courts, picnic areas, hiking trails, and a miniature golf course. The Park Authority's administrative offices are located in the stone lodge.

Fortunately, the continuous commercial operation of Grand Caverns has served to protect much of the cave's beauty from vandalism. (In contrast, both nearby Madison's Saltpetre Cave and Fountain Cave have been heavily vandalized.) There are areas of the cave where pieces of formations have been broken off by tourists seeking souvenirs, but this type of vandalism has been reduced to a minimum as a result of the watchfulness of the tour guides and the emphasis placed on the protection given the cave under the Virginia Cave Protection Act early in each guest's tour. Parts of the cave, especially in the Drapery Room and near the cave's natural entrance, have abundant graffiti. Much of this artistry dates to the early 1800s and the Civil War when leaving one's signature on the cave walls was considered more socially acceptable, but modern day graffiti is, unfortunately, also fairly common.

In the summer of 1981, a group of juveniles broke into Grand Caverns and vandalized the cave. Their arrest represents the first time anyone in Virginia was charged with cave vandalism. Through an alternative sentencing arrangement in juvenile court, the vandals agreed to perform a public service project for the Park Authority. In fulfillment of their obligations, the vandals and their parents purchased playground equipment for the park and installed it.

Most recently, the cave was threatened by the proposed construction of a water storage tank on top of Cave Hill by the nearby town of Grottoes. Of principle concern to the Park Authority was the potential damage to the cave's delicate shield formations that blasting might cause. The Park Authority asked the Virginia Cave Commission to advise them. Eventually an agreement was reached between the town of Grottoes, the Park Authority, and the Cave Commission banning the use of explosives on Cave Hill and setting up a procedure to monitor any construction activities which could create shock waves that might damage the cave.

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A Brief Overview of the History, Geology, and Management of Fountain Cave

Bob Custard*

In 1835, a major cave was discovered by Edmund Weaste on Cave Hill to the south of Weyer's Cave (Grand Caverns). It was known briefly as Weaste's Cave, but subsequently, the name was changed to Cave of the Fountains or simply Fountain Cave. During the 1800's, it enjoyed a period of popularity as a commercial cave. Together with Weyer's Cave, the commercial caves on Cave Hill were known as the Grottos of the Shenandoah. The stone archway at the Fountain Cave entrance and the many stone steps within the cave remain as evidence of the cave's formation commercialization.

The geology of the Fountain Cave differs from that of nearby Grand Caverns and Madison's Saltpetre Cave in that the limestone in the cave has a relatively low angle of dip in comparison to the vertical dip of the limestone in the caves further north in Cave Hill. This difference is the principle reason that Fountain Cave is characterized by larger and wider rooms, flatter ceilings, and large breakdown blocks. Passage development is predominantly along strike and secondarily along intersecting joints as with the other caves on Cave Hill. Although the cave exhibits some evidence of vadose modification where the cave comes particularly close to the surface, the passage development is primarily of the phreatic type.

Fountain Cave is characterized by a profusion of massive speleothems. In a number of areas, these formations choke off cave passages leading away from known areas of the cave. As with the other caves on Cave Hill, many columns and stalagmites in the cave were deposited on soft sediments which subsequently settled under the weight of the formations. Numerous cracked and tilted formations attest to this process.

Where the cave comes particularly close to the surface, mud and talus slopes are common. In some areas, tree roots penetrate the cave ceiling and fine organic debris filters into the cave along solution-enlarged joints. The room at the very back of the cave is actually overlain by a small cave opening onto the east side of Cave Hill south of the Fountain Cave entrance. This small cave undoubtedly provides a conduit for much of the organic debris seen in the back of Fountain Cave, but there is no passable connection between the caves.

As even the casual visitor to Fountain Cave will notice, the cave has been heavily vandalized. Most of the easily accessible small formations have been broken and many of the lower hanging stalactites and draperies have been damaged by rock-throwing vandals. A number of formations have holes or pock marks caused by gunfire. Spray paint and graffiti is ubiquitous throughout the cave. Litter and broken glass can be found in almost every hole where trash can conveniently be dumped.

In October, 1981, four local university students were arrested after they were caught by members of the Richmond Area Speleological Society carrying formations from the cave. The case was tried in the county general district court. Despite testimony from several witnesses, pictures of the culprits leaving the cave carrying formations, and statements from the culprits incriminating each other, the judge, in effect, let the accused off with a warning under the provision that they do something to further awareness of the Cave Protection Act. The students arranged to have a short article on the Cave Protection Act published in their school paper. Apparently, the judge didn't take the offense very seriously because it was only a Class 3 misdemeanor with a maximum penalty of a $500 fine. As a result of this incident, the Virginia Cave Commission proposed that cave vandalism under the Cave Protection Act be made a Class 1 misdemeanor with a maximum penalty of a $1000 fine and a year in jail. In 1982, the Virginia General Assembly followed the Cave

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Commission's recommendation and made cave vandalism a Class 1 misdemeanor.

The week after the four students were caught vandalizing Fountain Cave, the Cave Commission, in cooperation with the Cave Conservancy of the Virginias, gated the entrance and erected a sign stating the provisions of the Cave Protection Act. A management plan for the cave was then devloped by the Cave Commission in cooperation with the Upper Valley Regional Park Authority. The plan provides for recreational use of the cave under guidelines designed to protect the cave and make those entering the cave aware of good caving ethics and the legal protection given caves under state law.

