

# PHOLEOS

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*University Speleological Society*

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April, 2009





# PHOLEOS

*Pholeos* (Greek - *cave*) is a biannual journal of the Wittenberg University Speleological Society (WUSS), an internal organization of the National Speleological Society (NSS).

## Purpose

The Wittenberg University Speleological Society is a chartered internal organization of the National Speleological Society, Inc. The Grotto received its charter in May 1980 and is dedicated to the advancement of speleology, to cave conservation and preservation, and to the safety of all persons entering the spelean domain.

## WUSS Web page

<http://www.wusscavers.com>

**Subscription rates** are \$10 a year for two issues of *Pholeos*. Back issues are available at \$5.00 an issue.

**Exchanges** with other grottoes and caving groups are encouraged. Send all correspondence, subscriptions and exchanges to the grotto address.

## Membership

The Wittenberg University Speleological Society is open to all persons with an interest in caving. Membership is \$10 a semester or \$20 a year and comes with a subscription to *Pholeos*. Life membership is \$150.

## Meetings

Meetings are held every Wednesday at 7:00 p.m. when Wittenberg University classes are in session. Regular meetings are in Room 319 in the Barbara Deer Kuss Science Hall (corner of Plum St. and Bill Edwards Dr. - parking available in the adjacent lot).

## Submissions

Members are encouraged to submit articles, trip reports, artwork, photographs, and other material to the Editor. Submissions may be given to the Editor in person or sent to the Editor at the Grotto address. Guidelines for submitting research papers can be found on the inside back cover of this issue.

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# PHOLEOS

VOL. 27 (1,2)  
April 2009

## Contents:

- 1 *Editor's Note and 2009 Officers*
- 2 *Message from the President*

### CONSERVATION

- 3 **Local Wind Turbine Plans Changing** • *Kristine Cook*
- 46 **Logan County Sinkholes Available to WUSS** • *Polly Bargar*

### TRIPS

- 5 **A Tale of WUSS and the Doo-Dah Parade** • *Kevin Kissell*
- 10 **40 Years Ago** • *Allen Padgett*

### RESEARCH

- 11 **Importance of Bats in the Cave Ecosystem** • *Tyler Hall*
- 16 **Inadequacies of Cave Protection Laws** • *Kathleen Adams*

### TECHNICAL

- 24 **Cartography by Computer** • *Kevin Kissell*

### SURVEY

- 33 **Your Mom's Pit** • *Aaron Taylor, Kristen Baughman, Jared Embree, Kate Ferguson & Kevin Kissell*
- 37 **Skylight Cave** • *Kate Ferguson*
- 40 **Smoky Bridge Cave** • *Caleb Heimlich, Kevin Kissell*
- 43 **Blackbeard Cave** • *Kevin Kissell, Kate Ferguson, Holly Kellar, Horton Hobbs III, Bill Stitzel*

### GEAR

- 50 **Dirty Dave's Long Kneepads** • *Kevin Kissell*
- 52 **Princeton Tec Pilot LED** • *Kevin Kissell*

### MISCELLANEOUS

- 49 **15th International Congress of Speleology and 2009 NSS Convention** • *George Veni, Andrew Eavis*
- 55 **Caver's Crossword** • *Kevin Kissell, Linda Oxenrider*
- 56 **Photo Gallery** • *Horton H. Hobbs III, Kevin M. Kissell, Bill Stitzel, Erin Hazelton and George Hagen*

**Front Cover:** This transition image really shows how important a good sketch to scale technique can be when drafting a cave map using *Adobe Illustrator*. For more information regarding the use of *Illustrator* to draft a cave map, please see the accompanying article on page 24.

# EDITOR'S NOTE



## *Well, another year has gone by*

and we have one more volume of *Pholeos* ready for your enjoyment. As you read over the following pages I hope you realize the amount of work that was needed to put together such a dynamic issue. We have a wide range of articles this year, including our usual research and survey, but this year we also have an article from a local newspaper regarding current environmental protection, as well as a jaw dropping tale of hard work and triumph at the 2008 OTR. We have spent a great deal of time writing and compiling all the articles found within this exciting issue, and we are already preparing for the next issue. We also have exciting plans for some upcoming special editions of *Pholeos* which you should see here within the next year. As always we welcome your comments, suggestions, and articles so please feel free to write or email us; I look forward to hearing from you. Please enjoy this electrifying issue of *Pholeos* and I look forward to seeing all of you underground!

Kevin Kissell, Editor  
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NSS #54578



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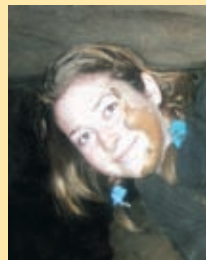
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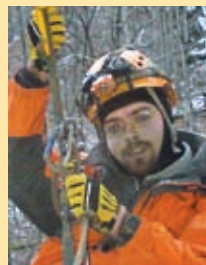
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# MESSAGE FROM THE PRESIDENT



## *Wow, another issue of Pholeos!*

Time just flies by, doesn't it? (I'd like to dare the next president to get through their tenure without saying that in their President's Message). But it's true enough. During the summer months, a band of WUSSes ventured to West Sister Island, a remote nature preserve and wildlife sanctuary in Lake Erie as part of our ongoing Ohio Cave Bioinventory. It felt, sounded, and smelled like I imagine Jurassic Park would: completely infested with cormorants! We didn't even find any caves there to make up for all the poo we walked in but the trip out to the island was well worth the putrid smell! But that was all a while ago, and our two year project with the Ohio Department of Natural Resources is winding down.

After a WUSS victory at OTR's Doo-Dah parade, fall semester got off to a rocky start. Our intro trip was delayed for about a month due to an increase in interest to go caving from Dr. Hobbs' WittSem class. While the delay cost us a few potential new students, whom we will get back next year, the freshmen that stayed are quickly becoming good cavers, and we have a TAG trip planned for spring break when they all pass their vertical test! The group that comes from Columbus

every week is especially excited about the trip and we are pushing to have a record number of vertically proficient WUSSes in the spring.

Besides learning vertical skills, our newbies are also getting solidly grounded in species conservation. Though we were all excited about the Crawlathon and even helping with the construction of the Corrugated Cave, everyone understood why the event had to be cancelled. Crawlathon or not, the WUSSes went down for a fun weekend of caving and partying with members of DUG and GCG! We are, however, watching anxiously as the disease jumps closer to Kentucky and praying that the reports of suspected White-Nose Syndrome in West Virginia were somehow a mistake.

Sadly, this is my last year as an over-active WUSS. I don't know yet where I'll go after this year, or what I'll be doing, but I surely hope there will be cavers there. No matter what, WUSS will be my home grotto, and I'll miss it more than I'll miss Witt. Thanks for letting me serve as an officer for the past couple years. It's been an honor, and I love you all.

Sincerely,  
Kate Ferguson, President  
WUSS #0544, NSS #56925

# Local Wind Turbine Plans Changing, But Not Stopping

Kristine Cook

*Bellefontaine Examiner* - December 18, 2008



Both major wind development companies looking to build turbines in Logan County faced setbacks recently, though modified plans are still moving forward.

“Basically we are still working on development plans for the Logan County project, but at this time, we have decided to release land owners from an area that will not be developed,” said Matt Dallas, spokesman for Babcock and Brown.

Mr. Dallas said the cuts are unrelated to the firm’s recent financial difficulties, including suspension of its shares on the Australian Securities Exchange when prices tumbled after a dispute with the company’s bank.

“We intend to continue working on the development plans in an area we would like to develop,” he said. “One of the areas wasn’t viable, so instead of dragging (leaseholders) on, we decided to release them and let them do other things with their land.”

Roger Brown, a resident of Bellefontaine who had a lease with Babcock in Jefferson Township, confirmed

that most of the leases within the township were among those released. However, it has not deterred wind proponents.

“Those in Jefferson Township are looking at what their options are and are considering another wind turbine company that has shown interest,” he said.

The other major company in the area, EverPower Renewables, which is seeking to build farms in southeastern Logan and northern Champaign counties, recently learned of the federally-endangered Indiana bat living within the company’s planned building zone. This was a result of a full range of wildlife studies done as part of the development efforts.

“Generally, the bats are found in southeastern Logan County,” said Megan Seymour, a wildlife biologist with the U.S. Fish and Wildlife Service Field Office in Reynoldsburg.



*This image, courtesy of the U.S. Fish and Wildlife Service Reynoldsburg Office, shows the federally-endangered Indiana bat that was recently found to inhabit southeastern Logan County.*

Because of these findings, part of the area that the company was looking at developing will fall under the U.S. Fish and Wildlife Service's permit process, according to Michael Speerschneider, director of development with EverPower.

The permit application, necessary when there is a risk of death or injury to an endangered species, could take anywhere from two to six months to review. Ms. Seymour explained it includes a habitat conservation plan that describes the measures a company will take to protect the bat, but does not prohibit turbines from being built.

According to Keith Lott, a wind energy wildlife biologist with the Ohio Department of Natural Resources Division of Wildlife, the monitoring guidelines for proposed on-shore wind energy facilities recently have been finalized and include some suggested minimization measures, but no specific restrictions.

"The results from these studies help us to assess the potential impact a wind energy facility may have on Ohio's wildlife resources ... and make recommendations to the Ohio Power Siting Board," Mr. Lott said. "Ultimately, the goal is to have sustainable growth of the wind industry while minimizing the impacts to wildlife."

One male, one juvenile and 11 female bats were captured during the survey. Male bats are usually solitary and females can congregate into colonies 40 to 100 bats with each having one juvenile. Detecting one female or one juvenile is enough to signal the presence of a colony, Ms. Seymour said.

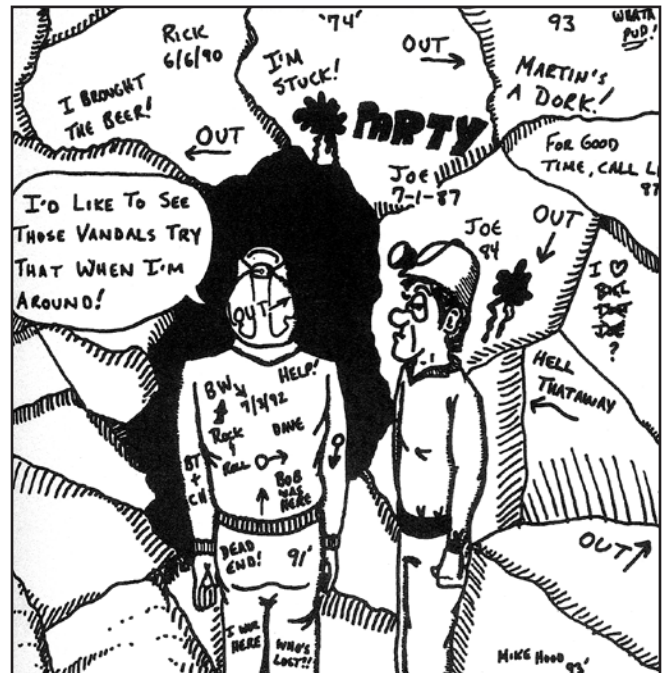
"I think as wind power continues growing in Ohio, there will be a lot of chances for us to work together with the development companies," Ms. Seymour said. "The Fish and Wildlife Service and the Ohio Department of Natural Resources are for wind power with the proper precautions in place."

Mr. Speerschneider agreed that working together will be of utmost importance as EverPower moves forward with its plans.

"We look to continue our development efforts in multiple sites throughout the state ... and to work with the ODNR and the USFWS to assess our options on the affected portions," he said.

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**Editor's Note** - This article has been reprinted with the express permission from the author; it was published originally in the 19 December 2008 edition of the Bellefontaine Examiner located in Bellefontaine, Ohio.



# A Tale of WUSS and the Doo-Dah Parade

Kevin Kissell (WUSS #0530, NSS #54578)

The annual pilgrimage to OTR is a welcome event for WUSS and hundreds of other cavers. For WUSS, it signals the end of summer, the beginning of a new school year, and an ongoing opportunity for competition. For the past three years WUSS has made concentrated efforts to win the annual Doo-Dah parade competition. Now, after crushing defeats, we have finally done it! And what did it take to accomplish our goal? Try close to a year of planning and a team of dedicated individuals!

## 363 Days Until Deadline. . .

It all started on the drive back from OTR in September of 2007. The stench of sadness filled the van due to our recent loss and we were discussing the theme for the next year. It just so happened that the theme was to be "Pirates of the Carabineer" and we knew we could win. For the entire six hour drive we hatched our elaborate, yet conceivable, plan of attack;

we wrote everything down on a Rite-in-the-Rain notebook. At the end of the drive we all vowed to uphold our ideas and start preparing as soon as we could.

## 184 Days Until Deadline. . .

Five months passed, then on a survey trip during Crawlathon we found the page we had scribbled notes on and more brainstorming ensued. We spent many months assembling the needed supplies, people, and tools that would be required to turn our ideas into a reality. By the time we were finished with the planning stage it was summer and the real work could begin.

## 45 Days Until Deadline. . .

Our over the top plans called for a pirate ship big enough to transport three individuals including, a captain, a driver, and a mermaid. We wanted the ship to have a mast that would reach no less than three



**Figure 1:** The hand painted seal took the better part of two weeks to complete. Photo by K. M. Kissell.



**Figure 2:** The handcrafted and hand painted steering wheel was the centerpiece for the entire ship. Photo by K. M. Kissell.



**Figure 3:** The recently dismantled golf cart, complete with wooden frame and deck. Photo by K. M. Kissell.

meters in the air, complete with a large sail. We planned on having multiple pirates on foot who would yell, sword fight, pass out drinks, and do other pirate related tasks. A golf cart was needed as the basis and frame of our pirate ship and large sheets of corrugated plastic would be used to construct the hull of the mighty ship. The mast was made from a three meter long piece of ten centimeter wide PVC pipe and the sail was cut from a queen-sized bed sheet. The sheer scale of the project caused problems, the largest of which was the location of the construction site. Due to the size, the entire project had to be built outside then taken apart and moved inside for storage each night. Much of the really hard work was done away from the principle building site; for example, the ship's wheel was built and painted by one person and the sail was cut, drawn, and painted by another group. Amazingly this piecemeal construction method actually worked! The rest of the construction was done in pieces designed for easy transport. Finally two weeks before OTR, the construction of the final product began.

#### 12 Days Until Deadline. . .

A drive to Columbus earlier in the week yielded a golf cart at no cost to us. We started by ripping all the useless parts off the golf cart, things like the canopy



**Figure 4:** The new WUSS camp; notice the “garage” in the background. The ship was built entirely under the cover of darkness to preserve secrecy. Photo by K. M. Kissell.

and windshield had to go. A wooden, load-bearing frame was mounted to the cart and secured to both bumpers; these would carry all the weight of the ship's hull. All of the sawing needed was performed during construction; one person called out measurements while another used the circular saw. Securing the mast caused problems but by using some fancy cutting and the preexisting golf cart frame, the crisis was averted. The sides of the ship were next but we decided that we would simply measure everything to make sure it worked then assemble it once we were at OTR. By this time the sun had gone down and it was becoming problematic to operate power tools that late at night. We retired our efforts and made plans to return in one week. During that week off the work continued. The hull was painted to look like planks of wood, the sail was painted with the WUSS seal, and supplies were bought for the pirate costumes and treasure chest.

#### 4 Days Until Deadline. . .

First order of business for the next weekend was to finish building the treasure chest which would be used to “tempt” the judges. The chest was hand built out of pieces of old tongue and groove flooring and lined with red padded silk. During all this, cannons were mounted on the side of ship and a deck was built on



*Figure 5: Our subtle bribe to the judges was filled with chocolate coin candy, beverages, and jewels. Photo by K. M. Kissell.*

the back to accommodate a mermaid. Costume pieces were constructed and final plans were devised. We also decided that a figurehead was needed for the bow of the ship. One of our ingenious planners mentioned “Bat Boy” and the idea grew from there. Construction began on a paper mache Bat Boy by making a frame from chicken wire. After a full day of building we retired once again; this time we had only one more day to finish the design, pack it all on a trailer, and get on the road.

**12 Hours Until Deadline. . .**

Three days later, we all met to finish as much of the construction as we could. We also needed to load the golf cart, ship parts, tools, and costume pieces onto a trailer for the six hour drive to the OTR site. Working by headlamp we finished construction and packed the trailer. Everything was covered by a large tarp to protect it and hide the trailer’s true contents. It was now up to the advanced team who left on Wednesday night while the rest of the WUSSes came down on Friday night. The advanced team, consisting of Jared Embree, Kate Ferguson, and myself were charged with transporting the trailer and its cargo, establishing a new OTR campsite, and rebuilding the ship at OTR.

**0 Hours Until Deadline. . .**

The drive was uneventful since we drove through the dead of night and morning. We made it to the OTR site three hours before the gates opened so we enjoyed a nice breakfast that felt more like a late dinner. After breakfast we ventured back to the main gate where the Gate Nazis told us we had to leave or else we would not be allowed to enter. We drove down the road and the waiting began. At 12 o’clock sharp we



*Figure 6: Easily the most recognizable piece of the ship was the paper mache Bat Boy who acted as our figurehead. Photo by N. Pfeffer.*



**Figure 7:** The final touches are put on the ship before the parade; notice the smoke billowing from the cannons. Photo by K. M. Kissell.



**Figure 8:** Perched on the back of the ship, our male “mermasian” drew the attention of all the parade onlookers. Photo by K. M. Kissell.

were permitted to enter. We found a nice big camping spot and made our claim. We spent most of the day setting up camp which consisted of a covered party area, courtyard surrounded by personal tents, and a garage to store the ship. Under the cover of darkness we began reassembling the massive ship. Amazingly all of our measurements worked perfectly and the ship went together like clockwork. The next day was spent finding last minute supplies and relaxing. We were all set for the parade by the time the rest of the WUSSes arrived Friday night.

### **Morning of the Parade. . .**

The WUSS camp was filled with movement and excitement. The ship was driven out of its secret hiding place, much to the surprise of our neighboring campers. The final preparations were completed; the cannons were loaded with dry ice, the sail was lowered, and a bat sticker was put on the back of the ship. Costumes were donned and roles were assigned. Finally, after all this time, we were ready. In no time we were rolling our way up to the staging area of the parade; looks of amazement followed in our wake. The parade started; we were positioned somewhere near the rear of the line. As we passed the judges, the treasure chest full of chocolate coin candy, beverages, and jewels was

presented, to much applause. Needless to say, the parade was an absolute blast, the air was filled with the sounds of pirate shanties and everyone shouted “AARRRRR” as the parade passed. For the next hour our ship, the aptly named “NSS OTRRRR” sailed through the parade, our mermaid, make that “mermasian,” tempted all to join the crew.

### **The Aftermath**

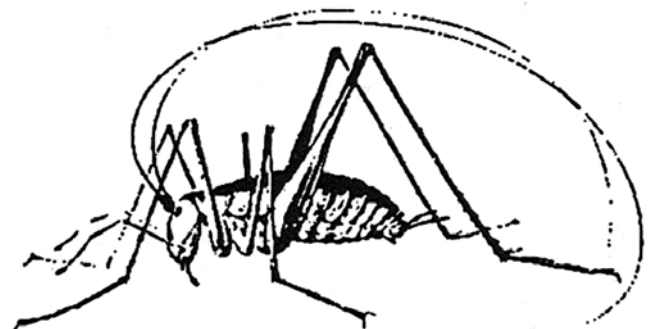
Once it was all over, everyone, especially me, breathed a sigh of relief. Somehow our shoddy construction and wild, over ambitious plans had all come together. Yet the most important thing was that we all had fun doing it. There is no doubt that it was a massive project and that it was our overpowering drive that made it all work. There is also no doubt that without the help of all the dedicated people this would not have been possible. I would like personally to extend my gratitude towards everyone who helped including Mary Katie Hutchins, Jared Embree, BJ Burke, Holly Gersbacher, Kate Ferguson, Dani Carey, Aaron Taylor, Erick Twaite, Linda Oxenrider, Holly Kellar, Mark Thomas, Steve Bloomingdale, and Susie Hobbs. I hope I did not miss anyone and I hope everyone knows how grateful I am to be able to call them friends.

