PHOLEOS

Journal Of The Wittenberg University Speleological Society

Volume 20 (1, 2)

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PHOLEOS

Pholeos 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://www4.wittenberg.edu/student_organizations /wuss/

Subscription rates are $7 a year for two issues of *Pholeos*. Back issues are available at $3.50 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 $20 a year and comes with a subscription to *Pholeos*. Life membership is $100.

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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CO-EDITOR'S NOTE

Welcome to another issue of *Pholeos*. Wittenberg's Speleological Society has compiled an interesting variety of literature and photos. The caving club has had an active season pursuing the ongoing surveys of caves in Carter County, Kentucky. Several trips to Carter Caves State Resort Park successfully completed the survey of Old Homestead Affluent Cave and started the project of surveying Cascade Cave.

I would like to thank all those who contributed their work to this issue of *Pholeos* and give special thanks to Carol Kneisley and Horton Hobbs III for their help in preparing this issue for publication.

Sara O'Donnell
WUSS #0473
NSS #48842

Stevens Gap, AL

FRONT COVER: A collage of W.U.S.S. activities over the past few years.

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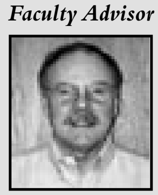

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PRESIDENT'S MESSAGE

I hope that as you read this edition of *Pholeos* you recognize it as the connection between the current expeditions and new members of the Wittenberg University Speleological Society (WUSS) with the incredible base of past members and their experiences. The growth and development of WUSS continues to be catalogued in the scientific articles, pictures, maps, and personal stories presented in this journal. I see *Pholeos* as a tribute to past, present, and future members and accomplishments of WUSS.

WUSS members were busy during the summer and became even busier once the fall semester began. Some of our members were involved with educating campers about caves and safely providing them with caving adventures, others spent the summer working on cave related research or brainstorming about future cave research. Our adviser, Dr. Hobbs, spent his summer caving and teaching others about caves and cave organisms. He even managed to make a trip to Australia to experience caving 'down under.' (My apologies for the awful pun). Our school year began with the traditional recruitment of new students for the club and the Officers Training Retreat (a.k.a., Old Timers' Reunion). Student and local members of WUSS spent a weekend providing some logistical and, more importantly, psychological support for Dr. Hobbs' Cave Ecology class. And of course, we spent two weekends training our newest members in safe and ecologically friendly caving.

Summer research projects continued and grew, and the summer brainstorming sprouted new projects. Several more trips followed, some strictly for fun and others with more productive goals. WUSS continues its desire to survey and map every cave possible; and we thank Carter Caves State Resort Park, KY for the surveying opportunities they provide. Conservation is a important function of WUSS and we gave our support by participating in the American Cave Conservation Association's annual cleanup. Club trips this year have taken us to Indiana, many parts of Kentucky, and Ohio. The list of accomplishments and adventures of the club grows daily, something I hope impresses and awes you as much as it does me.

Since I began caving my first year at Wittenberg, I have learned incredible amounts, and been provided many opportunities because of the work and community of WUSS. I see the continual development of other members of WUSS whenever we are together. Who could ask more of a grotto? Thank you for your participation in WUSS, and keep your eyes out for the contributions of other WUSSes!

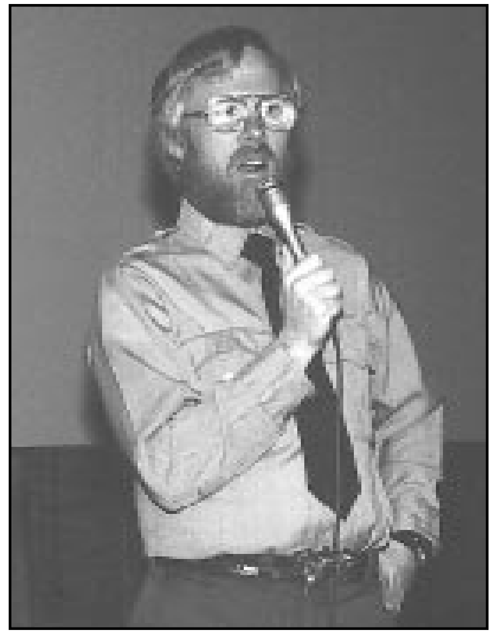
Matthew Hazelton, President
WUSS# 0449
NSS# 47187

ACCA cleanup

A TRIBUTE TO JOHN TIERNEY

Park Naturalist, Carter Caves State Resort Park, Carter County, Kentucky

Horton H. Hobbs III WUSS #0001; NSS #12386 HM,CM,FE



Park Naturalist John Tierney "doing his thing" at the1985 Crawlathon.

It was a sunny day during the summer of 1980 that I first met John Tierney over breakfast in the lodge at Carter Caves State Park (it wasn't a Resort back then). Although I had been to the park previously (on a return trip from the rainy1971 NSS Convention in Blacksburg, Virginia), I had not spent much time underground there and in 1980 I was visiting the park again, not to go caving but to collect crayfishes along Tygarts Creek. Knowing that the area had numerous caves, I asked John if those in the park had been surveyed and he replied that many had but that the work was carried out primarily during the 1960's and that they really needed to be resurveyed. I mentioned that the Wittenberg University Speleological Society was a fledgling organization that had been doing most of its caving in southern Ohio and that they were looking for some new cave areas as well as caves to survey. Not knowing anything about the group or me, John was amazingly open to the idea that WUSS would come down to do some work (maybe he looked at us as a group of gung ho suckers!!?). At any rate he did invite us to come to Kentucky and suggested that we tackle Laurel Cave (I guess this was our probationary challenge!). We finally got organized and on a cold weekend in January 1981 two teams headed into the cave and completed the survey (since then, I don't think the group has surveyed a cave of that size as quickly!). As a side note, we used a recently purchased rope as a belay for climbing from the stream to the upper dry level, stashed it behind some breakdown, and surveyed the upper level. Upon completion, we returned to make the climb down and found that our "virgin" rope had been stolen!! What a way to start!!! I don't think I ever told John about that frustrating beginning.

We published the map in Pholeos (Vol. 2, no. 1) and presented a copy of the map showing 1,091 meters (=3,600 feet) of horizontal passages on two levels. I guess John was sufficiently pleased since he suggested that we proceed on to the Saltpetre-Moon Cave system and we really have not stopped doing some kind of work in the park since that cold January weekend spent in Laurel Cave.

Clearly without John's encouragement to us and his keen interests in Carter Caves State Resort Park and Carter County, Kentucky WUSS would not have had such a grand playground to introduce literally hundreds of cavers to over the past 20 years. Of the 72 research articles that have been written by students since WUSS began, twenty-two of them have dealt exclusively with research projects or the descriptions (and maps) of caves in Carter County, Kentucky. The survey grand totals are: 26 caves surveyed and 10,525.9 meters (=34,524.95 feet or 6.54 miles) of total horizontal cave passages surveyed since January 1981. These figures can be increased to 13,783.9 meters (=45,211.19 feet or 8.56 miles) if the Canyon Cave survey data are added (cave survey nearly complete but due to closure by land owner, production of final map is delayed indefinitely). In reality and in practice, these numbers do not reflect the combined efforts of students working in the park over the years. This may seem to be a strange statement but these are the caves in which WUSSes cut their "survey teeth" and, as such, numerous small and occasionally major errors were made. This resulted in multiple resurveys (if I remember correctly, the upper level of Bat Cave was surveyed THREE times!). Additionally, many students have conducted research projects in caves. Most of these have ranged from three month durations to over a year of sampling a single cave or several caves and involved various questions concerning biology, geology, hydrology, meteorology, water quality, etc. Without the enthusiasm, curiosity, direction, and encouragement of John Tierney, these opportunities for students never would have occurred. In addition, all of us have enjoyed the grand winter weekends of John's creation that we dearly look forward to: CRAWLATHON. In spite of deep snow, ice storms, and even 60°F weather, John has organized and continually pulled off one of the great weekend events in organized caving.

On 18 April 2001 I received an e-mail from John that literally knocked me out of my chair. He stated that he was retiring and would do so 01 August 2001. I, like everyone who knows him, was stunned. I could not imagine "Carter Caves" without John. After a few moments of reflection and a few selfish grumblings to myself, I wrote him back and thanked him for all that he had done for me personally and for his insightful, influential, and encouraging role with WUSS. On 29 July, Susan and I drove down to Carter Caves to be a part of his retirement celebration. I knew that John was acquainted with lots of people but I was not prepared to see the masses of friends, family, and cavers that attended. He was cleverly roasted and toasted and numerous individuals had incredibly nice things to say about him. Towards the end of the ceremony I took the opportunity to present John with a plaque from the WUSSes as a token of our appreciation for all that he has done for the group. He was awarded Honorary Member, the only such membership ever presented to anyone by WUSS. He was moved and proudly stated that he "...always wanted to be a WUSS!" The plaque read:

WITTENBERG UNIVERSITY
SPELEOLOGICAL SOCIETY

HONORARY MEMBER
WUSS-HM #01

JOHN TIERNEY

July 29, 2001

FOR ONGOING INTEREST,
ASSISTANCE AND
ENCOURAGEMENT TO WUSS
1980-2001

Thank you, John. Now you have time to smell the roses, or cave mud, or... . . . .!

A great caving trip!

FLOYD COLLINS: The Man, the Media, and the Myth

by Kristen Baughman
WUSS # 0464
NSS # 48494

All ears are tuned to the man sitting on the log across from them with his feet outstretched, waiting for the slow hiss of the fire to die down so that he can begin the story everyone has been waiting to hear — "Floyd Collins: Greatest Caver Who Ever Lived." Some of the caving veterans gathered there might be inclined to call the story by another name — "Floyd Collins: Greatest Lone Cavin' Fool." Fool, that is, to enter by himself a small unstable cave, with far less than today's accepted standard of at least three sources of light. The story goes on to tell of Floyd's tragic misadventure in what became known as Sand Cave, located near Mammoth Cave in Kentucky. His lantern goes out in a tight passage. In his struggles to get it re-lit he dislodges a stone that entraps his foot, and after an eighteen-day attempt to free him, "Floyd Collins: Greatest Caver Who Ever Lived," lived no more.

At the time this story took place in February 1925, the media event that it triggered fascinated its audience, leaving in its wake a legend that has been told and re-told countless times. Many different versions have surfaced over the years, often told in situations not unlike the campfire scene described above. Not yet to be forgotten, this gruesome tale continues to this day to spark the interest of any who have ever imagined what it would be like to be trapped in the dark confines of the underground world of a cave.

The Floyd Collins rescue occurred at the perfect time to take advantage of the rapid expansion seen by the media world of the 1920s. The media coverage of this decade, which reflected the spirited and adventurous lifestyles of this post World War I era, has been labeled "jazz journalism."[1] According to the book *Media in the 20th Century*, the papers of this decade "provided little serious news," focusing more on "human interest stories, murders, crime, natural disasters, train accidents, and sports."[2] New technology also was more readily available to the public with the film industry having come "of age during World War I," and with the advent of radio.[3] In 1920 about 5,000 Americans owned radios, mostly crystal sets; by 1923 three million owned radios.[4] With a disastrous and chaotic atmosphere surrounding it and implications of a dark outcome, the Floyd Collins rescue fit the bill perfectly to become a huge media event at this time.