During the summer of 1982, vandals using a hacksaw were able to penetrate the cave gate and enter the cave. The gate is scheduled to be repaired and reinforced during the National Cave Conservation and Management Symposium. Despite the breach in the gate, the management plan seems to have for the most part stemmed unauthorized visitation and vandalism of the cave. A large-scale project to clean up and restore the cave is now being planned for next year.

A Brief History of Massanutten Caverns

Bob Custard*

Massanutten Caverns was discovered on November 5, 1892 by Augustine Armentrout and five workmen who were blasting for limestone in a small quarry on the Armentrout property. Work to clear tourist trails in the cave began almost immediately and continued for a number of years by fits and starts as the economy of the time roller coastered from boom to bust. Rock was removed from the cave using sledgehammers and star drills.

Crawling tours of the cave probably began shortly after the cave was discovered. An inscription which reads "G. Loewner, Nov. 13, 1892" still survives on the cave's walls. By the summer of 1893, the Armentrouts were conducting guided tours of the cave lighted by kerosene lamps hung from the cave ceiling. In 1906, Augustine Armentrout died, and control and management of the cave passed to his heirs. During this period, tours were characterized by fanciful descriptions and names for the many formations found in the cave. Little information about how the cave and its speleothems formed was known or presented to the public, however. In 1926, the cave and surrounding property were purchased by the Harrisonburg Massanutten Corporation for development into a resort. Stocks and bonds issued by the corporation were sold to numerous local investors. Although most of the Armentrout family sold their interest in the cave, Johnson Armentrout, Augustine's youngest son, traded his interest in the cave for stock in the corporation and continued to work at the cave as a manager and guide.

The lodge building near the cave entrance was built in early 1926 and the new owners held a gala grand opening on the 4th of July of that year. Guest cottages, a nine-hole golf course, an airstrip, and an olympic-sized swimming pool were also built on the caverns property. Cave formations removed from the cave by the Armentrouts during its development and stockpiled for sale as souvenirs were used by workmen as ballast in the bottom of the swimming pool. To create a loop in the cave tour a passage was cut through from the Wonderland Room to The Ballroom. In the early 1930's, motorcycle races were held on the caverns property.

In 1932, the Harrisonburg Massanutten Corporation went bankrupt and the court took possession of the property to protect the interest of the creditors. The cave was leased for six years to the Brown family, owners of nearby Endless Caverns. During this period, Johnson Armentrout continued to help manage the cave and served as a guide. Information on the genesis of the cave and its formation was by this time incorporated in the caverns tour and the tendency towards sensationalism and fanciful exaggeration had been somewhat curbed. In 1933, the last room of the cave was joined to the entrance room to create a complete loop tour. Excavation for the last passage was done by blasting the rock away using one-eighth of a stick of dynamite at a time.

In 1938, the Brown family chose not to renew their lease or exercise their option to buy the property, and the court again took over operation of the cave. Around 1940, Miss Ethyl Erwin bought the property. Johnson Armentrout continued as caverns manager. The acquisition of Massanutten Caverns by Miss Erwin roughly coincided with the founding of the National Speleological Society in nearby Washington, D.C., and many early NSS members including Robbie Robertson and Bill and Merle Stephenson became close friends of Miss Erwin. Through contacts with the NSS, much additional scientific information about how the cave and its speleothems formed was added to the

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Prepared by Bob Custard from information provided by Bradford Cobb information provided to the public by cavern guides. In 1946, Johnson Armentrout died and thus ended the long connection of the Armentrout family with the cave.

In the early fifties, an attempt was made to reopen the pool adjacent to the caverns lodge. Bob Lutz, an early NSS member, served as chief waterworks engineer for the project, and the pool was open for three summers. Water supply problems, however, made operation of the pool impractical, and the pool has never been open since. It was also about this time that the Stephenson's daughter, Sandra, spent a summer at the caverns working as a guide and Miss Erwin participated in the famous C-3 Expedition to Floyd Collins Crystal Cave in Kentucky. During this period, the lodge building was used as a dance hall on Saturday nights.

In 1953, Bradford Cobb, an NSS member from New York, was hired by Miss Erwin as caverns manager. Two years later on April 10th, 1955, Mr. Cobb contracted to buy the cave. Miss Erwin, however, retained ownership of the lodge and 85 acres of the property surrounding it. Since 1955, Massanutten Caverns has been operated by Mr. Cobb as a commercial attraction. The adjacent property and lodge are now owned by the Wolverley Corporation, a real estate investment firm which bought the property from Miss Erwin and now is in the process of selling it.

In the fall of 1980, Massanutten Caverns was broken into and vandalized while Mr. Cobb was away. This incident prompted the installation of the massive steel door at the caverns entrance and the erection of two signs stating the provisions of the Virginia Cave Protection Act. Also, as an outgrowth of this incident, the Cave Conservancy of the Viginias, with the help of members of the Viginia Region of the National Speleological Society established a $500 reward for information leading to the arrest and conviction of anyone violating the Cave Protection Act of Virginia, West Virginia, or Maryland. Subsequently, this reward was expanded by the NSS to encompass the entire United States.

