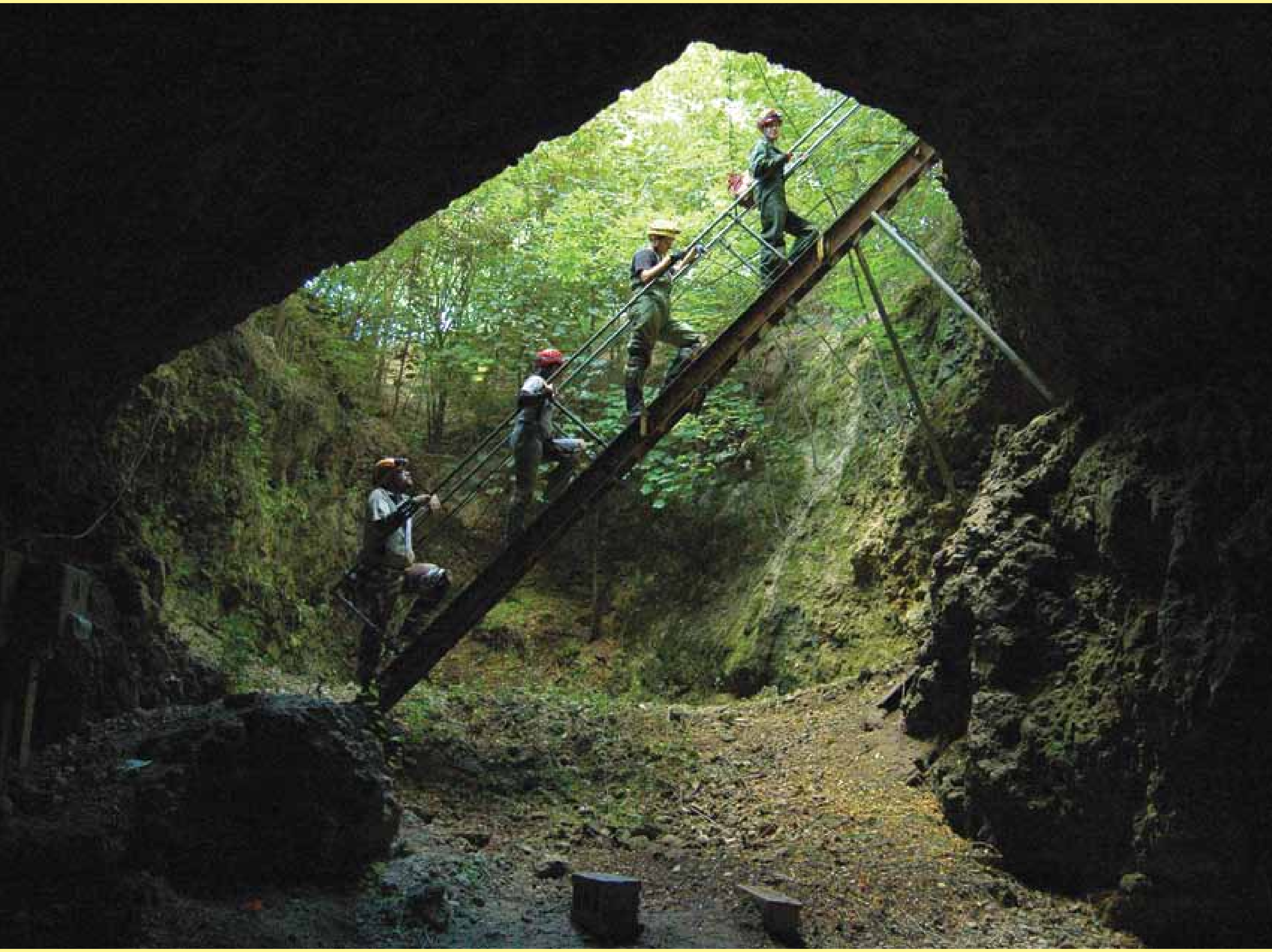
PHOLEOS

Journal Of The Wittenberg University Speleological Society

March, 2010



PHOLEOS

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

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

WUSS Web page
http://www.wusscavers.com

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

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

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

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

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

GROTTO ADDRESS
Wittenberg University Speleological Society
c/o Horton H. Hobbs III
Department of Biology
Wittenberg University
P.O. Box 720
Springfield, Ohio, USA 45501-0720

Tel. (937) 327-6484
FAX (937) 327-6487

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Front Cover: Four cavers ascend the stairs of the sinkhole entrance to Sheriden Cave during a July 2008 visit for the Ohio Cave Bioinventory. Photo by N. Pfeffer.
Back Cover: Design by K.M. Kissell.