Floyd Collins, a poor part-time farmer from Edmunson County, Kentucky, who had been in and out of caves since the age of six, was not merely exploring this cave for enjoyment. Rather, it was a business venture intended to boost the family income. Since about the 1880s Kentucky had been embroiled in what has become known as the "Cave Wars," the 1920s seeing the peak of this phenomenon that continued even as late as the 1960s and 1970s.[5] Local cave owners used many tactics to lure tourists away from the famous Mammoth Cave and into their own. The admission price charged to the visitors was putting food on the tables of many families in this region of rocky and rather unfertile soil. The Collins' family owned a cave on their property called Crystal Cave, discovered by Floyd Collins in 1917, through which they led tours as the family business. Being so far from the main road leading to Mammoth Cave, Crystal Cave was just too far away to attract enough visitors to be economically viable as the family's source of income. Intent on finding a new cave closer to the main highway, or perhaps even a new entrance to Mammoth Cave, Collins contracted with Bee Doyle and two other farmers, to search their property and split the profit if any such cave was found. This led Collins to the cave in which he became trapped on Friday, January 30, 1925.[6]

Rescue efforts were started on Saturday morning, after Collins had been in the cave for over twenty-four hours. When Floyd had not returned, Bee Doyle, Ed Estes, and Estes' son set out for the cave in search of Floyd. Being smaller than the other two, Jewell Estes entered the cave and went far enough in to hear Floyd's cries for help. Floyd asked them to send for his brother Homer. Homer, returning from a trip to Louisville, did not arrive at the scene until much later that day. He then stayed by his brother for hours working to clear away mud and rock, so that they might be able to get past Floyd to free the rock which pinned his foot. On Tuesday of the rescue, Homer brought in a harness to place around Floyd's shoulders, which was then attached to a rope with several men on the other end in an attempt to pull him out of the crevice by brute force. Homer recalled Floyd shouting, "It's breaking my back — stop them!"[7] His brother's cries panicked Homer and soon he was pulling against the other men shouting, "Stop you'll kill him!"[8] Obviously, new tactics were needed.

Homer Collins, along with Johnnie Gerald, another experienced local cave hunter, and Skeetz Miller, a cub reporter, were the main figures of the early part of the rescue. They were part of

only a very few people who actually braved the tiny cave passage that would allow them to be face to face with Collins. Others remained at the surface or came only into the larger crawlways at the front of the cave, too large or even too scared to venture in any further. It was discovered afterward that "the food which they were to carry to Floyd was later found lying on ledges all along the passage."[9] A human chain was formed to help haul away rocks and dirt being removed from the cave.
An article later written by Homer Collins says that this chain "as much as anything else contributed to the cave-in."[10]
The cave-in referred to, occurred on Wednesday, blocking the passage leading back to where Floyd lay, and forced alternative methods of extrication to be used. After the cave-in no one would again see Floyd Collins alive.

W. B. "Skeetz" Miller was a young reporter from the *Louisville Courier-Journa*l, one of the first reporters on the scene, and being small enough to get back to Collins, diligently stayed by his side and worked to free him. Miller played a vital role in helping to keep Floyd's spirits up throughout the ordeal, doing such things as stringing electric lights into the cave and hanging a bulb around Collins' neck to warm him. His first report of the rescue published in the *Courier-Journa*l on 3 February started out, "It was my first trip into a cave..."[11] This set the tone for the highly personal account that was to follow over the next two weeks, and would a year later win Skeetz Miller a Pulitzer Prize.

As hundreds of other reporters converged on the scene, the nearby Dixie Hotel in Cave City became their head-quarters.[12] As the rescue was painstakingly slow, reporters desperate for any new information to send back to their home papers wrote stories that went "beyond truth, to speculation, and pure fabrication." These headlined in newspapers all across the U.S. and even appeared in papers across the ocean such as the London *Times*.[13]

The hotel switchboard was constantly busy with reporters making calls back to their home bases. Near the rescue site a fleet of airplanes was on hand to fly stories to the big cities. Among the pilots was a young Charles Lindbergh, who two years later would create a rival media spectacle himself as he made his first solo flight across the Atlantic.[14] False stories, such as the London *Times* report that he was freed but trapped again by debris, and a rumor that it was all a hoax, were abundant during the eighteen-day ordeal. Suggestions on how to free Floyd poured in, showing peoples' confused concepts of what was really going on.[15] As Homer Collins later wrote, "Only those who actually reached Floyd were able to understand the difficulties involved."[16] A "carnival" atmosphere raged above the rescue attempts.[17] As hundreds of spectators gathered, souvenir tents were set up, and paradoxically both liquor and preachers became abundant.

Kentucky Governor William J. Fields, when he heard of the mass confusion going on above ground at the rescue site, sent in the National Guard under the leadership of General Harry Denhart, to keep control. According to Fields, he did so because "At stake are a man's life and a region's tourist interest."[18] The second half of this statement shows clearly just how lucrative the Kentucky cave business had become by the 1920s. Also, due to the public uproar caused by the rumor printed in newspapers all across the United States that the rescue was a hoax, he ordered an official military inquiry, which proved the rumor to be false.

The collapse in the cave passage that had prohibited anyone from reaching Collins led the National Guard to take over and start efforts to sink an alternate shaft to reach Floyd, despite the protests of Homer Collins and Gerald. It was necessary to have Gerald physically removed from the scene, and Homer did not think that sinking the shaft would work without killing Floyd.[19] Henry Carmichel, superintendent and chief engineer of Kentucky Rock and Asphalt Co., who had been appointed in charge of the task by General Denhart, proceeded anyway.
The digging process was painstakingly slow, much more so than expected at less than ten feet a day, and extremely dangerous for all involved. On the eighteenth day of the rescue Floyd was reached, but too late. Floyd's body was left in the passage, for no one was willing to risk their lives in the treacherous shaft just to recover a body. The shaft was closed up with Floyd's body still lying in its rocky tomb.

Not only was the event surrounding the rescue a carnival ride, so too was the course of events that followed. In an effort to raise money to recover Floyd's body for proper burial, Homer toured on vaudeville for several months recounting the tragedy. His father, Lee, also made stage appearances in Louisville. After his body was recovered, Floyd was buried on the family farm right above the family owned Crystal Cave. In 1927 Crystal Cave was sold, and Floyd's body was put in a coffin on display inside (Figure 1). The coffin and tombstone were on display for many years, even enduring a period of being stolen and recovered once again. Floyd's body was eventually taken out and, reaching a final resting place, the man who was "buried five times" was laid to rest in the Mammoth Cave Baptist Church cemetery.[20]

Even years after the event occurred the facts can get so jumbled that it is hard to tell what things are true and what are false. Some of the accounts that have been printed are so bad "that the Collins family has successfully sued the writers and publishers for libel."[21] One of the most famous and widely circulated photos of Floyd, used even as recently in a magazine article as 1998, was not even Floyd, but rather Homer Collins posing in the family's Crystal Cave.[22] Many inaccurate diagrams depicting Floyd's position in the cave were printed in newspapers all across the country, adding to peoples' confused conceptions of how the rescue attempt should have been handled. Amazingly, perhaps the worst of all these diagrams appeared next to Homer Collins' first-hand account of his experience published in 1958, along with the famous misidentified picture. These photos, added most likely by someone on the magazine staff, do bring into question how much of the article was really the voice of Homer Collins and how much of it reflected the thoughts of his co-writer, John Lerhberger. Even in a 1953 magazine story, the rock that held Floyd's foot was reported as six-tons, when the actual rock removed with Floyd's body in 1925 was only twenty-six pounds.[23]

Over the years different people have kept Floyd's memory alive in several ways. Collin's story has been recounted in books, ballads, poems, movies, and even a musical that debuted in 1995. To cavers, he is a lesson that must never be forgotten of just what exactly can go wrong any time they enter a cave. His story appears countless times in books on caving history and safety. In one particular "how to" book on caving the reader is warned that getting lost is not as dangerous when you are with a group, but can be tragic if caving alone, bearing the ominous words, "Never forget — Floyd Collins was a solo caver."[24]

Why did this story gain so much popularity during its day, and, continue even today to pop up now and then and generate interest? Many factors could contribute to this phenomenon. People were held in suspense as to what the outcome was going to be — would the gallant efforts of hundreds be in vain? Then, there is the fact that human beings are often fascinated with stories that do not always have happy endings. Also, the conflicting stories and facts that come into question pose the idea that a very different outcome could have occurred, had various things been handled differently. Miller's last report to the Courier-Journal stated, "It will be my everlasting regret that I could not effect his release, but never will I be weighed down with a personal responsibility for the death of Floyd Collins."[25] This would imply that perhaps others were to blame for the failure of the rescue attempt, as Johnnie Gerald and Homer Collins would agree to their dying days.

A 1931 history of the twenties writes that "it was the tragedy of Floyd Collins, perhaps, which gave the clearest indication up to that time of the unanimity with which the American people could become excited over a quite un-important event if only it were dramatic enough."[26] Perhaps in the grand scheme of things the story of the death of a poor Kentucky cave hunter, tragic though it may have been, is unimportant. The fact remains however that it has yet to fade from memory completely; every now and then a new article is published on it or (as was the case just last year), a new documentary film made on the story. Even those who have never heard the name Floyd Collins are immediately attracted to the story when given even a small amount of background on it, and are curious to hear more. Maybe this is due to human interest in oddities. In any case, had it not been for the media exploitation of the rescue, the name Floyd Collins would not have been known to more than his family and friends in Edmunson County, Kentucky. Raising Floyd's memory, had the media coverage not occurred, might only have led to the words listed as the cause of death on his death certificate, "trapped in cave."[27] The media did get involved, however, and today invoking the name Floyd Collins conjures up images of his epitaph, "Greatest Cave Explorer Ever Known," and the incredible story behind it.

No one will probably ever conclusively decide who, what, or if anyone — God, Mother Nature, the press and spectators, the National Guard, or Floyd himself, take your pick — were responsible for the awful outcome of this story. The questions still remain. Maybe the "grizzled native, drinking orange pop in the filling station" near Horse Cave, Kentucky, had it right when in 1953 he told a journalist for Collier's that, "Floyd Collins ain't dead at all. They done it just to get these here caves in the newspapers. It was just a dummy they took out that sinkhole. Floyd's living on a ranch out in Arizona."[28] Isn't that, after all, the stuff that legends are made of ?

Alexander, Oscar W. 1997. *Media in the Twentieth Century*. San Mateo, CA: Bluewood Books.

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Rarick, Ken. 1999. *The Floyd Collins Story*. Produced and Directed by Dorian Walker. 58 min. Cave City Chamber of Commerce and Peridot Pictures Corp. Videocassette.

NEWSPAPERS:

Collier's
Louisville Courier-Journal
Times (London)

1 Oscar W. Alexander. 1997. *Media in the 20th Century* (San Mateo, CA: Bluewood Books.), 64.

2 Jean Folkerts and Dwight L. Teeter Jr. 1989. *Voices of a Nation: A History of the Media in the United States* (New York: MacMillan.), 376.

3 Ibid., 393.

4 Alexander, *Media in the 20th Century*, 64.

5 For a good account of this phenomenon and tactics used to lure

ENDNOTES

in tourists, see: Ben Lucien Burman, "Kentucky's Crazy Cave War," *Collier's*, 6 June 1953, 64-5.

6 The details of Collins' life and his attempted rescue outlined in this paper are those accepted by most accounts as factual, recorded in numerous newspaper accounts, magazine articles, books, and other documents. The two most well researched, factual, and complete accounts I came across are: *The Floyd Collins Story*, prod. and dir. Dorian Walker, 58 min., Cave City Chamber of Commerce and Peridot Pictures Corp., 1999, videocassette. and Robert W. Brucker and Robert K. Murray, *Trapped!* (Lexington KY: University of Kentucky Press, 1982). Any facts specific to a particular work are so noted.

7 Homer Collins and John Lerhberger Jr. "Floyd Collins in Sand Cave: America's Greatest Rescue Story, *Cavalier* 6:55 (January 1958): 71.

8 Ibid.

9 Collins and Lehrberger, "Floyd Collins in Sand Cave," 72.

10 Ibid., 73.

11 *Louisville Courier-Journal*, 3 February 1925.

12 *The Floyd Collins Story*, prod. and dir. Dorian Walker, 58 min., Cave City Chamber of Commerce and Peridot Pictures Corp., 1999, videocassette.

13 Ibid.

14 Ibid.

15 Collins and Lehrberger, "Floyd Collins in Sand Cave," 72.

16 Ibid.

17 For a good article focusing mainly on this aspect of the rescue see: Michael Lesy. 1976. "Dark Carnival: The Death and Transfiguration of Floyd Collins," *American Heritage*, October 1976, 34-45.

18 *The Floyd Collins Story*, prod. and dir. Dorian Walker, videocassette.

