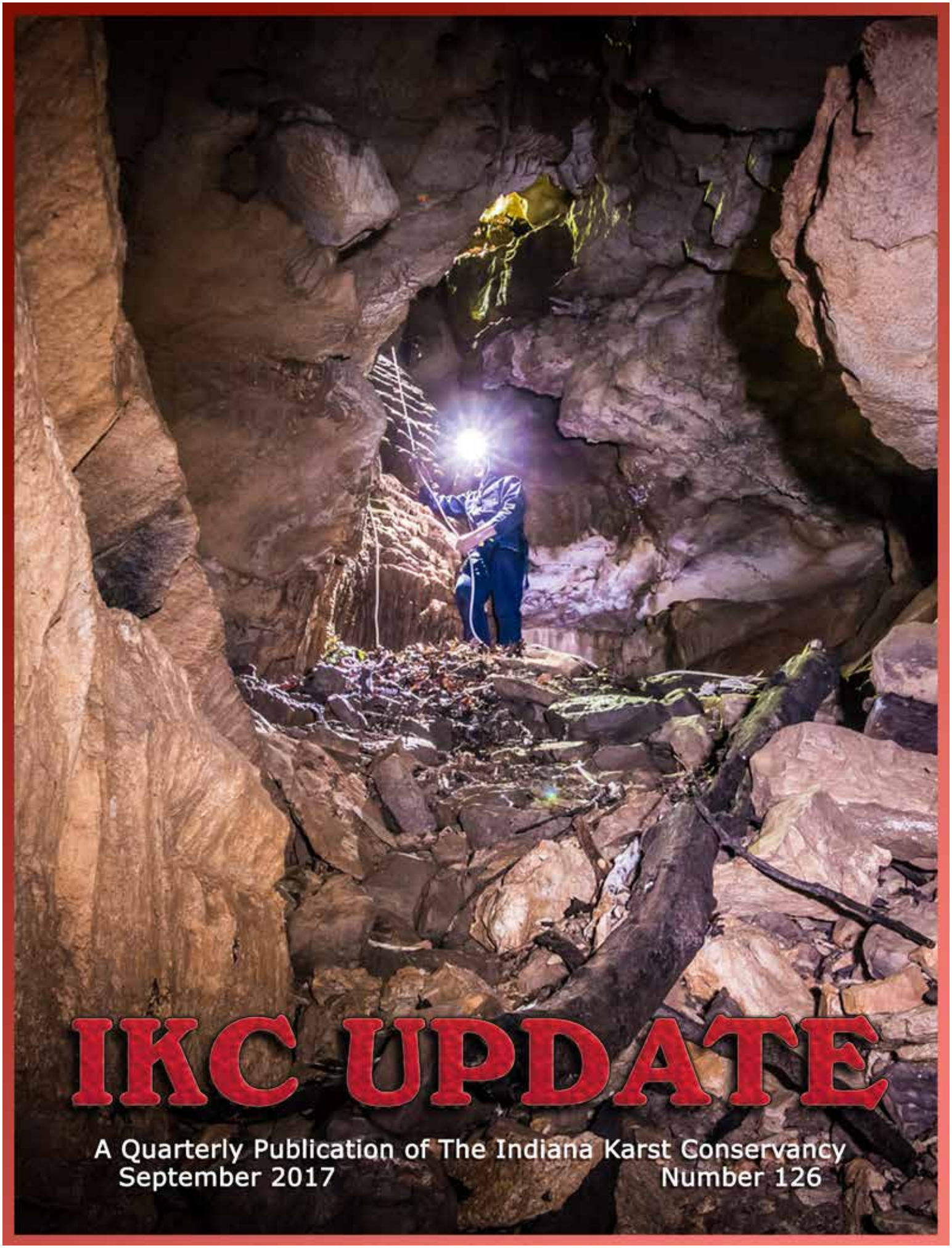


IKC UPDATE

A Quarterly Publication of The Indiana Karst Conservancy
September 2017 Number 126

INDIANA KARST CONSERVANCY, INC

PO Box 2401, Indianapolis, IN 46206-2401

ikc.caves.org

Affiliated with the National Speleological Society

The Indiana Karst Conservancy is a non-profit organization dedicated to the conservation and preservation of caves and karst features in Indiana and other areas of the world. The Conservancy encourages research and promotes education related to karst and its proper, environmentally compatible use.

Cover: Sue Vernier at the bottom of the entrance pit in Robinson Ladder Cave (Crawford County). Photo by Richard Vernier, August 2017.

Myotis Press

IKC QUARTERLY MEETING REMINDER

SATURDAY, SEPTEMBER 16th, 4:00 PM EDT

BORDEN, INDIANA

HOME OF SALISA & JERRY LEWIS

The quarterly meetings are for the Executive Board to conduct business, and for our members and other interested persons to have an open forum to talk about caves and karst conservation and related topics. Past, present, and future IKC projects are discussed to solicit comments and input from our members and the caving community as a whole. The meetings are informal, and everyone is encouraged to attend and participate. The IKC Board wants your input.

Preliminary Agenda: Recap of recent work/stewardship projects and promotion of upcoming fall projects at our various preserves; Educational outreach activities; Update of current research projects; Financial reports; Land acquisition activities; Sauerkraut Cave gate; and more....

Following the quarterly meeting (around 6 PM) will be the annual pitch-in cook-out. The main entree(s) will be provided. Please bring a salad, dessert, and/or other covered dish to share. If there are enough entries, we will also have a dessert contest. ***Please bring a lawn chair if you want to sit down during the meeting.***

Meeting address: 17903 State Road 60, Borden, IN 47106. Call Jerry at (812) 786-1744 if you get lost or have questions. More detailed directions can be found in *IKC Update* #102, page 15.

ACTIVITIES CALENDAR

Sept 16 – IKC Quarterly E-Board meeting (see above)

Dec ?? – IKC Quarterly Board Meeting (date & location to be determined)

March ?? – IKC Annual Business Meeting (date & location to be determined)

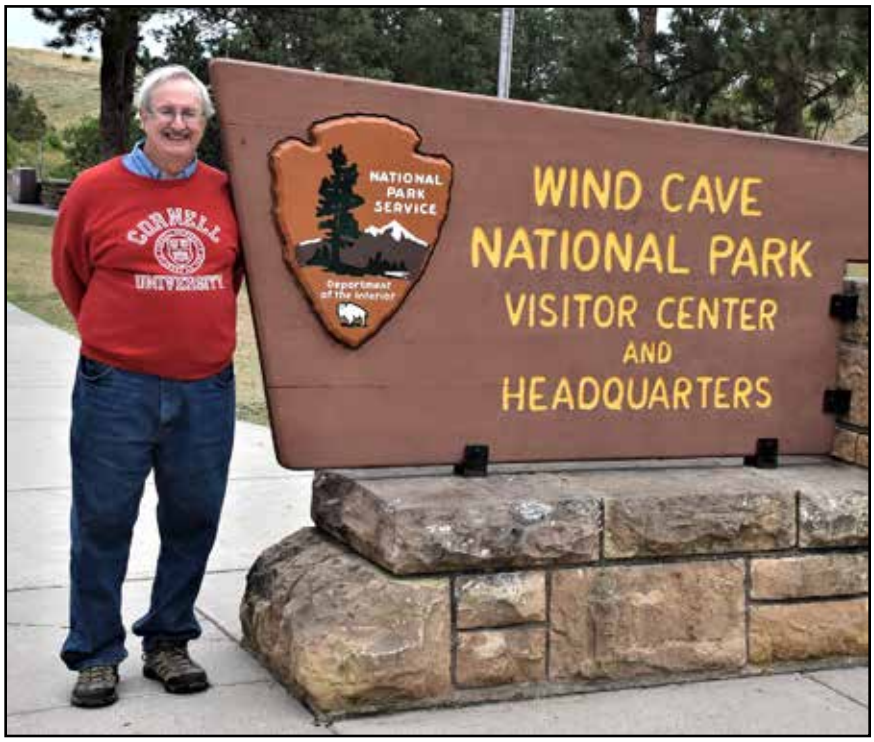
For more information on the Indiana Karst Conservancy, visit our website at ***ikc.caves.org*** or write to our PO box. Membership to the IKC is open to anyone or any organization interested in supporting cave and karst conservation. Annual dues are $15. Please see inside the back cover for a membership application form or to make a much-appreciated donation. Donations can also be made by credit card using the donation button located on our website's home page.