EDITOR'S NOTE

Here we are again, only a month after the last issue of *Pholeos* and I am thrilled to bring you the next exciting installment! In this edition, we attempt to get you in the mood for the 30th Anniversary with an article, written by our esteemed leader and originally published in one of the very first issues of *Pholeos*, as well as a few samples of our recent survey endeavors. On the slightly peculiar side, this issue is labeled as Vol. 29 (1 & 2) in the hopes that we will finally be caught up (an effort that has taken decades) with the volume numbers of *Pholeos* in relation to the years of the club's existence. That means that with any luck, Vol. 30 (1 & 2) will be out in time for the 30th Anniversary Weekend on April 9th – 11th, 2010. With the 30th anniversary issue coming up I would like to ask that if you have any unforgettable, funny, strange, or otherwise WUSS-related photos, stories, drawings, poems, etc. to please either email them to me at wusscavers@gmail.com or send them to the grotto address found in the inside back cover. We are always looking for more material, especially for anniversary issues. Anyway, please enjoy this issue of *Pholeos* and I hope to see you all in April.

Kevin M. Kissell, Editor
WUSS #0530
NSS #54578

WITTENBERG UNIVERSITY SPELEOLOGICAL SOCIETY
SPRINGFIELD, OHIO

2009 -2010 OFFICERS

Danielle Carey
Co-President
s10.dcarey@wittenberg.edu
WUSS #0551
NSS #59092

Holly Kellar
Co-President
s10.hkellar@wittenberg.edu
WUSS #0553
NSS #58851

John Mohr
Secretary
s12.jmohr@wittenberg.edu
WUSS #0568
NSS #61713

Travis Croxall
Treasurer
s11.tcroxall@wittenberg.edu
WUSS #0560
NSS #60826

Kevin M. Kissell
Editor
kmkviper@yahoo.com
WUSS #0530
NSS #54578

Horton H. Hobbs III
Faculty Advisor
hhobbs@wittenberg.edu
WUSS #0001
NSS #12386 HM, CM, SC, FE

MESSAGE FROM THE PRESIDENT

Fellow Cavers,

I hope that this new edition of *Pholeos* finds you plump from the delicious feasts and merry from the holiday season! Thus far into the beginning of the academic year, we have amazing new members that have enjoyed vertical clinics in John Bryan State Park and here on campus, rock climbing at the Urban Krag in Dayton, an intro trip to Sloan's Valley Cave in Kentucky, hiking in Hocking Hills, and a general good time! We have been trying to keep busy yet respectful of the current situation with the unfortunate White Nose Syndrome (WNS).

This year will culminate with the 30th Anniversary of WUSS which will be celebrated for an entire weekend. It will be the weekend of April 9-11, 2010 so mark your calendars! We have a great banquet speaker scheduled and some interesting WUSS "artifacts" to share. Because we are unaware of how WNS will affect Ohio caves in the spring, we are not going to any wild caves but we will have a trip to Seneca Caverns, one of the state's most interesting show caves. Our 30th edition of *Pholeos* will also be available for the 30th anniversary party!

It is our hope that you enjoy this edition of *Pholeos* and that you come to see past and present WUSSes during the anniversary weekend in April! Hope to see you all soon.

Danielle Carey, Co-President
WUSS #0551
NSS #59092

> "When I was a kid my favorite relative was Uncle Caveman. After school we'd all go play in his cave, and every once in a while he would eat one of us. It wasn't until later that I found out that Uncle Caveman was a bear." –Jack Handy

Ecology of Caves

Horton H. Hobbs III (WUSS #0001, NSS #12386 HM, CM, SC, FE)

This article was published originally in *Pholeos,* Vol. 2(1) in December 1981.

There are very few areas on the thin crustal veneer of the earth's surface that do not support life. Although caves are never exposed to the energetic rays of the sun, virtually all support varying forms of plants and animals. These life forms, functioning primarily as heterotrophs (consumers) depending ultimately on the surface for energy, have complex life histories, demonstrate intricate community dynamics, exhibit highly specialized adaptations for spelean existence, and are represented by numerous endemic species.