GENERAL

Cave Rescue

Tom Vines* and Dave Morrow**

Abstract

This session will cover what you need to know and do if a rescue is needed. What is involved in a cave rescue; how you can help; what resources and skills these cave rescue groups can bring and contribute to a cave rescue; potential problems one might encounter in a cave rescue and many other aspects of cave rescue.

No Manuscript Received

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Cave Diving for the Cave Manager

Arthur T. Leitheuser[*] and Dennis Williams[**]

Abstract

Cave diving is the highly specialized sport of scuba diving in water-filled caves. No other type of diving activity is as dependent on proper techniques, equipment and teamwork. Cave diving procedures and equipment must be utilized, since at any time direct access to the surface is limited.

Recognizing the unique environmental conditions characteristic of underwater caves is essential to the safety of the cave diving team. If direct access to the surface is limited, all problems must be dealt with when and where they occur. The most serious problem in cave diving is becoming lost. However, the proper use of a guideline and specially designed reel will provide a safe exit from the cave when visibility is reduced due to either light failure or silting. This can be a very difficult and stressful task. There is absolutely no substitute for experience for the proper execution of safe cave diving practices. Equipment redundancy is very important in cave diving. The cave's darkness is complete, making it necessary for the cave diver to carry adequate lights. Lights are an important backup system for exiting a cave and are also useful for communicating and keeping track of diving partners.

Proper training is essential to safe cave diving practices. Cave and cavern diving courses are available through both the National Association for Cave Diving and the National Speleological Society. Safety concepts which have been developed are based upon experience, common sense and a constant updating of training standards.

No Manuscript Received

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Using Photography to Educate and Communicate Cave Conservation

Chip Clark*

Abstract

Much of the work of cave conservation is the education of new cavers in the fragile nature of the spelean environment. Photography is ideally suited to this purpose. People respond to photographs but the images must be dynamic and appropriate to the message.

No Manuscript Received

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Perception of the NSS by Show Cave Operators

Dr. George N. Huppert* and Betty Wheeler**

Abstract

Between December of 1981 and May of 1982, a survey was conducted of twenty-five state or federal cave operators and seventy-five private show cave managers. The survey was set up to determine the image of the NSS as an organization and of individuals within the organization. In general, the NSS has a fair to good image throughout the country. However, the image varies greatly regionally. It seems the Society fares least well in the central states (e.g., Missouri, Arkansas, etc.) and in the border south (such as Kentucky and Tennessee). Significantly, these states have a great concentration of commercial caves and high regional caving pressure. This has great implications for cave conservation, as commercial caves have the broadest appeal of all caves to the public and are an ideal medium to promulgate the precepts of conservation.

Introduction

After a number of years of hearing many, sometimes conflicting, statements of what the operators of commercial caves think of the National Speleological Society, the authors decided to take a survey to quantitatively determine attitudes, if that is possible; to define and describe trends in perceptions; and to identify problem areas. Between December, 1981 and May, 1982, one hundred questionnaires were mailed to show cave managers. Seventy-five were sent to privately owned caves and twenty-five were sent to state or federally managed caves. Thirty-four (i.e., 45%) of the private cave questionnaires and twenty-one (84%) of the government cave questionnaires were returned, for a return of fifty-five (or 55%) of the one hundred sent. The fifty-five returns represent about 25% of the total number of commercial caves presently operating in the United States, as listed in The Gurnee Guide to American Caves (Gurnee and Gurnee, 1980).

Results of the Survey

The primary objective of the study is to determine how familiar commercial cave operators are with the National Caves Association and the National Speleological Society and their goals. Secondarily, the questionnaire asks a number of questions concerning cave protection laws, vandalism problems, budget constraints, conservation messages, etc. Table 1 summarizes the collective responses to selected questions.

There are some significant response patterns to note in Table 1. While all of the privately owned commercial cave tours have some sort of conservation message, only 80% of the federal and state managed caves have such a message. This is not what one would expect. Also note that the great majority of operators would support a cave protection law, and most would press charges against a vandal. It would seem obvious that commercial operators are an excellent source of support to get a cave protection law passed.

The NSS should recognize that a very few commercial cave owners or managers (only 20% government and 29.4% private) are members of the Society. It seems the managers perceive the Society as having little to offer them. Such a negative perception contradicts the overall image of the NSS membership, which is tabulated from the questionnaire responses in Table 2. This table clearly shows that the NSS has a rather good image with commercial cave operators. Well over 80% of the managers responding regard the Society as a group of responsible, respectful cavers and largely a conservation

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TABLE 1

	government	private	combined
Is vandalism in the cave serious?	20.0	17.6	20.4
Do you have a conservation message?	80.0	100.0	92.5
Are you aware of a cave protection law in your state?	75.0	67.6	70.3
Would you support a cave protection law?	95.0	94.1	94.4
Have you brought charges against a vandal?	25.0	29.4	27.7
Would you press charges against a vandal?	85.0	91.1	88.8
Are you a member of the NCA?	20.0	73.5	53.7
Are you familiar with the NCA and its goals?	50.0	97.0	79.6
Are you an NSS member?	20.0	29.4	25.9
Are you familiar with the NSS and its goals?	75.0	94.1	87.0
Are you a member of any other cave organization?	15.0	47.0	35.2

*Other organizations mentioned by respondents include Missouri Cave Association, Black Hills Cave Association, West Viginia Caves Association, and Pennsylvania Caves Association (all are state commercial caves groups). Several grottos of the NSS were also mentioned.

group rather than a scientific society. Interestingly, the Society is not generally considered to be a group of recreational cavers; only 17% of the respondents feel that way. Yet very few commercial cave operators claim either institutional or individual membership in the NSS. The Society seems highly regarded but few managers seem to feel that they personally have anything to gain from membership.