It took a full week for WUSS to find out that we had



**Figure 9:** The happy crew of the “NSS OTRRRR” poses before retiring their pirate gear for a relaxing night by the OTR bonfire. Photo by K. M. Kissell.

won the parade. There was no big announcement, rather we all congratulated each other and went our separate ways. The ship was burned in the OTR bonfire, the treasure chest was sold at the OTR auction, and the sail was put in the caving club office. The only thing we really got from this endeavor were some happy memories that will surely last way beyond next year’s OTR and the knowledge that together we can accomplish anything.



## 40 Years Ago

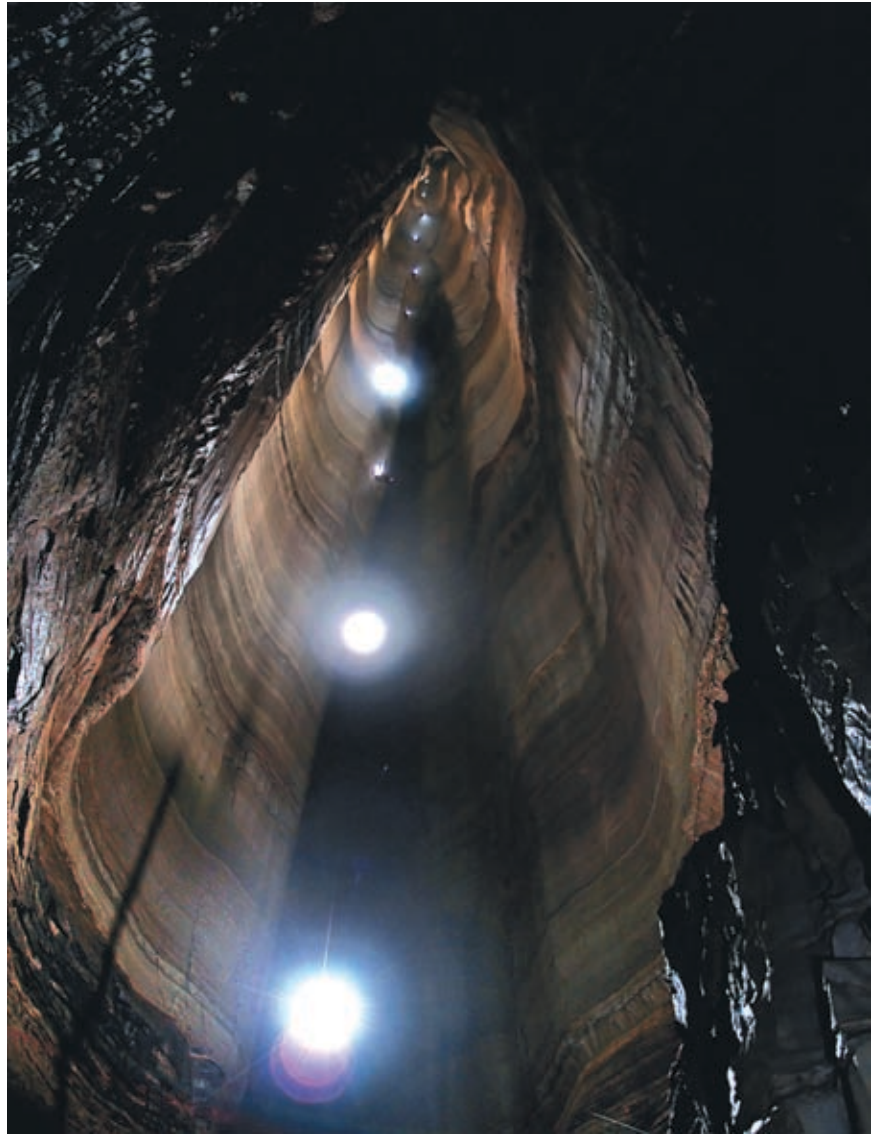
### First Descent of Fantastic Pit in Ellison's Cave, Georgia

Allen Padgett (NSS #10371)

On November 1, 1968 the first descent of Fantastic Pit in Ellison's Cave Georgia occurred. Richard Schreiber was first down followed by Della McGuffin, Jim Wilbanks, Mike Lemonds, David Stidham and Rob Culbertson. The trip was a 19+ hour marathon. The next day, Nov. 2 1968, a second group yo-yoed the pit. This group consisted of Jay Arnold, Bill Tozer, Sara Corrie, Dan Hale, Steve Richard, Ronnie Aycock, Diane Cousineau and Rick Foote. Accompanying this group but not descending the pit were Bill Cuddington, John Cole, Janet Cole and Penny Foote. So far all of the trips had entered the historic entrance, traversed the entire agony passage and rigged the big pit at the top of the waterfall directly in the water. A 510 ft. drop.

Only a month later was the ledge to the balcony cleared allowing access to the traditional 510 rig point. The dug entrance was opened by Bill Torode on Dec.7 1968.

Just remember at this time the rappel rack was a "new" rappel device, everyone climbed with three prusik knots and the standard caving attire was blue jeans, and a cotton sweat shirt, maybe a wool sweater if it was wet and cold. Helmets were construction hard hats and everybody used carbide cap lamps, cave packs were army surplus. There were no cave suits or 'poly.' There was no PMI or Bluewater II. There were no LED's or digital cameras. The first trip report was not on the TAG-Net but rather it was in the January 1969 issue of the NSS News. Times have changed.



*Fantastic Pit, the longest underground, free fall drop in the contiguous United States is seen here. This photo was published originally in the December 2007 edition of the Carbide Dump accompanying an article written by Rick Shortt, It was then used as a cover photo in the January 2008 edition of the same publication. Photo by Aaron Moses, lighting by Leanne Barley.*

**Editor's Note** - This article has been reprinted with the express permission from the author; it was published originally in TAG-Net #5101.

# The Importance of Bats in the Cave Ecosystem

Tyler Hall

Hamilton, Ohio. Wittenberg Class of 2012

In the animal kingdom, there are certain species that have a huge influence on the environments they live in and act as a cornerstone for the ecosystem. The actions of or on these organisms can have huge implications for the other fauna that they interact with and even the environment itself. Certainly bats are a prime example of being a crucial factor in their habitats, most, in particular, caves. Several species of bats provide important services and elements to the cave community and to the epigean world above, providing a link between the two different environments and utilizing each for their own survival. However, these miraculous troglodytes are under many threats and can easily be wiped out, taking their dependent benefactors with them.

For bats, the cave acts as a safe haven. When the mammals are not out feeding, they roost in the dark shelter of caverns. Depending on the species and the behavior of each, bats can be either very social and congregate in vast numbers or isolate themselves as singles or in small clusters. This nesting choice is also influenced by the characteristics of the region: bats are more apt to disperse into smaller portions when more caves are located in a given area, whereas a location with sparse caves will see a vast accumulation of bats in the same roost (Gnaspiini 2005). These creatures are extremely fastidious in what caves and where in these caves they will make their home. Smirnov et al. (2007) studied the populations of bats in artificial caves in Samara Luka in Russia. From their observations, factors such as landscape, climatic properties, neighboring areas, gallery arrangement, and microclimate determined where and in what numbers bats would roost. The group also noted other influences like air flow, which was unfavorable for hibernating bats. Also, “bats are very rare in caves



**Figure 1:** Bats, like this, provide essential services to cave ecosystems. (<http://graphics8.nytimes.com/images/2008/03/25/science/25bats.xlarge1.jpg>)

without cracks” (Smirnov et al. 2007). A myriad of aspects contribute to where bats inhabit and the size of the population, and any shift or alterations in these factors can upset bat dispersion.

Bats tend to utilize caves for two main purposes: the use as a maternity ward and a place to hibernate. The cave acts as a secure enclosure, not only protecting young pups in their early years but also safeguarding vulnerable hibernating bats (Stoffberg 2008). Newborn bats are small and helpless from predators which could easily prey on them out in the open. Not only do the cave walls and ceiling keep the young out of harms way, but also shield bats that have shut down their metabolism in hibernation. Since food disappears during the winter, bats must shut down their activity until they can once more feed. The dark and constant temperatures of a cave along with minimal variables in the environment make the confines of caverns ideal for providing a stable fortress.



**Figure 2:** Bats periodically leave the cave to feed outside, providing useful services like pollination in the process. ([http://www.beekeeping.com/articles/us/pictures/birds\\_bees\\_bats\\_2.jpg](http://www.beekeeping.com/articles/us/pictures/birds_bees_bats_2.jpg))

Above the word “trogloxene” was used in describing bats. These creatures, though closely tied with caves, do not spend all their time inside them. Depending on what species, bats will fly out and consume a variety of energy sources. These include but are not limited to nectar, insects, vegetation, and the blood of other animals (Gnaspini 2005). Guilbert et al. (2007) looked at the homing abilities and translocation used in hunting and returning to caves. A clear rate of reuse was noted since a good majority of bats returned to the same cave they had left to feed. Obviously bats are tied closely to the cave environment to return so devotedly to a home cave. The cave provides fundamental elements for different periods in the lifespan of bats; these flying mammals are highly dependent on caves and the characteristics that keep bats alive.

This habitation is not a one-way existence, however. Just as the bats benefit from the cave, they also make contributions to the cave ecosystem, creating a dependency in cave systems for bats. They participate in fundamental processes and life cycles such as distributing seeds and pollination (Murray and Kunz 2005; Clements et al. 2006). These insectivorous organisms also help control insect populations concerning agriculture. While the activities that take

place in the epigean environment may not seem to matter to the cave ecosystem, Murray and Kunz (2005) make it clear that the flora that bats interact with not only acts as the bats’ food source but functions as a buffer to wind and extreme environmental changes that may otherwise prove detrimental to the cave and its inhabitants. It is also because of these surface excursions that bats are able to return and provide the most important service to the cave ecosystem.

After feeding on insects and other nutritional sustenance, bats return to the cave and process the organic matter into guano. Gnaspini (2005) describes guano as “the accumulation of feces of particular animals in time and space.” Composed of feces and urine, guano from the bats is deposited in caves and builds up into heaping mounds of organic material. Within this pile of waste rests pieces of insects, seeds, fruits, and leaves (Murray and Kunz 2005). Guano has proved to have a significant variety of uses to humans, contributing to products ranging in every aspect of life from cosmetics, to fertilizer, to gunpowder (Gnaspini 2005). Wurster et al. (2008) have even utilized guano



**Figure 3:** Humans find bat guano useful in many practical undertakings such as a fertilizer for plants. ([http://www.batfree.com/db4/00384/batfree.com/\\_uimages/FH000009.jpg](http://www.batfree.com/db4/00384/batfree.com/_uimages/FH000009.jpg))



**Figure 4:** When humans enter caves, they run the risk of upsetting any sleeping bats that may be within. (<http://www.saudicaves.com/mx/zurdo/bats.jpg>)

heaps in deciphering paleoenvironmental information. In other words, by studying the chemical makeup and variance within the different layers of guano the scientists were able to develop climate archives and garner elusive information concerning the North American Monsoon. Such a recent innovation of bat guano displays just how versatile and useful these mammals can be.

Certainly the most essential function of bat guano is its life-giving attribute in the cave ecosystem. In a living environment with no base source of energy (i.e., the sun), the transitory organic matter (TOM) that bats provide through their guano acts as the first link in many cave systems' food chains. In addition, many small insects and isopods will use the guano pile as a microhabitat to survive, even using the waste as a nursery to lay their eggs (Gillieson 1996). Just as bats come in different species and vary in diet, a similar diversification occurs in the associated communities; some taxa are flexible and can feed on any guano, while some creatures are restricted to a particular species' (Gnaspini 2005). From these guanobites whose survival depends on the bats' waste deposits, a host of other cavernicoles continues the food web and transfers energy, allowing the cave ecosystem to flow and thrive.

Aside from the biological stimulation that bat guano provides, the environment itself can be affected by the presence of the waste pile. When bats occur in high congregations, a large amount of guano can

alter the climate in the cave: temperature increases and ammonia thickens the air, influencing chemical processes in the cave (Gnaspini 2005). Onac et al. (2007) found that guano combustion in caves leads to the formation of unique and "unusual high-temperature minerals" which would otherwise be absent. This is another fine example of what bat guano can do to alter and influence the cave environment. These caves become so structured around the resources that bats provide that, should the population disappear, the effect on the cave would be fatal.

If bats are threatened to the point where they are pushed out of the cave they frequent, the guano community therein will suffer tremendously. Gillieson (1996) explains that even when bats migrate and leave a cave for a short period of time, the major food source disappears and the guanobites either become inactive or will decline in numbers, possibly even becoming extinct in a given cave. Should a guanobite be a site-specific endemic species, the planet loses a prime example of diversity and versatility. It is important to realize what threats are endangering bats so they can be halted.



**Figure 5:** Fragile infant pups often meet a fatal end when spooked, falling to the cave floor to die. (<http://www.goodbyecitylife.com/fields/image/babybat.jpg>)

There are several hostile factors that challenge the bats' survival rates. Human disturbance is a major impediment during critical moments in the bats' life cycles. Even the most minor interference from outside contact can change the cave environment

and make it unsuitable for bats. Caving activities like mining and over-collection of bats can severally reduce core populations; quarrying activities, in particular, change the physical structure and microclimate in the



**Figure 6:** Bats infected with White Nose Syndrome. ([http://www.fws.gov/midwest/Endangered/img\\_coll/mammals/white\\_nose\\_AI\\_Hicks\\_NYDEC.jpg](http://www.fws.gov/midwest/Endangered/img_coll/mammals/white_nose_AI_Hicks_NYDEC.jpg))

cave (Murray and Kunz 2005). In a study by Betke et al. (2008), a decrease in bat populations was observed, plummeting from 54 million to 4 million in a grouping of caves. While inadequate data observance of past experience is taken into account, the group considers the likelihood of vandalism and cave commercialization to cause the bats to move out, to die, or move to other caves, even to man-made structures like bridges and barns. This was accounted for in the research gathered by Smirnov et al. (2007), and even in the artificial galleries bats would be evicted by noise and light brought by human visitors. When bats are forced out of their cave dwellings, they are threatened and at more risk from predators; this is all besides the fact that the cave ecosystem loses a vital source of stimulation.

People, even with the best of intentions, can harm fragile bats. For hibernating bats, the slightest disturbance can cause the bats to wake up and use valuable energy storage. This will limit the chances of survival through the winter season, killing off bats in great numbers. Even the pups are at risk—when entering a maternity cave, any disturbance can cause the mother to abort their offspring (Murray and Kunz

2005). The young themselves are easily frightened and fall to the floor when upset, leaving them dead or to be consumed (Gillieson 1996). The young populations are the most vulnerable of bat populations, as the reproductive rates of bats have been adapted to the cave environment and are extremely low (Eidels et al. 2007).

Insecticides are a huge threat to bats as well. When farmers spray pests to preserve their crops, they are also contaminating the food source of innumerable bat species, leading to poisoning and death. A closer look was taken in Indiana on the effect of environmental toxicants by Eidels et al. (2007). Different chemical toxins had severe side effects on bats, including impaired echolocation, reduced foraging ability, and the lack of coordination. All these effects caused the bats to lose survival skills, limiting their chances at life.

There is also a challenge in the form of disease. Young (2008) wrote on the function of bats as a reservoir for several viruses such as Ebola, Nipah, and SARS. Of course, bats are also infamous for carrying hydrophobia, the maddening rabies. More recently, a mysterious “white-nose syndrome” has begun to plague bats in New York (Hicks 2008). The bats affected by

this odd malady have white fungus around their snouts, and somehow consequently deplete their energy reserves prematurely during hibernation and die. These diseases could eliminate bats that cave ecosystems depend on to stabilize their environments. For such bat species as the Cape horseshoe bat, *Rhinolophus capensis*, endemism and extinction are ever-present threat to their fragile state of existence (Stoffberg 2008).

It is essential to note two things: one, that the bats inhabiting caves are a cornerstone to the ecosystem there, as most the fauna within rely on bat guano for survival, either directly or indirectly; and two, that these very same bats face a slew of trials every day in the struggle for survival. The disappointing aspect of this is that much of the threat comes from human negligence and poor judgment. If careful consideration and action are not taken in preserving these marvelous flying mammals, the earth will give up an incredibly versatile and unique specimen of adaptation and ecosystem interaction, not to mention the very ecosystems that these bats interact with on a daily basis. By educating the masses on the importance, the fragility, and the preciousness of bats, these wonderful beasts will continue to drive cave ecosystems around the world.

### Literature Cited

- Betke, Margrit, D. E. Hirsh, N.C. Makris, G.F. McCracken, M. Procopio, N.I. Hristov, S. Tang, A. Bagchi, J.D. Reichard, J.W. Horn, S. Crampton, C.J. Cleveland, and T.H. Kunz. 2008. Thermal imaging reveals significantly smaller Brazilian free-tailed bat colonies than previously estimated. *Journal of Mammalogy*, 89(1): 18-24.
- Clements, Reuben, Navjot S. Sodhi, Menno Schilthuizen, and Peter K. L. Ng. 2006. Limestone karts of Southeast Asia: imperialized arks of biodiversity. *BioScience*, 56(9): 733-742.
- Eidels, Ronny R., John O. Whitaker, Jr., and Daniel W. Sparks. 2007. Insecticide residues in bat and guano from Indiana. *Proceedings of the Indiana Academy of Science*, 116(1): 50-57.
- Gillieson, David. 1996. *Caves: Processes, Development, Management*. Blackwell Publishers, MA, pp. 227-234.
- Gnasparini, Pedro. 2005. Guano Communities. David C. Culver and William B. White (eds.). *Encyclopedia of Caves*. Elsevier Academic Press, MA, pp. 276-282.
- Guilbert, J.M., M.M. Walker, S. Greif, and S. Parsons. 2007. Evidence of homing following translocation of long-tailed bats (*Chalinolobus tuberculatus*) at Grand Canyon Cave, New Zealand. *New Zealand Journal of Zoology*, 34: 239-246.
- Hicks, Al. 2008. White Nose Syndrome endangers bats. *New York State Conservationist*, 62(4): 37.
- Murray, Susan W. and Thomas H. Kunz. 2005. Bats. David C. Culver and William B. White (eds.). *Encyclopedia of Caves*. Elsevier Academic Press, MA, pp. 39-45.
- Onac, Bogdan P., Herta S. Effenberger, and Radu C. Breban. 2007. High-temperature and "exotic" minerals from the Cioclovina Cave, Romania: a review. *Studia Universitatis Babeş-Bolyai, Geologia*, 52(2): 3-10.
- Smirnov, D.G., V.P. Vekhnik, N.M. Kurmaeva, A.A. Shepelev, and U.Yu. Il'in. 2007. Species structure and dynamics of bat communities (Chiroptera: Vespertilionidae) hibernating in Artificial Caves of Samara Luka. *Biology Bulletin*, 34(5): 507-516.
- Stoffberg, Samantha. 2008. *Rhinolophus capensis* (Chiroptera: Rhinolophidae). *Mammalian Species*, 810: 1-4.
- Wurster, Christopher M., William P. Patterson, Donal A. McFarlane, Leonard I. Wassenaar, Keith A. Hobson, Nancy B. Athfield, and Michael I. Bird. 2008. Stable carbon and hydrogen isotopes from bat guano in the Grand Canyon, USA, reveal Younger Dryas and 8.2 ka events. *Geology*, 36(9): 683-688.
- Young, Lowell S. 2008. Bats act as reservoirs for fulminant diseases. *Infectious Diseases in Children*, 21(3): 5.