"In addition to 1) an absence of light, the physical environment of a cave is characterized by 2) comparative silence; 3) nearly constant temperature; and 4) in 'wet caves,' an unusually high humidity which, except near entrances, makes for an exceptionally low rate of evaporation. The degree of constancy, rate of change, and faunal abundance are dependent upon how much the cave is subject to epigean influence. This depends upon number and size of streams (input and output), size, number, and exposure of entrances, and configuration of entrance passages . . ." (Hobbs and Burdsall, 1972:2). Many of these same conditions (particularly lack of light and food limitation) are characteristic of deep ocean systems, and because of these similarities analogy has been made for these two environments (see Poulson, 1971). In addition, it has been suggested by various authors (see Culver, 1970, 1971) that caves have similarities with islands (e.g., both are discontinuous habitats, both contain highly modified organisms, and both contain relatively low numbers of species).

This short discussion of cave ecology will present some of the physical and chemical aspects of the cave environment, define the ecological zones of caves, examine representative types of cavernicoles (cave-dwellers), and cave community energetic will be treated briefly.

In employing "community" there is an obvious misconception of the term as used in association with caves. Specifically, communities consist of organisms (producers, consumers, and decomposers) that exist in some state of dynamic equilibrium. Cave "communities" lack the external solar energy source and therefore, in fact, are lacking the producer trophic level (see below for a discussion of the minor role played by a few autotrophic bacteria). Thus, the majority of organisms living in caves are heterotrophic and are in reality only part of a larger, more complex community originating on the surface where light energy is available. The light energy is converted to chemical energy and is stored in plant biomass through complex biochemical processes collectively called photosynthesis. Green plants directly or indirectly contribute energy to the "cave community" as organic matter is brought into the cave environment. Hence, with appropriate reservation, the somewhat ingrained term "cave community" will undoubtedly continue to appear in the literature and will be used throughout this paper.

Ecological Zonation

Caves can be separated into a series of zones, each of which is represented by a distinct set of chemical, physical, and biological characteristics: the threshold (Entrance and Twilight) and the dark (Variable-Temperature and Constant-Temperature) zones. The threshold zone (sometimes called the "Pro-epigean domain" or the "light zone"—Jefferson, 1976) extends from the surface opening of the cave to the furthest point to which daylight can penetrate. It is an area of the cave where physical factors are relatively variable. The environment in the entrance area is controlled by prevailing local climatic and meteorological conditions and exhibits characteristics of both epigean systems (surface) and the cave interior (hypogean). Muchmore (1976) discussed the effects of cave entrance on the distribution of cavernicolous terrestrial arthropods (see also Ives, 1927 and Culver and Pouson, 1970). Progressing from the entrance, light intensity diminishes rapidly to the twilight zone; light obviously varies with time of day and with external conditions. Other parameters such as humidity and temperature are also similarly variable. Relative humidity increases and may vary from 10% to 100%, yet it is generally far more constant than that of the surface. Temperature may range from -10 to +30°C in the entrance and from 0 to +20°C in the twilight zone of temperate caves. Even though these fluctuations occur, the threshold is considerably less variable that the exterior environment. The biota of these regions is the most diverse of any area of the cave. Both green plants and animals inhabit the threshold zone, and Poulson and White (1969) reported that the entrance area typically supports 100-300 species with a diversity index on 1.5 and a biomass (gram/hectare) of 1,000,000, whereas the twilight zone has up to 50 species, with a diversity index of 0.5 and a biomass of 300. These values are considerably higher than those of Ohio caves.

The variable-temperature dark zone is much more constant than the preceding zones. Darkness is undoubtedly the most important feature, ecologically. The relative humidity is increased and varies from 30% to 100%, and temperatures commonly vary from 3 to 15°C. Barr (1967a) suggests that it is the evaporation rate and not the variation in temperature which is the most significant environmental parameter in this zone. Further discussion concerning variations and effects of temperature change may be found in Cropley (1965). The biota shows a great decrease in both numbers of individuals and species. The number of species is typically reduced to 10 with 0.2 diversity index and biomass ranges from 100 to 5000 g/ha (Poulson and White, 1969). This lower biomass reflects the scarcity of organisms as well as their small size.