19 Ibid. and Collins and Lehrberger, "Floyd Collins in Sand Cave," 73.

20 Danny Fulks, "Buried Five Times: Floyd Collins, Caver," *Timeline*, May/June 1998, 2-17.

21 William R. Halliday. 1974 *American Caves and Caving* (New York: Harper & Row, 1974), 54.

22 This photo appeared in most magazine articles labeled Floyd Collins. I was actually under the impression it was Floyd until I came across the first document which pointed out the error: William R. Halliday. 1998. *Floyd Collins of Sand Cave: A Photographic Memoria*l, (Louisville, Kentucky: Bryon's Printing & Graphics), 32. After taking a second look at photos of both Floyd and Homer, it became clear that it was in fact Homer, not Floyd.

23 Burman, "Kentucky's Crazy Cave War," 64.

24 David McClurg. 1996. *Adventure of Caving*, new updated edition, (Carlsbad, NM: D. & J. Press.), 16.

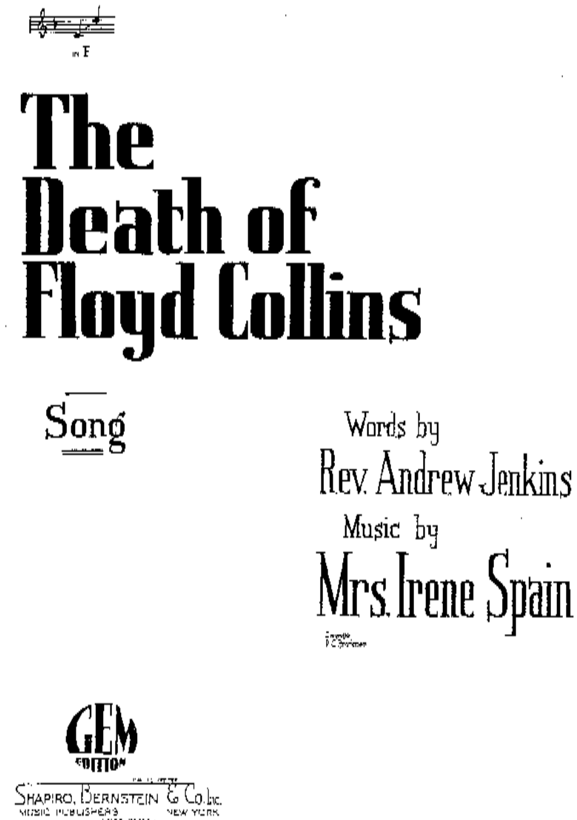
25 *Louisville Courier-Journa*l, 18 February 1925.

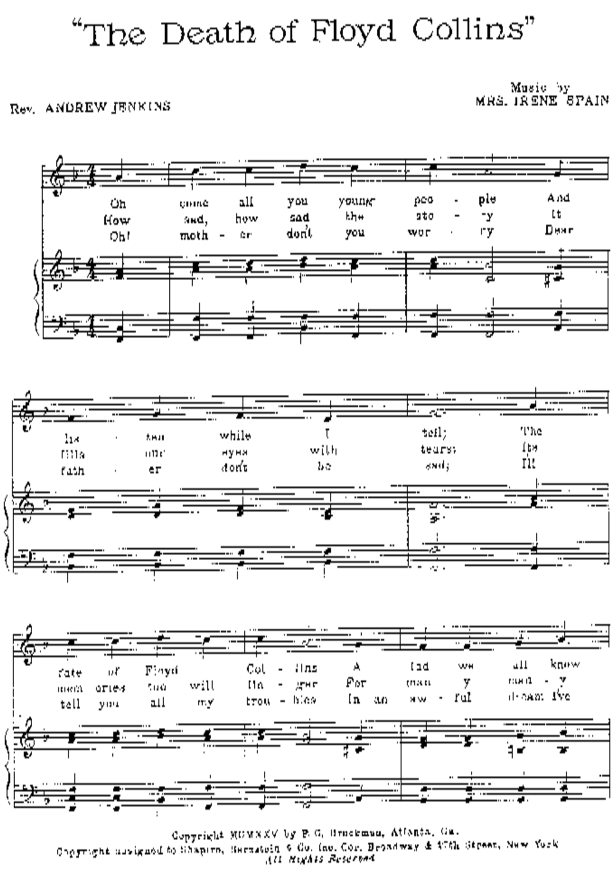
26 Fredrick Lewis Allen. 1964. *Only Yesterday: An Informal History of the 1920s* (New York: Harper & Row, 1964), 161. This history was originally published in 1931.

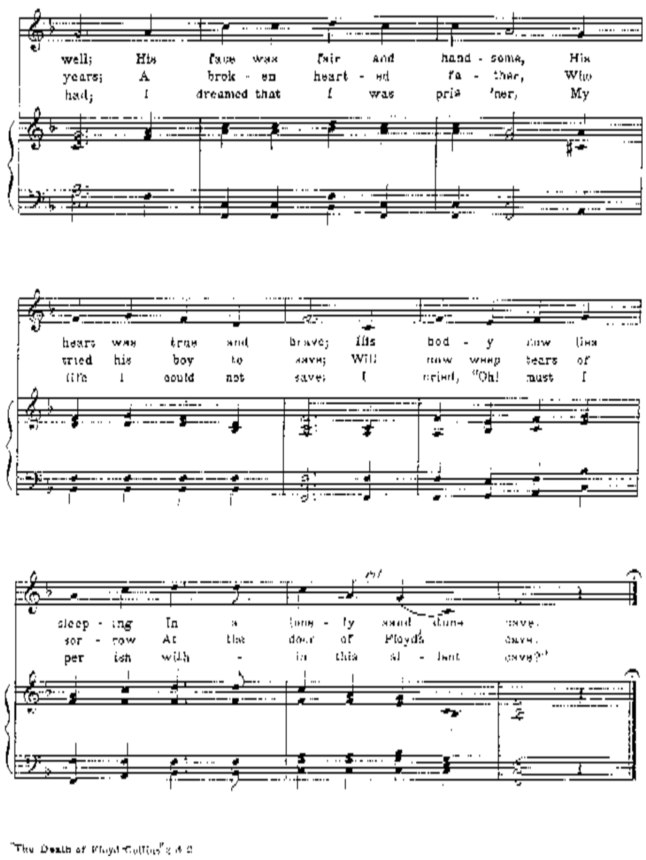
27 "Floyd's Death Certificate," *Floyd's Web Page*, Available from http://www.webpub.com/`jhageelfloyd-c.html, Internet, accessed 2 February 2000.

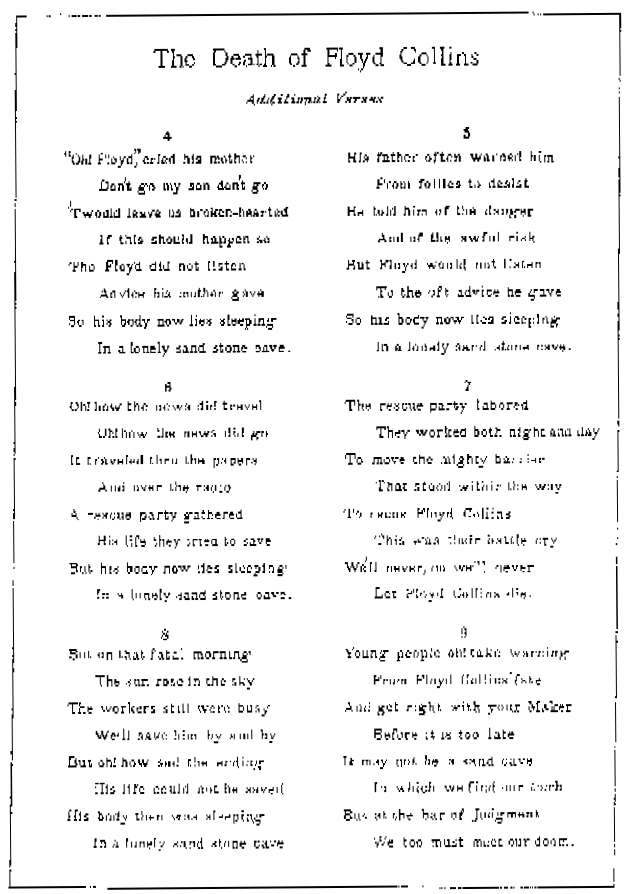
[28] Burman, "Kentucky's Crazy Cave War," 65.

Figure 1. Postcard, circa 1951, showing casket (bottom center) containing the body of Floyd Collins, Grand Canyon Avenue in Floyd Collins Crystal Cave, Kentucky.









The Death of Floyd Collins

Additional Verses

4

"Oh! Floyd," cried his mother
Don't go my son don't go
'Twould leave us broken-hearted
If this should happen so
Tho Floyd did not listen
Advice his mother gave
So his body now lies sleeping
In a lonely sand stone cave.

5

His father often warned him
From follies to desist
He told him of the danger
And of the awful risk
But Floyd would not listen
To the oft advice he gave
So his body now lies sleeping
In a lonely sand stone cave.

6

Oh! how the news did travel
Oh! how the news did go
It traveled thru the papers
And over the radio
A rescue party gathered
His life they tried to save
But his body now lies sleeping
In a lonely sand stone cave.

7

The rescue party labored
They worked both night and day
To move the mighty barrier
That stood within the way
To rescue Floyd Collins
This was their battle cry
We'll never, no we'll never
Let Floyd Collins die.

8

But on that fatal morning
The sun rose in the sky
The workers still were busy
We'll save him by and by
But oh! how sad the ending
His life could not be saved
His body then was sleeping
In a lonely sand stone cave

9

Young people oh! take warning
From Floyd Collins' fate
And get right with your Maker
Before it is too late
It may not be a sand cave
In which we find our tomb
But at the bar of Judgment
We too must meet our doom.

PHOLEOS SCRAPBOOK

▲ *Laura Davis in the squeeze box at Crawlathon, Jan. 29, 2000, Carter Caves, KY.*

◀ *ACCA Cleanup, Nov. 16, 2000, Horse Cave, KY.*

▼ *Crawlathon, Jan. 28, 2001, Carter Caves, KY.*

▲ *Ben Grostic chinneying out of Turtle Pit, Coon-in-the-Crack Cave II, Carter County, KY*

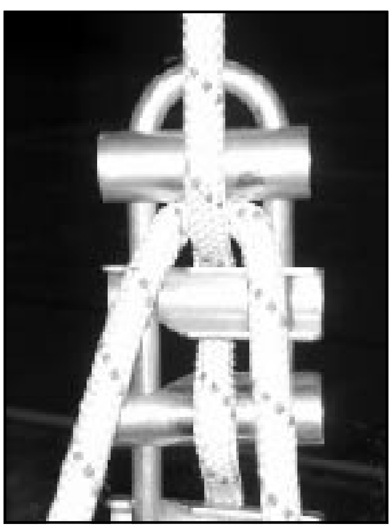
▼ *Wittenberg Univ. Speleological Society's trip to Carter Caves in Kentucky, Sept. 18, 1999.*

▲ *Crawlathon 2001, Tarkiln Cave, Olive Hill, KY.*

A SIMPLE ... AND SAFE CHANGE-OVER PROCEDURE

by Matt Hazelton, WUSS #0449; NSS #47187
and Horton Hobbs III, WUSS #001; NSS #12386 HM, CM, FE

Rappelling, ascending, and caving are inherently dangerous sports and should be experienced only after receiving proper training. Most importantly, all procedures described in this article should be practiced in a safe and controlled environment with direct instruction from a knowledgeable teacher. Accidents may happen even if these instructions are followed exactly. In no way can the authors, Wittenberg University Speleological Society, Wittenberg University, or the National Speleological Society be held accountable for any accident(s) due to gear malfunction, improper instruction, or unforeseen acts of God.



Vertical rope work is enjoyable and, if practiced properly, usually very safe. Occasionally problems arise while you are on-rope (e.g., the rope rigged too-short, clothing or hair become caught in rack, or you need to pass over a knot when two ropes are tied together). When a problem occurs, it is paramount that you have the training and experience needed to correct the problem and/or safely get off-rope. One fundamental skill for accomplishing these is "changing-over." This procedure involves switching from rappelling to ascending or ascending to rappelling while on-rope. The instructions that follow are intended to provide a refined technique for Single Rope Technique (SRT) users to change-over. This method specifically eliminates the problem of pinned rope (Figure 1), as described by Jancin (1994), while tying-off. Bain (1991) and Jancin (1994) addressed the use of the Carabiner Rack Configuration (CRC) (Figure 2), but until now the CRC has not been incorporated as a fundamental step of changing-over.