# Inadequacies of Federal and State Cave Protection Laws

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## Abstract

*This brief paper addresses the need for cave protection and summarizes the threats that human beings can pose to caves. The focus of the paper is on the Federal Cave Resources Protection Act and the state cave protection laws of Kentucky and Ohio. Current laws are not doing enough to protect all of the important resources associated with caves and a specific example of cave vandalism in Floyd Collins Crystal Cave in Kentucky is presented. Stricter and more detailed laws along with an extreme increase in public education and awareness about caves are needed.*



**Figure 1:** 08 August 1923 photograph of Floyd Collins standing in the Helicite Route in Crystal Cave. These speleothems were destroyed in the 1995 vandalism incident (photo taken by John Bath, West Lafayette, Indiana; photo courtesy of J. Andrew Roberts – WUSS #0429, NSS # 45162).

Caves are an amazing and “uncommon geologic phenomena” that need protection (Anonymous 2008a). They are important for a variety of reasons. They have a variety of unique values including scientific, recreational, and scenic (Anonymous 2008b). Caves provide conduits for groundwater movement and they are storehouses for rare and unique minerals (Huppert 1995). They are also home to many endangered species; “in 2005, 36 (3%) of the 1,155 worldwide animals on the federal endangered and threatened list were cave dwellers, and all the listed cave species were from the USA” (Elliott 2005a). Karst aquifers also provide a source for approximately 25% of the world’s water (Drew and Dunne 2004). Caves are much different than the surface environment and therefore require their own distinct set of environmental protection laws

that deal with caves directly.

They need protection for all of the reasons stated above. So what is it then that they need protection from? Mainly, it is the ecological impact of *Homo sapiens* above and inside the cave. Land development above caves poses a threat due to the possible alteration of the normal hydrologic cycle and an increase in sedimentation. Also, “overpumping of karst groundwater can lower groundwater to the point where important springs and wells run dry.” Threatening water sources is a huge danger to all cave-dwelling species. Pollution and contaminants that can seep into streams also can cause huge problems because as soon as chemicals infiltrate the groundwater, they are nearly impossible to remove (Elliott 2005b). Also, the simple presence of a human being and the extra energy

he or she brings in a cave can alter the environment (Hobbs 1993).

The state and federal cave protection laws attempt to protect caves and their resources, but these laws have many limitations that include problems dealing with awareness, enforcement, and funding. The inadequacies of these laws need immediate attention or should be addressed from a non-legal standpoint and rather one of public and private conservation policies.

There are several federal laws that either directly or indirectly attempt to protect caves. The Federal Cave Resources Protection Act of 1988 (Public Law 100-691 – see Appendix I) is one of the most significant and will be focused on here. The first overriding inadequacy of this act is that it only deals with caves on federal lands and certain Indian lands. The act also states that the Secretary (of the Interior or of Agriculture) is in charge of providing a list of the significant caves out of all the ones on federal land. The act provides that the only caves that will be protected are the ones deemed significant (Anonymous 2008c). There obviously is “considerable argument on what is to be considered significant and what will happen to the caves deemed as not significant” (Huppert 1995).

The act does lay out a decent punishment plan for any person who “destroys, disturbs, defaces, mars, alters, removes or harms any significant cave or alters the free movement of any animal or plant life into or out of any significant cave located on Federal lands.” The punishment for committing any of those acts for the first time “shall be imprisonment of not more than one year or a fine,” subsequent violations will be “imprisonment of not more than 3 years or a fine.” Unfortunately, the act does little to explain who will be enforcing such protections. The act does, however, authorize a measly \$100,000 to “carry out the purposes of the act.” And although there are other federal laws that indirectly seek to protect water and wildlife in caves, this specific cave protection law does not allocate for any specific protection of either (Anonymous 2008c).

Twenty-seven states have enacted cave protection

laws (Zellmer 2004). The magnitude of coverage in these laws is varied. Some laws only protect caves found on public lands, but some protect on private as well (Huppert 1995). Some of the state laws encompass “all speleological features such as decorations, archaeological contents, biota, water, etc” but some are limited to only the “geologic contents or decorations” (Huppert 1995). This paper will focus on cave protection laws put in place by Kentucky and Ohio.

The Kentucky Cave Law constitutes a cave violation if any visitor were to “break, break off, crack, carve upon, write, burn, or otherwise mark upon, remove, or in any manner destroy, disturb, deface, mar or harm the surfaces of any cave or material which may be found therein.” It also protects against tampering with and obstructions (gates, locks, doors) designed to keep visitors out of a cave or part of a cave. The law also prohibits anyone from placing their own obstruction which may restrict the movement of air or animals. Kentucky’s law protects against litter or disposal of any sewage or toxic substances harmful to cave life. The law attempts to forbid anyone from removing any organism from the cave. Although these restrictions attempt to be very beneficial to the cave and its ecology, there is no formal statement of what punishments await violators of this law. The Kentucky Law also states no plan for who will be enforcing it (Anonymous 2008d – see Appendix II).

The Ohio Cave Law is very similar to Kentucky’s in its layout of restrictions of behavior in state caves (see Appendix III). It prohibits disturbing any surface of the cave, tampering with established obstructions, removing signs, disposing of hazardous materials, and removing or killing any cave life. Unlike Kentucky’s law however, the Ohio statute lays out the punishment for any violations. It states that any first time offense will be punished with a fine of not less than twenty-five nor more than five hundred dollars and for any subsequent offenses, the violator will be fined not less than two hundred nor more than one thousand dollars (Anonymous 2008a). While it is progressive that Ohio has laid out punishments, these paltry fines do nothing

to replace the priceless and invaluable harm caused in the caves. The speleothems have taken hundreds to thousands of years to form and for someone purposely to ruin them, a fine of twenty-five dollars seems completely insufficient. The Ohio Law also lays out no statement about who is responsible for enforcing such restrictions.

One example of the horrible vandalism that can occur to caves is of Floyd Collins Crystal Cave in Kentucky. In the spring of 1995, three men from Kentucky were found to have destroyed an incredible amount of the helictites and gypsum crystal layers in the cave. They also were found to have removed many of the large cave formations for commercial purposes (Figure 1). These violations seriously broke regulations set forth by both the Kentucky Cave Protection Act and the Federal Cave Resources Act but they were not punished under these laws. The men were charged with theft and destruction of government property because violating these laws meant stricter penalties. Neither the Kentucky state law nor the federal law allocated sufficient punishments for such vandalism (Nims and Foster 1995). One of the men was sentenced to 33 months in a federal prison, followed by three years of probation and 550 hours of community service. The other two men were each sentenced with 21 months in a federal prison, followed by three years of probation, and 500 hours of community service (Anonymous 1996). The punishments they all received will not bring back the miraculous and priceless speleothems that were destroyed, but they do serve as examples to other potential vandals of the possible punishments they could receive. Unfortunately, this case also depicts more inadequacies of the state and federal laws. The vandals were not even punished under the laws that seek to protect caves. This illustrates the crucial need for cave protection laws to become more detailed and strict.

The laws need to be expanded; they need to authorize for more funding and more sources for enforcement. They also need to lay out sufficient and complete punishments. Most importantly, however, is that in order to protect caves, the general public needs to be educated. Most people are completely unaware or

simply unconcerned with the earth below them. People need to be attentive of the delicate nature of caves and of the importance of cave conservation to the earth's ecologic system. The National Speleological Society (NSS) encourages projects that address education and research concerning the causes and prevention of cave vandalism. The NSS also promotes cooperation with other groups dedicated to the conservation of natural resources (Anonymous 2008b). Another important factor in cave protection is good cave management. This incorporates developing rules about when and how often visitors are allowed into caves. At times, there will be certain caves that need to be left completely untouched by human hands and feet (Elliott 2005b). At other times, when cavers are permitted to enjoy the beauty and scenery within caves they simply need to cave softly, follow the policies of leave no trace, and be aware of their surroundings. When a cave is vandalized, there is never a way to bring it back to its natural, beautiful state. The future of all caves relies heavily on first and foremost, public education and awareness and secondly, on complete and strict laws for the unfortunate circumstance when someone fails to respect and appreciate the caves the world has left.

### Literature Cited

- Anonymous. 1996. Vandals receive their due. *NSS News*, 54(8):226.
- Anonymous. 2008a, date accessed. The Dayton Underground Grotto. Ohio Cave Laws. <http://www.dugcaves.com/more/ohcavelaw.html>
- Anonymous. 2008b, date accessed. National Speleological Society Conservation Policy. <http://caves.org/info/policy.shtml>
- Anonymous. 2008c, date accessed. The Federal Cave Protection Act of 1988. <http://www.karst.org/fedlaw.htm>
- Anonymous. 2008d, date accessed. The Dayton

Underground Grotto. Kentucky Cave Laws.  
<http://www.dugcaves.com/more/kycavelaw.html>

Drew, D. and S. Dunne. 2004. Groundwater protection. IN, Gunn, J. (ed.), *Encyclopedia of Caves and Karst Science*, Fitzroy Dearborn, NY, pp. 408-409.

Elliott, W.R. 2005a. Critical issues in cave biology. National Cave and Karst Management Symposium 2005, 2005:35-39.

Elliott, W.R. 2005b. Protecting caves and cave life. IN, Culver, D.C. and W.B. White (eds.), *Encyclopedia of Caves*, Academic Press, pp. 458-467.

Huppert, G. N. 1995. Legal protection for caves in the United States. *Environmental Geology*, 26:121-123.

Hobbs, H.H. 1993. Protection of karst resources – are we too late? *Ohio Journal of Science*. 93(2):42.

Nims, P. and D. Foster. 1995. American caves – objects of beauty become victims of vandalism. *American Caves*, 8(1):12-17.

Zellmer, L. 2004. How homeland security affects spatial information. *Computers in Libraries*, 24(4):6-8.

**Appendix I.** The Federal Cave Resources Protection Act of 1988

Be it enacted by the Senate and the House of Representatives of the United States of America in Congress Assembled  
**SECTION 2. FINDINGS, PURPOSES, AND POLICY**

(a) **FINDINGS.**—The Congress finds and declares that—  
 1. significant caves on Federal lands are an invaluable and irreplaceable part of the Nation’s natural heritage; and  
 2. in some instances, these significant caves are threatened due to improper use, increased recreational demand, urban spread, and a lack of specific statutory protection.

(b) **PURPOSES.**—The purposes of this Act are—  
 1. to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people; and

2. to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on Federal lands for scientific, education, or recreational purposes.

(c) **POLICY.**—It is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves.

**SECTION 4. MANAGEMENT ACTIONS**

a. **REGULATIONS.**—Not later than nine months after the date of the enactment of this Act, the Secretary shall issue such regulations as he deems necessary to achieve the purposes of the Act. Regulations shall include, but not be limited to, criteria for the identification of significant caves. The Secretaries shall cooperate and consult with one another in preparation of the regulations. To the extent practical regulations promulgated by the respective Secretaries should be similar.

(b) **IN GENERAL.**—The secretary shall take such actions as may be necessary to further the purposes of this Act. These actions shall include (but not be limited to)–

1. identification of significant caves on federal lands;  
 (A) The Secretary shall prepare an initial list of significant caves for lands under his jurisdiction not later than one year after the publication of final regulations using the significance criteria defined in such regulations. Such a list shall be developed after consultation with appropriate private sector interests, including cavers.

(B) The initial list of significant caves shall be updated periodically, after consultation with appropriate private sector interests, including cavers. The Secretary shall prescribe by policy or regulation the requirements and process by which the initial list will be updated, including management measures to assure that caves under consideration for the list are protected during the period of consideration. Each cave recommended to the Secretary by interested groups for possible inclusion on the list of significant caves shall be considered by the Secretary according to the requirements prescribed pursuant to this paragraph and shall be added to the list if the Secretary determines that the cave meets the criteria for significance as defined by the regulations.

2. regulation or restriction of use of significant caves, as appropriate;  
 3. entering into volunteer management agreements with persons of the scientific and recreational caving community; and  
 4. appointment of appropriate advisory committees

## (c) PLANNING AND PUBLIC PARTICIPATION.

The Secretary shall-

1. ensure that significant caves are considered in the preparation or implementation of any land management plan if the preparation or revision of the plan began after the enactment of this Act;
2. foster communication, cooperation, and exchange of information between land managers, those who utilize caves, and the public.

**Appendix II.** The Kentucky Cave Protection Law of 1988 433.871 Definitions.

As used in this chapter, the following words shall have the meanings stated unless the context requires otherwise:

- (1) "Cave" means any naturally occurring void, cavity, recess, or system of interconnecting passages beneath the surface of the earth containing a black zone including natural subterranean water and drainage systems, but not including any mine, tunnel, aqueduct, or other man-made excavation, which is large enough to permit a person to enter. The term "cave" includes or is synonymous with "cavern."
- (2) "Commercial cave" means any cave utilized by the owner for the purposes of exhibition to the general public, whether as a profit or nonprofit enterprise, wherein a fee for entry is collected.
- (3) "Gate" means any structure or device situated so as to limit or prohibit access or entry to any cave.
- (4) "Person" or "persons" means any individual, partnership, firm, association, trust, or corporation or other legal entity.
- (5) "Owner" means a person who owns title to land wherein a cave is located, including a person who owns title to a leasehold estate in the land and specifically including the Commonwealth and any of its agencies, departments, boards, bureaus, commissions, or authorities as well as counties, municipalities and other political subdivisions of the Commonwealth.
- (6) "Speleothem" means a natural mineral formation or deposit occurring in a cave. This shall include or be synonymous with, but not restricted to stalagmite, stalactite, helectite, shield, anthodite, gypsum flower and needle, angel's hair, soda straw, drapery, bacon, cave pearl, popcorn, coral, rimstone dam, column, palette, flowstone, et cetera.
- (7) "Speleogen" means an erosional feature of the cave boundary and includes or is synonymous with, but not limited to anastomoses, scallops, rills, flutes, spongework, boxwork, and pendants.

(8) "Material" means all or any part of any archaeological, paleontological, biological, or historical item including, but not limited to, any petroglyph, pictograph, basketry, human remains, tool, beads, pottery, projectile point, remains of historical mining activity or any other occupation, found in any cave.

(9) "Cave life" means any life form which normally occurs in, uses, visits, or inhabits any cave or subterranean water system, excepting those animals and species covered by any of the game laws of the Commonwealth of Kentucky.

(10) "Troglobitic" means or refers to any form of cave life specifically adapted to the cave environment and which carries out its entire life cycle in the cave.

(11) "Troglophilic" means or refers to any form of cave life which, although lacking specific biological adaptations necessary for permanent residence in any cave, carries out at least a portion of its life cycle in the cave.

Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 1, effective July 15, 1988.

433.873 Wrongful disturbance or damage to cave surfaces or material found therein.

(1) It shall be unlawful for any person, without the express, prior, written permission of the owner, to willfully and knowingly:

(a) Break, break off, crack, carve upon, write, burn, or otherwise mark upon, remove, or in any manner destroy, disturb, deface, mar or harm the surfaces of any cave or any material which may be found therein, notwithstanding whether such material is attached or broken, including speleothems, speleogens, and sedimentary deposits. The provisions of this section shall not prohibit minimal disturbance for scientific exploration.

(b) Break, force, tamper with or otherwise disturb a door, lock, gate, or other obstruction designed to control or prevent access to any cave, even though entrance thereto may not be gained.

(c) Place any gate or other obstruction which may restrict the movement of air or animals through such device.

(d) Deface, tamper with or remove a sign stating that a cave is posted or citing provisions of this chapter.

(e) Excavate, remove, destroy, injure, deface, or in any other manner disturb any burial grounds, historic or prehistoric resources, archaeological or paleontological site or any part thereof, including fossils, bones, relics, inscriptions, saltpeter workings, remains of historical human activity, or any other such features which may be found in any cave, except

those caves owned by the Commonwealth or designated as Commonwealth archaeological sites or zones, and which are subject to the provisions of KRS 164.705 to 164.735.

(2) The entering or remaining in a cave which has not been posted by the owner shall not by itself constitute a violation of this section.

Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 2, effective July 15, 1988.

433.875 Unlawful dumping, disposal or burning within cave.

It shall be unlawful to store, dump, litter, dispose of or otherwise place any refuse, garbage, dead animals, sewage, toxic substances harmful to cave life or humans, or to store other such similar materials in any quantity in any cave. It shall also be unlawful to burn within a cave any material which produces any smoke or gas which is harmful to any naturally occurring organisms in the cave, except acetylene gas produced by carbide lamps.

Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 3, effective July 15, 1988.

433.877 Unlawful removal or disturbance of naturally occurring organisms in cave.

(1) It shall be unlawful to remove, kill, harm, or otherwise disturb any naturally occurring organism found within any cave, except for safety or health reasons. Scientific collecting permits may be obtained from the state nongame biologist.

(2) It shall also be unlawful to collect any form of troglolithic or troglophilic cave life for commercial sale, whether or not a profit is gained by such sale.

Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 4, effective July 15, 1988.

433.879 Excavation permits -- Requirements -- Supervision by state archaeologist and Kentucky Heritage Council.

(1) In addition to the written permission of the owner required by KRS 433.873(1), a person shall also obtain a permit from the state archaeologist prior to excavating or removing any archaeological, paleontological, prehistoric or historic feature of any cave. The state archaeologist shall issue a permit to excavate or remove such a feature if he finds that it is in the best interest of the Commonwealth and that the applicant meets the criteria of this section and is an historic, scientific or educational institution, professional archaeologist or amateur who is qualified and recognized in the areas of field investigations or archaeology. The permit

shall be issued for a period of two (2) years and may be renewed upon expiration. The permit shall not be transferable; however, the provisions of this section shall not preclude any person from working under the direct supervision of the permittee.

(2) All field investigations, explorations or recovery operations undertaken under this section shall be carried out under the general supervision of the state archaeologist and the Kentucky Heritage Council and in a manner to ensure that the maximum amount of historic, scientific, archaeological, and educational information may be recovered and preserved in addition to the physical recovery of objects.

(3) A person applying for a permit pursuant to this section shall: (a) Have knowledge of archaeology, paleontology or history as qualified in subsection (1) of this section; (b) Provide a detailed statement to the state archaeologist giving the reasons and objectives for excavation or removal and the benefits expected to be obtained from the contemplated work; (c) Provide data and results of any completed excavation, study, or collection at the first of each calendar year; (d) Obtain the prior written permission of the owner if the site of the proposed excavation is on privately owned land; and (e) Carry the permit while exercising the privileges granted. Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 5, effective July 15, 1988.

433.881 Unlawful sale of speleothems.

It shall be unlawful for any person to sell or offer for sale any speleothems in this Commonwealth, export them for sale outside the Commonwealth, or import speleothems into the Commonwealth for sale.

Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 6, effective July 15, 1988.

433.883 Cave owner or his agent not to be held liable.

(1) Neither the owner of a cave nor his authorized agents acting within the scope of their authority shall be liable for injuries sustained by any person using the cave for recreational or scientific purposes if no charge has been made for the use of the cave, notwithstanding that an inquiry may have been made as to the experience or expertise of the person or persons seeking consent.

(2) Nothing in this section shall be construed to constitute a waiver of the sovereign immunity of the Commonwealth or any of its boards, departments, bureaus or agencies.

Effective: July 15, 1988 History: Created 1988 Ky. Acts ch. 168, sec. 7, effective July 15, 1988.

**Appendix III.** The Ohio Cave Protection Law of 1988  
The Ohio Revised Code

Section 1517.21 General Assembly: 117. Bill Number:

Amended S.B. 177 Effective Date: 3/22/89

As used in sections 1517.21 to 1517.26 of the Revised Code:

(A) "Cave" means a naturally occurring void, cavity, recess, or system of interconnecting passages beneath the surface of the earth or within a cliff or ledge, including, without limitation, a grotto, rock shelter, sinkhole, cavern, pit, natural well, pothole, or subsurface water and drainage system.

(B) "Cave life" means any organism that naturally occurs in, uses, visits, or inhabits any cave, except those animals that are permitted to be taken under Chapter 1533. of the Revised Code.