The IKC Update, distributed for free, is published quarterly for members and other interested parties. The purpose of this newsletter is to keep the membership and caving community informed of IKC activities and other news related to cave/karst conservation. Submission of original or reprinted articles for publication is encouraged.

RAMBLINGS FROM THE PRESIDENT...

I'm writing this in Rapid City, South Dakota, and as you'll see from the subject matter, this is my Halloween opus, admittedly a little early. In this ramble, I'm exploring ghosts: first my own, then some others. I invite you to conjure your own ghosts as I tell you a little about mine.

I'm thinking back to my last visit to South Dakota, when my parents had set out in 1963 for a month-long trip across the American west with my older brother and myself in tow. I was nine years old. My dad was a school principal, my mom a teacher, so their school duties allowed them time to travel during the summers. So off we went, my father driving the family station wagon, pulling a tent camper, with my eager young self in the back seat, undoubtedly asking, "Are we there yet!" as often as I could without my brother popping me. Actually he popped me anyway, but that's a different story.



Earlier today I encountered the spectre of my young self, as I stood at the small natural entrance to Wind Cave, listening to the National Park Service guide talk about the discovery of the cave. I remembered standing in the same spot over fifty years ago, listening to much the same spiel from another undoubtedly long-since retired NPS guide. It was sort of eerie, as if I could sense my younger self standing there (enter Rod Serling). My brother had researched the cave and on the long drive to South Dakota had extolled the wonders of the boxwork formations for which Wind Cave was best known. Keep in mind this was decades before google, and it was the job of my brother and myself to write letters to the various national parks we intended to visit to ask for park brochures and anything else they might be willing to send us. So my brother's knowledge of the cave would have been derived from a park brochure or maybe from perusing the Encyclopedia Americana at the library.

I believe Wind Cave was the first cave I'd ever visited – a trip to Mammoth Cave followed shortly after this vacation for the occasion of my tenth birthday. I vividly remember seeing the promised boxwork carpeting the cave's walls and ceilings, and thanks to the National Park Service, it's still there today. It's poignant for me to think of what seed was planted on that day that eventually led me to a life-long pursuit of caves and subterranean fauna. Perhaps as you read this, you're travelling back in time to conjure your own ghost at a place where it all started for you.

After the Wind Cave trip that morning in 1963, in the afternoon my brother took me (he had just gotten his license) on another underground adventure, to a small commercial cave grandly named Stagebarn Crystal Cave. I suspect my parents were happy to get rid of us for a couple hours, or… go ahead and say it… get rid of me and my nine year old "Are we there yet" self. I remember Stagebarn being equal parts exciting and terrifying. The entrance to the cave was gained by climbing up a staircase that to me appeared to be suspended from a cliff-face by little if anything. The cave was small, but I recall the guide turning out the lights and shining a hand-held black light on some short stalactites that made the calcite fluoresce in a spooky purple glow of the ultraviolet light. I wanted to revisit this cave on our current 2017 trip, but alas, Stagebarn Crystal Cave had closed in 2007.

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Now leaving behind my childhood ghosts, here in the present I was recently reading Edrick Thay's "Ghost Stories of Indiana" (2001), a compilation of short stories about the origin of some of our ethereal neighbors. One of the tales cited, "Two miles northwest of what is now Mauckport is Haunted Hollow. Loaded with caves and rocks, Haunted Hollow provided a place from which the pirates could strike quickly and then hide themselves from the light of justice." Doing a quick fact check, I looked at the USGS topo map of the area and sure enough, on the Ohio River two miles downstream of Mauckport is indeed Haunted Hollow. The book suggests two versions of the origin of a headless ghost who to this day walks Haunted Hollow, one a river boatman and the other a limekiln operator, but both have the common thread of thieves decapitating an early 19th century Hoosier.

I wonder if this ghost story is related to reported events at what is possibly the most politically-incorrectly named cave in Indiana, the infamous Nigger Jim Cave. The cave is located just below the top of the ridge above Haunted Hollow – coincidence? According to a description of the cave by Dave Black in the first HogFest guidebook back in 1990, the legend surrounding the cave is that this Jim fellow was murdered and his body dispatched into the cave. The map of the cave shows that about twenty feet below the entrance climbdown, a thirty-three foot pit is reached, which subsequently gives access to a large room. The end of this 155-foot long cave is a drain at the far end of the room. According to the Hogfest article, a local farmer tells of a person being lowered into the pit and then returning with a human skull and femur. When cavers later explored the cave in 1965, they also reported finding a femur and some ribs. Subsequently Ron Richards, the paleontologist for the Indiana State Museum, visited the cave and found a single bone remaining. Was it human?

Another cave located in the Mauckport quad was discussed in the Volume 9#3 (1983) issue of the I.U. Spelunking Club, again by noted spelunker Dave Black. He reported that in the late 1800s, a doctor living near this short spring cave stored cadavers in the spring, and "even practiced his operations on them in the coolness of the spring". Dave didn't cite the source of his information on the doctor and his cadavers, but the idea of doing autopsies on corpses hunched over in a small wet cave is implausible, not to mention over-the-top on the creepy-meter. On a visit to this cave about fifteen years after Dave's report, I noted a small shack above the cave and it seems more realistic that this might have been the site for whatever ghoulish stuff this doctor was ostensibly conducting.

Departing the haunted Mauckport area and travelling a few dozen miles north and west, I cite the astoundingly stupid judgement of a southern Indiana gentleman whose wife turned up missing in 1997. When questioned by the police, he at first indicated that he and his wife had argued and that she had left the house. Ultimately however, he admitted that he had strangled her with a cord and hid the body in a cave, presumably a place he believed the body would never be found. He took officers to the cave where his wife was found inside a black canvas bag, with the cord still around her neck. The secret hiding place? Langdon's Cave on the Harrison-Crawford State Forest, one of the most heavily visited caves in Indiana. He was subsequently convicted by a jury of murder, received 65 years in prison term.

Moving to north of Salem, one finds Suicide Cave, managed by the IKC. In the guidebook for the 1992 NSS Convention in Salem, Scott Fee and Ed DeJean presented a long history of how the cave came to have its name. The short version is that back in the 1920s, three locals had a cave trip cut short when they encountered the body of Bailey Bowling, who had laid down on a ledge in the entrance passage of the cave and committed suicide by shooting himself. Today no hint of this macabre chapter in the cave's history remains to be seen, but the legend remains.

It seems that southern Indiana caves have been the site of a number of tragic events over the course of time. The episodes cited above are all historical in nature, but sadly the trend continues. In a manner similar to that at Suicide Cave, a Georgetown man entered Breathing Hole (near Wyandotte Cave) in 2011 and died of a self-inflicted gunshot wound. He had been missing and the extensive search for him in the Harrison-Crawford State Forest had been the topic of news articles. His corpse was unexpectedly discovered by a group of cavers six months later, with a subsequent difficult body recovery due to the many constrictions in the passage, and the relative remoteness of the part of the cave in which he chose to end his life.

There remain other similar tales that could be told, but at this point I've creeped myself out, so I'll just wish you an early festive "trick or treat!" and I'll start thinking about finding my young self's ghost next at Carlsbad Caverns.