*Note:** There are many ascending systems used by cavers (e.g., Three-knot prusik, Mitchell, single or double bungee ropewalker, Frog). The system used here is a hybrid, much like the one pictured in Smith and Padgett *(1996: Fig 6-34).*

GEAR NEEDED FOR ASCENDING, RAPPELLING, AND CHANGING-OVER

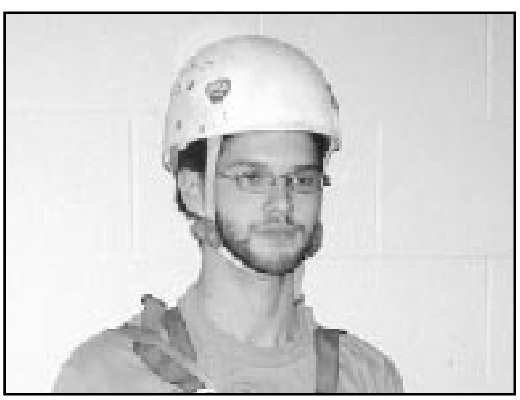
- Rope 7/16" (rigging equipment and know-how)

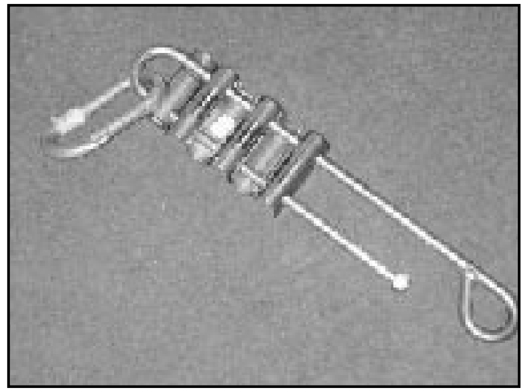
- Seat harness *(Figure 3)*
- Helmet *(Figure 4)*
- Rack (with stainless steel bars and a non- locking carabiner attached above the top bar of the rack (hanging on the open side of the rack) *(Figure 5)*
- Screw link (a.k.a. maillon) or locking carabiner *(Figure 6)* used with seat harness
- Chest harness w/ roller and non-locking carabiner attached *(Figure 7)*
- QAS (Quick Attachment Safety – e.g., Jumar with attachment to harness) *(Figure 8)*
- Foot ascender (with foot attachment) *(Figure 9-1)*
- Knee ascender (with foot attachment) also attached by cord to harness *(Figure 9-2)*
- Gloves (preferably leather palmed)

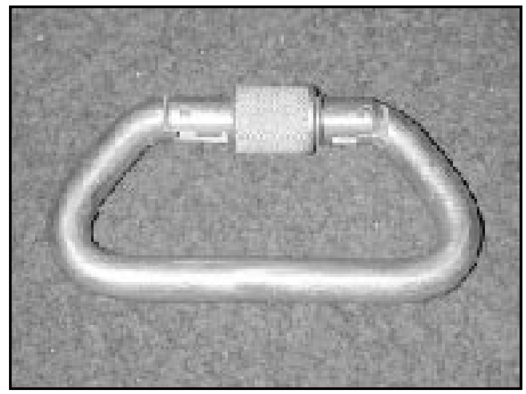
Full gear correctly positioned on a person ***(Figure 10)***

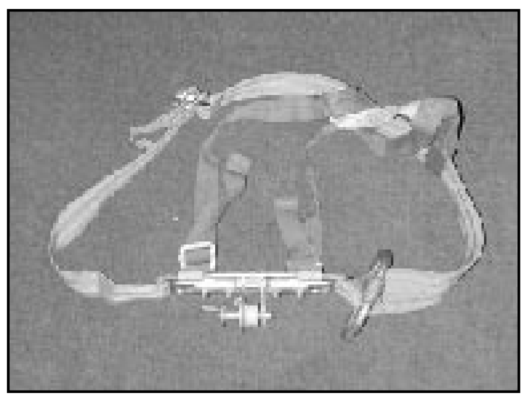
RAPPELLING:

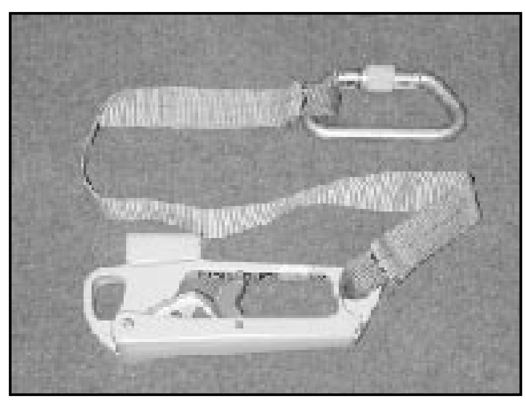
Before you begin rappelling, you must make sure that the rope is properly and safely rigged and that there is a figure eight on a bight at

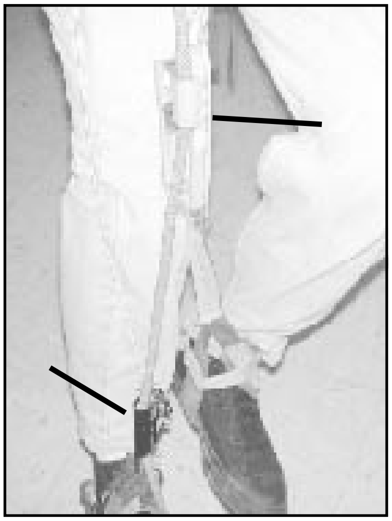




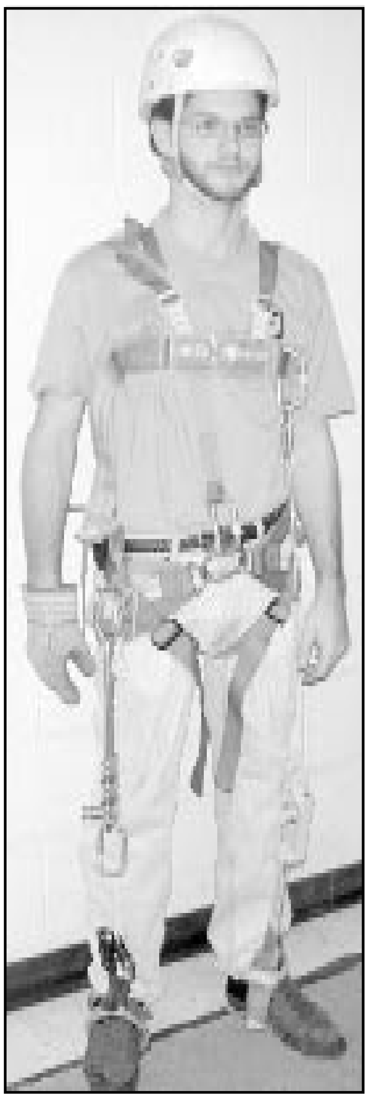








the trailing end of the rope. For safety purposes, full sets of rappelling as well as ascending gear need to be worn for the rappel (this should be a procedure used by all cavers but is absolutely **mandatory** for the first person rappelling into a pit). Attach the QAS to the rope before you approach the edge.
Announce to everyone around, especially your belayer (if you have one), that you are "On Rope." Attach your rappelling rack to the rope and make sure that you have the rack oriented and threaded correctly. Have a knowledgeable person double-check your gear to make sure that it is properly attached and ready for use. If you have a belayer, ask the question "On Belay?" Wait for the reply "Belay On" from your belayer. Hold the trailing end of the rope in your dominant hand and do not let go with this hand until your rappel is completed. Announce that you are "Rappelling" and wait for the response "Rappel On" from your belayer. Remove your QAS from the rope using your non-dominant hand, secure it to your seat harness, and begin your rappel. Once you are finished with your rappel, remove the rack from the rope, move away from the rope, and call out that you are "Off Rope and All Clear."



RAPPELLING SUMMARY:

- Make sure that you have on a full set of rappelling and ascending gear *(Figure 10)*
- Make sure the rope has a figure eight at the trailing end
- Have QAS attached to the rope before approaching the edge
- Announce that you are "On Rope"
- Attach your rappelling rack making sure you are threading it correctly *(Figures 2, 15, 17)*
- Have a knowledgeable person check to see that all your gear is attached properly and ready to be used
- Ask "On Belay"
- Wait for reply "Belay On" (if someone is able to belay your rappel)
- Hold the trailing rope in your dominant hand (do not let go with this hand until the rappel is completed)
- Announce that you are "Rappelling"
- Wait for reply "Rappel On" from your belayer (if you are being belayed)
- Remove your QAS with your non-dominant hand
- Begin your rappel

CHANGING-OVER FROM RAPPELLING TO ASCENDING:

Another unfortunate circumstance (e.g., rope does not reach the bottom of the pit) has forced you to change-over from rappelling to ascending. Begin by bringing the rope under the last bar and pulling up to tighten the bars together. Then, take the loop of rope, which you just pulled up, and clip it to the carabiner attached above the top bar on the rack. Attach the QAS to the rope, above the rack, and push it as high as possible. Once the QAS is high on the rope, attach both your foot and knee ascenders to the rope. Make sure that your foot and knee ascenders are high enough on the rope so that when you stand, the QAS attachment to your harness becomes limp, yet the foot and knee ascenders should not be so high that it is excessively difficult to stand. Stand up on your foot and knee ascenders and push the QAS up the rope as far as possible. The attachment between the QAS and your harness should be taut. Now, sit down in your seat harness and detach the rappelling rack from the rope. Attach the roller of your chest harness to the rope and begin your ascent.

CHANGE-OVER SUMMARY (RAPPEL TO ASCEND):

- Bring the rope under the last bar and pull up to tighten the bars together *(Figure 18)*
- Clip the loop of rope, which you just pulled up, through the carabiner attached above the top bar on the rack *(Figures 18 and 19)*
- Attach the QAS to the rope, above the rack, and push it as high as possible *(Figure 26)*
- Attach your knee ascender *(Figure 24)*
- Attach your foot ascender *(Figure 14)*
- Your foot and knee ascenders should be high enough on the rope that when you stand the QAS attachment becomes limp, but not so high that it is excessively difficult to stand
- Stand up on your foot and knee ascenders
- Push the QAS as high on the rope as possible *(Figure 21)*
- Sit down in your seat harness
- Detach the rappelling rack from the rope *(Figure 17)*

- Attach the roller of your chest harness to the rope *(Figure 12)*
- Begin to ascend

ASCENDING:

Before you begin ascending, as you approach the rope, announce that you are "On Rope." Attach your gear to the rope in a bottom-up sequence, beginning with your foot ascender. Next, attach your knee ascender, followed by attaching the chest roller to the rope. The Quick Attachment Safety (QAS) is the last piece of gear to be attached and the cord, or webbing, should run behind the chest harness or through a second chest harness roller if the harness has two. A knowledgeable person should check over the attachment of the gear before you begin to climb. Specifically, make sure the seat harness has its straps doubled back, all carabiners and screw-links are locked, the chest harness is tightened and the roller(s) properly closed, that each ascender's cam is closed correctly, and that the rope is properly and safely rigged. Announce that you are beginning to ascend by calling out "Climbing." After getting the reply "Climb On" you may begin ascending. When you are climbing, take short steps and do not try to climb using your arms and QAS to pull you up the rope; it is much more efficient to climb by walking up the rope - let your legs do the work.

ASCENDING SUMMARY:

- Announce that you are "On Rope"
- Attach gear to the rope from the bottom up
    - o Foot ascender (Figure 9-1)
    - o Knee ascender (Figure 9-2)
    - o Chest harness roller (Figure 12)
    - o QAS with its cord or webbing running behind the chest harness (or through chest harness roller if harness has two) *(Figure 11)*
- Have a knowledgeable person check over attachment of gear (carabiners locked, harness doubled back, gear correctly positioned and tightened, and the rope rigged correctly).
- Announce that you are "Climbing"
- Take short steps and do not try to climb using your arms and QAS to pull you up the rope. It is most efficient to walk up the rope.