(C) "Material" includes:

(1) Any speleothem, whether attached or broken, found in a cave;

(2) Any clay or mud formation or concretion or sedimentary deposit found in a cave;

(3) Any scallop, rill, or other corrosional or corrasional feature of a cave;

(4) Any wall or ceiling of a cave or any other part of the speleogen.

(D) "Owner" means any person having title to land in which a cave is located.

(E) "Speleothem" means any stalactite, stalagmite, or other natural mineral formation or deposit occurring in a cave.

(F) "Speleogen" means the surrounding material or bedrock in which a cave is formed, including walls, floors, ceilings, and similar related structural and geological components.

(G) "Sinkhole" means a closed topographic depression or basin generally draining underground, including, without limitation, a blind valley, swallowhole, or sink.

(H) "Hazard" means a risk of serious physical harm to persons or property.

Section 1517.22 General Assembly: 117. Bill Number:

Amended S.B. 177 Effective Date: 03/22/89

The general assembly hereby finds that caves are uncommon geologic phenomena and that the minerals deposited in them may be rare and occur in unique forms of great beauty that are irreplaceable if destroyed. Also irreplaceable are the archeological resources in caves, which are of great scientific and historic value. It is further found that species

of cave life are unusual and of limited numbers; that many are rare, threatened, or endangered species; and that caves are a natural conduit for groundwater flow and are highly subject to water pollution, thus having far-reaching effects transcending man's property boundaries. It is therefore declared to be the policy of the general assembly to protect these unique and great natural, historical, scientific, and cultural resources.

Section 1517.23 General Assembly: 117. Bill Number:

Amended S.B. 177 Effective Date: 3-22-89

With the advice of the Ohio natural areas council created under section 1517.03 of the Revised Code, the chief of the division of natural areas and preserves shall:

(A) Formulate policies and plans and establish a program incorporating them for the identification and protection of the state's cave resources and adopt, amend, or rescind rules in accordance with Chapter 119. of the Revised Code to implement that program;

(B) Provide technical assistance and management advice to owners upon request concerning the protection of caves on their land.

Section 1517.24 General Assembly: 117. Bill Number:

Amended S.B. 177 Effective Date: 3/22/89

(A) Without the express written permission of the owner and, if the owner has leased the land, without the express written permission of the lessee, no person shall knowingly:

(1) Break, break off, crack, carve on, write on, mark on, burn, remove, or in any other manner destroy, deface, mark, or disturb the surfaces of any cave or any natural material found in any cave, whether attached or broken, including, without limitation, speleothems, speleogens, and sedimentary deposits;

(2) Break, force, tamper with, or otherwise disturb any lock, door, gate, or other device designed to limit, control, or prevent access to or entry into a cave;

(3) Remove, deface, or tamper with any posted sign giving notice against unauthorized access to or presence in a cave or citing any of the provisions of sections 1517.21 to 1517.26 or division (B) of section 1517.99 of the Revised Code;

(4) Place refuse, garbage, dead animals, sewage, or toxic substances harmful to cave life or humans in a cave;

(5) Burn within a cave any substance other than acetylene gas burned in a carbide lamp that produces smoke or gas

that is harmful to cave life;

(6) Use any door, gate, or other device designed to limit, control, or prevent access to or entry into a cave that does not allow free and unimpeded passage of air, water, and cave life;

(7) Excavate or remove historic or prehistoric ruins, burial grounds, or archaeological or paleontological sites found in a cave, including, without limitation, saltpeter workings, relics, inscriptions, fossilized footprints, and bones;

(8) Remove, kill, harm, or disturb any cave life found within a cave.

(B) Without the express written permission of the owner and, if the owner has leased the land, without the express written permission of the lessee, no person shall purposely destroy, injure, or deface historic or prehistoric ruins, burial grounds, or archaeological or paleontological sites found in a cave, including, without limitation, saltpeter workings, relics, inscriptions, fossilized footprints, and bones.

Section 1517.25 General Assembly: 117. Bill Number: Amended S.B. 177 Effective Date: 3-22-89

No person shall sell or offer for sale speleothems collected from caves in this state.

Section 1517.26 General Assembly: 117. Bill Number: Amended S.B. 177 Effective Date: 3/22/89

(A) Owners and, if the owner has leased the land, the lessee, are not liable for injuries, death, or loss sustained by any permittee on their land if no charge has been made. By granting permission for entry, the owner or lessee does not:

- (1) Extend to the permittee any assurance that the premises are safe for such purposes;
- (2) Confer on the permittee the legal status of an invitee or licensee to whom a duty of care is owed;
- (3) Assume responsibility for or incur liability for any injury, death, or loss to person or property caused by an act or omission of a permittee.

(B) This section does not limit the liability which otherwise exists for injury, death, or loss to persons or property caused by an act or omission of the owner or lessee as follows:

- (1) Negligent failure to warn the permittee against a hazard of which the owner or lessee had actual knowledge prior to the permittee's entry on the land;
- (2) Willful or wanton misconduct;
- (3) Intentionally tortious conduct.

Section 1517.99 General Assembly: 117. Bill Number: Amended S.B. 177 Effective Date: 3-22-89

(A) Whoever violates division (A) of section 1517.021 or section 1517.051 of the Revised Code shall be fined not less than twenty-five nor more than five hundred dollars for a first offense; for each subsequent offense the person shall be fined not less than two hundred nor more than one thousand dollars.

(B) Whoever violates division (A) of section 1517.24 or section 1517.25 of the Revised Code is guilty of a misdemeanor of the third degree.

(C) Whoever violates division (B) of section 1517.24 of the Revised Code is guilty of a misdemeanor of the second degree.



# Wave of the Future Part 2 – Cartography by Computer

Kevin Kissell (WUSS #0530, NSS #54578)

## Disclaimer

This article is not really meant to be a step-by-step guide to drafting a cave map on the computer; instead it is intended to be an overview of the basic methods used and a stepping stone for all those cartographers who are either discouraged or searching for a start in the world of digital cartography. Not all steps in the process will be covered by this article; instead a few assumptions need to be addressed. As a cartographer it is assumed that you already use a computer to aid in creating a line plot and to detect errors. For basic purposes it does not really matter which program you use, whether it be *Compass*, *Walls*, or *Winkarst*, etc. For this article it is also assumed that you have chosen *Adobe Illustrator* as your drawing program. While there are a number of good drawing programs out there, *Illustrator* is one of the most popular and considered by many to be the best program for cave cartography.

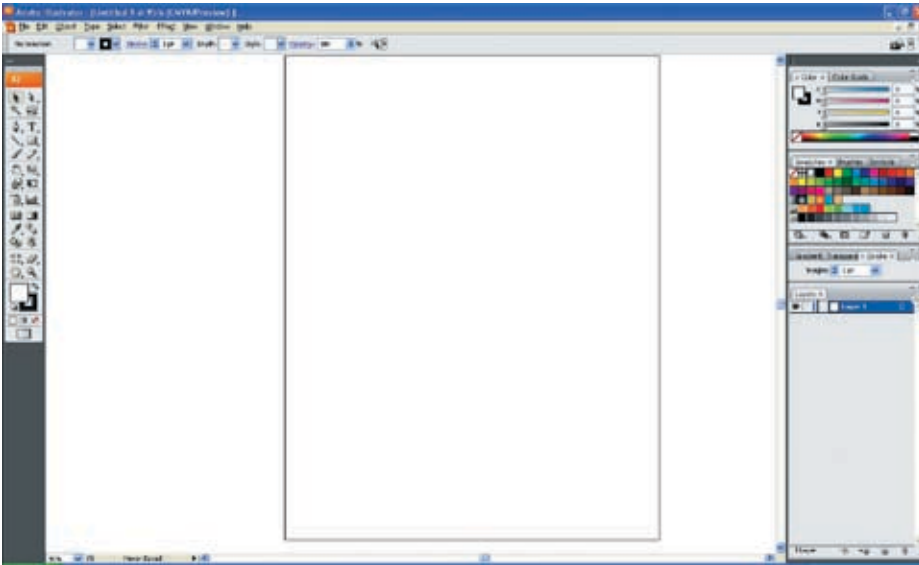
It is important to remember that there are multiple versions of *Adobe Illustrator* on both Windows and Mac operating systems. For this tutorial, I will be using *Adobe Illustrator CS 3* for Windows which is the newest version of the program, at least at the time of this writing. There are slight differences among the versions, one of the most important to the cave cartographer, is the ability to import certain file formats. Previous versions would allow the user to import a line plot directly from *Compass*. However, the new versions do not allow this file format; instead the user must take a screen shot of the line plot, import the screen shot into *Illustrator*, then separate and delete everything that is not the physical line plot. This is just one example of the differences between the versions of *Illustrator*; keep this in mind while reading and using the following article.

## Introduction

*Adobe Illustrator* is a vector based drawing program cultivated and marketed by Adobe Systems. It was first developed for the Apple Macintosh and is the companion product of *Adobe Photoshop*. *Photoshop* is primarily geared toward digital photo manipulation and photorealistic styles of computer illustration, while *Illustrator* provides results in the typesetting and logo graphic areas of design. The program was originally released in the mid 1980's and since then there have been thirteen generations of the product, culminating in the current product, *Adobe Illustrator CS 3*. *Illustrator* has been adopted by the digital cave cartography community due to its flexibility and customizability. However, *Illustrator* is a very technical program; don't expect to open the program for the first time and draw a perfect cave map – much of the finer details of the program can be learned only through time and practice. Since much of the digital cave cartography community uses *Illustrator* there is no shortage of online support including but not limited to written how-to guides, video tutorials, and freeware in the form of common cartography symbols. See the **Notes** section of this article for a short list of resources.

## The Adobe Illustrator CS 3 Workspace

Upon opening *Adobe Illustrator* the user will be confronted with a large drawing canvas and a plethora of both buttons and drop down menus. On a whole this is known as the “workspace” (Figure 1). The workspace is divided into four primary elements: on the top of the screen is the **Menu Bar**, on the left of the screen is the **Tools Palette**, on the right of the screen is the **Individual Palettes**, and the center of the screen is dominated by the **Canvas**.



**Figure 1:** The Adobe Illustrator CS 3 workspace is a well conceived layout; notice the **Menu Bar** at the top, the **Tools Palette** on the left, the **Individualized Palettes** on the right, and the **Canvas** dominating the center of the screen.

The **Menu Bar** has a number of drop-down menus similar to many Windows based programs; these include **File, Edit, Object, Type, Select, Filter, Effect, View, Window,** and **Help**. The **File** menu has information and commands related to your file (for example, this is where you would go if you wanted to save the file or open a new file). You can use the **Edit** menu to edit your document—options such as copy, paste, and undo are found here. The **Object** menu allows you to edit selectable objects within your document whether they are lines, fills, or shapes. The **Type** menu deals directly with fonts within your document. The **Select** menu provides options for objects that you select in the document. Most of this menu is unusable unless you have an object selected in the **Canvas**. The **Filter** and **Effect** menus apply specific characteristics to drawn or imported objects. These menus are not used very much in cave cartography. The **View** menu has the settings that adjust what you see or how much you see on the **Canvas**. If you wanted to see rulers, gridlines, print preview, or zoom you would change those settings in the **View** menu. The **Window** menu has a listing of all the available palettes and libraries. The palettes,

when selected, will show up in the **Individual Palettes** area of the workspace. They are definable by the user but the common ones for cave cartography include **Color, Layers, Symbols, Stroke,** and **Tools**; these will be discussed later. The libraries allow the user to load, create, and import saved sets of objects like brushes, symbols, and swatches. This is useful because there are already sets of things that other users have created (e.g., cave survey symbols) that you can import from the web. For more information on where to find these symbols please see the Notes section at the end of this article. Finally the **Help** menu

allows you to search for ways to fix any problems you may run into while creating your document. Along with the above listed drop down menus, the new versions of *Illustrator* have a set of icons and settings for changing the varying attributes of tools we select. This set of icons and settings is dynamic in that it changes depending on what you may be doing. You also can find these same options by going through the above mentioned drop down menus.

The **Tools Palette** is the second important element in the *Illustrator* workspace. It uses icons to display all the necessary tools that allow you to create shapes, objects, and diagrams. The icons are broken up by use in the **Tools Palette**. The first four tools are grouped together and these are used to select objects on the **Canvas**. The next six icons are employed to create lines, paths, and shapes; the type tool is also found here. The four icons below that deal with modifying an object or path, whether modifications involve rotating, transforming, or skewing. The next two icons are not used during cave cartography since they deal with modifying graphs. However, the six icons after that allow you to fill an object with color or a particular swatch or pattern. The final four icons

allow you to cut, erase, and navigate through the document. Below this final set of icons are two squares, one with a square hole in the middle of it. These define the color of the stroke (the one with the hole in it) and the fill color of a selected object. By double clicking either of these a small box will be opened, known as the 'Fill' color box, where you can adjust the color to anything imaginable. Many of the above mentioned icons actually have multiple options; the ones currently shown are typically the most used. You can change to a different tool by holding down the click on an icon that has a small triangle in the lower right hand corner; if there is no triangle there is only one tool for that icon.

The **Individual Palettes** are located, by default, on the right side of the screen. Since these are user definable you may have to activate a palette by going to the **Menu Bar**, selecting the **Window** menu, and clicking on the desired palette. For the purpose of this article I will briefly go over the palettes that are commonly used for cave cartography. Palettes can be combined or individualized as per the user's desire by clicking on the name of the palette in the top left corner and dragging into another palette or out of an existing palette. Each palette is unique in that it controls a varying aspect on the **Canvas**; since there are so many options only the most popular are shown by default. In order to display all available options for a palette the user must click on the small arrow in the top right corner of the palette. By default the **Stroke** palette is visible and is used to modify the attributes of a selected line or path. The **Layer** palette is extremely useful because it gives an ordered listing of the layers of your document. The importance of layers will be discussed in further detail below. The final palette I find of great importance is the **Symbol** palette. The **Symbol** palette is useful when there is an object that is used repeatedly. In order to add a new symbol to the **Symbol** palette the user must select only the drawn object and drag it over to the **Symbol** palette. This allows for a quick creation of any number of symbols. The symbols then

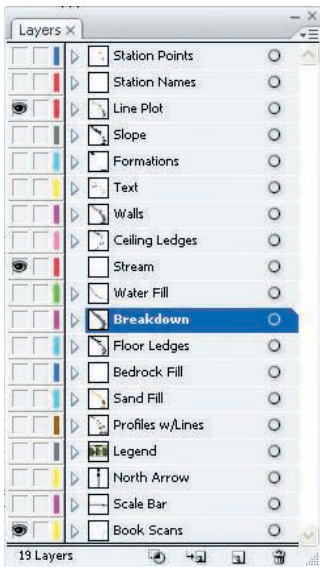
can be saved for future use or to upload to the internet for communal sharing. To use the newly created symbol or an existing symbol the user simply clicks on the desired symbol and drags it into place. It is important to remember that since the **Individualized Palettes** are user defined they can be adjusted at anytime. If you find yourself using the **Menu Bar** frequently, look at the available palettes for shortcuts.

The last of the four main elements of the *Illustrator* workspace is the **Canvas** which displays a number of facts about your document. At the top is the name, current zoom, and color format of the document. The bottom has a drop down menu for changing the zoom and another drop down for displaying certain characteristics of your document. Finally, at the bottom and on the right are scroll bars that allow you to navigate to a location within your document.

## Setting up a Document

To start a new map project, go up to the **Menu Bar**, select the **File** menu, and click on **New**. A small window opens and asks you to name your file and select a few parameters. I typically do not change anything until the map is finished since I can always modify these settings later by going up to **File** and clicking **Document Setup**.

The next basic step in creating a cohesive cave map is creating and setting up varying layers that can handle all of the symbols, shapes, and objects that are required in a cave map. Layering your drawing allows you not only to organize your map but also to create a hierarchy of the symbols, shapes, and objects within the document. New layers can be created by using the **New Layer** button on the **Layers** palette of the **Individualized Palettes** (Figure 2). The layers can be reorganized by simply clicking and dragging them above or below their current position. It is also important to name any new layers in a logical fashion since you will more than likely be turning layers on and off throughout the drawing process. The layer



**Figure 2:** The **Layers** palette displays all user created layers; remember that layers high on the list will appear on top of those that are lower on the list. Each layer is assigned a color, which can be changed, that allows for easy identification while on the **Canvas**.

system within *Illustrator* allows the user to decide which pieces of the map should be most prominent and what shapes, symbols, and objects should appear on top of others. What this basically means is that if a symbol is in the top end of the layer order it will appear on top of a shape that is in the lower end of the order. This is useful because in a cave map you will more than likely have symbols and drawings on top of one another. It is important that the user decide for themselves how many layers they want to use and what order the layers should be organized. Keep in mind, the more layers means the more control in your final product. For a typical cave map I use a nineteen layer system (Figure 2). When deciding your layer order it is important to remember what needs to be seen in your cave map. For example, you would not want to place any symbols for slope or formations lower than a fill layer because the fill layer would cover up the symbols. Like much of *Illustrator* these ideas and considerations simply take time to develop.

### The Line Plot and Proper Scaling

Importing a line plot from your current cave survey management program will not be discussed due to the variety of techniques available to you. However proper scaling of your line plot and map sketches can prove to be extremely valuable and is therefore worth

mentioning. Once your line plot has been imported into its proper layer, it is time to import your in-cave sketches. It is important to remember that if you do not practice an accurate sketch to scale technique while underground this method will not work for you. Instead of the following method, you will have to print out your line plot at your desired scale and draw the walls around your line plot. You may then scan the line plot with the walls, import and trace them into *Illustrator*, and then fill in the detail of the cave on the computer. However, assuming your sketch to scale technique is highly developed, it is rather easy to transform your hand drawn sketches into a traceable object in *Illustrator*. Simply scan your book pages onto the computer and save them as a .jpeg file. You can import these .jpeg files into *Illustrator* by going to the **Menu Bar** and selecting **Place** from the **File** menu; the images of your book pages will stay the same size as your original ones when you import them. The



**Figure 3:** With the layers properly set, it is easy to scale your book sketches to match the line plot. The exactness of the match between the sketches and line plot will vary based on the cartographer's own sketch to scale technique.



**Figure 4** (above): With *Illustrator*, you can very easily trace your original book sketches to recreate your map. I typically draw the walls first then begin drawing large objects, like the breakdown seen here.

better your sketch to scale technique the easier it will be to match your drawings to your line plot (Figure 3). However you can stretch the images to match up to the properly scaled line plot if necessary. In order to ensure the vertical and horizontal relationship of your drawing is not tainted during the scaling process, make sure you only stretch the image by clicking in one of the four corners and holding down the **Shift** key as you drag. This method ensures that you do not accidentally stretch the image more across the horizontal plane than the vertical plane, or vice versa.

### Basic Drawing and Fills

Once the line plot and original sketches are scaled properly, it is time to start the arduous task of using a mouse to redraw your original in-cave sketches. Most of this process can be completed by simply tracing the existing lines and shapes from your in-cave sketches and placing symbols at the appropriate locations. The 'Pencil Tool' or 'Pen Tool' (found on the **Tools Palette**) can be used to trace walls and large pieces of

**Figure 5** (right): The 'Fill' color box can be found at the bottom of the **Tools Palette**.



breakdown (Figure 4). When tracing the walls of a cave it is important to try to draw one long continuous line, however this can be difficult if your map is large enough to require zooming. To alleviate this, when adding onto an existing line, simply overlap the previous line with the new line; *Illustrator* understands this as continuing an already established line rather than making a new line. The thickness, or weight, of lines can be changed by using the **Brush** palette on the **Individualized Palettes**. Typically the walls of a cave are thicker than any other line on the map; this draws attention to the map and gives the map a nice clean look.