The constant-temperature dark zone is characterized by relatively stable temperatures (air temperatures rarely vary more than 1°C throughout the year at any one place) which approximate the mean annual surface temperatures for the area, being largely dependent on latitude and altitude. Water temperatures are generally not as stable, being subject to change as a result of ice and snow melt and can be altered as flood waters flow through underground aquifers; fluctuations of 5°C or more may occur. The relative humidity is continuously high, ranging normally from 80% to 100%. Evaporation rates are consequently low, yet the air is not stagnant, as most caves generally ventilate continuously. The composition of air is usually similar to that in the epigean environment, although the concentration of carbon dioxide may sometimes be higher. In areas of caves isolated from moving water, elevated levels of carbon dioxide are occasionally found associated with clay beds; it may also accumulate at bases of shafts and in passages where there is little air movement and where there are deposits of organic debris.

It should be noted that the horizontal zonation described herein also can be applied to the vertical scale, however not so well defined: specific zonation, particularly within the threshold area, occurs as one passes down from the pit entrance into the cave below. Senger (1980) discusses the relationships between cave morphology and cave climate.

The characteristics of water in limestone-dolomite caves are quite variable. The waters of pools can be quite distinct from those of underground streams and in those waters supplied by the sinking of surface streams, both the chemical and physical features will be affected to some extent by surface conditions. Such streams generally contain higher concentrations of organic matter (allochthonous, CPOM, FPOM, and DOM), most of which is transported in from the surface, both as living organisms and as detritus which can provide a source of nutrients for cave-dwellers. Most cave waters tend to be alkaline (pH ranging from 7 to 8+) and have a high alkaline hardness. The biochemical oxygen demand is generally low, and, even in static pools, oxygen is at or near saturation values. Conductivity (µmho•cm^{-1}) varies with temperature change but generally ranges from 50-600 µmho•cm^{-1} at 25°C. High values of phosphorous (>50 µg PO_4 –P•1^{-1}) and nitrite (>100 µg NO_3 –N•1^{-1}) usually indicate contamination by sewage or excessive use of fertilizers. Expected values of solutes in "unpolluted waters" in limestone areas are presented in Table I (see Bray 1969, Jacobson and Langmuir 1970, Langmuir 1971, Shuster and White 1971, Barr and Kuehne 1971, Jones 1973, and Vineyard and Feder 1974, for additional chemical data of karst waters).

Table I: Values of Selected Solutes in Unpolluted Waters in Limestone Areas (from Picknett et al., 1976)

Solute	Mean Values	Extreme Values	Units
Total hardness	15-300	10-400	mg 1^{-1} $CaCO_3$
Alkaline hardness	5-250	0-350	mg 1^{-1} $CaCO_3$
Magnesium Hardness	10- 30	2- 60	10^{-5}M Mg^{2+}
Silica	5	2- 15	mg 1^{-1} SiO_2
Potassium	2	0.1- 15	mg 1^{-1} K
Iron	0.05	0.01-0.4	mg 1^{-1}Fe
Oxygen demand (4 hours)	0.5- 4	0- 10	mg 1^{-1} O_2

Cave Biota

Organisms occurring in caves not only are represented by a wide range of different systematic groups, but they also are customarily classified as to length of life history spent in caves and to degree of specialized adaptations exhibited. Some species are found only in underground habitats, while others which occur there are also found in various other environmental situations.

Cave Flora

Plants occupying caves are generally considered to be representative of those epigean species of the area that demonstrate some degree of shade tolerance, many of which have developed remarkable characteristics of their own (Tomaselli, 1951:67). Transects of plant species taken horizontally or vertically from the entrance into the cave interior indicate that the more advanced species (tracheophytes—ferns and flowering plants) occupy the entrance area but quickly disappear as the light diminishes. Bryophytes (mosses and liverworts) are found farther into the threshold zone, but the thallophytes (algae) are the most resistant to decreasing light and thus penetrate farther into the cave than any other green plants (Tomaselli, 1847 and Dalby, 1966). See Kofoid (1900), Scott (1909), and Barr (1967b: 178-184) for additional information concerning algae in caves.

Light reduction has been shown to initiate structural changes in tissues of green plants (Dalby, 1966). For example, low light intensity restricts vegetative growth (mitosis), thus reducing the maximum potential size of the plant (e.g., liverwort). Dalby (1966) has shown that the photosynthetic area of leaves is often increased (e.g., moss) as light intensity falls. The effects of pH, humidity, substrate, and other physical factors which create variation even at the microclimate level has been discussed by Morton (1939) and by Mason-Williams and Benson-Evans (1958). Seeds of angiosperms are often washed into caves and etiolated seedlings are commonly encountered, having germinated in the threshold or dark recesses and appear long, thin, and pale. They have no chloroplasts and are destined only to death in their fruitless search for light. Undoubtedly these life forms contribute nutrients to the intricate food webs within the cave ecosystem.