The same number of government managers (20%) said they are members of both the NSS and the NCA. A significantly larger number of private cave managers indicated they are members of the NCA (73.5%) than claimed membership to the NSS (29.4%). In line with this tie to the NCA, 97% of all private managers expressed familiarity with the NCA and is goals, but only 50% of the government managers indicated such familiarity. These statistics can be contrasted with the familiarity with the NSS and its goals; 75% of the government and over 94% of the private managers responded affirmatively on this question. For good or bad, a larger total number of cave managers feel they know what the NSS is about through their perception of its reputation, as compared with their familiarity with the NCA. Yet more than twice as many of the combined totals of cave managers actually belong to the NCA, compared with membership to the NSS. In addition, the government managers, as a group, magnify these overall trends; only 50% are familiar with the NCA. Yet an equal number (20%) of those cave managers belong to each organization. It appears that the reputation of the NSS is more generally known, yet the NCA seems to be the more favored organization with which to be involved, once the managers are familiarized with it and its goals.

Unfavorable responses about the Society were few but significant. Responses from government cave operators rated NSS members a few prcentage points poorer than did private managers. Most of these responses described NSS members as irresponsible and general nuisances on tours.

There were some specific unsolicited comments made on the survey with which the NSS should be concerned. Most of the remarks dealt with individuals or groups within the Society, not the NSS as a whole; however, these people were identified as being associated with the Society. Most of these additional comments related to unsavory actions of cavers and groups that were using the cave property for regional or local meetings. The majority of such comments were concerned with the Mississippi Valley Ozark Region. There were a few comments about cavers' appearance on tours, cavers' demands for special treatment, and "smart" remarks made on tours which make the guide appear inadequate. Perhaps even more disturbing were comments regarding specific members or officers who have in the past made promises to the managers that were never kept. Examples of such promises include offers for information or help at the cave which were never given, or encouragements for participation on NSS projects, but no prior notices of meetings were ever sent. Officers and members should realize that cave managers are professional businessmen and businesswomen, and all contacts with them should be carried out in a professional way, especially including the maintenance of frequent contacts. It should be added that almost all of these additional responses included a statement by the manager that he realizes that the misdeeds enumerated are not indicative of the Society as a whole, but were only the actions of a few inconsiderate individuals.

Another interesting aspect involves the question of why there was not a higher return of the survey from show cave managers. Note that only 45% of the private, while 84% of the government managers responded to the survey. It would be instructive to know why there was such a difference in numbers of returns. The survey found that the government caves are generally open year-round, and that they usually have more than one employee. Thus, it may be relatively convenient for them to complete a questionnaire such as this. Many private caves, however, are open only during the summer or tourist season months. Therefore, there may be some problem in receiving mail between December and May. Also, during those months the manager may be the only employee, and it might be very inconvenient for him to complete any questionnaire at that time. Still, note that more than one-half of the private managers did not bother to return the questionnaire. Few other questions on the survey seem to shed light on the problem of return levels. However, some unsolicited comments of one manager should be considered; perhaps his thoughts reflect the feelings of others as well. This manager mentioned that he has received an abundance of similar surveys in the past. He indicated that he has never so far seen any benefit to his business by cooperating in these surveys; yet he believes that by answering such surveys he is divulging private information, and he resents being asked to do so. It seems that this manager is making a plea to the NSS: If the NSS is truly concerned with establishing

TABLE 2

What do you perceive the NSS to be? Please check all that apply.

govt.	private	combined	
88.2	97.0	93.3	A group of basically responsible cavers.
11.8	7.7	9.4	A group of basically irresponsible cavers.
82.9	88.5	86.1	Persons who are respectful of your cave and employees.
17.1	5.7	10.6	Persons who are disrespectful of your cave and employees.
13.2	14.4	13.9	Egomaniacs who only want free passes and to get off route.
17.5	15.4	16.3	Nuisances on tours because they show off their knowledge.
15.7	32.7	25.5	Helpful on tours because of their knowledge.
48.0	53.8	51.5	A scientific organization.
81.0	73.0	76.6	A cave conservation/protection society.
8.7	23.0	17.0	A group only interested in recreational caving.
5.2	0	2.2	I have heard of the NSS but don't know anything about it.
5.2	3.8	4.4	I have never met an NSS member

(Numbers represent the percentage in each category that checked that questions.)

good relations with show cave managers, it should make a meaningful commitment to do so. If the NSS is unwilling to make such a commitment, then the show cave managers may not want to be bothered by future requests from the NSS or its members.

Financially, it is important to be aware that any caver and his actions may be associated with the Society, even if he is not a member. So the NSS is frequently brushed with the guilt of the actions of non-member cavers.