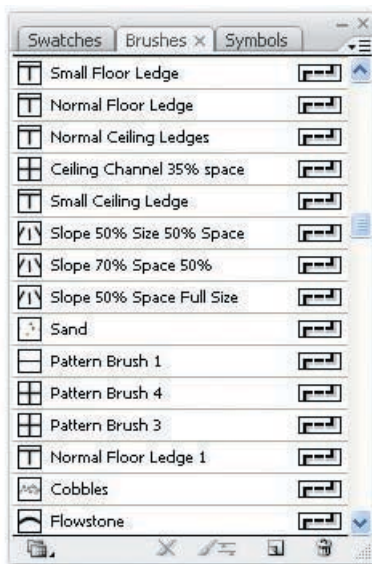
Fills are used when applying color to a drawn shape. In order for the color to be evenly distributed the line that defines the shape must be a solid line. A fill color can be added to any solid shape by merely selecting the shape and double clicking the 'Fill' color box on the **Tools Palette** (Figure 5). When attempting to fill the entire cave with color you can simply copy all of the walls and place them in another layer, labeled appropriately. Join any open ends by either overlapping the lines or using the join command, found on the **Menu Bar**, and then filling the new shape with the desired color. Remember to keep the walls layer above the new fill layer or else you will be unable to see the walls when the fill is turned on.

### Creating Symbols and Brushes

Symbols and brushes are extremely useful for representing cave formations and features such as stalactites, stalagmites, slope, ledges, and domes, just to name a few. The initial creation of symbols and brushes can be grueling; however once they are created they can be saved so that each time *Illustrator* is opened they appear.

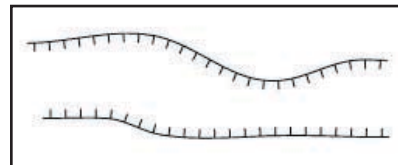
The first step in creating a symbol is to draw the desired symbol using either the pencil tool, line tool, or some other drawing tool from the **Tools Palette**. When drawing your symbols make sure it is exactly how you want because once the symbol is created it cannot be edited, other than to resize it. Pay particular attention to the stroke weight of the lines, which can be adjusted by using the **Stroke** palette on the **Individualized Palettes**, and make sure they are appropriate for the symbol's size. Once you have created the desired symbol you can simply select all the parts of the symbol together and drag it in the **Symbols** palette on the **Individualized Palettes**. The symbol can be named appropriately by clicking on the 'Symbol Options' button in the **Symbol** palette. With the symbol created, you can now drag the symbol from the **Symbol** palette onto any location on the map.

Brushes are useful for when there is a particular style you want to apply to a line within your map; brushes would be typically used for depicting ledges and domes. Like symbols, brushes can be time consuming to create but very helpful since they are saved and can be used each time *Illustrator* is opened. For instructive purposes and to demonstrate the basic technique what follows is an explanation of how to create a ledge brush. First use your line tool, found on the **Tools Palette**, to draw a short (roughly two centimeters)



**Figure 6:** The **Brushes** layer will display all of the available brushes; remember to name them appropriately. The brushes will be saved so that each time you open *Illustrator* they will appear.

straight line. Continue with the line tool to draw small vertical lines (hash marks) perpendicular to the previous line. Repeat this as necessary to create a short version of the standard ledge symbol, making sure to space the hash marks evenly. Remember to pay attention to the stroke of the lines; too fat and the hash marks will blend together, too skinny and lines will go unnoticed. Once finished, select all of the newly drawn lines and open the **Brushes** palette on the **Individualized Palettes**. Click the 'New Brush' symbol (Figure 6) on the bottom of the **Brushes** palette; a small window will appear with four options. Select the 'New Pattern Brush' option. Your new brush will now be shown as an option, which can be labeled much like a new symbol. It is important to remember that pattern brushes are directional, meaning that the direction of the hash marks will change based on the direction from which the line is drawn. Try drawing



**Figure 7:** Pattern brushes are directional; these two lines were drawn using the same brush except that they were drawn from different directions. The top line was drawn left to right; the bottom line was drawn right to left.

a ledge from left to right; note what direction the hash marks are, then draw the same line from right to left (Figure 7). A brush style can be added to an existing line by selecting the line and clicking on the desired brush in the **Brushes** palette.

## The Use of Color

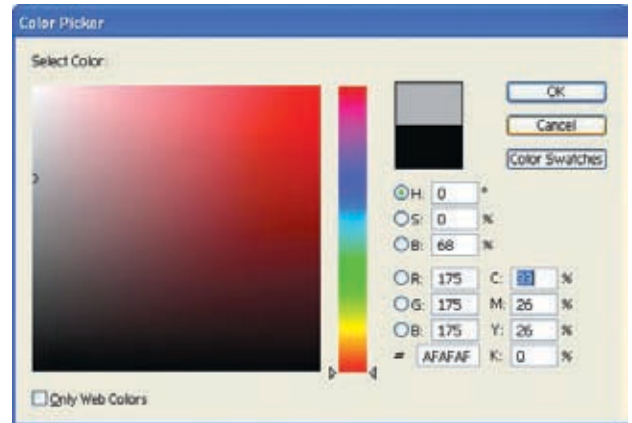
Color can play a large role in understanding a cave map, especially for the inexperienced or amateurish onlooker. When deciding on color choices it is important to ask yourself whether adding color to your map will enhance or detract from the overall map. Also if your map is not going to be viewed or printed in color it may be less important to apply a particular color to a particular object; instead you may



**Figure 8:** The use of color can help enhance a map's readability if used logically. Here the brown color simulates a sand or dirt floor, the light grey is used for bedrock floors and ledges, and the dark grey can be used for breakdown.

want to pick colors that contrast sharply rather than blend together. If you are fortunate enough to be able to produce a full color map, choose your colors wisely. The logical use of color will not only enhance the map but also help an onlooker to understand the map better. For example, brown or tan is an excellent choice to show a sand or mud floor and grey is best used for a rock floor or breakdown (Figure 8). Water can easily be recognized by using a blue color. Choosing an easily recognizable color for a shape or fill may be a better choice, especially if you are creating a map without a legend or if the map is going to be viewed by individuals who do not have prior knowledge of standard cave survey symbols. When applying color to multiple similar objects, such as breakdown, it is important to stay uniform throughout. Each color that is created in *Illustrator* is assigned a unique six digit identification that can be used to reproduce the same color continually. It is a good idea, once you find colors that you like, to record the six digit ID for later use (Figure 9). Remember that in some maps adding color can detract from the overall purpose of the map; after

**Figure 9 (right):** When you double click on the 'Fill' color box a separate window will open. Notice the box marked with a '#' which is where you will find the six digit ID for each color. The grey shown is what I use for breakdown.

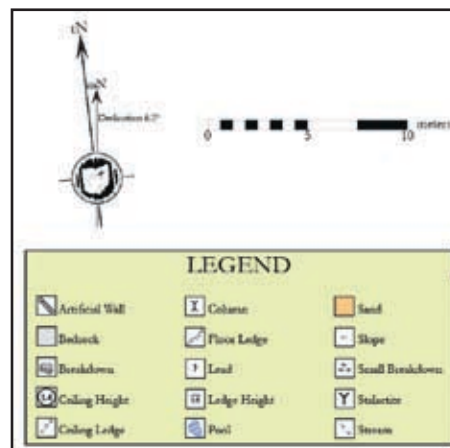


all, it is better to have a black and white map than one that is distractingly colorful.

## Adding Text

One of the last bits of information that is typically added to a cave map is textual characters; these can be added by using the type tool found in the **Tools Palette**. The type tool works just like a text box tool in

**Figure 10 (right):** The information found in the title box will vary based on the individual cartographer. For uniformity, remember to use the same font throughout the map.



**Figure 11 (left):** Here examples of a north arrow, scale bar, and legend are shown; again these will vary by cartographer.

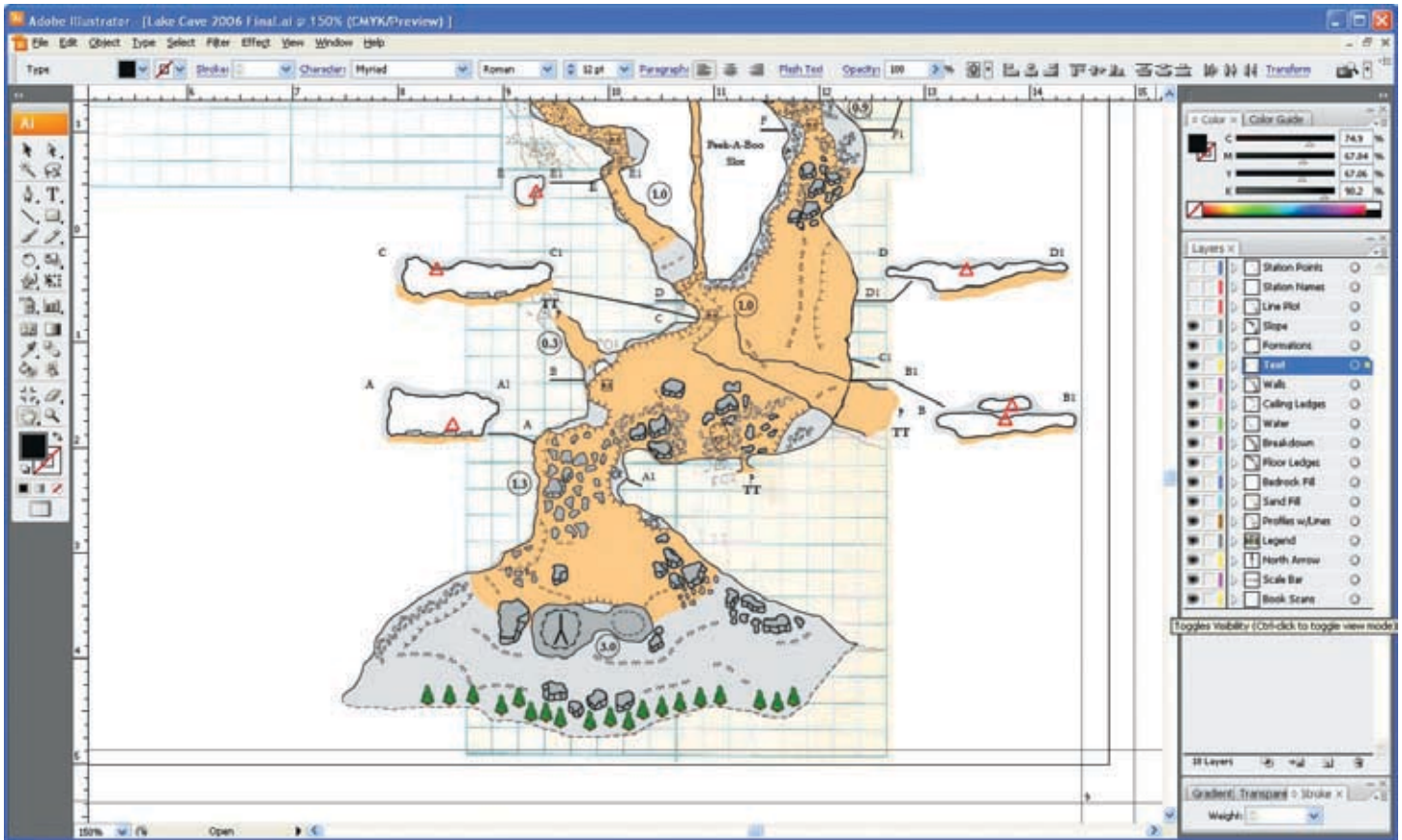


Figure 12: Obviously, each map will be different once completed but it is important to preserve the maps' readability and function.

Microsoft Office in that it allows you to create a box in which you can type. The box can be adjusted for size, outline color, and fill color, as can the text found inside the box. In order to maintain consistency throughout your project make sure all text found on the map is the same font and all similar text objects are the same size. All of these options can be modified in the **Menu Bar** of *Adobe Illustrator CS 3*. The amount of text on a particular map can vary based on the size of the map and cartographer's preference. It is important not to overwhelm an onlooker by having too much text. You also can use text to indicate the location of entrances, unique speleothems, and areas of the cave that are too tight for human travel. Obviously each map will have a title but the amount of information included with the title will vary (Figure 10) based on cartographer and available space.

### Final Thoughts and Considerations

The same techniques used in drawing a map can also be used to create other map-related objects, such as legends, north arrows, scale bars, and logos (Figure 11). However, when creating these objects make sure they do not distract from the map itself. The design of these elements and that of the cave is only prohibited by the cartographer's imagination.

You now have a very basic tutorial of how to begin digital cave cartography. Obviously this should only be considered a stepping stone and not a complete how to guide, as it would be close to impossible to write out all the necessary steps to draft a cave map fully. Much of the techniques and shortcuts needed to draft a map efficiently come only with practice and time. The best way to learn these skills, if possible, is by talking to a seasoned digital cave cartographer or at least someone who is familiar with *Adobe Illustrator*. A good substitute however can be found on the internet; for more

information on tutorial videos and guides please see the **Notes** section.

## Notes

All screen images used for this article were taken from *Adobe Illustrator CS 3* by the author. The map shown in the images is Lake Cave in Carter County, Kentucky.

For more information on *Adobe Illustrator*, including how to purchase, please visit Adobe's webpage at <http://www.adobe.com/>.

For up to date information on all aspects of cave survey please visit the survey links page of [cavediggers.com](http://www.cavediggers.com/caving.html#Space) at <http://www.cavediggers.com/caving.html#Space>. The following is a list of useful numbers and topics that correspond to that page:

1. Visit the [InCaveDigitalSurvey.com](http://www.InCaveDigitalSurvey.com) Online Discussion Board

*This is a link that will redirect you to a forum of cavers that specialize in all aspects of in cave digital surveying. They can be very useful and informational. In order to ask a question you must be a member, however membership is free.*

11. Illustrator Library download (1'-90' Ceiling Heights and Pit Depths .zip file)

*This file is a user created set of symbols for ceiling heights and pit depths, the numbers are whole numbers and each is inside either a square or circle as needed. This file is freeware.*

43. Adobe Illustrator for Cavers (QuickTime)

*This is a link that will redirect you to Brandon Kowallis' website. Here you will find a very good set of tutorial videos that deal specifically with using Adobe Illustrator to draft a cave.*

55. Here Be Dragons by Jeff Bartlett (PDF)

*This article was written by Jeff Bartlett of Little Rock Grotto; in the article Jeff explains Adobe Illustrator and how he learned to be proficient in its usage.*

## References

- Kissell, Kevin, Polly Bargar, Kate Ferguson, Linda Oxenrider, Aaron Taylor, and Christy Taylor. 2007. Lake Cave, Carter Caves State Resort Park, Kentucky. *Pholeos*, 25(1): 24-28.



# Your Mom's Pit

## Carter Caves State Resort Park, Kentucky

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**12 January 2008**

Throughout time, people have searched for those places of legend such as Atlantis, The Lost Incan City of Gold, and the Fountain of Youth. Where those people failed, on Saturday 12 January 2008, WUSS triumphed!

On this date, at approximately 1400 hours, a hearty team of dedicated WUSS cavers found what may be the single greatest discovery the caving community has seen in over a decade.

Recognizing this was possibly the height of their caving career, the team promptly bestowed upon this place a name befitting the significance of the discovery. They called it "Your Mom's Pit," in honor of moms everywhere.

The team consisted of Miss Katherine "Kate" Ferguson, Miss Kristen Baughman, Mr. Kevin Kissell, Mr. Jared Embree, and Sgt. Aaron R. Taylor. This motley crew, forged together by their shared passion for exploration and discovery, set forth on a mission with such dedication and such devotion, it has only ever been matched by beach landings at Normandy, or the Marines assault on Iwo Jima. And like those great leaders that have gone before her, Kate Ferguson rallied the troops with her now famous battle cry, "We shall not fail!" Thus began the adventure.

Mere words cannot describe Your Mom's Pit. It is a place of such beauty and magnificence, that to see it, to stand before it, will easily rank among the most inspirational moments in one's life. Sgt. Taylor was quoted as saying "It is like the first time I heard Credence Clearwater Revival," and then he wept.

The entrance of this cave of caves bestows upon its visitors a breathtaking view of The Great Smoky Lake of Carter Caves State Resort Park. Mr. Embree



**Figure 1:** The bravest man alive, Aaron Taylor, prepares for his decent using the most advanced climbing and safety system known to man. Photo by K. M. Kissell.

likened this view to that of looking from the top of the Eiffel Tower out over Paris after a spring rain. "I was awestruck, unable to move, afraid I would never find this level of happiness again."

Looking down into the abyss, one can almost see the gates of Hades. Their depths obscured only by the thick leaf litter at the bottom of this five meter shaft! It soon became apparent that one of the team must enter this chasm and it was decided that the eldest of the group should go. After 33 years, Aaron had lived a full life, and was willing to give the rest of it for his grotto. The rigging was masterminded by Jared, who with 20 meters of tubular webbing, two carabineers, a pocket knife, and the tenacity of Fidel Castro fighting against father time, formulated a safe system of descent that would have impressed even the late Sir Edmund Hillary.

So with Kristen persistently recording every step of the endeavor, Aaron began the descent. The harrowing



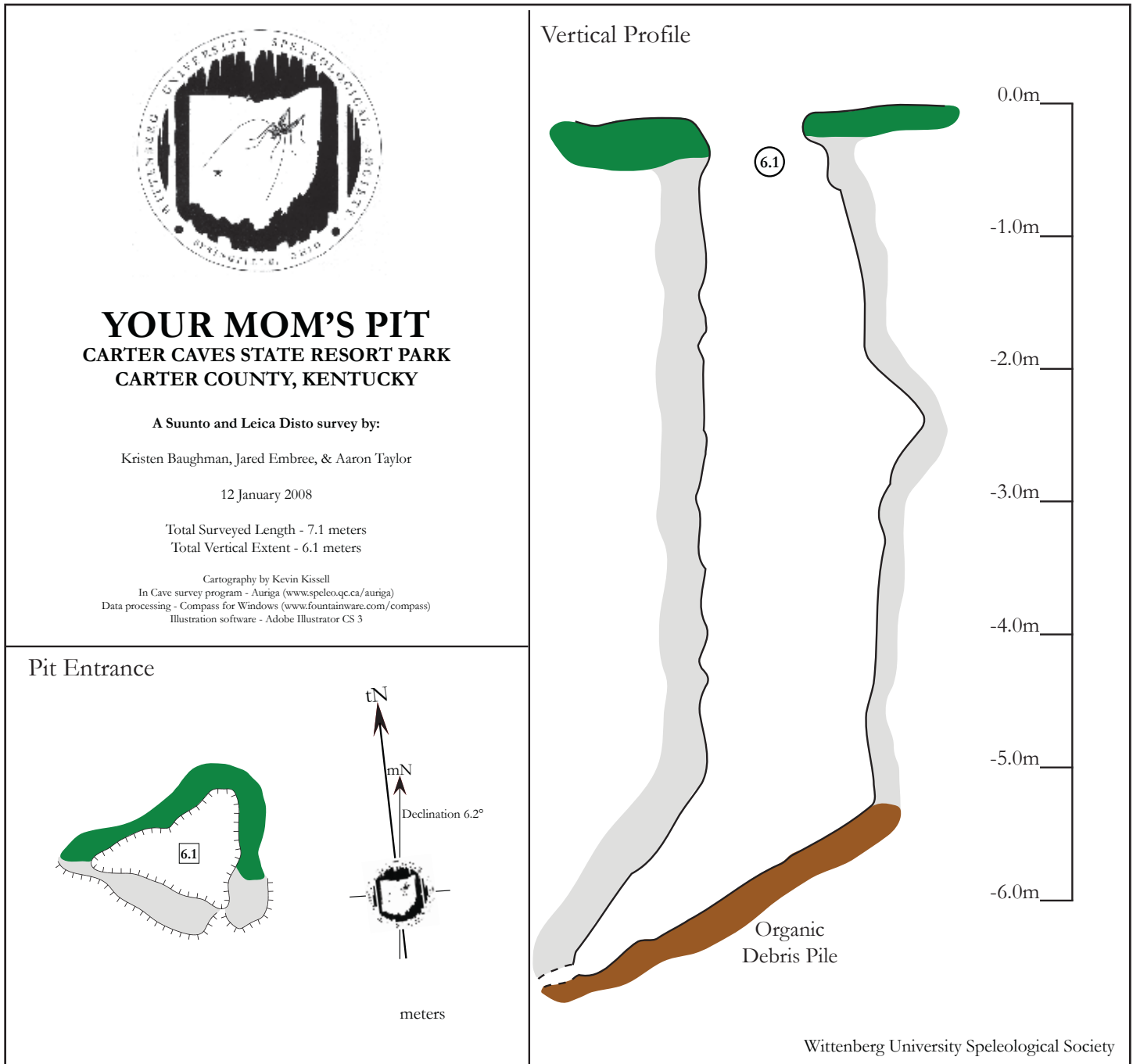
**Figure 3:** The rest of the team waiting in anticipation at the top of the pit; notice the expressions of fear and concern etched on their faces. Pictured from left to right: (back row) Kate Ferguson, Kevin Kissell; (front row) Kristen Baughman. Photo by J. Embree.