Jerry Lewis

SPECIES SURVEYS WITHIN THE GARRISON CHAPEL KARST AREA HINT AT HIGH SPECIES RICHNESS

by Marc Milne

The Garrison Chapel Karst Area has been visited and explored by scientists and cavers (and caver scientists, for that matter) for over 100 years. It's chock full of sinkholes, springs, and caves – a true karst habitat. Although inhabited by First Nations people for thousands of years, it was only until the early 1910's that scientists mapped, described, and named many of the epigean and subterranean sites within the area. The recognition of the importance of this area largely falls to R. B. Marshall and J. W. Beede, who, in 1910 and 1911, respectively, described the topography and geology of the area, including the underground compartmentalization that occurs throughout. As explained by G. A. Conner (1987), the Garrison Chapel Karst Area encompasses four main cavern systems: 1) To the north there are interconnected streams that flow through Coons, Grotto, Salamander, and Shaft caves, 2) near the center is Wayne cave, with Buckner as well a little more to the south, 3) furthest south is the Blair Springs system, and 4) to the east is Eller Cave. A more detailed explanation of the geology of Garrison Chapel Karst Area is given by W. L. Wilson (1985), who explained its connection to the Mitchell Plain and how river and stream flow created the subterranean passages. Moreover, many of the caves throughout this area were originally reported by W. S. Blatchley (1897). Within and around these caves are organisms that depend on the health of these systems for their very survival.

Pseudanophthalmus. Photo by Dante Fenolio.

One of the most notable cave organisms, bats, have been well documented from several Garrison Chapel caves over the past 35 years. The bat fauna within some Garrison Chapel Area caves has been shown to be very large while, in others the bat populations were nonexistent. Some caves, such as Grotto Cave and Coon Cave, have – historically – held substantially large populations of *Myotis sodalis*, the Indiana bat. Other caves within the area, such as Eller Cave and Shaft Cave have no records of hibernating bat populations. However, in the caves that do possess records of bats, the trend is clear: bat populations are plummeting. For example, since 2010, the *M. sodalis* population in Grotto Cave has dropped by 99.5%. Coon Cave bat population numbers are also falling, though less frighteningly so (-37%). Similarly, today, Buckner Cave is virtually bat-free when less than five years ago, its bat population numbers were over 350. The survival of Indiana bat populations may hinge on the protection and proper management of karst areas due to the devastating effects of White Nose Syndrome (WNS) (Thogmartin, et al 2012). While completely closing all caves to human visitors may not be the answer, leaving caves alone to be mis-managed or unmanaged is clearly not the answer either. It's likely that the best way to protect these bats is by conserving the land around these caves as well as the caves themselves (potentially including the installation of bat-friendly gates, monitoring bat populations, and restricting the spread of WNS through the encouragement of proper decontamination procedures).

The invertebrate fauna within this area is likely extensive, but two discoveries by two IKC members are worth discussing further. The first discovery, by our IKC President, Dr Jerry Lewis, and his amazing wife, Salisa Lewis, was from a survey of Wayne Cave they conducted in 2008 for the IDNR Division of Nature Preserves. Jerry and Salisa had intended for the Wayne Cave bioinventory to be "Part 1" of a multi-part project on the biology of the caves of the Garrison Chapel karst, with Salamander/Shaft/Grotto/Coon caves the intended target of "Part 2". That plan changed when caves were closed by the USFWS due to White Nose Syndrome, then the IKC discontinued its stewardship over some of these caves due to circumstances beyond its control. In that initial biological inventory, the Lewis's reported a vast collection of organisms, from flatworms (Weingartner's cave flatworm) and crayfish and their inhabitants (Barr's crayfish ostracod) to millipedes (Bollman's cave millipede) and salamanders (Cave salamander). In fact, Lewis and Lewis (2008) discovered 47 different organisms in Wayne cave, fourteen of which were considered obligate cave

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species (troglobitic). This level of troglobitic species richness is quite high for Indiana and places Wayne Cave as tied for the fifth-richest cave in the state in this regard. However, the most surprising find was an undescribed species of beetle. This beetle is in the genus, *Pseudanophthalmus*, and is only known from Wayne cave, making it an endemic species. It remains undescribed.

The second interesting discovery is an epigean one. During the Wayne Cave area clean-up in early June 2017, with permission, I collected spiders on the property in the area around the parking area. As it turns out, one of the species that was collected that day in early June was *Oxyopes aglossus*, a lynx spider that has never been found in Indiana. This new distribution record for the state is an important find because its presence reiterates the fact that the Garrison Chapel Karst Area – especially the wooded land around Wayne Cave – is a healthy, diverse habitat that possesses many rare species to the state. Taken together, these two discoveries emphasize that the conservation of much of the Garrison Chapel Karst Area would be a boon to the species present – both below and above ground.

Oxyopes aglossus. Photo by Marc Milne.

Sources:

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NEWS BRIEFS...

- With two 5+ inch rains this spring, the 2016/2017 tree plantation at Robinson Ladder Cave Preserve is showing great progress. There is one hybrid American chestnut tree that has surpassed eight feet in height and many more chestnut, butternut, and black walnut trees that are over six feet tall. The red oaks are doing fine too, but typical for them, they spend their first few years building a root system prior to adding height. The main factor to the trees' success is the perimeter fence that excludes deer from the planting area. Because of the importance and expense of the chestnut trees (provided by The American Chestnut Foundation in cooperation with the US Forest Service and Purdue), we are investing a lot of effort into the trees with twice annual herbicide treatments, as well as two mowings per year. Mortality this year has been very low, and the ones that did die were likely due to too much rain right after the trees were planted.

- The IKC has gained three new member in the last quarter. Welcome Ken Nisly-Nagele, Dan Vetters, and Nick Saulcy. The IKC membership currently stands at 198.

INDIANA'S KARST – WHAT DO WE CONSERVE?

by Matt Selig

One of the main pillars of the Indiana Karst Conservancy's mission is to conserve Indiana's cave and karst resources. I have thought often on just what is a "karst resource" while driving up and down State Road 37, crawling through the hinterlands of too many caves to count, and while observing the surface topography of Indiana's karst region.

As a caver, I was fortunate to take Roger Brucker's "Speleology" class in 1997 at Mammoth Cave, sponsored by the Center for Cave & Karst Studies. We spent a week learning about Roger's take on the Mississippian limestone karst areas which stretch from northern Indiana to the Gulf of Mexico, and so definitively describe the caves of Indiana and the Mammoth Cave region.

"Speleologist" is a cumbersome word. Everyone I know prefers the word "caver" to describe the scientists that study and love caves. We have earned the right to call ourselves cavers, separating ourselves from "spelunkers" and hobbyists who also use and sometimes misuse karst resources. I know in this newsletter that I am preaching to the choir, but it bears noting, and we should continue to say it, as long as non-cavers ask us, "So you're a spelunker?"

Brucker's way of looking at karst was to consider six scientific disciplines which bear on cave regions. Before he had laid out this structure, I had only considered one aspect of karst – Geology. Brucker insisted the scientific disciplines that need to be looked at in an integrative fashion when considering "karst" are:

Geology	Hydrology
Chemistry	Biology
Archeology	History

As I have pondered on these topics while pulling surveying tapes through long, wet crawlways and hauling buckets of rock from digs to nowhere, it makes me think, in terms of karst conservation, "Just what exactly are we conserving?"

The following pages are thoughts I've had about cave and karst conservation seen through the lens of Brucker's Six Scientific Disciplines of Speleology. These reflections relate mainly to the caves of Indiana and the Mammoth Cave region. I make no claims they are applicable karst and caves everywhere, nor do I guarantee they are completely scientifically accurate, nor detailed down to the last considerations, although I have made every effort to stick to known and accepted fact, and avoid speculation, and to (mud)paint in broad brush strokes, as opposed to finicky detail.