Conclusions and Suggestions

In general, the Society has a good reputation with both government and privately managed commercial cave operators. The paradox here is that even though the NSS is well regarded as a conservation and scientific group, show cave managers apparently do not perceive a need to belong to the Society. It seems they do not think the NSS has much to offer that would benefit them in their business.

Problems do exist, but they can usually be ascribed to the actions of a few inconsiderate individuals and groups, and not to the actions and policies of the NSS as a whole. One exception was the comment of one manager who wanted to work directly with the Society and other managers to improve the relationship between the two groups and thus improve the management of caves. This individual's efforts were ignored by the NSS leadership, and as a result he withdrew his membership and interest in the NSS. However, it should again be pointed out that even though there are some difficulties, the relationships between the Society, its subgroups, or its individual members, and the vast majority of show cave managers are excellent. This does not mean there is no room for improvement. The following list suggests some possibilities.

1. The Society should initiate a more positive line of communication with commercial cave operators.

   a. Show cave managers should be aware of the management, scientific, and exploration skills of members of the Society that may be of benefit to them. While a large number of managers are aware of these skills, many are not.

   b. Where a good relationship exists with managers of commercial caves, the Society may be able to make good use of the 'captive audience' on a tour to get across a strong conservation message.

   c. A medium should be found to keep tour cave managers informed of activities of the Society and achievements in speleology in general. This should be a free service; that is the only way to be sure every manager gets a copy. This would only have to be a short informational flyer. If the reader doesn't think the NSS must communicate with show cave managers, the statistics in Table 2 show that some 5% of government cave managers have never heard of the National Speleological Society!

2. The NSS must take the actions of their members and groups more seriously. For example, the Society has an informal 'code of ethics' which is often stated. Yet grottos and the Society administration do little to really enforce it. Some actions should be taken to modify the behavior of some individuals. After a sincere effort at persuasion, if there is no significant change, those individuals or groups should be removed from the NSS. The Society should not shirk from issuing official reprimands or expelling chronic offenders. This statement is not to be taken as a charge against people enjoying themselves at official Society or grotto funtions. It does mean that good, common sense and consideration should be used to modify some actions in regions where such behavior is considered offensive.

Many of the commercial caves in this country are among the most beautiful of all caves, and they are certainly valuable scientific, educational, and recreational resources when properly managed. The caves, the managers, individual cavers, and the Society have much to offer one another, so positive communications must be maintained. The Society must make a sincere effort to improve the tarnished areas of a generally excellent image, so that interaction can continue with managers. Together ways can be found to put across a stronger lasting conservation message to the cave touring public.

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The NSS and Cave Management

Bob Liebman*

Abstract

A brief history of the founding and purposes of the NSS. Its role in cave exploration, conservation and speleology will be explained. The resources available to the NSS and some of the projects it has undertaken will be described. The strengths and weaknesses of the organization in what it can do to help, manage and conserve caves will be presented along with reasons why you might wish to join the NSS as a member and participate.

No Manuscript Received

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FILM: Underground Rivers

Abstract

As caves in the Canadian national parks are closed to the general public because they often contain fragile formations and hazards dangerous to the inexperienced, this film was produced in order to allow the public to experience several caves in Glacier National Park vicariously. Rather than attempting to explain in detail the processes of cave formation or the techniques of caving, the film concentrates on trying to convey the experience of caving, emphasizing in particular the visible and audible presence of the "underground rivers" which have formed the Nakimu and Cascade cave systems.

This film was produced by Dream Machine Film Corporation for the National Film Board of Canada and Parks, Canada. It was released in 1982.