CHANGING-OVER FROM ASCENDING TO RAPPELLING:

Once you have reached a place or circumstance where you need to go back down the rope, you will need to change-over to rappel. Begin by pushing your QAS as high on the rope as possible. Next, detach the chest roller from the rope and sit down in your seat harness. Be sure to replace the pin of the chest roller. Detach your foot ascender from the rope, making sure to keep your knee ascender and QAS attached to the rope. Attach the rack to your seat harness screw link (a.k.a. maillon) or locking carabiner with a locking carabiner and position it so that the groove on the top bar is facing up at you [**NOTE**: NEVER unlock your seat harness screw link (maillon) or locking carabiner. Always use an additional locking carabiner to attach the rack to the seat harness]. Thread the rope through the rack while keeping the rack as high on the rope as possible. The higher on the rope you attach the rack the more easily and safely the rest of the change-over will proceed. Once you have threaded the rack completely, bring the rope under the last bar and lift it up to position the bars closer together. Clip the rope, which you just pulled up, through the carabiner on the top of the rack and pull it down by your hip. You now have the rack tied off completely. This method of tying off the rack is far superior to the traditional method of bring the rope under the last bar and looping it over the top of the rack. The traditional tie off often results in getting the rope stuck ("pinned") between the two top bars of the rack and the rope *(Figure 1)*, thus making restarting your rappel difficult, to impossible, and unsafe. Stand up on the leg that is still attached to the rope, and slide the QAS down close to the top of the rack (but not touching the rack, otherwise it may get jammed). Sit down in the harness again and then detach the knee ascender. From this point on, you must hold the trailing rope in your dominant hand as if you are rappelling. Detach the QAS, keeping in mind that you must never remove your dominant hand from the rope. Now, hold the trailing rope vertically above the rack and unclip the carabiner at the top of the rack with your non-dominant hand. You are now ready to proceed with your rappel.

CHANGE-OVER SUMMARY (ASCEND TO RAPPEL):

- Push QAS as high as it will go on the rope *(Figure 11)*
- Detach chest roller from rope *(Figure 12)*
- Sit down in seat harness *(Figure 13)*
- Detach foot ascender *(Figure 14)*
- Make sure the rack is correctly aligned *(Figure 15)* and attach it to your seat harness carabiner or screw link with a locking carabiner *(Figure 16)*
- Thread the rack and make sure to keep the rack as high on the rope as possible *(Figure 17)*
- Bring the rope under the last bar and pull up to tighten the bars together *(Figure 18)*
- Clip the loop of rope, which you just pulled up, through the carabiner attached above the top bar on the rack *(Figures 19, 20)*
- Stand up on your leg that is still attached to the rope *(Figure 21)*
- Slide the QAS down close to the top of the rack (but not touching the rack; it can get jammed in the rack) *(Figure 22)*
- Sit down in the harness again *(Figure 23)*
- Detach the knee ascender *(Figure 24)*

- Hold the trailing rope in your dominant hand as if you were rappelling *(Figure25)*
- Detach the QAS with your non-dominant hand keeping in mind that you must never remove your dominant hand from the trailing rope for the remainder of the change-over or rappel *(Figure 26)*
- Hold the trailing rope vertically above the rack *(Figure 27)*
- Remove the rope from the carabiner at the top of the rack by unclipping the carabiner with your non-dominant hand *(Figure 28)*
- Proceed with your rappel

Practice the techniques above ground prior to entering a cave and you should be able to have enjoyable and safe experiences in pits. These techniques should be practiced often and you should become proficient sufficiently enough to conduct change-overs in the dark (your light might fail while you are on rope...).

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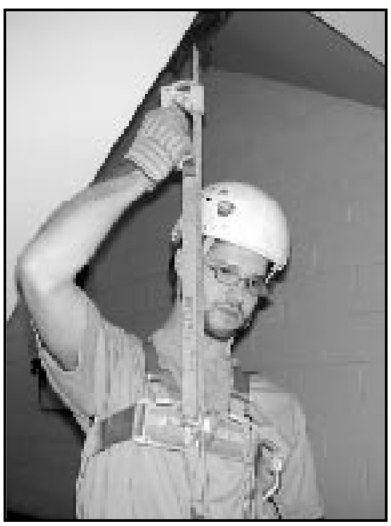
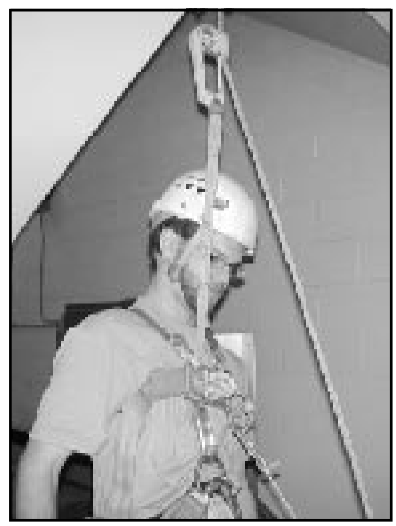
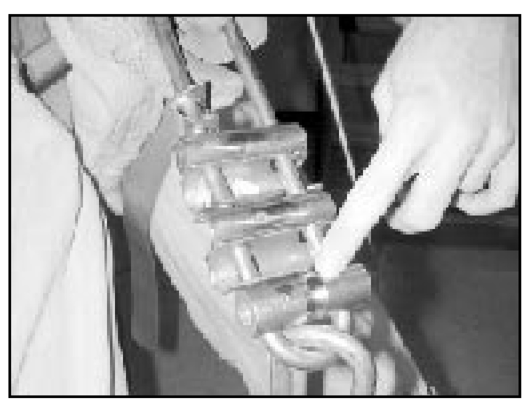
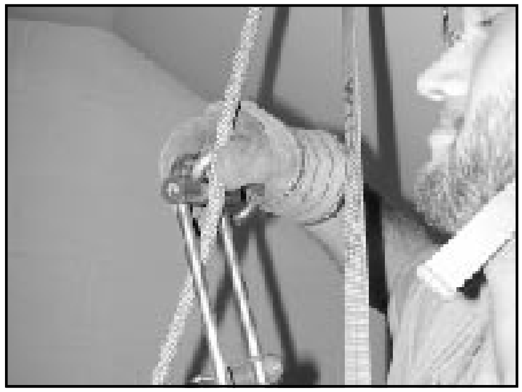
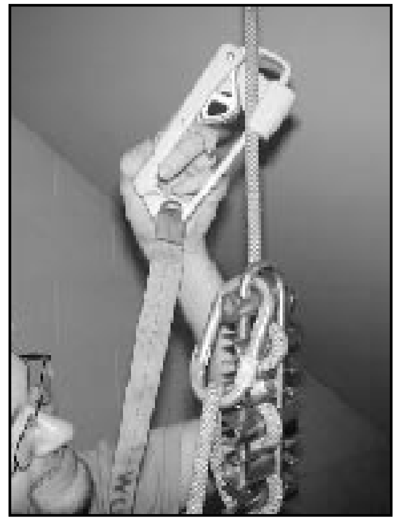


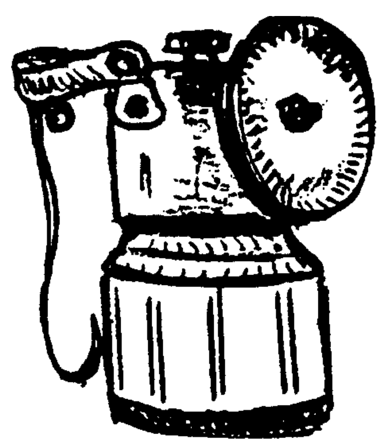










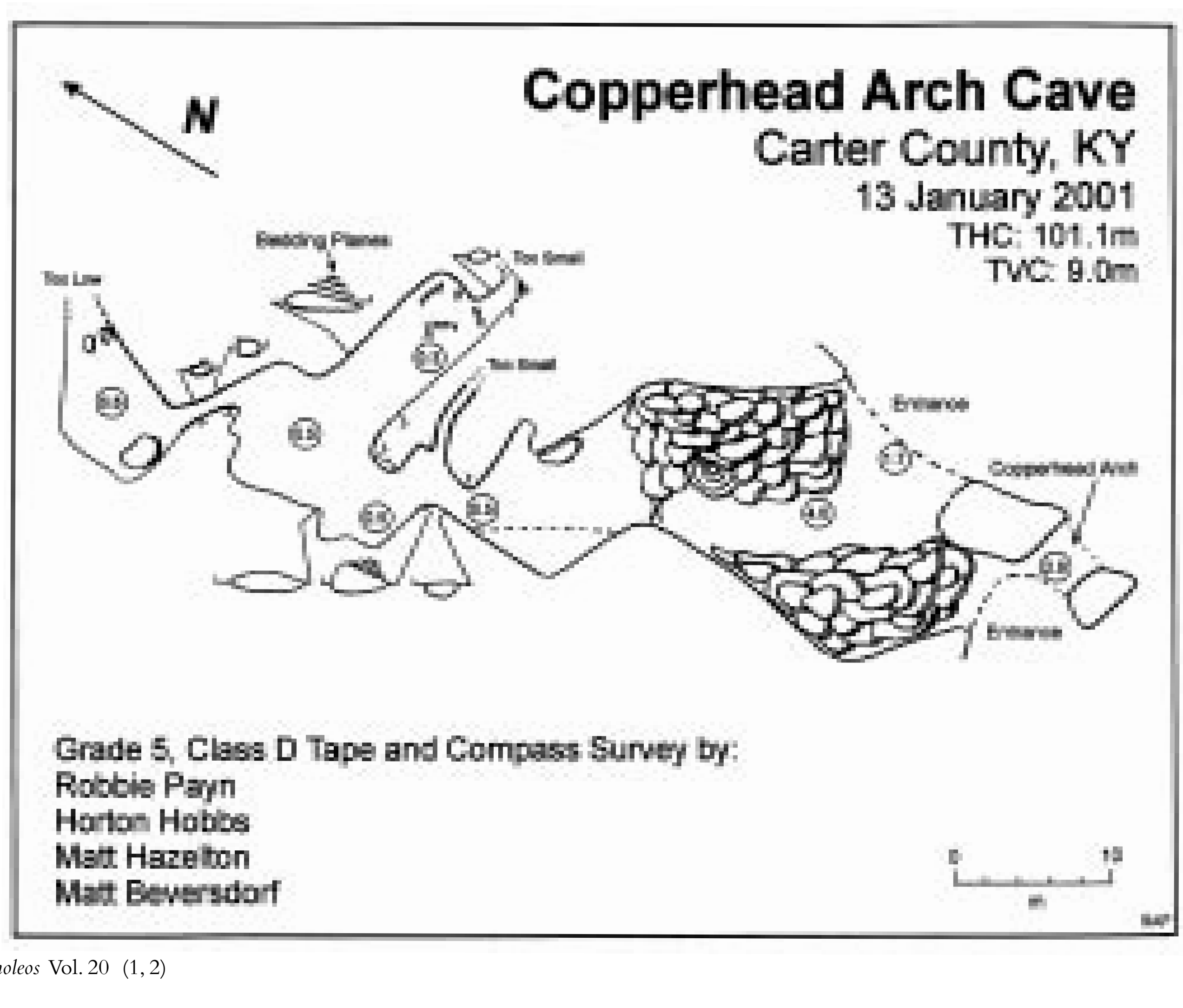



Copperhead Arch Cave

Robbie Payn, WUSS #0362, NSS #41322

The relatively gentle slope of a hollow in Carter Caves State Resort Park, Carter County, KY, is interrupted by a limestone bluff and the entrance complex of Copperhead Arch Cave. The signature feature of the cave, a natural arch remnant of passage long ago collapsed, divides two entrances. The arch is partially hidden when approaching from the northern end of the hollow, but prominent from the south. The entrances to the cave show signs of many past collapses with large piles of breakdown. Typical of many caves in the park, the entrance area of the cave is large, but as the light dims, the passage dwindles.

The cave is quite short and scattered with a few small speleothems. With the exception of a large flowstone pile in the entrance room, the cave is mostly decorated with small stalactites and soda straws. In many sections, a steep dip to the north is evident in the thinly bedded, cross-bedded limestone rock. Few biota were observed during the chilly January survey, including a big brown bat near the entrance (*Eptesicus fuscus*) and a cluster of an unknown species of harvestman.