Brucker was a marketing professor by background, while I am an accountant. I have no specific expertise in any of these scientific disciplines and ask if anyone finds any factual whoppers in this article to please (gently) correct me. These thoughts are meant more as reflections on a general philosophy of caves and karst conservation, and they are what I think about when I go caving!

Before our first underground trip in Brucker's Speleology class, he told us, "I went on my first cave trip when I was eight years old. It felt like I was jumping over the fence and going somewhere I wasn't allowed to go. I'm 70 and I'm just as excited about this cave trip we're taking today as I was my first one in 1935! Let's go!" I feel the same way about all the cave trips I've ever been on!

Likewise, let's put on our helmets, tighten up our kneepads, jump over the fence, flip on our high-speed LED light systems, snap on our Flint Ridge cave packs over our shoulders, and head off into the dark unknown…

Geology

The first feature of Indiana's cave region is rocks. Lots of rocks. They are the most obvious component of Indiana's karst region. One definition of the word cave is "a void in the rocks." Brucker found this laugh out loud funny, that cave sciences begin with the study of emptiness, the examination of something defined by its absence, as much as anything.

But we know the Mississippian rocks that contain the majority of Indiana's caves (disregarding the few caves found in Indiana's Devonian and Silurian limestones) were deposited in Indiana by a shallow ocean between 323 – 359 million years ago. As this shallow ocean was repeatedly inundated and abandoned the land, it left behind layers (known as "bedding planes") of limestone, sandstone, cherts, and other minerals which contain indicators of the ancient environmental conditions that existed at the time they were deposited.

In Indiana, most of our cave systems are located (from top to bottom, or youngest to oldest layers) in the Paoli and St. Genevieve limestone formations, with some passages in the St. Louis

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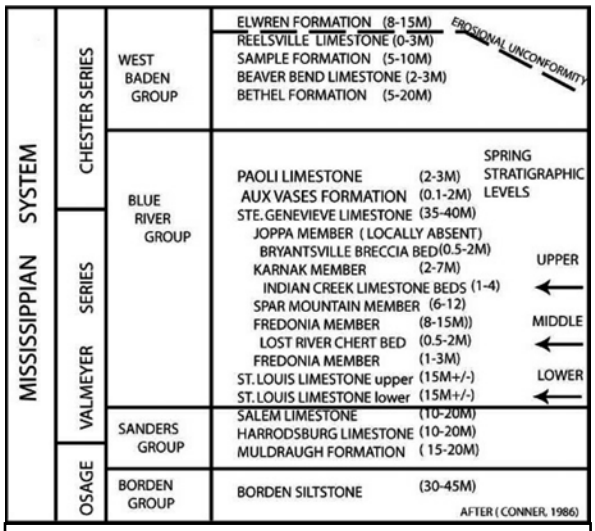
limestone formation. These latter limestone beds were named after the town of St. Genevieve, Missouri and St. Louis, Missouri, where they were first scientifically described, which gives us some idea of the extent of this ancient inland sea.



Mississippian Karst Limestone of Indiana, Stratigraphic Column. Garre Conner (2011).

The law of horizontal deposition says these limestone beds were deposited and lithified (turned to stone) in horizontal sheets, described in the stratigraphic column, above. Given that the surface of the earth is curved, the massive weight of these limestone beds caused them to crack to conform to the earth's surface (imagine wrapping a flat piece of paper around a basketball).

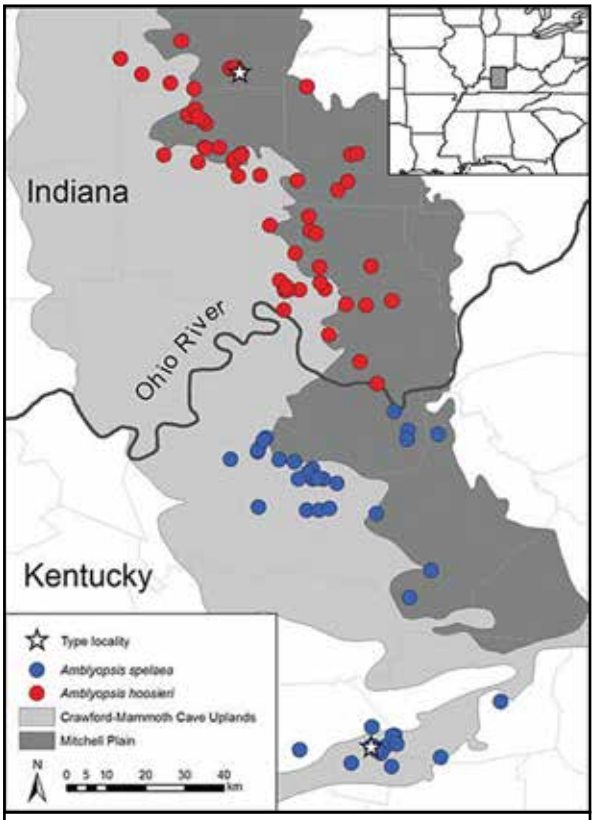
These cracks are known as joints. Due to the crystal structure of limestone (calcium carbonate, or $CaCO_3$), these joints form in a regional boxwork pattern of near right angles spread across the limestone beds. Joints running parallel to the dip are called "dip joints" and joints which run at a 90-degree angle to the dip are called "strike joints."

What is "dip"? Geological processes of uplift and subsidence also cause these sheets to lay at a downward angle, which is called the "dip." In general (and it is a big "in general"), in Indiana, these limestone beds dip at a slope of 20 feet per mile, generally to the south and west across the region. In the Mammoth Cave region, this dip slope is roughly 40 feet per mile, and the limestone beds are much thicker compared with Indiana's, allowing for the development of larger cave systems. This dip slope allows water to flow over and through the limestone with the force of gravity.

There are two basic areas of these Mississippian limestones in Indiana. One, the Crawford Uplands (see below), is covered by a formation known as the Big Clifty Sandstone, which protects the limestones underneath it from erosion caused by surface water. Caves in the Garrison Chapel Valley region fit this description. Cavers standing in the parking lots at NSS's Buckner Cave or the IKC's Wayne Cave preserves are standing on top of the Big Clifty Sandstone in the Crawford Uplands.

The other Mississippian karst region in Indiana consists of limestones not covered and protected by the Big Clifty Sandstone. This area (in Indiana) is known as the Mitchell Plain (and known as the Pennyroyal Plateau in the Mammoth Cave region) and from the air, its thousands upon thousands of sinkholes make it look like a World War I "no-man's land", because the limestone surface is not protected by sandstone from dissolution, as are the same limestone beds of the Crawford Uplands. The IKC's Shawnee Karst Preserve and Buddha Karst Nature Preserve (and the caves of Spring Mill State Park) are prime examples of caves that have formed underneath the Mitchell Plain, as is the Lost River Cave in the Wesley Chapel Gulf area.

The boundary between the limestones covered by the Big Clifty Sandstone and those exposed



Crawford Uplands and the Mitchell Plain - This map also shows the range and extent of blind cave fish, along with the borders of the Crawford Uplands and the Mitchell Plain in Southern Indiana and the Mammoth Cave Region.

en.wikipedia.org/wiki/File:Amblyopsis_hoosieri_range_map_29327.jpg

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The Springville Escarpment (the second/distant ridge at the top of the photo) viewed east of Orleans, Indiana on the Mitchell Plain looking to the west across the river bed of the Lost River. Photo by Matt Selig (2017).

to the elements is known as the "escarpment", a cliff-like structure of sandstone which can be seen to the west of State Road 37, while driving south from Mitchell, Indiana (see above).