Bacteria are represented throughout caves by both heterotrophs and autotrophs, although not usually together in the same community. Numerous forms are carried into the hypogean environment via air circulation, by animals (including man), and by seepage and stream input.

The autotrophic forms are represented by the iron bacteria which derive their energy from the simple oxidation of iron compounds. These bacteria, like the majority of bacteria currently known from caves, are not confined to grottoes, and are also found in many surface soils. A possible exception is the iron bacterium, *Perabacterium spelei*, which may prove to be a true cave species (Caumartin, 1959). Brock, et al. (1973) noted that obligately psychrophilic bacteria have not evolved in or colonized the constantly cool waters of caves. The sulphur bacteria are both oxidizers and reducers of sulphur and yield detectable quantities of sulphide (Cubbon, 1969). Like the iron bacteria they employ carbon dioxide (or bicarbonate) as a source of carbon. Nitrifying bacteria obtain their energy from the oxidation of ammonia to nitrite or to nitrate, also using carbon dioxide as a carbon source. Gram-negative microbes, such as *Azotobacter* sp. and *Clostridium* sp., when supplied with an energy source (e.g., carbohydrate) convert atmospheric nitrogen to organic nitrogen compounds (Mason-Williams and Benson-Evans, 1958, and Cuonot, 1967). Heterotrophic bacteria obviously degrade complex organic materials and liberate simpler substances which have potential food value for other organisms (see Pliermans and Schmidt, 1977). Organic debris may be imported by flowing water or by visiting animals, and waste materials deposited by cavernicoles all serve as nutrient reservoirs (see Lavoie, 1980). Regardless of the energy source, these chemosynthetic microbes play a fundamental role in nutrient cycling within cave ecosystems.

Intermediate in character between bacteria and Fungi are the Actinomycetes microflora (mold-like filamentous bacteria) inhabiting caves (Lovett, 1949). These are ubiquitous soil organisms about which little is known except their potential role related to antibiotics. Caumartin (1963) and Picknett (1967) suggested that the peculiar and distinctive "earthly" odor of caves is produced in part by cave actinomycetes.

The occurrence and dynamics of fungi in caves have been treated by Tomaselli (1953), Hazelton and Glennie (1962), Caumartin (1963), Mason-Williams (1965), and Hunter and Thomas (1975). The majority of fungi found in caves are of epigean origin; however, Tomaselli (1956) described a number of forms that may be highly specialized cavernicoles. Upon entering caves, fungi must find a suitable substrate (organic material, living or dead) in order to survive. The debris and animal and plant life that are brought into caves undoubtedly also have a host of microfungal flora associated with them. These fungi will continue to grow as long as that substrate exists. They may completely utilize that substrate or become established members of the cave ecosystem—the ultimate outcome is dependent on the types and counts of nutrients as well as on their tolerance to the physical and chemical condition within the cave. Regardless, in time fungi make available (direct or indirect) food sources (such as nutrients) for organisms already present in the cave community. Dickson (1975) indicated that bacterial and fungal populations may not only serve as basic food sources in caves but also may influence the distribution of specialized invertebrate cavernicoles (see also Dickson and Kirk, 1976). It should be quite apparent that both autotrophic and heterotrophic (see Kirk, 1973) micro-organisms are virtually "all over" caves (e.g., mud, water, dung, living and dead organisms, and even speleothems).

It should be noted that several pathogenic micro-organisms are known to inhabit caves. Holsinger (1966), Wells (1973), Wagner et al. (1976), and Brucker (1979) reported sewage pollution in various cave systems and the occurrence of coliform bacteria is undoubtedly becoming more common in cave ecosystems. This is certainly apparent when one compares the results of Gardiner (1971) and Hoey (1976)—groundwaters in the environs of Bloomington, Indiana, are contaminated with fecal coliforms and fecal streptococci, and their densities have shown marked increases in the five-year time span which separated their studies. This is certainly not uncommon in Ohio as well (e.g., Thompson Cave, Miami County, receives seepage from a residential septic tank). The reader is referred to Prager (1972) for an overview of ground water pollution in U.S. karst regions and Minear and Patterson (1973) for a discussion of ground water contamination resulting from septic tank system failure. In addition to treating pollution, Wilson (1977) briefly demonstrated the effects of cultural eutrophication and certain caver activities on cave ecosystems.