ROAD LOGS

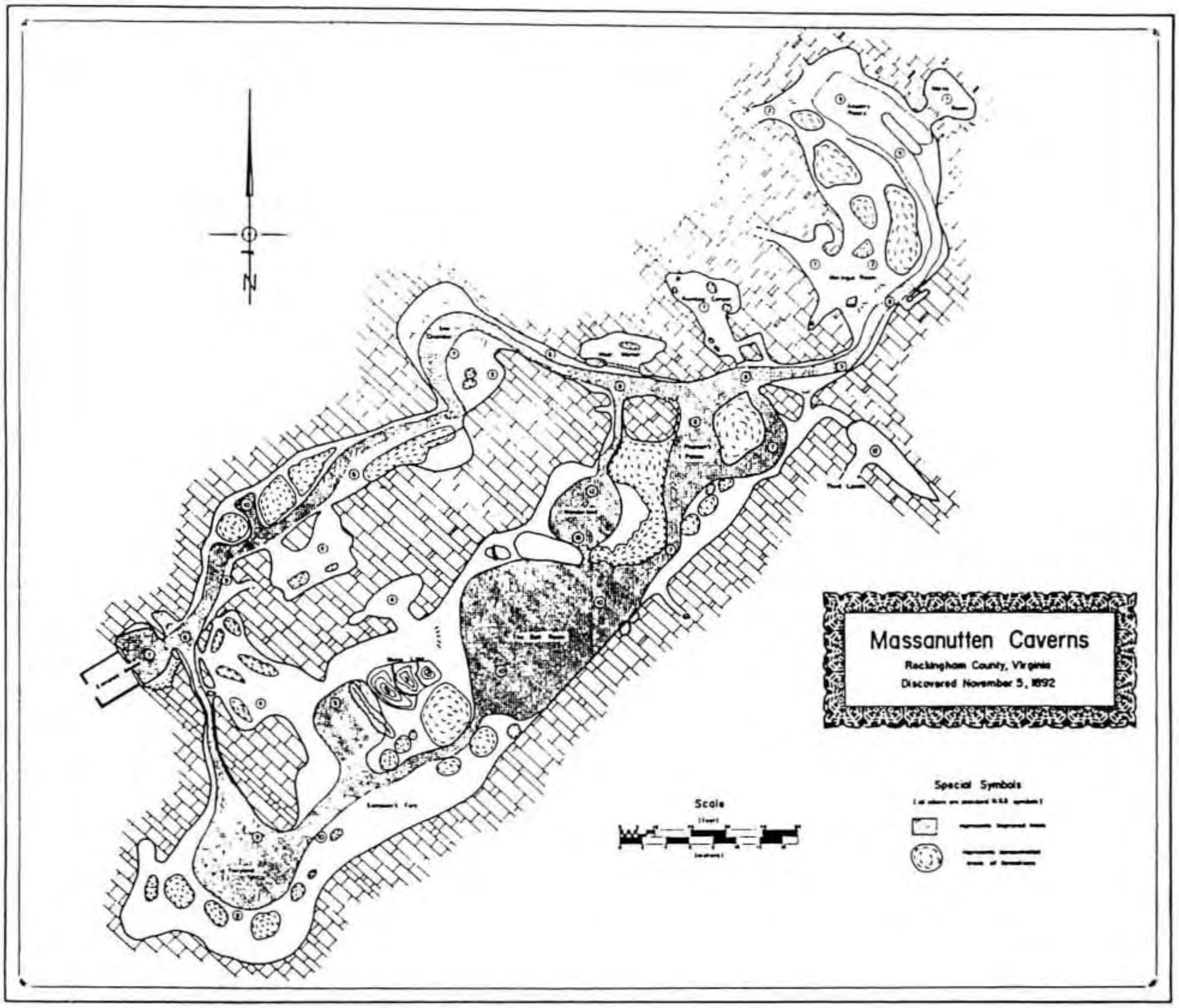
Road Log

David A. Hubbard

This field trip is divided into two segments. This segment entails a visit to Massanutten Caverns. The latter segment involves visits to Shenandoah Caverns and Luray Caverns. Both excursions depart from the Sheraton Motor Inn, Harrisonburg, Virginia.

Segment 1: Massanuttan Caverns

Cumulative Mileage	Interval Mileage	Explanation
0.00	0.00	Sheraton Motor Inn. Turn left and proceed southeast on U.S. Highway 33.
2.30	2.30	Massanutten Mountain, the southern end of this synclinorium is the southwestern limit of Silurian sandstones in the Shenandoah Valley.
3.70	1.40	Junction of U. S. Highway 33 and State Road 620. Turn left and proceed past Keezletown on Cambro-Ordovician carbonates of the Conococheague Formation and the Beekmantown Group. Watch for dog leg to right in Keezletown.
5.70	2.00	Junction of State Road 620 and State Road 685. Turn right and proceed to Massanutten Caverns.
6.20	0.50	STOP at Massanutten Caverns. This beautiful cavern is developed in the Middle Ordovician Lincolnshire and New Market limestones. McGill (1933) reports the cave is located on an anticline. This semi-maze cave shows strike and joint orientation.
8.65	2.45	Return to U. S. Highway 33 by turning left on State Road 620. Turn right and return to the Sheraton Motor Inn.
9.70	1.05	Staunton Rault thrusts Cambrian carbonates of the Elbrook Formation over Ordovician carbonates of the Beekmantown Group.
12.20	2.50	Sheraton Motor Inn access road.