As sandstone isn't soluble in acidic water, this escarpment erodes very slowly compared to the limestone, but over the course of geologic time, this escarpment will continue to retreat south and west and expose more limestone beds to surface erosion. In other words, the Mitchell Plain is growing larger, while the Crawford Uplands are becoming smaller.

A happy fact for cavers is that in the Crawford Uplands, cave entrances and pits form mainly at the intersection of the sandstone cap rock and the limestone beds beneath it, where this sandstone-limestone "contact" crosses an intersection of dip and strike joints. As water rolls off the top of the insoluble sandstone cap rock, it dives straight down this joint intersection and forms a (geologically speaking) young pit by enlarging this joint intersection. If this pit intersects a previously formed horizontal cave borehole, an entrance can be created. Wayne Cave is a great example of this type of entrance morphology, where all of these phenomena can be readily observed.

And what are we conserving with this geological aspect of caves? Surely southern Indiana will not run out of various types of limestones and sandstones in the course of human history, but it must be remembered that our study of ancient climates depends on reading the historical record. Also, southern Indiana's limestones serve an important economic function, as they decorate the exteriors of some of the most famous buildings in the world, including the Empire State Building, for which over 35 million pounds of Mississippian limestones were mined from the Empire Quarry south of Bloomington. Additionally, according to Wikipedia, 35 state capitol buildings are covered in Indiana limestones.

So, water dripping and seeping through and over these rock units creates the voids we seek to explore and conserve. Let us now think about the water resources in southern Indiana's karst landscape.

Hydrology

Over the Indiana karst region, water generally flows in the direction of the landscape's regional dip, towards "base level streams" where the water is collected and eventually routed to the Mississippi River, then to the Gulf of Mexico. When we say "base level streams," we can mean anything from local base levels such as Rattlesnake Creek near Spencer, Indiana, to the very large regional base levels where these localized base levels drain into, such as the West Fork of the White River, where State Road 46 crosses the river between Spencer and McCormick's Creek State Park (which contains the small but heavily visited Wolf Cave).

There are five major base level rivers in Indiana's karst territories, which are, more or less, from north to south:

	USGS Gage #
West Fork of the White River	03357000
East Fork of the White River	03371500
Lost River	03373560
Patoka River	03374500
Blue River	03302800

Think of a drainage basin as defined by which river a drop of water will flow to if it falls on a part of Indiana's karst landscape. A drop of water that falls near Salamander Cave in Garrison Chapel Valley will flow to the West Fork of the White River. A drop of water that falls near Orleans, Indiana will flow to the Lost River. A drop of water that falls near the entrance of Binkley's Cave near Corydon, Indiana will flow to the Blue River.

Think also of other liquids. An underground storage tank in Bedford, Indiana can leak and the petroleum products will (and they have in the past) flow through and contaminate cave passages flowing towards the East Fork of the White River. Industrial waste, septic tank effluent, livestock

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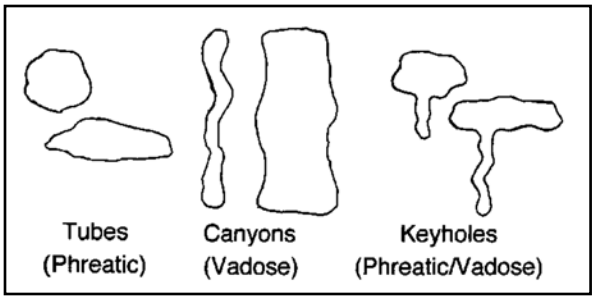
manure, agricultural chemicals, and contaminant spills of any type can quickly flow into and transport faster than first responders can contain or remediate the damage.

As we discussed in the Geology section, these fluids flow through cracks in the rocks (joints), from areas of relatively high hydraulic head (pressure) to areas of low hydraulic head. For example, think of the point where the Lost River disappears into the Mitchell Plain as an area of high hydraulic head relative to where it re-emerges south of Orangeville, at the True Rise of the Lost River, which is an area of (relatively) low hydraulic head.

With the exception of some "sealed" sinkhole ponds, karst regions do not hold surface water for any length of time (apart from base level streams and rivers) because rainwater that falls on Indiana's karst quickly sinks through the limestone joints and sinkholes to the water table, defined as the surface of the water we see in underground streams and other bodies of water in Indiana's caves.

Cave passages that form in "pipe full" conditions are known as phreatic passages, while passages that form with some air in them are known as vadose passages. Each condition creates stereotypical oval tubes (in phreatic conditions) and canyons (in vadose conditions). Passages formed under both conditions take on a "keyhole" shape.



GCG Newsletter, March 1998.

In the picture (above right) from Pine Valley Cave (Orange County), the phreatic tube at the top (filled with the caver) and the vadose canyon on the bottom (the area below the caver) of this keyhole passage are visible. Note the clearly visible limestone bedding plane next to the red helmet, separating two layers of limestone.

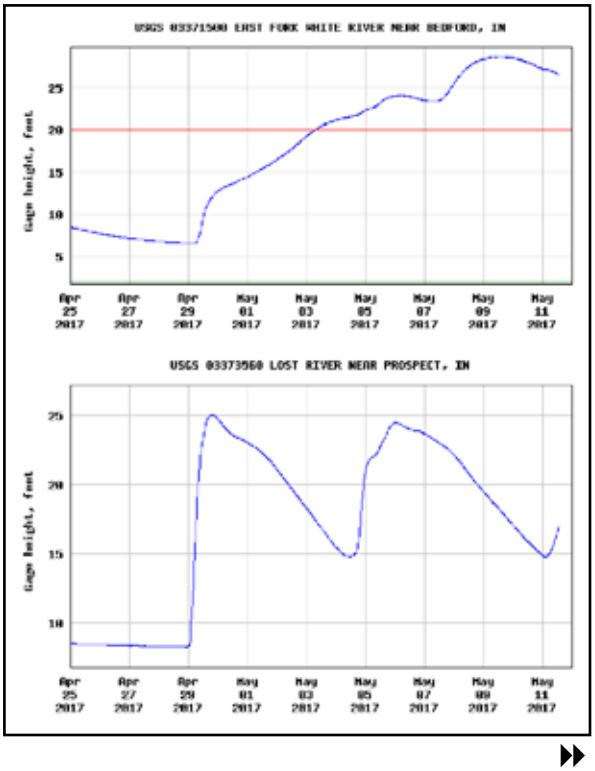
The level of the water in the "intermediate" phreatic zone is primarily controlled by the water height in the local and regional base level streams that receive drainage from the cave springs of the drainage basin in question.

The United States Geological Survey (USGS) posts data from its Indiana stream gages online so that we can monitor stream flow data in terms of stream height and water volume in near real time

photo by Matt Selig (2004).

as rainfall events move through Indiana's karst region. I have included the Stream Gage identification numbers associated with the regional base level streams previously noted (see page 10). More USGS Indiana Stream Gage data are located at ***waterwatch.usgs.gov/?m=real&r=in***.

Let's examine one rainfall event as it moved through the drainage basins of Indiana's major karst base level streams. This rainfall event is reflected in the water height hydrographs shown below between the dates of April 25, 2017 and May 11, 2017. Looking at these hydrographs, it can be observed that the same rainfall event creates different effects of stream height as it surges through the different regional base levels' drainage basins. We can see that the rainfall event surge at the East Fork of the White River near Bedford responds differently from the Lost River gage near Prospect



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due to the drainage basin characteristics and river bed geometry that the water moves through, although these considerations are beyond the scope of this essay. Conversely, it can also be observed that rivers with similar hydrographic responses ofen share similar physical characteristics.

In order to see the contrasting stream bed's response to this rainfall event, compare the East Fork of the White River (above) with the Lost River (below) on May 14, 2017.

As can be seen from these two points on State Road 37 (which are only a short drive from one another), that: 1) the river bed geometry of each river is very different; and 2) these two regional base level streams respond very differently to the same rainfall event. Another factor to consider is that even in these high-water conditions, as reflected by the hydrographs, the majority of the Lost River's water is transported underground.