**Figure 2:** Aaron Taylor begins his harrowing descent into the great chasm known as *Your Mom's Pit*, the team knows this could be the last time he is ever seen alive. Photo by J. Embree.

details of this down climb are not included in this narrative out of respect for our younger readers, for which the details may not be appropriate. Rest assured it was the hardest five meter down climb of Aaron's life.

Once on the bottom, Aaron was immediately enveloped in darkness. He thought back to his training and that's when it hit him...turn on your light! But the light was not enough to shake the cold hard fact that he was alone. "Although I was only five meters away from my comrades, it felt like six meters, maybe six and



a half! I was scared. The only comfort I had was the knowledge that my comrades would never leave me.” Above him, the team stood fast, eating granola bars, debating what movie to see that night, and trusting that their faith in each other would see them through.

Observed at the bottom of this fissure was thick leaf litter cascading down at an approximate 45 degree

angle to an approximately 15 by 30 cm drain. The drain was not entered, but the team has concluded that it may be a connection to the great Mammoth Cave system. It may also just be a drain to the nearby hillside and river, we may never know...

Also observed was a spider. This eight legged beast was not able to be identified during the survey. Later



**Figure 4 (left):** Aaron Taylor controls his fears long enough to make a quick sketch of the pit; after all a momentous expedition such as this needs documentation! Photo by K. M. Kissell.

**Figure 5 (below):** A victorious Aaron Taylor smiles at the top of the pit after his treacherous climb out. He has since said that he knew he should have perished in the pit but that a mysterious force helped him in his time of need. Photo by K. M. Kissell.

discussions with the group's spider expert indicated that it was either a surface creature, or a previously undocumented new species of man-eating spider that breathes fire. At this time, the team is more inclined to trust the latter hypothesis.

Not much is known about the ascent out of Your Mom's Pit. When the team members welcomed Aaron back to the light, they could see he was different, a changed man. They don't ask him about it, and he doesn't talk about it. But there are rumors he cries out in the night something about not trusting anyone over 30, and The Man oppressing his people.

Before ascending out Your Mom's Pit, the good Sergeant recorded the details of the cave on an Etch-a-Sketch. At the time of this printing, the rendering was on display in the office of WUSS's founder, Faculty Advisor, and patriarch, Dr. Horton Hobbs III (WUSS #0001, NSS #12386). WUSS is considering donating this piece of history to the Smithsonian Institution or the National Science Foundation so that the contributions of this legendary team will be forever recorded in the history of these United States.



The opportunity to look upon the awesomeness of Your Mom's Pit is rivaled only by the act of making the annual pilgrimage to the great holy caving Mecca called Old Timer's Reunion, aka: OTR. Kevin, who intends to chronicle this journey to Your Mom's Pit in his memoirs, later compared the cave to Lechuguilla. "Its exactly like Lech, except for it's missing all the pretty stuff, a twilight zone, complete darkness, bats, formations, uniqueness, rooms, horizontal passage, and of course its only five meters deep. But other than that, it is basically the same cave."

# Skylight Cave

## Carter Caves State Resort Park, Kentucky

Kate Ferguson (WUSS #0544, NSS #56925)



*Figure 1: Kate Ferguson takes a nap next to some icicles in the entrance of Skylight Cave. Photo by K. M. Kissell.*

Why Skylight Cave was given its name was a mystery to WUSS for a long time. It only had two rooms, if you wanted to call the thing at the back a room, which were connected by a short crawlway. Nobody, in all the years of looking in this cave found anything resembling a skylight. Had someone mislabeled the cave in our database? Were they thinking of someplace else in the park? We eventually gave up trying to figure it out.

Then, in January 2008, we had a spare weekend and a new sketcher to train. Our team was a little too large for such a small cave with five people: Horton

Hobbs, Bill Stitzel, Holly Kellar, Kevin Kissell, and myself. We really wanted to spend the day surveying some small caves in the park so we decided to visit the tourist-friendly caves in the valley that leads to Smoky Bridge. Skylight Cave is one of the largest caves in the valley and is the farthest away from the bridge. The entrance room, roughly six meters by six meters, was gorgeous with ice formations which Kevin managed to get some very nice pictures of before they melted away entirely. Hobbs and Bill took instruments, while our new sketcher, Holly, perfected her newly learned

# SKYLIGHT CAVE

## CARTER CAVES STATE RESORT PARK CARTER COUNTY, KENTUCKY

A Suunto and Leica Disto survey by:

Kate Ferguson, Horton Hobbs III, Holly Kellar, Kevin Kissell, & Bill Stitzel

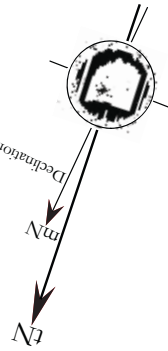
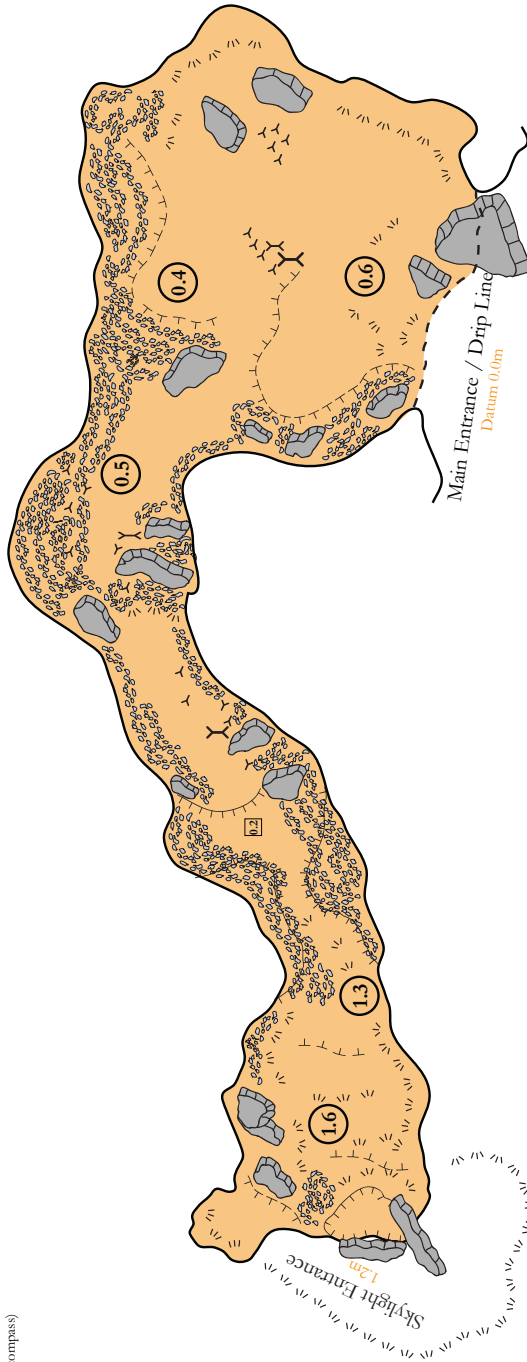
4 January 2008

Total Surveyed Length - 32.5 meters  
Total Vertical Extent - 2.3 meters

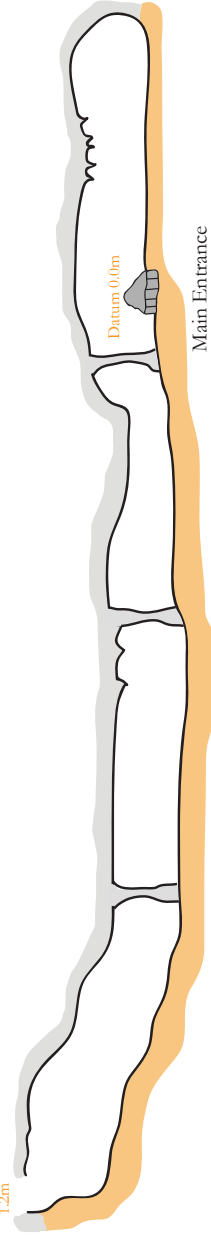
Cartography by Kevin Kissell  
In Cave survey program - Aungia (www.pelocycle.com/aungia)  
Data processing - Compass for Windows (www.fountainware.com/compass)  
Illustration software - Adobe Illustrator CS 3



LEGEND			
	Bedrock		Slope
	Breakdown		Floor Ledge
	Ceiling Height		Ice Column
	Ceiling Ledge		Ledge Height
	Sand		Stalactite
	Stalagmite		Small Breakdown



Skylight Entrance  
1.2m



Profile View



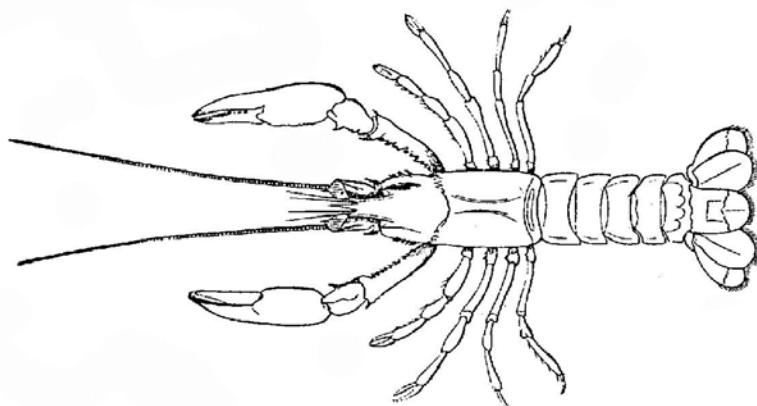
**Figure 2:** Kate Ferguson lines up for the last shot of the cave, the shot looks out of the feature that gives the cave its name.  
Photo by K. M. Kissell.



**Figure 3:** Horton Hobbs climbs out of the skylight entrance. The smile can be attributed to the forthcoming dinner at the park's lodge.  
Photo by K. M. Kissell.

technique. Not having anything else to do, I crawled around to note the general condition of the cave and got in everyone's way. The main entrance to the cave is right off the trail and is clearly used as a trash can by passing hikers. The back of the entrance room and the southern end of the crawl has obviously been used as a drinking spot for some time. I don't know how they do it – the crawl was lined with large, angular cobbles and not at all comfortable. I didn't see any graffiti or damage to the few formations in the cave but the presences of human visitation was undeniable. Once the crawl narrowed and apparently ended after a few body lengths, I turned around and exited through the main entrance. Just goes to show how easily you can miss something!

The surveyors diligently continued after I exited the cave. After a while, Kevin, who was still in the entrance room, relayed a message to me from Hobbs and Holly to go north from the entrance and listen. A couple meters off the path I heard voices. They'd found the skylight! Apparently at what I thought was the end of the crawl, there is a slope that leads up through a slot to a room proper, which is tall enough to sit or kneel in and roomy enough for several people. Though animals use it and there was plenty of natural litter, there was almost no trash. In a brief period of acting like a spelunker, I'd been stopped by a nerd gate. How embarrassing. From the outside, there is a nice slope down to the skylight entrance, which is a little more than a meter across. The same slope makes exiting a little more difficult than it needs to be.



## Smoky Bridge Cave Carter Caves State Resort Park, Kentucky

Caleb Heimlich (WUSS #0539, NSS #55745)

Kevin Kissell (WUSS #0530, NSS #54578)

Smoky Bridge Cave is located in Carter Caves State Resort Park in Carter County, Kentucky. It is also a feature of Smoky Bridge Arch from which it derives its name. Smoky Bridge Arch is a spectacular natural arch approximately 18 meters wide, 20 meters long and 27 meters high. The arch is formed in the Ste Genevieve limestone and

Smoky Bridge Cave is formed in the middle of this highly cross-bedded layer of Mississippian bedrock.

Like many caves in Carter Caves State Resort Park, Smoky Bridge Cave has relatively little vertical or horizontal development. Total surveyed length is 57.3 meters and the ceiling height varies from 0.3 meters to 2.5 meters tall. The cave has an entrance outside the natural arch as well as a sizeable opening into the arch itself. The park service has added a stone wall to the outside entrance which is indicated on the survey. After a crawl through a small breached hole in the wall, there is a sandy floor which slopes slightly downward



**Figure 1** (top): The original entrance to the cave was mortared up years ago leaving a small belly crawl entrance. Photo by K. M. Kissell.

**Figure 2** (right): Upon entering the cave, you are greeted with a view that overlooks the inside of Smoky Arch. The icicles are a typical sight in February. Photo by K. M. Kissell.



# SMOKY BRIDGE CAVE

CARTER CAVES STATE RESORT PARK  
CARTER COUNTY, KENTUCKY

A Suunto and Leica Disto survey by:

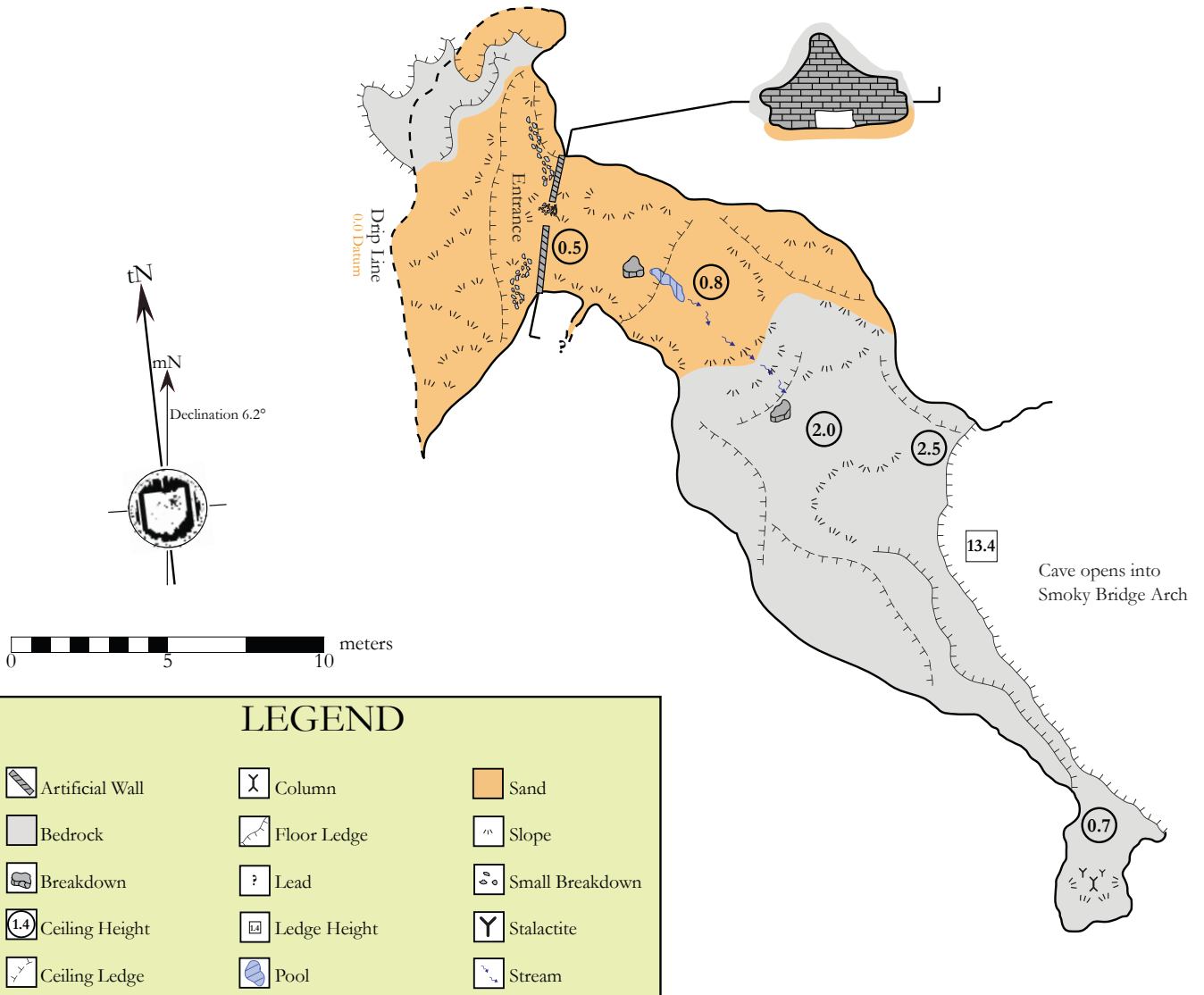
Caleb Heimlich & Kevin Kissell

4 February 2007

Total Surveyed Length - 57.3 meters

Total Vertical Extent - 0.8 meters

Cartography by Kevin Kissell  
In Cave survey program - Auriga ([www.speleo.qc.ca/auriga](http://www.speleo.qc.ca/auriga))  
Data processing - Compass for Windows ([www.fountainware.com/compass](http://www.fountainware.com/compass))  
Illustration software - Adobe Illustrator CS 3



Wittenberg University Speleological Society



**Figure 3 (left):** Here Caleb Heimlich can be seen around the corner in a small alcove that requires a hairy traverse. Photo by K. M. Kissell.

**Figure 4 (below):** Caleb Heimlich poses in the small alcove; behind him the cave floor drops more than 13 meters to the floor of the arch. Photo by K. M. Kissell.

toward the opening into Smoky Bridge Arch. The opening into the Arch occurs approximately 13 meters above the floor of the arch and is a rather sheer drop. A short belayed scramble along the edge of the opening to the arch arrives at the end of the cave in a small nook with a few dry speleothems. The most striking feature of Smoky Bridge Cave is the wonderful view into the natural arch.



**...IT'S CALLED COLLEGE!**

# Blackbeard Cave

## Carter Caves State Resort Park, Kentucky

Kevin Kissell (WUSS #0530, NSS #54578)  
 Kate Ferguson (WUSS #0544, NSS #56925)  
 Holly Kellar (WUSS #0553, NSS #58851)

Horton Hobbs III (WUSS #0001, NSS #12386  
 HM, CM, FE)  
 Bill Stitzel (WUSS #0132, NSS #27643 FE)



*Figure 1: Kate Ferguson takes the first shot into Blackbeard Cave. Photo by K. M. Kissell.*

Blackbeard Cave is a small limestone cave north of Smoky Lake and west of the Lewis Caveland Lodge. The cave is situated on the southwest slope of a small valley along the Red Trail; this valley also contains the Smoky Bridge Arch. Impossible Cave, Bio Cave, and Skylight Cave are located in the same valley, though on the opposite side from Blackbeard Cave. The cave is fairly short and horizontal with a total length of 21.1 meters and a total vertical extent of 2.2 meters.