Histoplasmosis is a disease caused by the fungus *Histoplam capsulatum* Darling. The symptoms and effects are commonly similar to those of tuberculosis, being characterized by loss of weight, fever, anemia, coughs, and severe chest pain, although quite often the infection is mild. This is a cosmopolitan disease and is present in 31 of the 48 contiguous United States (Ajello, 1971), and the Ohio River Valley is a particularly high incidence area (Sarosi et al., 1971). This is an "occupational hazard" for Midwest caves, (particularly for Ohio cavers!). Shacklette and Hasenclever (1968) studied the effect of flooding in a cave system on the distribution of *H. capsulatum* with the air, soil, and animal life of the cave. Beck et al. (1976) discussed the occurrence of histoplasmosis in caves in the central mountains of Puerto Rico. They, Disalvo (1971), and Ajello et al. (1977) discussed the role of bats in the ecology of *H. capsulatum*, and Smith (1964) presented an eradication method that has proven successful in the fight against histoplasmosis (application of a 3% formalin solution)—undoubtedly this also greatly affects other cave organisms as well!

Cave Fauna

A classification system for cave-inhabiting animals has been proposed numerous times (see Schiner 1854, Schiodte 1849, Racovitza 1907, Hazelton and Glennie 1962, and Hamilton-Smith 1971); however, the most commonly used system places animals into one of four ecological-evolutionary categories (Barr 1963, 1968):

> Troglobites—obligatory cave species which are morphologically specialized for, and restricted to, the cave habitat; they are unable to exist in epigean habitats.
>
> Troglophiles—facultative cave species which frequently inhabit caves and are capable of completing their entire life histories there (many do!), but may occupy ecologically similar habitats outside of the cave environment.
>
> Trogloxenes—species often occurring in caves but are incapable of completing their entire life history in the cave environment, generally having to exit for feeding and/or mating purposes.
>
> Accidentals—species which accidently wander, wash, or fall into caves and can exist there only temporarily; they may serve as food sources for regular cavernicoles, yet they are of no importance in distributional or evolutionary analyses of cave fauna.

Two other terms are also employed for certain cave (and surface) animals:

> Edaphobites—species that are obligatory deep-soil dwelling forms which may occasionally occur in caves.
>
> Phreatobites—species which are obligatory to ground water habitats; they are often found in slowly moving interstitial ground waters; they are not necessarily found in caves and are frequently sampled in seeps, springs, and wells.

The distribution and ecology of numerous cavernicoles are inadequately known, and their assignment to one of the above ecological-evolutionary categories is often, at best, tenuous. Some general groups are characteristically placed in specific categories: *phreatobites*—some copepods, isopods, amphipods; *edaphobites*—earthworms; *trogloxenes*—bats, bears, raccoons, moths, mosquitoes, man!; *troglophiles*—some salamanders, beetles, crustaceans; *troglobites*—blind cave fishes, some flatworms, isopods, amphipods, decapods, pseudoscorpions, spiders, millipedes, and a large number of insects. For a more detailed treatment of cavernicoles, see Vandel (1965) and Jefferson (1976).

Of specific interest is the troglobitic group of cavernicoles. These organisms are highly specialized and show varying degrees of adaptation for existing in the cave environment. For example, there are nearly 60 species of troglobitic decapods known from the Americas (Hobbs et al., 1977), and many of the adaptations common to all troglobites are recognized in this group. The most obvious character that is common to virtually all troglobites is a strong reduction in pigmentation, frequently a total loss. Also conspicuous are the reduced eyes and, in the case of many troglobitic decapods, they may completely lack faceted corneas. Attenuated appendages are characteristic of many forms, and numerous troglobites tend to be smaller, or at least superficially more delicately constructed, than their epigean relatives. Although few data are available, a lower basic metabolic rate ("metabolic economy" by Poulson, 1963, 1964) is suggested for most troglobites. See Schlagel and Breder (1947), Burbank et al. (1948), Troiani (1954), and Culver and Poulson (1971) for comparative in cave and surface biota. Cooper and Cooper (1976, 1978) presented data that indicate certain troglobitic crayfishes have considerably longer life spans than have been proposed for any other cave species. Ginet (1960, 1969) and Turquin (1981) discussed longevity in the amphipod *Niphargus* and a number of troglobitic terrestrial species (e.g., *Anthrobia*—see Poulson, 1978a) have prolonged life histories; all of these examples suggest a correlation with lowered metabolism. Production of fewer eggs in troglobitic decapods when compared with related epigean species (see Bechler, 1981) is usually associated with lesser available energy in the cave environment. Also, Hobbs (1973) suggests that individual females within a given population do not necessarily reproduce annually but resorb oocytes and reproduce only on a staggered basis. Thus, in addition to obvious morphological adaptations, many troglobites demonstrate low reproductive rates, extended life expectancies, and extreme resource efficiency.