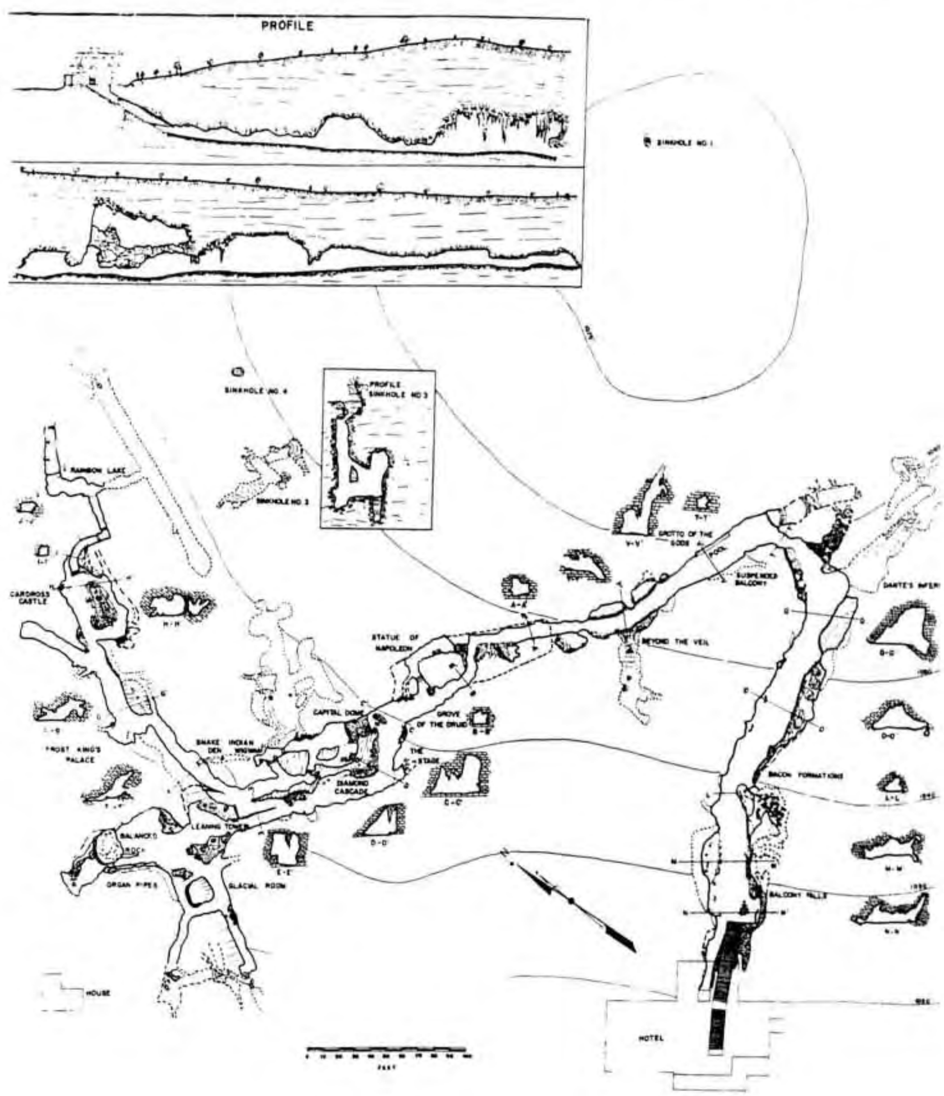


Segment 2: Shenandoah and Luray Caverns

Cumulative Mileage	Interval Mileage	Explanation
0.00	0.00	Sheraton Motor Inn. Turn right and proceed northwest on U.S. Highway 33.
0.25	0.25	Junction U. S. Highway 33 and Interstate 81. Turn right and proceed north on Interstate 81 towards Winchester.
2.50	2.25	Hills to the east, up to a half mile away, are composed of New Market and Lincolnshire limestones. These formations are often quarried for high calcium limestones. The Interstate overlies the Ordovician Edinburg Formation. A few small sinkholes may be observed occasionally along the Interstate.
4.60	2.10	Beefalo Ranch.

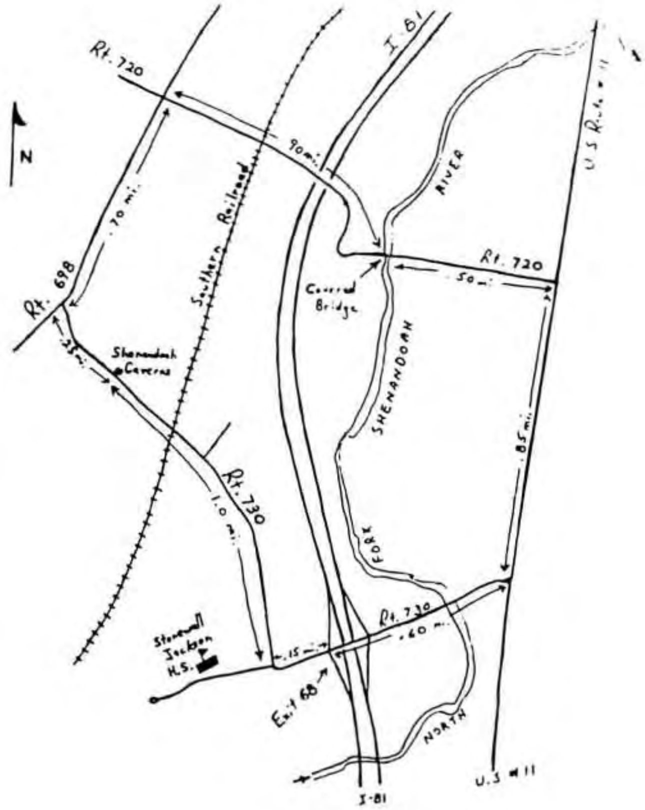
6.70	2.10	Melrose Caverns lies approximately 0.6 miles to the west. Formerly known as Blue Grottoes and Virginia Caverns, this former commercial attraction is developed in an anticline in the Middle Ordovician New Market and Lincolnshire limestones.
10.50	3.80	Ten miles to the west, an anomalous Upper Orodvician-Lower Silurian sandstone section is exposed at Brocks Gap. Rader and Perry (1976) provide an interpretation of this section. Note the continuance of the New Market and Lincolnshire limestones forming the ridge to the west.
13.50	3.00	Approximately 2.5 miles to the east lies Endless Caverns. This large cave (excess of 1.5 miles) is developed in the carbonates of the Beekmantown Group. This cave is situated on the western limb of a NNE plunging anticlne. Passages are strike and joint controlled.
15.00	1.50	The limestone and chert ridge of the New Market and and Lincolnshire limestones continues just to the west.
21.75	6.75	Exit 68, Shenandoah Caverns. Turn left (west) on Route 730.
22.05	.30	Bear right (north) continuing on Route 730.
23.05	1.00	STOP 1: Shenandoah Caverns. These caverns are developed along joints and a fault in the Cambrian Conococheague carbonates along the axis of the Mount Jackson Anticline.
24.20	1.15	Return to Interstate 81. Turn right and proceed south towards Harrisonburg.
28.70	4.50	Exit 67, New Market. Turn left (east) on Route 260 towards New Market.
29.00	.30	In New Market turn left (north) on U.S. Route 11.
29.25	.25	Junction of U. S. Highway 11 and U. S. Highway 211. Turn right and proceed east. The wind gap ahead of of you is New Market Gap. This gap occurs at a structural high in the plunge of the Massanutten synclinorium, where the Massanutten sandstone is breached (Gathright and Rader, 1981). You will be on the Ordovician Martinsburg Formation (shale) until you cross the Shenandoah River.
32.90	3.65	New Market Gap. During the late Middle and Late Ordovician, the eastern portion of the Appalachian miogeocline was subsiding rapidly and receiving sediments from the east. Some formed turbidites. Typical base- and top-truncated Bouma cycles are preserved in the Martinsburg Formation in the