Blackbeard Cave consists of a single main passage that trends from south to north. After roughly four meters the main passage leads to the only intersection in the cave. To the west is a small dome room; to the east is a stream passage that is not big enough for human travel. The ceiling height varies between 0.3 meters and 3.0 meters tall. The lowest ceiling height occurs in the entrance where a hands and knees crawl is necessary to enter the cave. The tallest point in the

# BLACKBEARD CAVE

## CARTER CAVES STATE RESORT PARK

### CARTER COUNTY, KENTUCKY



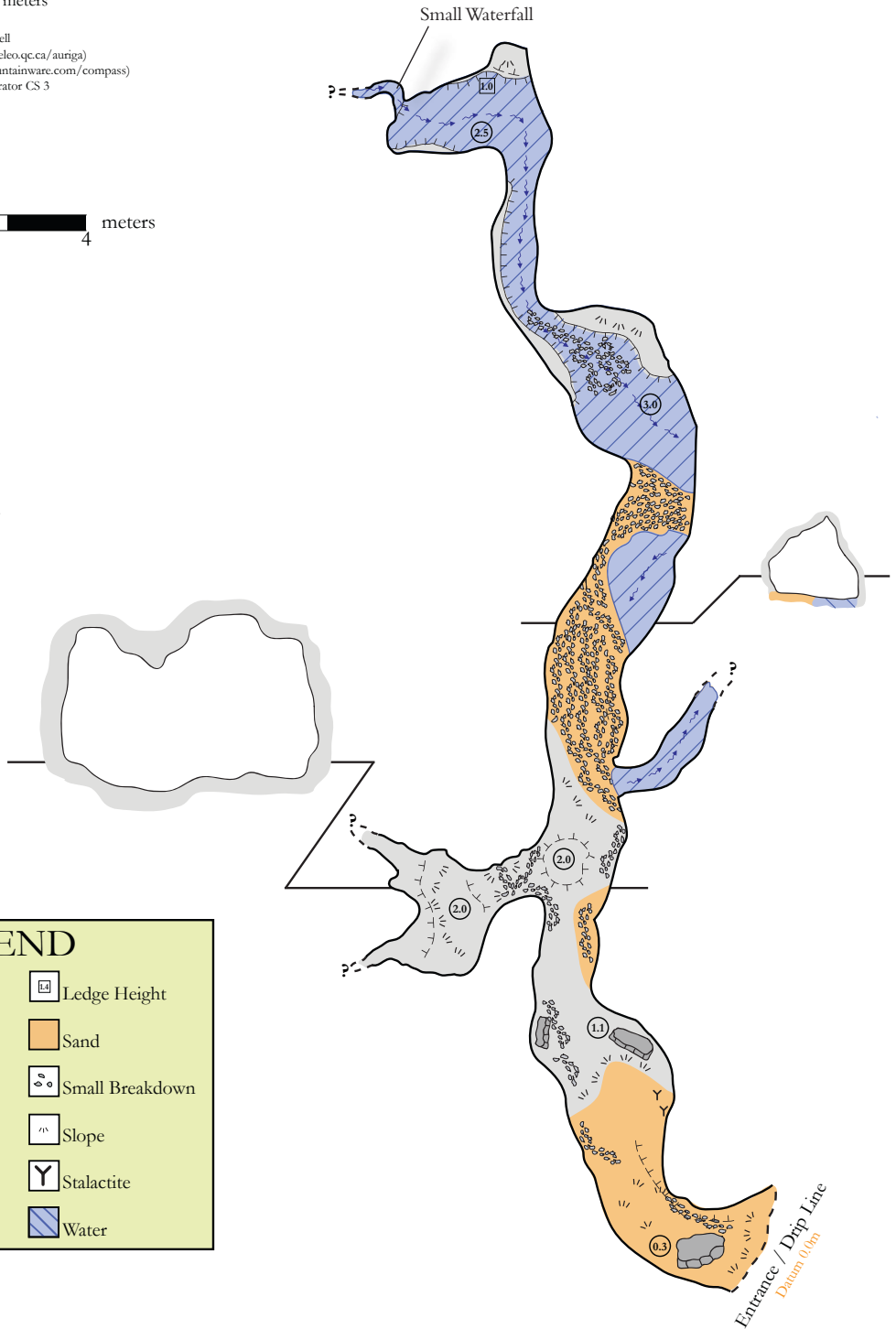
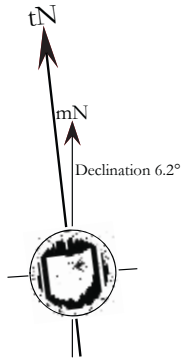
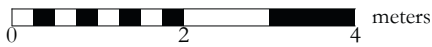
A Suunto and Leica Disto survey by:

Kate Ferguson, Horton Hobbs III, Holly Kellar, Kevin Kissell, & Bill Stitzel

4 January 2008

Total Surveyed Length - 21.1 meters  
Total Vertical Extent - 2.2 meters

Cartography by Kevin Kissell  
In Cave survey program - Auriga ([www.speleo.qc.ca/auriga](http://www.speleo.qc.ca/auriga))  
Data processing - Compass for Windows ([www.fountainware.com/compass](http://www.fountainware.com/compass))  
Illustration software - Adobe Illustrator CS 3



LEGEND	
Bedrock	Ledge Height
Breakdown	Sand
Ceiling Height	Small Breakdown
Ceiling Ledge	Slope
Floor Ledge	Stalactite
Lead	Water



**Figure 2:** Holly Kellar sketches the passage leading into a small dome room. Photo by K. M. Kissell.

cave is at roughly 10 meters where a stream dominates the passage. This stream is shallow, never rising higher than the surveyors “Wellies” and flows towards the southeast. The stream originates at the cave’s terminus, a small passage that is not big enough for human travel, and reappears a number of times throughout the cave before disappearing down another passage that is not large enough for cavers. The cave floor consists mostly of wet mud/gravel except around the intersection where bedrock is present. No critters were seen during the survey; this may be due to high water levels under heavy rain conditions. The cave has no obvious signs of visitation by humans and, even though it is fairly close to the Red Trail, it is rather well hidden by fallen trees and vegetative debris.



**Figure 3:** Holly Kellar washes her hands in the small stream waterfall in the very back of the cave. Photo by K. M. Kissell.

## Logan County Sinkholes Available to WUSS for Research and Clean Ups

Polly Bargar (WUSS #0555)

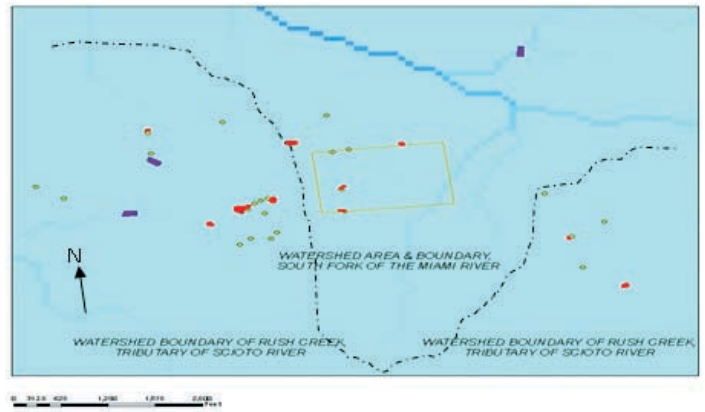
### Introduction

Several years ago, an environmentally conscious landowner contacted WUSS regarding his property and its cave - sinkhole potential. It was discussed at a meeting and two members set off to check out the site. Initial inspections revealed sinkholes, with one or more exhibiting noticeable air flow. Anticipating (or hopeful) of future use of the site, since the owners wanted to see the site cleaned up and used for research, the landowner installed a gravel parking lot suitable for three or four vehicles. Little occurred in the ensuing months. Then, in 2005, interest in the area was revived through a commuter student who had recently become a WUSS member and lived within easy driving distance of the site. Contact with the landowners was renewed, the site was more thoroughly investigated, and the initial results are as follow.

### Description

The 17.7 hectare farm field is located in the northeast section of Ohio's Bellefontaine Outlier. ODNR describes the Outlier as "an erosional resistant "island" of Devonian carbonates capped by Ohio Shale and surrounded by a "sea" of Silurian strata (see Hobbs 1990). Though completely glaciated, the Outlier was such an impediment to Ice Age glaciers that it repeatedly separated advancing sheets into two glacial lobes - the Miami Lobe on the west and the Scioto Lobe on the east. Most Ohioans recognize the Outlier as the location of Campbell Hill - the highest point in the state at an elevation of 472 meters above mean sea level." ([www.dnr.state.oh.us/Portals/0/publications/water/pdfs/karstmapback.pdf](http://www.dnr.state.oh.us/Portals/0/publications/water/pdfs/karstmapback.pdf))

The property is also part of Rushcreek Township, Logan County - one of two townships containing the



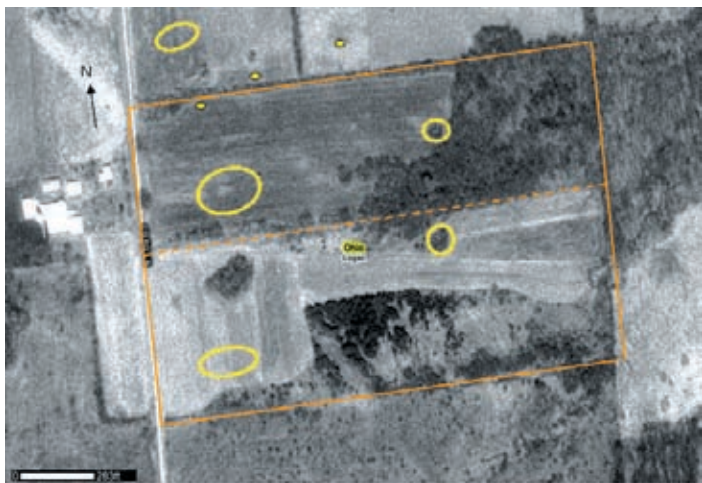
**Figure 1:** GIS generated watershed map; study area outlined in orange.

"greatest sinkhole concentrations, where the density of sinkholes in some areas approaches 30 per square mile. Sinkholes here typically occur in upland areas of Devonian Lucas Dolomite or Columbus Limestone that are 9 to 15 meters or more above surrounding drainage and are covered by less than 6 meters of glacial drift and/or Ohio Shale." ([www.dnr.state.oh.us/Portals/0/publications/water/pdfs/karstmapback.pdf](http://www.dnr.state.oh.us/Portals/0/publications/water/pdfs/karstmapback.pdf))

A closer examination finds the 17.7 hectares on the eastern slope of a rolling area that divides the Scioto and South Fork of the Miami River watersheds (Figure 1). Yellow dots mark sinkholes recorded by the Division of Geological Survey, red areas indicate depressions found on quadrangle maps, and purple blocks indicate depression modeled through ArcGIS. Actual property boundaries are best estimates since this acreage is in the northernmost section of Virginia Military District lands; the property markers include wood posts, stones, iron pipes, and an iron marker.

### Detail

The land is divided into two fields (Figure 2), with



**Figure 2:** Aerial photo of study area outlined in orange. Areas circled in yellow indicate sink activity.

tillable acreage in hay production and the remaining area covered in deciduous and conifer woodlots. The sinkhole farthest south on the property shows the most promise for further subterranean passage, but is filled with rolls of barbed wire fence buried under years of organic material. In some areas, the base of the sink seems flimsy and spongy, but this may be a result of more rolls of barbed wire.

Three sinks are thoroughly choked with trash and organic debris, so any subsurface passage or airflow is unknown. A fifth sinkhole has developed, but thus far has remained small and is developing extremely slowly. All sinks do drain, albeit slowly. Neighboring sinks, indicated in yellow, are the fastest developing and exhibit steep funnel shapes.

In an informal interview on-site in 2005, the landowner (now very hard of hearing) recalled spending many times playing with his friend in the entrance of the largest and oldest sinkhole. On one occasion, they brought along his dog, which chased off after some animal or a scent and became lost in passage for some time. He recalled only one sinkhole at that time and noted (now, with regret) that in his later years the family, and likely others, used it as a local dump (a copy of the property description indicated that the current landowners acquired the acreage in 1945). At

the end of the tour of the grounds given by his son, the landowner remarked strongly that he would like to see the sink “cleaned up somehow” and used for educational purposes.

The landowner declined to walk with us for the overland tour, citing his health, and waited in the jeep while his son showed me the sinkholes and the woods and pointed out property lines. He noted that the sink farthest from the road was again being used illegally as a trash burning and dump site (apparently this activity had been halted temporarily by one of the locals). While exploring the eastern side of the north field we came across a fifth sinkhole. No evidence of subsidence was found in the deciduous woodlot. Although the southern conifer lot was not thoroughly inspected, a cursory view showed no activity.

## Discussion

When the landowner mentions the words, “cleaned up somehow,” he indeed understands it will not be an easy task. Sink number one shows landfill items of a certain age and patina. Shoes and metal parts seem to be a recurring theme. Sink two appears to be strictly barbed wire. Sink three is a trash burning site used by neighbors and sink five is primarily a building materials dump, with some household items thrown in. Sink four is a newly developed location, less than ten years as estimated by the landowner. The smallest of the five depressions, it is a bowl shape at nearly eight meters in diameter with a one meter spherical surface entrance. At no time during visits to the site in 2007–2008 did the entrance exhibit air movement or temperature gradient. Currently, the sink is not suitable for humans; immediately under the surface the passage turns 90 degrees and shrinks to burrow-size. Several deciduous understory trees have sprouted among relic burrows scattered along the rim, while the floor remains largely free of thorny vegetation. This depression will be monitored as it develops.

Considering the extensive smattering of sinks across the township, it is unlikely that the dumping seen on this property is unique.



**Figure 3:** The oldest sink ringed by mature trees, this depression is 16 meters N-S by 66 meters E-W. This view, looking SE, is taken standing at the western end of the fence row that divides the two fields. Photo by P. Bargar.

The landowners are most certainly interested in a cleanup, although how it would be afforded is unknown, since disposal will be costly due to the sheer volume and require several removal stages. This summer and fall, questions were raised regarding

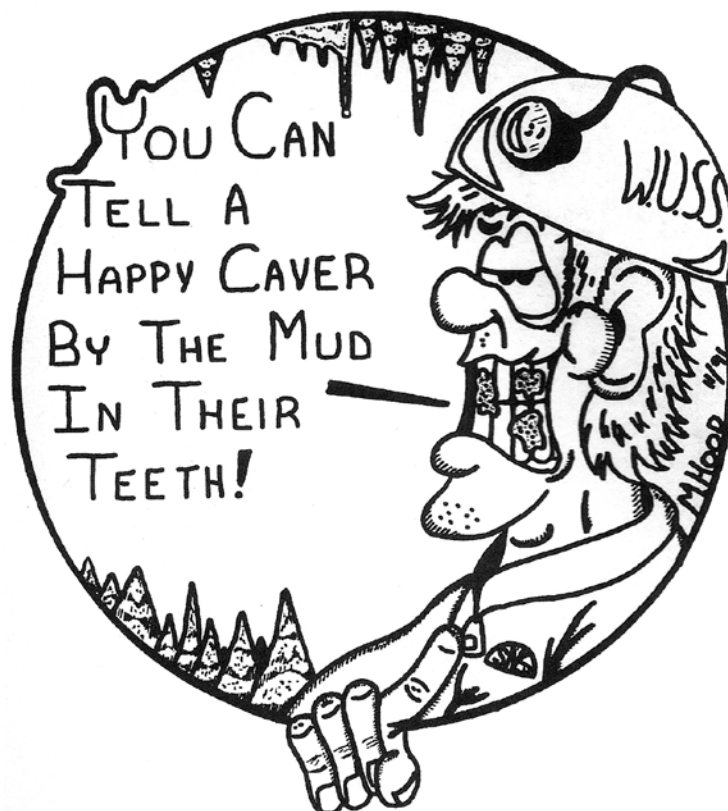
nominating the location for an Ohio Valley Regional cleanup site. At this point, it is unknown if the site will be chosen. Since subsurface drainage is also unknown and may possibly affect the Miami River, the Scioto River or both, perhaps funding from other sources could be found. Even if no funding is located, knowing that the site is available for study to WUSS could lead to several short or long term projects.

### Note

The landowners names and addresses have been withheld from publication for privacy reasons. The aerial photograph was provided by LIDAR through Wittenberg University.

### References

Hobbs, H. H. III. 1990. Zane Caverns: an island within an ellipse. *Pholeos*, 10(1):3-10, map.



# 15<sup>th</sup> International Congress of Speleology and 2009 NSS Convention

George Veni (NSS #17322) and Andrew Eavis (NSS #43156)



The International Congress of Speleology (ICS) is the world's premier speleological event. An event of the International Union of Speleology, it is held once every four years in a location selected by the delegates of the UIS member nations. The next ICS will be held in Kerrville, Texas, USA on 19–26 July 2009. An estimated 2,000 people from nearly 60 countries are expected to attend to share the results of their latest exploration, research, and techniques.

The National Speleological Society (NSS) of the United States will host the ICS in combination with its annual convention for a truly spectacular affair. All of the usual ICS and NSS events will occur in 2009, as well as some new ones. Here is a summary of what to expect:

- Beautiful university venue with camping and air conditioned

apartments and dormitories

- Free shuttle bus to nearby hotels
- A full week of activities for registered children ages 7–17
- 1,000 m<sup>2</sup> of air conditioned indoor space for vendors and exhibitors (outdoor space available too!)
- Papers on the latest discoveries in cave science and exploration (abstracts due 1 December 2008; papers due 1 February 2009)
- 15 special technical symposia
- Workshops, classes, organizational meetings
- 10 different competitions in cave arts and music
- SpeleOlympic athletic competitions
- Caving day trips: simple, difficult, wet dry, horizontal vertical—something for everyone
- Family day trips: shopping, tourist sites, hiking, amusement parks
- 12 pre-ICS excursions and field camps, nine post-ICS excursions and

field camps, and 20 “Wednesday” (day off from sessions) trips on all aspects of speleology

- Three delicious banquets
- Evening activities: bat-watching, show cave tours, auction, music, dancing

The ICS 2<sup>nd</sup> Circular is posted on the website. Use it as a guide and then look at the website for complete details: <http://www.ics2009.us>. Don't forget to watch the 15-minute video on the website to see Kerrville and more of what the 15<sup>th</sup> ICS has to offer. If you still have questions, please contact us at: 15<sup>th</sup> ICS, P.O. Box 691965, San Antonio, Texas 78269 USA, 001-413-383-2276 (fax), [secretary@ics2009.us](mailto:secretary@ics2009.us) [secretary@ics2009.us](mailto:secretary@ics2009.us) or [johnmoses@excite.com](mailto:johnmoses@excite.com)” [johnmoses@excite.com](mailto:johnmoses@excite.com).

## Dirty Dave's Long Kneepads

Kevin Kissell (WUSS #0530, NSS #54578)

If there is one piece of gear no caver, at least no Kentucky caver, can take for granted, it's his/her kneepads. Kneepads are essential to a cheery caving trip, especially since many of the caves visited by WUSS are fairly low in height and require a good deal of hands and knees crawling. Kneepads afford a variety of functions while underground, including protection of the knees and possible shins, providing a no slip surface for climbing, increasing stability while walking, and even supplying a comfy pad for sitting on cold, wet rocks during long survey trips. With all these uses, it is no wonder why we cavers take our kneepads very seriously. Kneepads come in a variety of shapes, sizes, and costs ranging from inexpensive, "volleyball" and "rollerblading" styles to sixty dollar, caver designed, full knee and shin covering models. Now I am not here to debate which manufacturer is best nor which model is the one you should buy; these are questions you yourself should test and answer. Rather, I simply want to offer you the humble opinion and experience of a caver who spends the majority of his weekends on his hands and knees and enjoys it!

Like so many other first time cavers, my first kneepads were of the "volleyball" variety. They were thick, bulky, and after a few minutes, were cutting off circulation in my legs. In short, they were rubbish! It was soon after that I learned of the, then popular, kneepads known simply as "Bombers." With this new



**Figure 1:** *The Dirty Dave's Long Knee Pads come in three different sizes and a few colors including red and black.*

found knowledge I purchased a pair and lived in total crawling happiness. Bomber Gear, the company responsible for "Bombers" specialized in making equipment for kayakers and other extreme water sports; this was both good and bad. What made the "Bombers" so absolutely fantastic was the high impact foam that covered from above the knee all the way down to the ankle, coupled with the three strap closure. They were extremely comfortable to wear and crawl on, but since they were not designed for cavers they were not indestructible. In their original form, they lasted two years. Sometime during that two year period, Bomber Gear stopped selling the kneepads, disappointing the entire caving community. Like so many other cavers, I scrambled to find a new pair or a suitable replacement for my beloved "Bombers". Alas after three long years I may have actually found something just as good, if not better.