An investigation of physicochemical characteristics and macroinvertebrate assemblages in Web Spring, John Bryan State Park, Greene County, Ohio

by Laurie Bauer

ABSTRACT

An investigation of a small hardwater spring was conducted in the summer/fall of 2000 to examine the differences between spring pool and run physicochemistry and macroinvertebrate constitution. Web Spring emerges from a dolomite bluff on the south side of the Little Miami River in John Bryan State Park, Greene County, Ohio, and following impoundment at the head of the spring, flows north into the river. The physicochemical characteristics and macro-invertebrate assemblages and patterns in the pool at the spring effluent and several successive points along the stream run and the Little Miami River were studied. The primary organisms inhabiting the spring are the isopod, *Lirceus fontinalis* and the amphipod, *Synurella dentata*. The pool was characterized by high isopod densities, while the spring run had greater species richness but progressively lower numbers of organisms per meter. Temperature [(spring effluent mean (SEM): 11.5˚C, range: 11.0-11.8˚C; spring run lowest site mean (SRLSM): 11.7˚C, range: 4.8-12.8˚C)], dissolved oxygen (SEM: 8.3 mg/l, range: 7.8-9.8 mg/l; SRLSM: 10.3 mg/l, range: 4.4-11.2 mg/l), and pH (SEM: 7.30, range: 6.41-7.73; SRLSM: 7.86, range: 6.85-8.25) increased moving downstream, but there was no significant variation in hardness and the concentration of dissolved substances at different points in the spring pool and run. The Little Miami River differed from the spring chemically (higher temperature (mean= 17.2˚C), pH (mean= 8.05), sulfates (mean= 72.8 mg/l)), turbidity (mean= 6.49 NTU), lower dissolved oxygen (mean= 8.1 mg/l), nitrates (mean= 3.9 mg/l)), and experienced greater seasonal variation. The river macroinvertebrate community consisted primarily of aquatic insects (Ephemeroptera, Trichoptera, Diptera).

INTRODUCTION

Springs, which are natural discharges of water originating from an aquifer, are present in a variety of environments, including areas with surficial carbonate deposits. In many cases, the emerging water flows down a gradient as a surface spring, which is called a spring "run" (Hobbs 1992). They are classified by numerous hydraulic and geologic parameters, including their water source, the size and type of openings in the substrate, and temperature. "Free flow" springs that derive their water from the water table are smaller and more variable than artesian springs, which originate from a larger underground reservoir (Hobbs 1992). A seepage spring percolates from many small openings, in contrast to larger tubular conduits or fracture openings. When considering temperature, springs may be classified as thermal or nonthermal.

Spring habitats are unique because they have nearly constant chemical and physical characteristics (Glazier 1991). The continuous recharge and current help to bring about this stability but also contribute to variabilities in different sections of the stream, [e.g., the boil, pool, and run (Whitford 1956)].

Springs generally contain fewer species than other communities, there is often no true plankton, and the dominant flora tend to be filamentous algae, watercress, and mosses (Teal 1957, Hobbs 1992). The resident fauna depend upon these autotrophic organisms, as well as allochthonous input (e.g., leaves) for food. The macroinvertebrate species composition and density vary among springs with different geochemical parameters. Research in North America has shown that acidic, softwater springs are dominated by insect taxa, while peri-caridans (e.g., amphipods and isopods), molluscs, and turbellaria are characteristic of alkaline, hardwater springs (Glazier and Gooch 1987, Glazier 1991). The type of substrate also affects the macroinvertebrate assemblage (Glazier and Gooch 1987).

Although the qualitative analyses of springs have been well documented, there has been little research on downstream (the spring run) changes. Tilly's (1968) studies of Cone Spring in Iowa revealed that the major species were uniformly distributed throughout the spring and run, which enters a marsh. In contrast, Sloan's (1956) investigations in Florida springs showed that the invertebrate populations were lower at the spring head, increased downstream, and then decreased as the intersection with the Gulf of Mexico was approached. While this pattern may be different when a spring flows into a body of freshwater, it is likewise dependent upon factors such as velocity, food availability, and chemical composition.

Clifton Gorge, located in John Bryan State Park, Greene County, Ohio, is composed of a number of dolomite formations of Silurian age. Several springs originate from the bluffs above the south side of the Little Miami River *(Figure 1)*. Waters emerge from Web Spring at an elevation of 280m, are immediately impounded by a concrete basin, and then flow approximately 100m downslope and enter the Little Miami River at an elevation of 267m (Butler and Hobbs 1982). Past studies of the stream have described it as a free flow, seepage, temperate cold-water, hardwater spring (Porter 1995).

Web Spring and nearby OZ Spring have been studied with regards to their limnological parameters (Butler 1980), primary production (Savage and Fish 1995), invertebrate drift and upstream movement (Butler and Hobbs 1982), and comparative amphipod and isopod densities in the headwaters (Porter 1995). In addition, chemical analyses have shown that the spring is stable thermally and chemically (Butler and Hobbs 1982, Porter 1995). The purpose of this investigation was to study possible differences in the physicochemical characteristics and invertebrate composition and densities from Web Spring's emergence from beneath dolomite bluffs to its confluence with the Little Miami River.

METHODS

Six sites were selected for the investigation. Site #1 is located at the head of the spring (the impounded pool), Sites #2-5 are found at successive points along the spring run, and Site #6 (The Little Miami River) is situated just west of the spring run confluence.

At each site, the physicochemical characteristics were analyzed on a weekly basis during the summer and 1-2 times per month in the fall. Water samples were collected and tested for nitrate-nitrogen, orthophosphate, sulfate-sulfur, and iron using the HACH Chemical 2010 Portable Datalogging Spectrophotometer. Oxygen saturation was determined using a Yellow Springs Instrument Company (YSI) Model Dissolved Oxygen Meter Model #58. The pH and specific conductance of the water was measured with a YSI Model SCT pH Meter Model 63. Water hardness was assessed using a HACH Chemical Company Model P2100 Digital Titrator. Turbidity values were obtained with the aid of a HACH Chemical Company Model 16900-01 Portable Turbidimeter. A Global Flow Probe, Model FP201 (flow meter) was utilized at sites along the stream run to measure the velocity of flow.

To determine the species composition and density in Web Spring, a Surber sampler was employed on each sampling day. The organisms were identified and counted before being returned to the stream, and this information was used to calculate the number of organisms of each species per square meter. A Hess Sampler was used periodically to obtain a qualitative representation of the macroinvertebrates in the Little Miami River.

At each site in the spring, a capture-recapture experiment as described in Nichols (1992), and Knapp and Fong (1999) was usedt to estimate the size of the isopod and amphipod populations in the spring. This method was carried out over six occasions from 7/20/00 to 8/2/00 and four times over an intensive eight hour study on 9/30/00. The organisms were blotted with paper towels to remove excess water, marked with a permanent Sharpie® brand marker, and then placed in a dish of water for a minute for observation before being returned to the spring. Recaptured organisms during subsequent trips were noted and marked again with a different color before they were again released.

Physicochemical data were graphed using Sigma Plot. An ANOVA (α=0.05) was performed for each parameter to analyze the variation within Web Spring (sites 1-5) and between the spring and the river (all sites). Macroinvertebrate counts were converted to density (org/m^2) and the relative abundance of the species or type was graphed as an Excel pie chart for each spring site.

RESULTS

Temperature values at site 1 were consistently lower than at site 5 throughout the summer months and the effluent experienced smaller variation in the fall than the spring run and river *(Figure 2)*. The mean temperature in Web Spring was 11.5˚C (range: 11.0-11.8˚C) at site 1, 11.7˚C (range: 4.812.8˚C) at site 5, and 17.9˚C (range: 5.2-22.2˚C) in the Little Miami River at site 6 *(Figure 3a)*. When values from 18 Nov. 2000 were not included in the mean, the average temperature rose to 12.2˚C at site 5 and 18.9 (±3.1)˚C in the river.

Statistically, mean dissolved oxygen at site 1 (8.3 mg/l) was significantly different from mean values at the sites along the spring run, which ranged from 9.67 mg/l at site 2 and 10.6 mg/l at site 4 *(Figure 3c)*. Percent saturation in the spring ranged from 75.0% at site 1 to 98.7% at site 5 *(Figure 3d)*. The pH also increased moving downstream, averaging 7.30 (range: 6.41-7.73) at site 1 and 7.86 (range: 6.85-8.25) at site 5 *(Figure 3b)*. The

Little Miami River averaged 8.1mg/l dissolved oxygen and 82.0% saturation. The mean river pH was 8.05 (range: 7.33-8.41), which was higher than at any of the sites in Web Spring and the spring run.

There was no significant difference between specific conductance or hardness in the spring and river water. Specific conductance ranged from 619.6 µS/cm at site 5 to 683.9 at site 1 and averaged 684.4 in the river *(Figure 3e)*. Hardness ranged from 342.9 mg/l $CaCO_3$ at site 1 to 347.2 mg/l $CaCO_3$ at site 5 and averaged 356.7 mg/l $CaCO_3$ in the river *(Figure 3f)*. Orthophosphate levels also did not vary significantly at any of the sites, although site 1 (mean: 0.601 mg/l, range: 0.00-2.61 mg/l) tended to experience greater variation than any other points on the spring run or river, where mean values ranged from 0.157 mg/l at site 4 to 0.348 mg/l at site 2 *(Figure 4a)*.

Statistically, iron, sulfate, and nitrate levels did not vary significantly between the spring effluent and run sites, but these values were notably different in the river. Mean spring iron levels were low, ranging from 0.013 mg/l at site 5 to 0.028 mg/l at site 1, while the iron in the river was consistently higher, averaging 0.103 mg/l *(Figure 4b)*. Mean sulfate levels also were higher in the river (72.8 mg/l) compared to the spring sites 1-5 mean of 39.9 mg/l *(Figure 4c)*. Mean nitrate values, in contrast, were higher in the spring, ranging from 8.6 mg/l at site 5 to 9.0 mg/l at site 2, while the average river level was 3.9 mg/l *(Figure 4d)*.

Turbidity values were highly variable but significantly greater in the river than the spring *(Figure 4e)*. Mean river turbidity was 6.49 NTU and ranged from 1.2-45.8 NTU. Average spring turbidity ranged from 0.43 NTU at site 1 to 1.5 NTU at site 5.

Average spring run velocity ranged from 6.3 cfs at site 2 to 8.0 cfs at site 4, although by October accumulated leaf litter impaired flow such that the flow meter could no longer be utilized.

Comparative macroinvertebrate densities are shown in Figure 5. Site 1 was dominated by the isopod *Lirceus fontinalis*, where calculated isopoda density averaged 122 organisms/sq. meter (org/m^2) *(Figure 5a)*. Occasional unidentified diptera larvae also were found in the impounded spring effluent, and Gerridae were seen in the pool but never captured in the Surber. The most abundant organisms at site 2 were *L. fontinalis* (37 org/m^2), the amphipod *Synurella dentata* (10 org/m^2), and unidentified oligochaetes (11 org/m^2) *(Figure 5b)*. Plecoptera (Perlidae), Tricoptera (Hydropsychidae), Ephemeroptera (Baetidae), *Physa*, and planarians also were counted at this spring run site. Site 3 had a similar macro-invertebrate composition, although *S. dentata* densities (20 org/m^2) were higher than *L. fontinalis* (8 org/m^2), and the total number of organisms was lower *(Figure 5c)*. Sites 4 and 5 were marked by a drop in macroinvertebrate abundance *(Figure 5d,e)*. On several occasions no macroinvertebrates were captured at these points.

Isopod densities fluctuated significantly over the study period, ranging from 43 to 269 org/m^2 at site 1 and from 0 to 86 org/m^2 at site 2. Amphipod densities ranged from 0 to 22 org/m^2 at site 2 and 0 to 75 org/m^2 at site 3. Results from the mark-recapture experiment were sparse, only one isopod was recaptured in the pool during the summer study and two isopods were recaptured, one at site 1 and one at site 2, during the day long intensive study. Due to the extremely small number of recaptures, population estimations using the Lincoln-Peterson Index were not done.