From a standpoint of conservation (and safety), it should be noted that based on where a drop of water or a contaminant lands in Indiana's karst region, it will behave differently as it moves through the drainage basin it lands in. For cave trip leaders reading this article, in addition to checking the weather report for rain before leading a cave trip, please also consider checking the USGS stream gages (there are many more than noted here) for the area you plan to go caving.

Also, we should carefully note that the same rainfall event can cause flood stage water events on some rivers while no flooding on others, and that just because a cave in one drainage basin might not be flooded, it should not be assumed that caves in other drainage basins will not flood due to the same rainfall event.

Another factor affecting hydrology in karst regions is human activities. A perfect example of this effect is seen at the Williams Dam west of Bedford on the East Fork of the White River, which in the picture (below) demonstrates how dams raise the surface of regional base level streams, which in turn raises the level of water in caves controlled by these

base level streams, such as in Doghill Donahue Cave, as discussed below, and in Bluesprings Caverns, which is also upstream of the Williams Dam.

In fact, a great example of an Indiana cave system where a caver can trace the complete underground route of water from where it sinks to where it drains into a major base level stream is to enter the Culvert entrance of Doghill-Donahue cave and complete a through-trip to the Boat Club entrance, which overlooks the East Fork of the White River.

The following picture is taken looking towards the Boat Club entrance of Doghill Donahue cave. It is not difficult to imagine that as water in the East Fork of the White River floods (as evidenced by the submerged picnic area), water

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in the cave backs up into the cave and raises the water level in the cave's intermediate phreatic zone, as discussed previously.

And don't forget, all the spring exits from caves in Indiana's karst territory are not necessarily visible from the surface. A cave's spring exit may lie underneath the surface of the base level stream into which it drains. Underwater spring exits can be located in major base level streams by measuring ion concentrations of dissolved Calcium Carbonate ($CaCO_3$, or limestone), which is a great opportunity to transition to…

Chemistry

Now that the rocks and water of Indiana's Mississippian karst region are in place, we get to the magic that "makes" karst worth exploring, studying and conserving. Most of the magic of southern Indiana's caves can be distilled into the beautiful (at least to me) chemical equation:

$$CaCO_3 + H_2O + CO_2 \leftrightarrows Ca(HCO_3)_2$$

Say what??? Let's dig into this... As noted previously, calcium carbonate is the main ingredient of limestone. In chemistry, limestone is notated as "$CaCO_3$". Calcium carbonate does not dissolve in neutral pH water, but readily dissolves in acidic water.

This acidic water in Indiana's karst region is created when rainwater falls from the sky, lands on the decaying vegetation covering the karst bedrocks, which in turn releases carbon dioxide (CO_2) that dissolves in the rainwater, creating the weak organic acid, carbonic acid (H_2CO_3).

In plain English:

water + carbon dioxide = carbonic acid

carbonic acid + limestone = caves

Let's consider this process in more detail. Imagine you are standing on the Mitchell Plain, observing where the Lost River sinks into the earth, and disappears. If you were to measure the level of calcium carbonate dissolved in this water where the Lost River sinks, you would note a (relatively) low concentration of dissolved calcium carbonate.

If you were then to travel to the True Rise of the Lost River, where this same water re-emerges back into the light of day, you would be able to measure a stronger concentration of calcium carbonate in the water, and a less acidic pH. If you could estimate the volume of "voids" that exist in the limestone of Indiana's karst regions, and then come up with an average dissolution rate based on these measurements of relative calcium carbonate concentrations, you would have one estimate of how long it took to create the voids (cave passages) we seek to conserve.

Depending on when this dissolution process started, most reasonable estimates of when Indiana's caves began forming point to one to three million years before present. Or another way of looking at this, by knowing the regional water flow (which can be determined from the USGS stream gage data) and dissolution rate, we could calculate the volume of new caves created every year in Indiana's karst region.

We will note at this point that pits and shafts in caves (such as Shaft Cave and Gory Hole) form by the same dissolution process, but as Brucker notes, this process happens relatively quickly (in geologic time) and we cannot use this same method of measuring calcium carbonate concentrations to estimate their age. The reason shafts form relatively quickly is that when the sandstone caprock covering the limestone bedrock beneath erodes sufficiently to allow water access to the joints in the limestone underneath it, water swiftly sheets down the joint causing rapid dissolution, which in turn widens the joint and forms vertical shafts.

It must also be remembered that millions of tons of limestone are transported through the forming caves, out spring exits, into base level streams and eventually to the Gulf of Mexico where they can be redeposited and (perhaps) in another 350 million years form new karst features. Brucker (and many others) are adamant on the point that the creation of caves in Indiana and Kentucky's karst region is a chemical process as opposed to a mechanical process. Although as with the sandstone erosion of the Crawford Uplands, there is some erosion caused solely by mechanical processes.

These same chemical dissolution and deposition processes are responsible for many of the beautiful cave formations we seek to preserve as well. Stalactites, stalagmites, soda straws, rimstone dams, helictites, scallops, curtains, draperies, bacon rind, all of these formations (when formed from calcium carbonate) find their ultimate origin in this same chemical process and its resulting dissolution and re-deposition. And we have all seen that spelunkers and others with no interest in preserving karst find these features attractive targets for vandalism.

Other minerals exist in abundance in Indiana's karst, as well. Gypsum deposits glitter in the dark (as in Wayne Cave's Gypsum Passage) and form

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cave flowers as it extrudes from the rock matrix onto limestone walls. Mud deposits from glacial sediment surges fill passages and saltpeter was actively mined from these caves to make gunpowder in late 18th century. Mirabilite was used as a laxative by Paleo-Indians, and a casual observer could note the many other (and unusual) minerals found in Indiana's karst region, such as the glacial granite boulders found in the karst valleys to the northwest of Spencer, Indiana.

Which leads us to the discussion of the biological abundance found in caves, and ultimately how the impact of the humans of recent history and our ancestors have left their imprint on Indiana's karst regions, and things we need to think about in terms of karst conservation's impact on living organisms of the past and present. These topics, and more, will be covered in the December *IKC Update*.

A LOOK BACK AT INDIANA KARST

by John M Benton

On The Discovery of Marengo Cave Indiana

Marengo Cave, located in Crawford County Indiana, has been operated as a show cave since its discovery in 1883. A brother and sister, Orris and Blanche Hiestand, are given credit as the original discoverers of the cave; they were students at the nearby Marengo Academy. A story has persisted that they found the cave after pursuing a rabbit; this was not the case as the following signed affidavit by Orris shows. The siblings noticed the opening and explored it. The following was notarized in Tulsa County Oklahoma on September 30, 1946 by Orris Hiestand which is where he resided at the time, some 63 years after the discovery:

My sister, Blanche Hiestand and I, deliberately discovered the Marengo Cave and we were not running down a rabbit, as has been told for many years. The following tells how we came to discover the cave.

August 1883, Ferdinand Jones and some other students of the Marengo Academy, taught by Prof. J.M. Johnson, had been to a woods pasture east of the cemetery, to a spring that came up out of the ground. This field was owned by Samuel M. Stewart. A few feet from the spring, was a large "sinkhole." It was probably six or eight feet across. Pigs would fall in it and never get out, so Mr. Stewart had put old stumps, logs, rocks, etc. in it to fill it up.

Mr. Jones struck matches and looked in the hole and saw it was a large cavity. When he came back to Prof. Johnson's home where he boarded, he told Roma Johnson and my sister Blanche, what he had seen and said it might be a cave.