		Massanutten synclinorium. The Martinsburg is overlain by the Massanutten Sandstone (Lower and Middle Silurian) (Gathright and Rader, 1981). Roberts and Kite (1978) have described the depositional history of the Massanutten Sandstone.
35.90	3.00	Typical Martinsburg turbidites can be observed along the highway for three miles.
38.40	2.50	South Fork Shenandoah River. Here disharmonic, recumbent folds and klippen occur in the carbonates underlying the Martinsburg Formation. Note the sinkholes along the road to Luray Caverns.
41.65	3.25	Junction U.S. Highway 211 and State Road 647. Turn left. Luray Caverns are located in the hill to your left.
41.90	.25	STOP 2: Luray Caverns is developed along strike and joints in dolomite of the Ordovician Beekmantown Group. A geological description of Luray Caverns is provided by Hack and Durloo (1962).



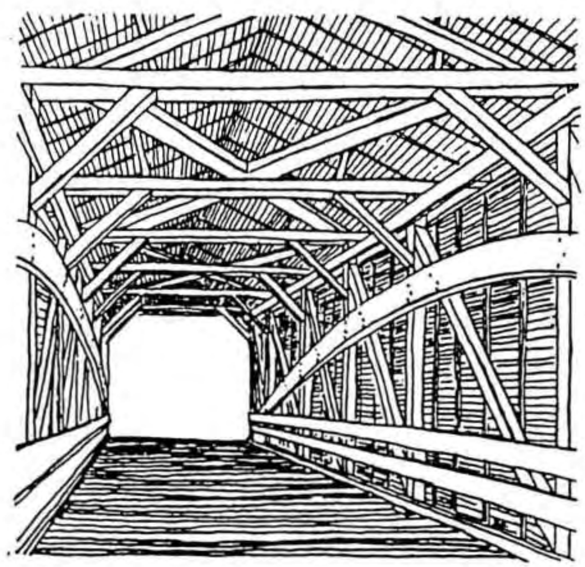
SPECIAL WOODEN BRIDGE TOUR

Any history buffs in our group may want to visit historic Meems Bottom Bridge while they are in the vicinity of Shenandoah Caverns. To see this historic old covered bridge continue west from Shenandoah Caverns on Route 730 for 1/4 mile to Route 698. Turn right and proceed north for .70 mile to Route 720. Turn right and proceed east for .90 mile to Meems Bottom Bridge. To return to the road log route cross the bridge and continue east for 1/2 mile to U.S. Route 11. Turn right and proceed south for .85 mile to Route 70. Turn right and proceed west to interstate 81. Here you can pick up the road log at the 24.20 mile mark. (This short detour adds about 2-1/2 miles to your trip.)



One bridge normally in use is a 204-foot, single-span Burr truss in the Shanandoah Valley, where the romanticist can step back into the past while less than a half-mile away 20th century traffic rolls along today's modern Interstate 81.

This site is known locally as Meems Bottom, taking its name from the Meems family, who owned Strathmore estate west of the river. The bridge was burned and almost completely destroyed by vandals on Halloween, 1976. It was reconstructed, using some of the original wood, and reopened to traffic in August, 1979.



The long span, over the North Fork of the Shenandoah River about two miles south of Mount Jackson and just west of U.S. 11 (the Valley Turnpike of yesteryear), has been carrying traffic for some 85 years. The bridge was built in 1892-93 from materials hewed and quarried nearby for the massive arch supports and the stone abutments, which extend 10 feet below the riverbed.

It succeeded at least two other bridges. Records show that one was burned in 1892 as Jackson went up the Valley ahead of Fremont, prior to the battles of Harrisonburg, Cross Keys and Port Republic, and another was washed away during a flood in 1870. "Up the Valley" here is southward since rivers flow northward to joint the Potomac at Harpers Ferry.

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