Tricoptera (Hydropsychidae) was the most abundant taxon in Hess samples from the Little Miami River. Other macroinvertebrates inhabiting the river were Ephemeroptera (Baetidae, Ephemeridae), Diptera (Tabanidae, Chironomidae), Coleoptera (*Psephenus*), and Odonata (Anisoptera).

DISCUSSION

Physicochemical data are comparable to other recent investigations of Web Spring and nearby OZ Spring, providing further evidence of the thermal and chemical stability of the spring (Butler and Hobbs 1982, Porter 1995, Savage and Fish 1995). A noted difference is the apparent rise in nitrate levels, which was previously reported 3.3-5.9 mg/l (Porter 1995). Prior studies in OZ Spring have been similar; nitrate levels ranged from 4.5-6.7 mg/l in Butler and Hobbs (1982), and from 2.4-6.3 mg/l in Savage and Fish (1995). The springs drain from agricultural lands, which accounts for the high nitrate values in comparison to the river (Butler and Hobbs 1982). While it is unknown why spring nitrate levels have increased, I speculate that, knowing the ties to agricultural lands, this may be linked to fertilizer use.

The pool at the spring effluent differed from other sites on the spring run in regards to pH, dissolved oxygen, and temperature, and as the fall progressed temperature was more stable than in the lower spring run. The constant recharge and depth likely contribute to the enhanced stability in the pool, while the increased aeration and in the fast flowing run account for the elevated temperature, pH, and dissolved oxygen downstream.

Overall, physicochemical parameters in Web spring were generally stable compared to the Little Miami River. Spring temperature remained constant into the fall even as air temperature declined and during the summer did not vary more than 1°C at any of the sites *(Figure 2)*. Dissolved oxygen and pH were consistently high, especially closest to the effluent. These parameters were lowest in the spring run in the late fall, when leaf litter was highest and flow in the lower reaches of the run was greatly diminished. Nitrate, sulfate, and phosphate fluctuated throughout the study but were generally high, which as previously stated can be influenced by the land use of the drainage area. Hardness and specific conductance were high in both the spring and river, which is expected due to the under-lying carbonate bedrock.

The dominant macroinvertebrate taxa inhabiting the spring are *Lirceus fontinalis* and *Synurella dentata (Figure 5)*. The largest density of isopods and total macroinvertebrates was found at the spring head. The pool was characterized by soft sediments, large rocks, and allochthonous input (e.g. leaves), in contrast to the run, where the substrate was primarily a thin layer of gravel-sized marl deposits, and exposed bedrock further downstream. There also were small, temporary pools at several points along the run, created by logs and other natural barriers, but these were largely avoided in this survey in order to concentrate on the fast flowing sections of the run for consistency. Although flow and water depth decreased in the run in late summer and in the fall, at no time during the study did the spring run dry.

The dominance of *L. fontinalis*, and lack of *S. dentata* at the effluent may be an indication of habitat preference. *L. fontinalis* feeds on detritus and appears to favor oxygen rich, low light environments and is typically found in pools or along stream banks among sediment and vegetation matter (Styron 1968).
In addition, the organism exhibits antipredatory behavior (e.g., seeking refuge) when exposed to fish and salamander larvae (Huang and Sih 1991). While there are no fish inhabiting Web Spring, small salamanders were observed occasionally throughout the study in both the pool (site 1) and run. The larger isopod density in the pool compared to the run may be due to greater food availability, added leaf cover, and thicker, smaller sized sediment that would benefit *L. fontinalis* in terms of predator and light evasion. Dissolved oxygen was high at all spring sites and would not likely affect the distribution of *L. fontinalis*.

Little research has been done on the natural history of *S. dentata* but more is known about the ecology of other species of gammarids living in a variety of environments. *Gammarus pulex* in a Danish stream has been identified as a leaf shredder and has a life history of two years (Iverson 1988). *Hyalella azteca* in Michigan lakes has a temperature dependent molting period of 5-8 days and feeds on organic material in the substrate and often grazes on filamentous algae (Cooper 1965). Strong's (1972) studies of *H. azteca* in Oregon lakes also supported the association with algae as well as rooted aquatic macrophytes, and more amphipods were found hiding in this vegetation than in bare gravel. Wild impatiens were abundant along the edges and in Web Spring run during the summer months, although the sampler had to be used where the substratum was free of large objects in order to be set on the bottom firmly. The possible association of *S. dentata* and the vegetation was not examined in this study and needs to be looked at more closely, especially in spring environments.

The isopod and amphipod densities at the spring head are lower than were found by Porter (1995), where cages were used to estimate population density. The difference could indicate a decrease in population but may be due to the difference in sampling technique. The decision to use a Surber sampler in this study was due to convenience, the ease of returning captured organisms to the stream, and its design for flowing water, but it posed a problem in the pool, where the only flow was at the seep. The depth of the water and large materials among the fine grained substrate made it difficult to position the sampler to get a tight seal on the bottom. As a result, organisms could often escape under the base when the substrate was being stirred, and counts would thus be on the lower side of the actual density of the pool.

The failure of the mark-recapture method to produce usable results is due to several factors. First, this could indicate a large population of isopods and amphipods, where recapture of individuals would be unlikely. Knapp and Fong (1999) determined that there was a large hidden population of the amphipod *Stygobromus emarginatus* inhabiting the epikarst in a stream in Organ Cave, West Virginia. The ability for isopods to migrate freely in the basin at the source of Web Spring, and drift of the organisms in the run would affect the probability of the organisms to remain in the same location. The previously stated problem with the Surber sampler in the pool would be a factor as well. Organisms smaller than 0.5 cm were unable to be marked, and isopods of this size would often constitute a significant proportion of the population in the pool. Lastly, due to the sparse life history and ecology studies on *L. fontinalis* and *S. dentata*, it is impossible to know precisely when the organisms would be molting and thus shedding the mark, although in a one day study this would not be appreciable.

Future attempts of the mark-recapture method in spring habitats may be more effective with cages at the spring sites in order to disturb the organisms less. Other possible research opportunities in Web Spring lie in comparing organism density in the small pool microhabitats at points along the run with the main pool at the effluent. The life history of *L. fontinalis* and especially *S. dentata*, as well as the interactions between the two species, are important to assess more effectively the reasons for their distribution and densities and need to be studied more extensively. Physicochemical characteristics should be continued to be monitored as good water quality is imperative to the survival of macroinvertebrates in spring habitats.

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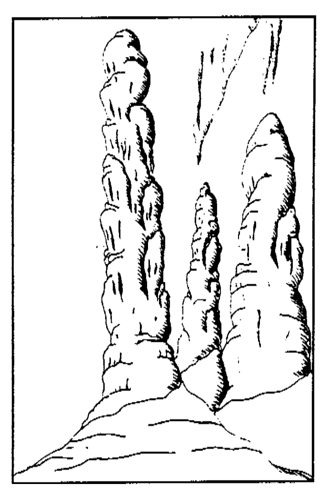

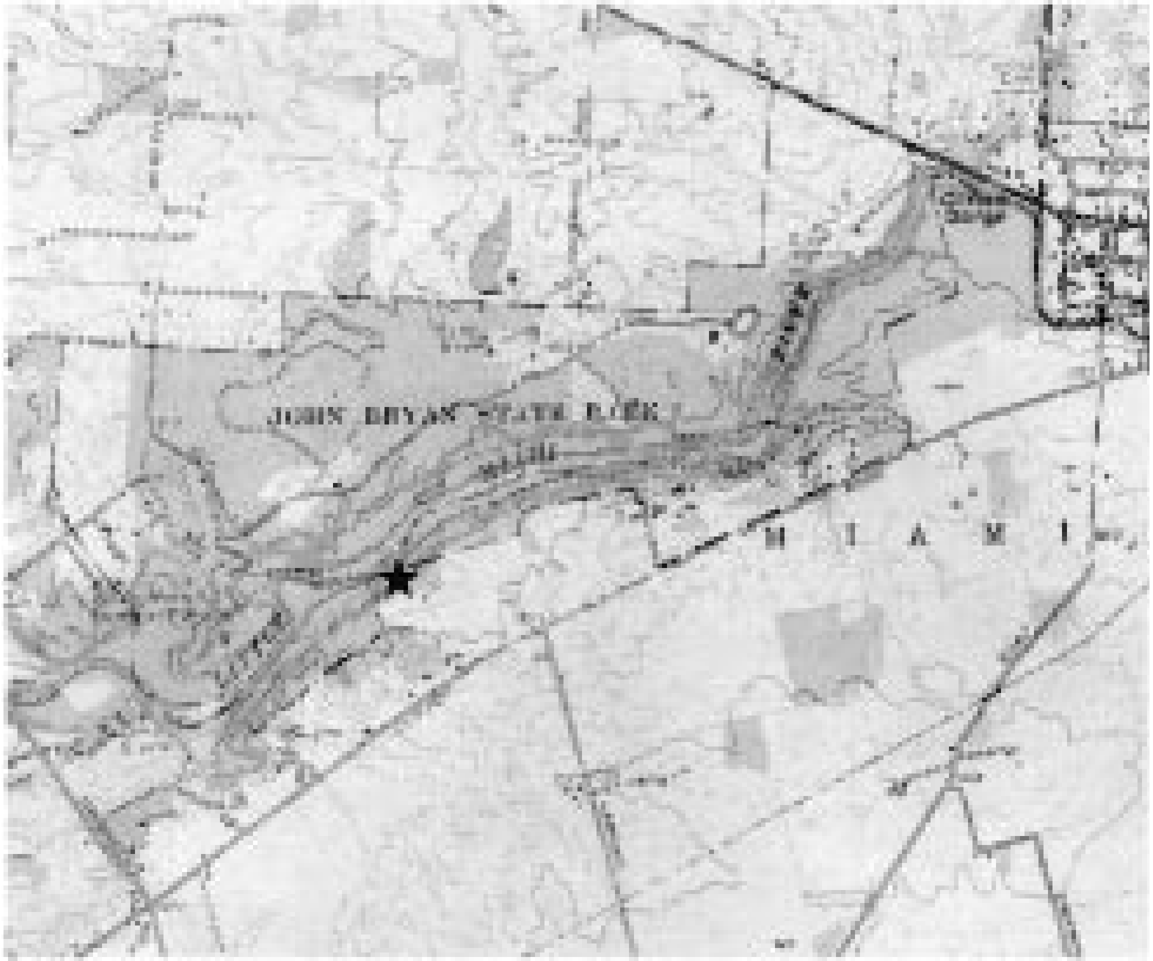

Figure 1. A topographic map of John Bryan State Park (outlined). The star represents the location of Web Spring

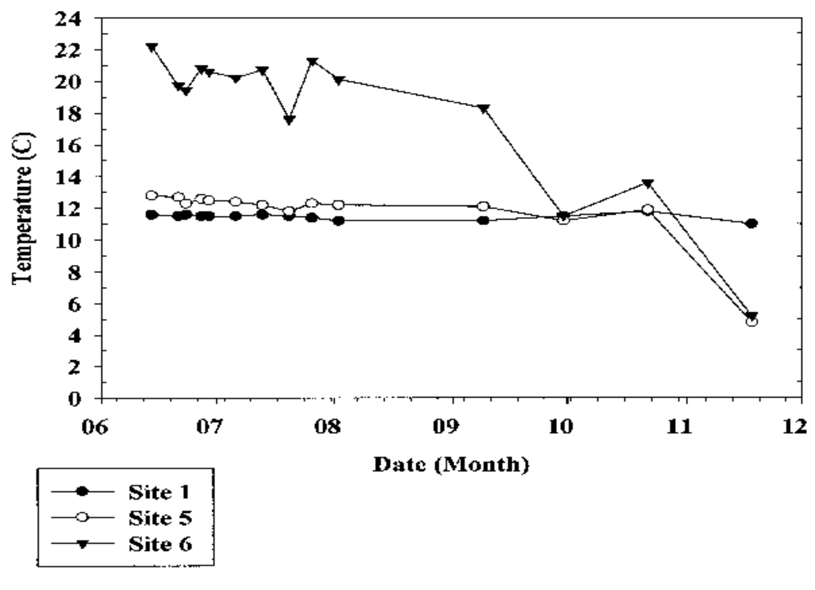

Figure 2. Temperature values at site1, site 5, and the Little Miami River over the study period from June to November.