Blanche told me about it and suggested that we take a look. We managed to get two candles and slipped away from home. We got down on some logs in the hole, then I'd locate a place where we could let ourselves down and have a foothold. It was a very steep slope, but we made it down to solid ground. We would go a few steps, then look back for the streak of light from the opening. We figured we could follow our foot prints back. When we reached the bottom of the slope, we saw the grandest feat of one continuous sparkle, sides, ceiling, and floor. We were excited and of course we did not know the commercial value of it. To us, it was just a grand and wonderful place of beautiful formations. This was on Thursday, Aug. 27, 1883.

I went to where our father was building a house and told him what Blanche and I had seen. He thought it was "just another cave spring" but said he would go with us on Sunday to have a look.

The original sinkhole entrance to Marengo Cave, now physically closed. John Benton (2015).

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Sunday came and we were ready to start when Rev. Samuel Hobson and wife came to spend the day, so father couldn't go.

Morton Patterson was my big boy friend, being some older than me and he would get me out of boy scrapes, such as fishing on Sunday, so I told him and we got John Kimbrell and Sam Land and we four went in the cave on Sunday September 6, 1883. After this, the news got out about the cave and everyone around, came to see the wonderful cave.

So, the Marengo Cave was discovered by the curiosity of a sixteen year old girl, Blanche Hiestand and here eleven year old brother, Orris. Charles Stewart, one of the sons of Samuel M. Stewart, owner of the cave land, lives in Marengo, and has always been a friend of the Hiestands. Roma Johnson, referred to above, married Victor Claycomb and they were the parents of Lloyd D. Claycomb, Judge of Marion County Circuit Court.

The author greatly thanks long time caver and past Marengo Cave co-owner, Gary Roberson, for providing a copy of this document to me, several years ago.

MARENGO CAVE ORIGINAL ENTRANCE BUILDING
CIRCA 1883 - 1910

CAVE WEEKEND AT SPRING MILL STATE PARK

by Jerry Lewis

On August 26, Jerry and Salisa Lewis represented the IKC by participating in Spring Mill State Park's "Cave Weekend". They presented a slideshow on the karst, caves, and cave life at Spring Mill to a standing room only audience. As part of the IKC's ongoing education and outreach program, Salisa came sporting the latest fashions in caving attire – helmet, light, elbow and knee pads, and cave pack, and talked about how the gear was necessary to safely enter caves. For points in the presentation, examples were given for ways that the audience members could "see for themselves" during their visit to the park. For instance, the early twentieth century ruins of Carl Eigenmann's concrete fish tanks were shown with the suggestion that park visitors could see them by taking the trail to Donaldson Cave. The IKC's presentation was greeted with an enthusiastic audience with many questions. After the presentation, much of the audience remained to ask more questions, try on the cave gear, and look at examples of cave bugs.

The IKC presentation was just one facet of a weekend of activities at Spring Mill. Other speakers on Saturday included geologist Richard Powell talking about caves and cave formations, and Dr. Tim Carter (Ball State University) talking about bats and their special relationship to caves. Spring Mill interpretive staff led hikes to Donaldson Cave and to the cave entrances around the pioneer village. In addition to the Upper Twin Cave boat tours, special trips were also led to Endless Cave in the Cave River Valley, the satellite unit of Spring Mill State Park.

This was the first "Cave Weekend" in several years and the IKC's involvement has already been requested for next year!

Boat Dock entrance to Upper Twin Cave in Spring Mill State Park. Jerry Lewis (2017).

THE IKC AND AMAZONSMILE – SHOP AND DONATE!!

by Bruce Bowman

AmazonSmile is a "separate" shopping website operated by Amazon.com. Customers experience the same selection of products, prices and features as on Amazon… the only difference is that when you shop at ***smile.amazon.com*** their foundation ***donates 0.5% of the price*** of eligible products to the charitable organization of your choice.

A few years ago, the IKC registered with AmazonSmile to receive the benefits of this program. Since then we have been receiving periodic donations. Below are a few answers to Frequently Asked Questions about AmazonSmile.

What is the AmazonSmile Foundation? The AmazonSmile Foundation is a 501(c)(3) private foundation created by Amazon to administer the AmazonSmile program.

Are other non-profits using AmazonSmile? Many other charities are registered, including such prominent organizations as the American Red Cross, ASPCA, The Nature Conservancy, etc. As of May 2017, total donations made by the AmazonSmile Foundation have exceeded $54 million.

How do I select the IKC as my destination charity? There are three simple ways to do this:

- Type ***https://smile.amazon.com/ch/31-1185033*** into your web browser.
- Scan the QR code at right into your smartphone or other mobile device.
- Click on the "Shop at AmazonSmile" logo above, which also appears on the ***IKC home page***.

Your selection is stored and used for future visits to ***smile.amazon.com***. However, be advised if you subsequently visit the main Amazon site by mistake you will not be notified of an error and no donation will be received.

Do I have to set up a separate AmazonSmile account? No… you use the same account on both Amazon.com and AmazonSmile. Your shopping cart, Wish List, wedding or baby registry, and other account settings are also the same.

Is there any difference in the price or selection of products? No… the shopping experience is identical to that at Amazon.com, and there is no cost to either the IKC as an organization or to you as a customer.

Which Amazon products are "ineligible?" Recurring Subscribe-and-Save purchases and subscription renewals are not currently eligible.

Can I deduct 0.5% of my purchases on my personal tax return? No… legally, these funds are being donated by the AmazonSmile Foundation.

How will the IKC receive the money? The IKC has provided AmazonSmile with our bank account information; we automatically receive accumulated donations as an electronic fund transfer on a quarterly basis.

The IKC encourages all Amazon shoppers to use this service for the benefit of the organization.

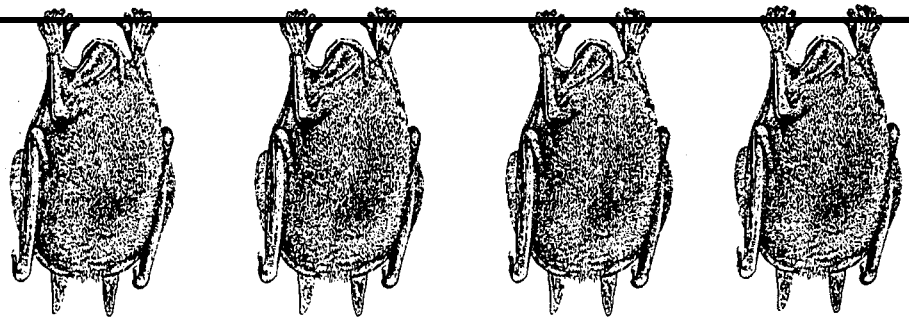
INDIANA KARST CONSERVANCY TREASURY REPORT

Income/Expense Statement
From April 1, 2017 to June 30, 2017

INCOME:		
Dues Apportionment and Residuals	690.00	
Donations - General	376.89	
Donations - Land Acquisition Fund	920.00	
Interest	342.91	
		$2,329.80
EXPENSES:		
IKC Update (printing, production, mailing)	307.42	
Education / Outreach	153.96	
Stewardship/Conservation	300.21	
Property taxes	35.00	
Business (safety deposit box , donation fees, etc)	105.34	
Transfers to/from restricted funds/other adjustments	1,132.14	
		($2,034.07)
NET OPERATING EXCESS (DEFICIT) THIS PERIOD:		$295.73