Long crawls can be punishing on your knees and shins; happily the gear manufacturers have heard our cries of pain. There are now a couple of manufacturers making the long variety of knee pads that were popularized by Bomber Gear. However due to the high demand from cavers, the relatively small supply, and the customized requirements of cavers, these knee pads are fairly expensive. The cheapest of the three readily available is the Gonzo Guano Gear Behemoth Knee Armor, which retails for about \$40, while the most expensive is the, new to the market, Crawladdies at \$60. How-



**Figure 2:** Here you can see the placement of the long knee pad as well as the three straps used to secure it to your leg.  
Photo by K. M. Kissell.



**Figure 3:** A close up of the strap and loop closure which does a great job of holding the pad in place on your leg.  
Photo by K. M. Kissell.



**Figure 4:** A size comparison photo of the Bomber Gear knee pads (green) and the newer Dirty Dave's (black). The "Bombers" have recently been refinished with new fabric yet I still choose the Dirty Dave's as my knee pads of choice. Photo by K. M. Kissell.

ever, for my replacement "Bombers" I chose the Dirty Dave's Long Knee Pads, which sell for \$50; now let me tell you why.

The Dirty Dave's pads will be very familiar to any former "Bombers" owners. The basic size, shape, and thickness is the same, as well as the three straps used to secure them to your legs. However, the closure system and strap construction varies. Instead of an elastic strap like that of the Bomber Gear variety, the Dirty Dave's use a non elastic piece of nylon fabric with Velcro on one side. To secure the pads you simply pass the strap through a loop on the other side of the pad and double it back onto itself. While this method does not have the double Velcro closure of the "Bombers," it does seem to work very well. In the two years I have caved with the Dirty Dave's pads I have yet to have an instance where the Velcro has come undone. Since the strap is not elastic, it makes the pads infinitely adjustable, meaning that you can tighten the pads as needed. This is helpful on long crawls when pads tend to loosen up and in preventing pads from sliding around and off your knee. However, unlike the "Bombers," you cannot remove the actual pad from the fabric, like you would want to for cleaning. The original "Bombers" had a Velcro

closure on top that allowed for pad removal. This is not the case for the Dirty Dave's, although it is very easy to modify them and install the Velcro closure, something that I would highly recommend. The outer material of the Dirty Dave's is quite durable and there do not seem to be as many seams, which is good since a seam constitutes a weak point in the construction. The Dirty Dave's pads come in three sizes, providing availability for a wide range of cavers and the pad inside is made of medical grade foam so crawling on the pads is an absolute joy.

In short, whether you are looking for your first pair of serious knee pads or for a replacement for your demolished "Bombers," the Dirty Dave's Long Knee Pads may be for you. I certainly enjoy the time I spend on my knees in a cave and that is solely thanks to the Dirty Dave's pads. They are durable, maintainable, and function as advertised. I actually like them more than my recently repaired "Bombers" and I find myself choosing my Dirty Dave's over my "Bombers" every time. While the Dirty Dave's Long Knee Pads will cause your wallet to decrease faintly in weight, your knees and shins will thank you in the long run, oops-I mean long crawl!

## Princeton Tec Pilot LED

Kevin Kissell (WUSS #0530, NSS #54578)



*Figure 1: The Pilot is shown here with the light unit and its headlamp strap attachment. With a simple twist the two components can either separate or join.*

In caving, the headlamp is king and all good covers carry multiple light sources underground. Of course, the downside of carrying multiples of anything underground is the increasing weight and bulk of our cave packs. While this is no excuse not to carry multiple sources of light it does provide reason for looking for a lighter weight option. This is where the Princeton Tec Pilot LED light really shines, no pun intended. Now before I continue, let me make one thing perfectly clear; these little lights SHOULD NOT be used as a primary light source while caving—they are simply not robust enough to survive a caving trip alone. Rather these lights make a great backup light source for your primary headlamp.

The Princeton Tec Pilot LED functions perfectly as a backup accessory light that is compatible with most headlamp straps. If you own a headlamp with wires connecting to rear or remote battery packs, you can replace the standard wire clip by using the Pilot's

built-in wire holder. Weighing in at only 15 grams with batteries, the system will keep your load light. The Pilot can be easily detached from its clip base for use as a handheld light or as a marking light set on the blinking/signaling mode. The light itself consists of one Ultrabright LED that can throw out its two lumens over eight meters away. Its single push button switch operates the lights in one of two modes: constant and flash. While the constant mode will provide light for 15 hours the flash mode will double that on a standard set of two CR 2016 Lithium Coin Cell batteries.

The Pilot has proven useful in a number of situations, from swapping your primary light's batteries to marking a survey station. In fact, many of us at WUSS keep three of these little lights on our helmets at all times. They make great survey station markers when sighting a compass or clinometer and can even be used to mark passages in a maze. The Pilot comes in three convenient colors: red, green, and white; all three have



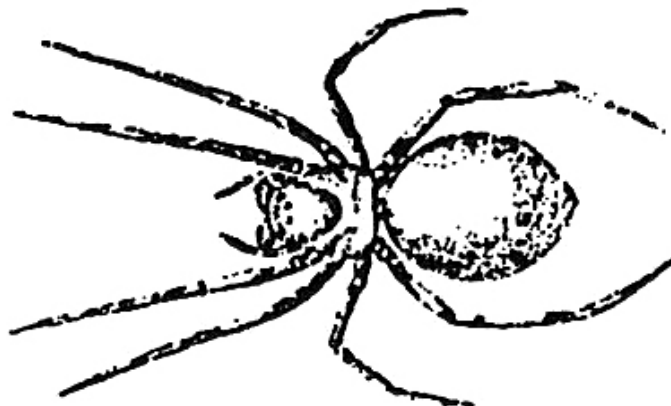
**Figure 2:** Here the author's helmet can be seen with his primary light source and three of the Pilot lights. This is easily one of the lightest and most redundant helmet configurations. Photo by K. M. Kissell.



**Figure 3:** A size comparison photo of the Pilot, a U.S. quarter, and another favorite caver's backup, the Petzl Tikka Plus. With the weight of one Tikka, a caver could carry five Princeton Tec Pilots! Photo by K. M. Kissell.

the same specifications. The lights are durable but not waterproof. In fact, after a complete helmet submersion the lights have a tendency to stay in the on position until the battery is depleted, but I guess this is better than not coming on at all! And the best feature of the light, they can typically be found for around eight dollars so buying countless will not break the bank!

All in all, the Princeton Tec Pilot LED makes a weightless and welcome addition to any caver's helmet. They are so light that you will not know they are there until you need a backup light source and then they are worth their weight in gold.



# Want to own a piece of WUSS history?

**For a limited time only you can purchase an authentic WUSS T-Shirt!**

**We only have a few left so order now! All shirts are only \$10.00, sizes vary. Window clings are only \$3.00.**

This, grey with red lettering, T-shirt will surely bring back fond memories of college with the inscription "There's a time and a place for caving . . . its called college!" centered around a caving tiger. The classic WUSS seal is on the front left breast.



The classic Wittenberg logo, a cave cricket, and salamander adorn the back of this heather grey T-shirt that commemorates WUSS's twentieth anniversary. The front left breast features the WUSS seal and "Twentieth Anniversary Celebration" in black print.

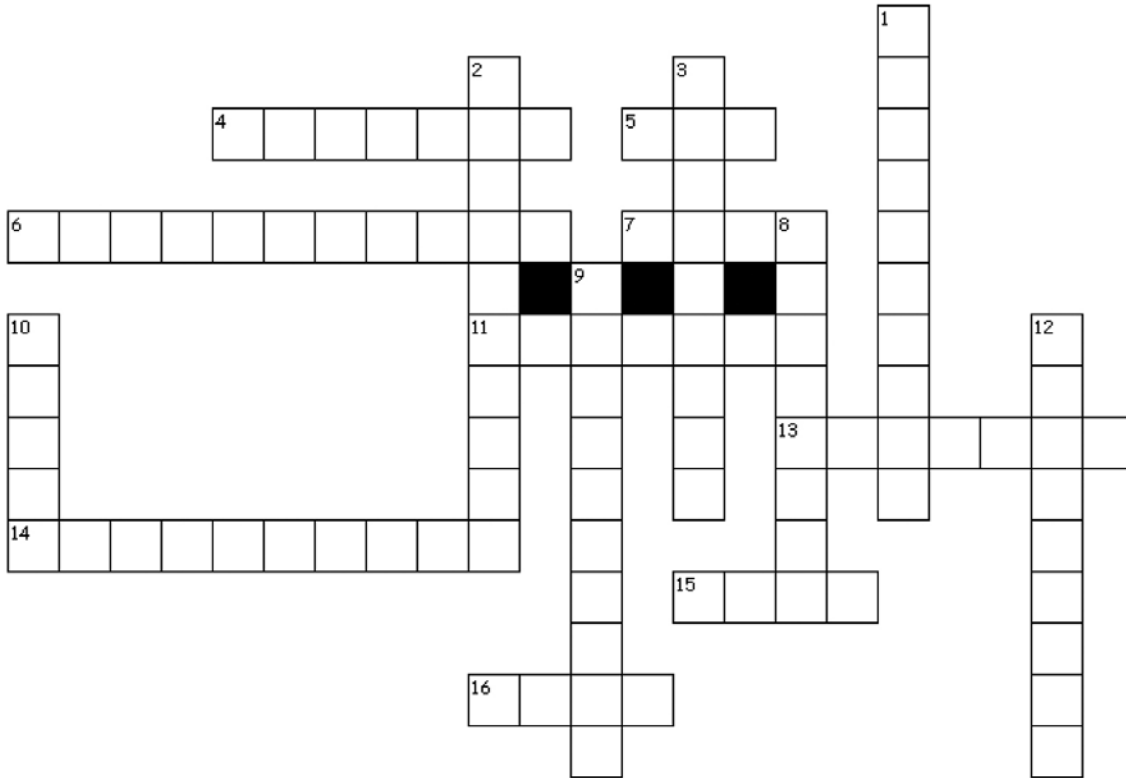


This starburst tie-dye T-shirt remembers WUSS's twenty-fifth anniversary with a drawing by former president, Michele Maxson. On the front, the WUSS seal is surrounded by the words "25<sup>th</sup> Anniversary Celebration."



This window cling makes a perfect addition to any vehicle! The words "Guano Breakfast of Champions" and the outline of a bat clearly identify you as a caver!

For more information please send an email to [wuss@wittenberg.edu](mailto:wuss@wittenberg.edu) or call (937) 327-6484.



## Caver's Crossword

Kevin Kissell (WUSS #0530, NSS #54578)  
and Linda Oxenrider (WUSS #0535, NSS #59861)

### Across

4. Longest cave system in the world.
5. Premiere US vertical caving local.
6. Highly decorated cave in New Mexico.
7. Descending device for long drops.
11. An explosive light source.
13. Publication of WUSS.
14. Formation that "grows up from the ground."
15. Wittenberg University Speleological Society abbvr.
16. Preferred climbing system of Kermit.

### Down

1. Type of competition during caver events.
2. Formation that holds "tight to the ceiling."
3. Comes in locking and non-locking
8. Leg protectors.
9. Annual January caving event at Carter.
10. Host state of 2009 NSS Convention.
12. Who a caver rescues.

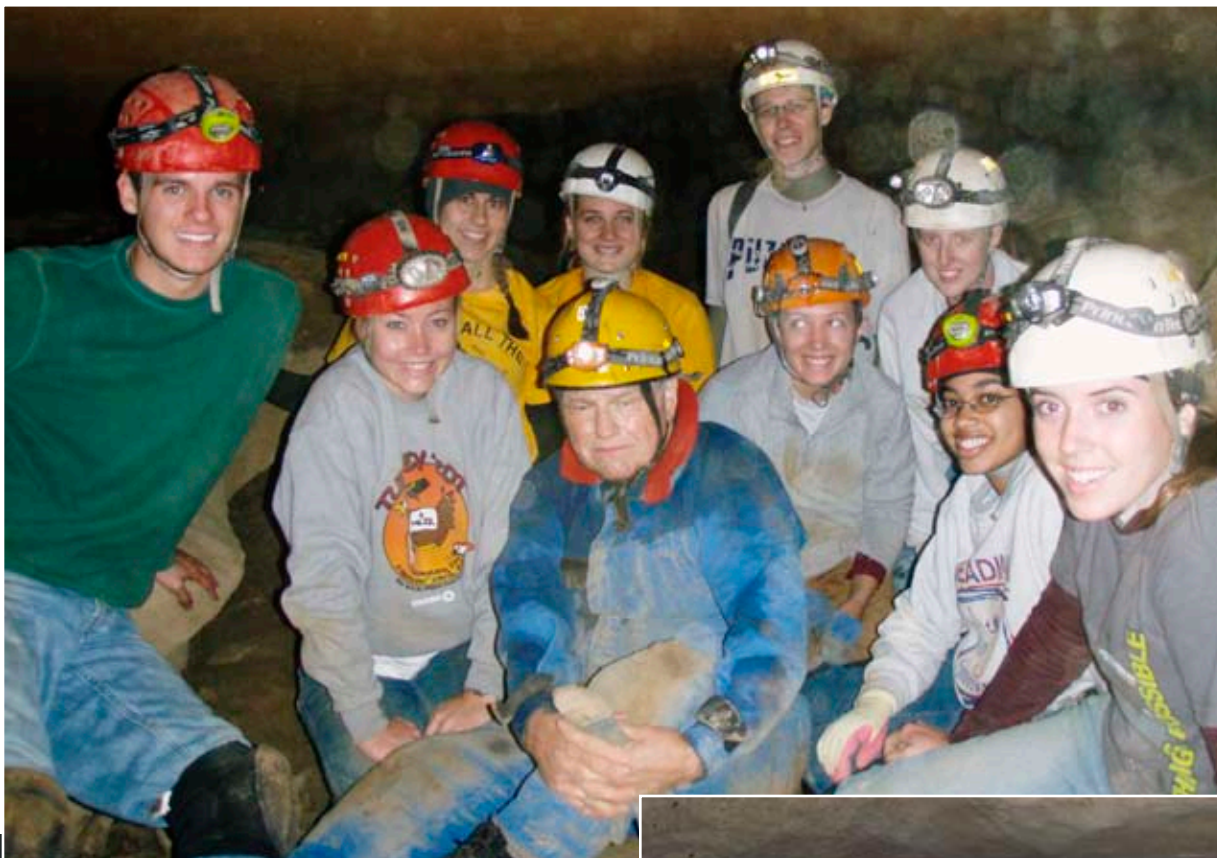
1. Squeezbox 2. Stalactite 3. Carabiner 4. Mammoth 5. TAG 6. Lechnugilla 7. Rack 8. Kneepads  
9. Crawllathon 10. Texas 11. Carbide 12. Spelunker 13. Phloes 14. Stalagmite 15. WUSS 16. Frog

**Key**

# GALLERY

*Photos contributed by Horton H. Hobbs III, Kevin M. Kissell, Bill Stitzel, Erin Hazelton and George Hagen*

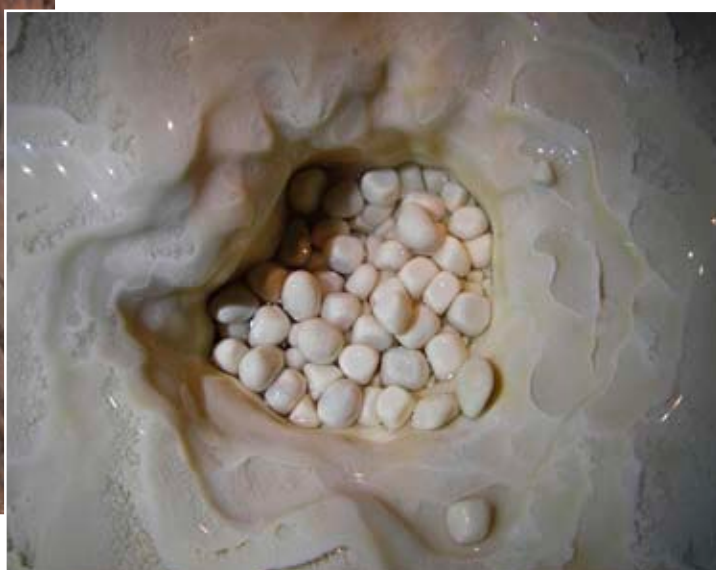




# GALLERY

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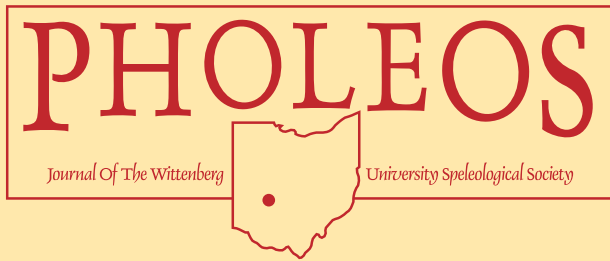


# GALLERY

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# INFORMATION FOR CONTRIBUTORS



**EDITORIAL POLICY:** Manuscripts treating basic research in any aspect of speleology will be considered for publication. They must not have been previously published, accepted for publications, or be under consideration elsewhere.

All manuscripts are to be in English. Metric and Celsius units must be used, and SI units are preferred. The CBE Style Manual, the Handbook for Authors of Papers of the American Chemical Society, and Webster's Ninth Collegiate Dictionary are useful guides for matters of form and spelling.

The original of the manuscript must be typed double-spaced on one side of white bond paper approximately 8.5 x 11 inches, leaving margins of one inch. Use triple-space above headings.

The most effective way to submit a manuscript is as an attachment to an e-mail message sent to the editor. A second approach is to submit three (3) hard copies of the manuscript, figures, and tables along with a CD-ROM of the manuscript, figures, and tables in separate files.

Number pages consecutively at the top right-hand corner. Underline scientific names of genera and lower categories. Acknowledgments should be on a separate, double-spaced page. Each figure and table must be referred to in the text. Text references are by author, followed by year of publication.

The sequence of material in the manuscript should be as follows.

1. The *title* page should include the title, author's name, affiliation, WUSS and NSS membership number, and mailing address.
2. The *abstract* should not exceed one double-spaced page. It should contain a summary of significant findings and note the implications of these findings.

3. The *introduction*.
4. *Methods and materials*.
5. *Results*.
6. *Discussion*.
7. *Literature Cited*. List all publications referred to in the manuscript alphabetically by first author on a separate sheet of paper (double-spaced). Each citation must be complete, according to the following examples:

**Journal Article:**

Peck, S.B. 1974. The food of the salamanders *Eurycea lucifuga* and *Plethodon glutinosus* in caves. NSS Bulletin, 36(4): 7-10.

**Book:**

Moore, G. W., and N. Sullivan. 1997. Speleology: Caves and the cave environment. St. Louis, Missouri: Cave Books.

**Chapter:**

Hobbs, H.H. 1992. Caves and springs. *IN*, C.T. Hackney, S.M. Adams, and W.A. Martin (eds.), Biodiversity of Southeastern United States/Aquatic Communities. John Wiley & Sons, pp. 59-131.

8. *Figures and Tables* should be self-explanatory, with captions of tables placed above and those for figures situated beneath. Each table and figure should start on a separate sheet. Headings and format should be consistent. Originals for all figures and tables should be submitted with the manuscript or, if in electronic form, should have a minimum resolution of 300 dpi.

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The proud WUSSes pose next to their beloved *NSS OTRRR* during the annual Doo-Dah Parade at OTR 2008. See article on Page 5. Photo by K. M. Kissell.



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