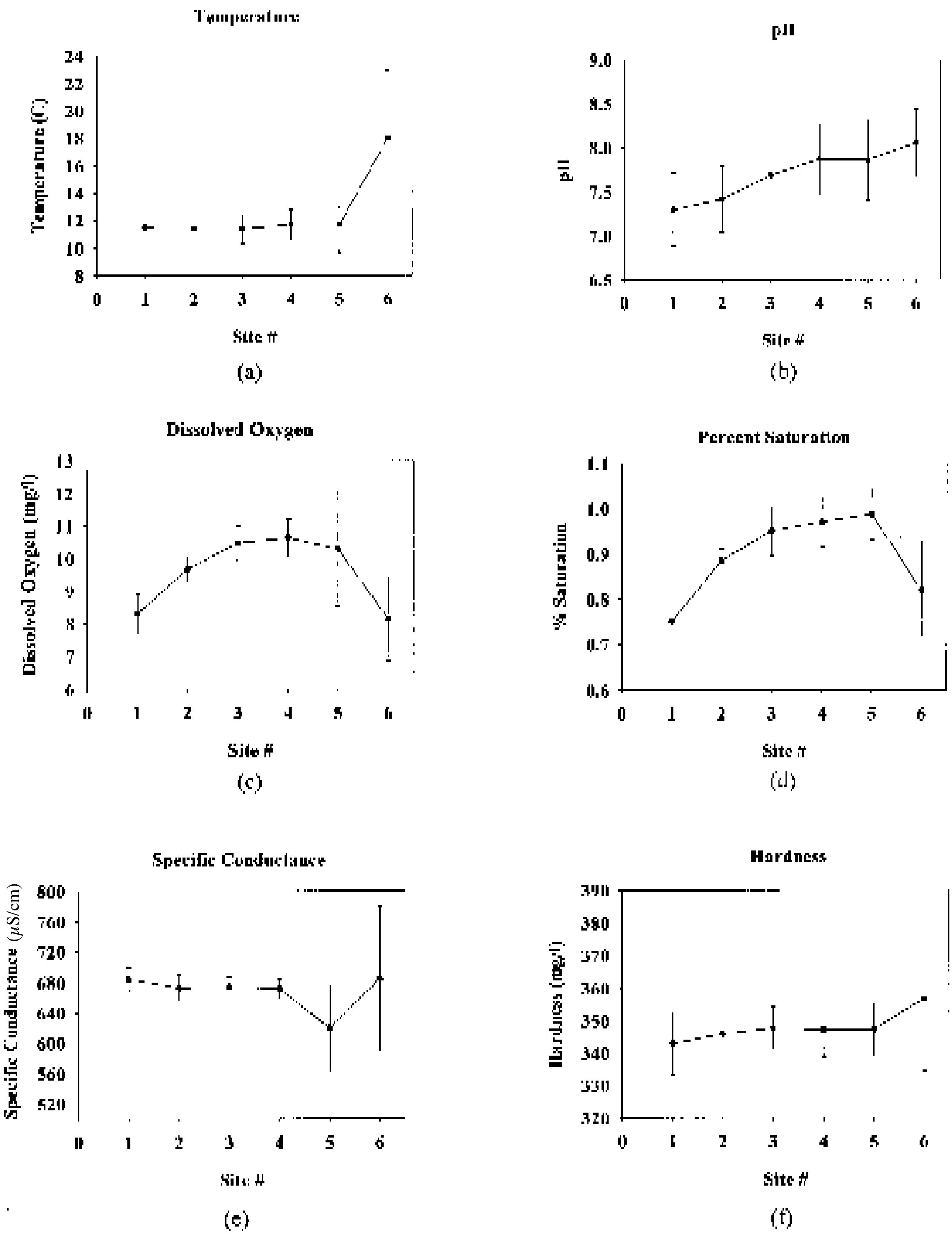

Figure 3. Mean temperature, pH, dissolved oxygen, percent saturation, specific conductance, and hardness at sites 1-6. The error bars represent the standard deviation.

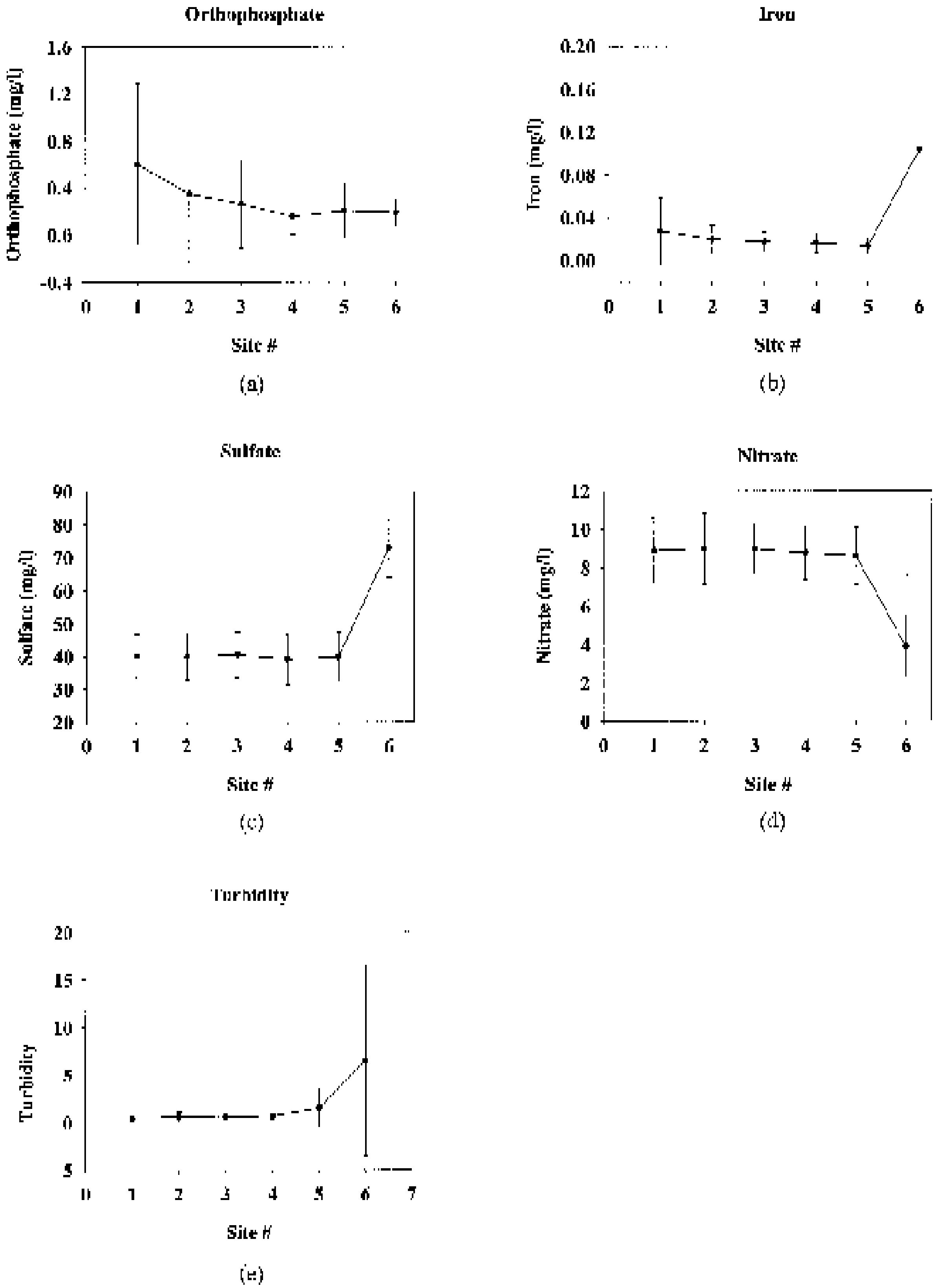

Figure 4. Mean iron, orthophosphate, sulfate, nitrate, and turbidity at sites 1-6. The error bars represent the standard deviation. 18

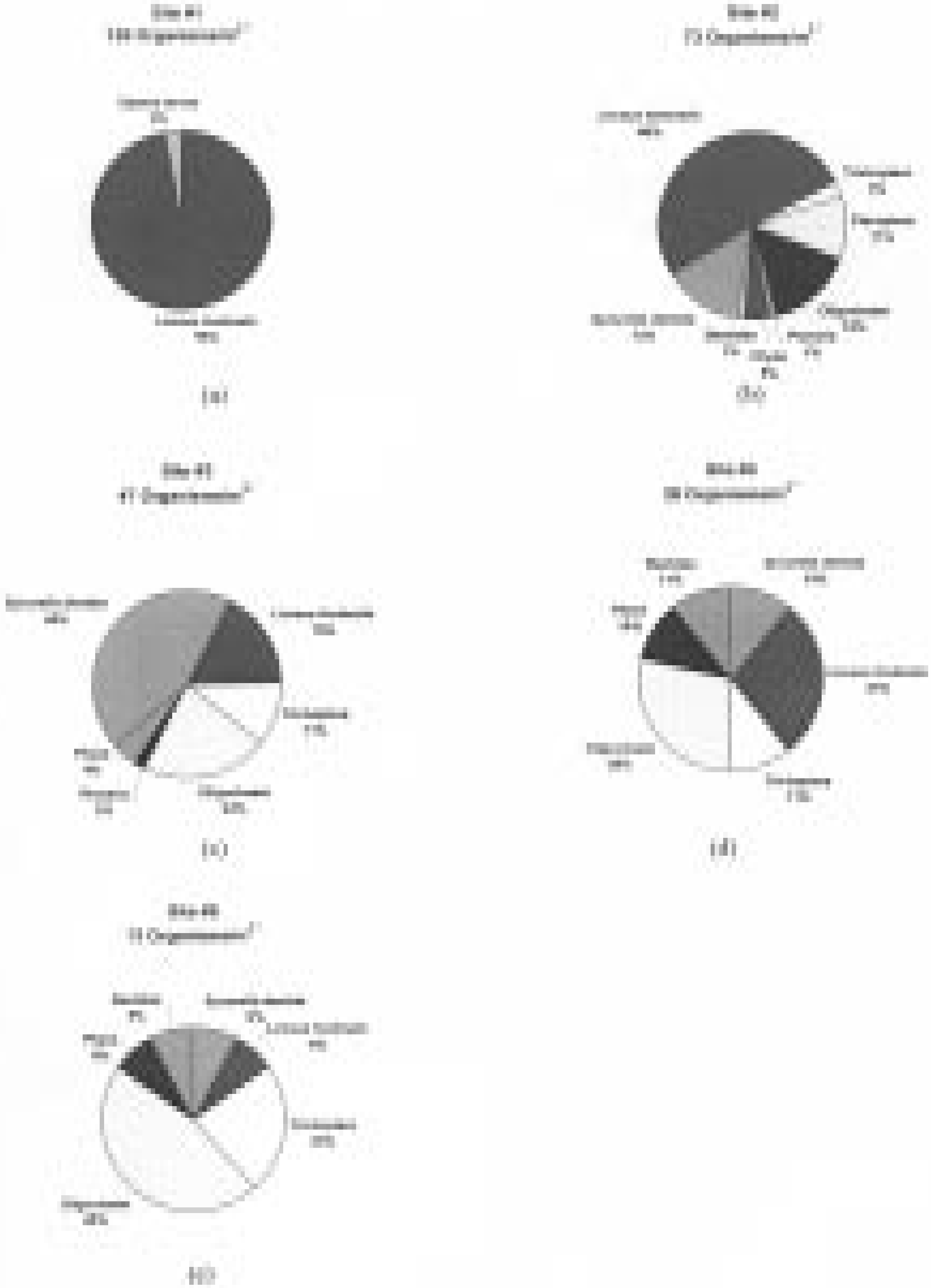

Figure 1. Densities of macroinvertebrates at sites 1-5 in Web Spring. Numbers represent mean values. Original macroinvertebrate counts were converted to organisms/m^2.

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