Balance Sheet
June 30, 2017

ASSETS:			
Cash in Checking / Saving Accounts / CDs		164,670.76	
Robinson Ladder Cave Preserve	(73.48 acres)	162,000.00	
Shawnee Karst Preserve	(50.31 acres)	105,000.00	
Wayne Cave Preserve	(31.85 acres)	85,000.00	
Sullivan Cave Preserve	(28.00 acres)	72,000.00	
Buddha Karst Nature Preserve	(36.84 acres)	29,000.00	
Orangeville Rise Nature Preserve	(3.01 acres)	7,000.00	
Indian Creek Conservation Easement (valued at $1/acre)		13.16	
			$624,683.92
FUNDS & OPERATING EXCESS:			
Land Acquisition Restricted Fund		41,272.95	
Deferred Dues Restricted Fund (180 members)		4,380.00	
Stewardship Endowment Restricted Fund		57,162.09	
Previous General Fund (total)	61,573.15		
Net Excess (Deficit) This Period	295.73		
Current General Fund (unrestricted)		61,868.88	
Current General Fund (committed)	600.00		
Real estate liquidity (basis value)		460,000.00	
Total Liabilities & Operating Excess			$624,683.92



IKC QUARTERLY BOARD MEETING MINUTES

Saturday, June 3, 2017, 1:30 PM EDT – Bloomington, Indiana

Board Members Present:

Jerry Lewis, President
Sue Vernier, Secretary
Keith Dunlap, Treasurer
Joy Baiz (proxied by Salisa Lewis)
Danyele Green
Dave Haun
Everett Pulliam
Matt Selig
Bob Sergesketter
Kevin Smith
Tom Sollman
Carla Striegel-Winner
Richard Vernier
Jamie Winner

Board Members Absent:

Bruce Bowman

The meeting was called to order by President Jerry Lewis at 1:30 PM EDT at the Monroe County Library, Bloomington, Indiana.

March Meeting Minutes

The minutes from the March Annual Board meeting were approved as published in the June, 2017 *IKC Update*. Since we have a new Director, Matt Selig, Jerry asked everyone to introduce themselves.

Treasurer's Report

Treasurer Keith Dunlap reported cash assets totaling $163,705.79 and land assets totaling $460,000 for total assets of $623,705.79. Funds include Stewardship: $56,949.95; Land Acquisition: $40,377.95; Deferred Dues: $4,650.00; and General Fund (unrestricted): $61,727.89. The IKC membership currently stands at 195 with renewals in 2017 of 176 and 19 yet to renew (deadline was March 31st).

Special Presentation

Jerry Lewis announced that Keith Dunlap's mother had passed and, in lieu of flowers, Jerry had set up a memorial fund to the IKC in memory of Dottie Dunlap. Jerry presented to Keith the funds that were collected, and Keith was asked to decide the best use for the money on behalf of the IKC.

Shawnee Karst Preserve

Keith Dunlap and Bambi Dunlap have mowed the two loop trails. Two trees were down that will need to be dealt with (probably after tick season is past). The area above the cave entrance is slumping again. If it comes down in small sections, it should flush through. Options discussed were to let nature take its course for now, or install expanded metal with angle iron (open shed roof) across the entrance. Keith and Tom Sollman expressed a preference to wait and see if the problem can be dealt with naturally. Also, Jerry Lewis announced his intention to lead a trip for the Beckham Bird Club on the property in the future (surface activity does not require Board approval).

Buddha Karst Nature Preserve

Keith has mowed the trails. Two of the four chestnut trees that were planted last fall look fine; the remainder suffered deer damage.

Sullivan Cave Preserve

Keith mowed the camping area. He has committed to fixing the latch on the cave gate and plans to do so within the next two weeks. He needs a couple of helpers (mainly carrying the welder). The highway department temporarily fixed the driveway entrance drop-off. Danyele Green noted the declining condition of the port-a-john. Keith advised that he is having problems getting it serviced. He has asked for a quote from another source (disclosure: his son-in-law's business) to get it pumped a couple of times a year.

Wayne Cave Preserve

Robert Sollman reported on today's stewardship activities: invasives were sprayed, the clearing and trail to the cave were mowed, brush was trimmed, and eight bags of trash were picked up along the road.

Robinson Ladder Cave Preserve

Keith reported that last year's non-surviving trees were replaced with newly planted trees in April: chestnut, butternut, walnut, and red oak. A few days later (when it was not raining), Keith sprayed the area around the trees. In late May, Keith and Bambi mowed all of the tree planting area inside the deer fencing. Jamie Winner mowed the camping area and the access road.

Preserve Emergency Protocol Committee

Jerry advised that he, Salisa Lewis, and Danyele Green met to begin work on emergency protocols for the IKC preserves. Jerry has been unable to meet with Anmar Mirza, but he's still working on it.

Sauerkraut Cave Gate Project Update

Jerry said the detailed plans are in place to install the biota-friendly gate to protect the rare Louisville cave beetle. He, Keith Dunlap, Bambi Dunlap, Tom Sollman, and Mike Floyd (USFWS) met at the cave to discuss details. However, the contract and cave access agreement have not been finalized. The project will not be happening in June — maybe in the fall — it is up to the USFWS to

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get the paperwork done. Jerry said the contract and cave access agreement will have to be signed or the IKC will not go forward with the project.

Land Acquisition Activities

Keith Dunlap discussed two properties:

1) The Hancock property (290 acres containing Coon, Grotto and Shaft caves), with an asking price of $500,000, is twice Keith's estimate of the market value typical for hunting property (the mitigation easement already prevents development).

2) The property south of Wayne Cave which has many interesting karst features, one small 30' pit (Mr. Potato Pit) and a nice woods. Richard Vernier discussed his early years of caving when he and his friend discovered the pit and named it. The property protects the Blair Hollow watershed which would fit our mission. Jerry will contact TNC to see if Wayne Cave is a portfolio site for them (presence of rare and endangered animals). It might qualify on a landscape scale, which TNC prefers. Keith knows an anonymous donor who could provide additional funding as an enticement to go forward and pursue acquisition. Tom Sollman is very much in favor of pursuing classic karst terrain which could eventually connect Buckner Cave and Wayne Cave properties. Dave Haun made a motion to pursue, in cooperation with Richard Blenz Nature Conservancy and other concerned entities, the acquisition of a 56-acres tract adjacent to Wayne Cave Preserve. Everett Pulliam seconded. Motion passed with 14 yeas.

Education & Outreach

Jerry said that he, Tom Sollman, and Keith Dunlap provided training for Spring Mill State Park's seasonal boat tour cave guides. After their presentations, they visited Endless Cave for additional interpretive training. Tom discussed his ongoing efforts to conduct population counts of cavefish and crayfish at Upper Twin Cave.

Salamander Research Update

Jerry said that Gavin Bradley, doctoral student, has not yet done the behavioral studies with Cave salamanders in Sullivan Cave Preserve, but he actually wants to scale up to do a bigger version at Buddha Karst Nature Preserve. Jerry has the permit from the Division of Nature Preserves to conduct the research at Buddha. Gavin wants to study the interaction with predators using clay Cave salamander models. Keith Dunlap made the motion to approve a salamander research project investigation at Buddha Cave. Everett Pulliam seconded. The motion was approved.

Items from the Floor

None.

Next Meeting

Jerry proposes hosting the next meeting at his house on September 16 at 4 PM EDT.

Adjourn

The meeting was adjourned at 3:17 PM EDT.

Respectfully submitted, Sue Vernier, IKC Secretary

INDIANA KARST CONSERVANCY, PO BOX 2401, INDIANAPOLIS, IN 46206-2401

I would like to help the IKC protect Indiana's unique caves and other karst features. Enclosed is:

$_____ for IKC membership dues at $15 per year (dues expire March 31st of each year, please pro-rate @ $1.25/month).

$_____ donation to the general IKC fund.

$_____ donation restricted to a specific IKC project. Please specify: _____

_____ I know of an area worthy of protection. Please contact me.

_____ I would like to volunteer to help. Please contact me.

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

PHONE # _____

Make checks payable to the Indiana Karst Conservancy, Inc. and mail to the IKC Treasurer, c/o Indiana Karst Conservancy, PO Box 2401, Indianapolis, IN 46206-2401. The IKC is an IRS recognized 501(c)(3) non-profit organization with membership dues and donations fully tax deductible.