Animal species richness in caves and dispersal potential, among other factors, are greatly influenced by the specific geological formations of the area in which caves are developed (e.g., continuity and separation of limestone units). "In the Appalachian Valley, where limestone is exposed in many narrow, anticlinal strike belts, species density per unit area is high, and dispersal of troglobites through subterranean channels is severely restricted by geologic structure. In the Mississippi Plateau, where thick caverniferous limestone is widely and continuously exposed, there are fewer species per unit area; and subterranean dispersal has taken place over considerable distances." (Barr, 1967a: 488).

Cave Community Energetics

Generally, cave communities are regarded as relatively simple systems having few species and low productivity (Barr 1968, Poulson and White 1969, Culver 1976). Notable exceptions to this are the approximately 300 species of animal and plant life in the Mammoth-Flint Ridge Cave system in Kentucky (Barr, 1967b), the rich aquatic fauna of the cave communities of the Edwards Aquifer (22 troglobites in the artesian well in San Marcos, Texas—Holsinger and Longley, 1980), and the diverse aquatic community of Shelta Cave in Madison County, Alabama (Cooper, 1975).

As previously mentioned, lacking the autotrophic component, all cave communities ("complex" or "simple") must depend on exogenous organic material to be transferred from the surface. Every cave or cave system will demonstrate variances in energy input over time and space. Hawes (1939) indicated the importance of the flood factor in the ecology of caves, particularly with reference to food input. In addition, he, and others, pointed out that floods may operate as agents of distribution and colonization as well as may function to stimulate reproductive activity and to trigger molting cycles in certain organisms (see Jegla 1966, 1969, and Jegla and Poulson, 1970).

Poulson (1978b: 94) has proposed that "Energy availability depends on rigor, variability, and predictability of energy concentration, renewal, and quality." Quite obviously, all organic materials do not have equal caloric values; therefore, energy availability of certain foods is greater than others (e.g., raccoon feces are high payoff food—Poulson 1977, 1978b). Undoubtedly energy availability can be affect greatly the numbers and biomass that can supported, can affect foraging behaviors, overall energetics, life histories, and ultimately community organization. Additional information concerning effect of energy availability can be obtained in Poulson (1979).

Most caves receive food in the form of dissolved organic matter, organic litter and detritus, bacteria, protozoans, and other organisms that are washed, blown, or carried in. Temporal variations in quality and quantity are evident, with greatest inputs occurring in late winter and spring. The microflora, as previously stated, are responsible for decomposition and transformation of this allochthonous material, yet they themselves are sources of energy when detritus is consumed (the "peanut butter" on the "detrital cracker"!). These food sources are supportive of both the terrestrial and aquatic cave communities.

Guano is another major food source of many caves. Cricket guano, as well as cricket eggs and dead crickets, can form a major food source (Park and Barr, 1961). Reichle et al. (1965) found that *Hadenoecus subterraneus* feeds almost entirely on forest floor arthropods outside caves at night, returning to its roosting spot during the day. The crickets move toward entrances in late afternoon and emerge at twilight, often moving up to several hundred meters from the cave entrance prior to their return. The guano accumulates in a thin layer (up to 5-10mm deep) beneath roosts, but its production is largely limited to the warmer months of the year.

Bat guano not only serves as a source of organic matter to a cave but guano piles also function as distinct and complex ecosystems. Spatial variation in guano piles leads to sharp microzonation; thus there is spatial as well as temporal variability within the ecosystem. The increase in food input (food pulse) that is initiated at each year when bats return to a cave greatly affects the community of guanobites. For further information concerning bat guano ecosystems the reader is referred to the following papers: Mitchell (1970), Richards (1971), Peck (1971), Horst (1972), Poulson (1972), Fletcher (1976), Martin (1977), Franklin (1978), and Hill (1981).

In addition to cricket and bat guano, dung of larger vertebrates (mammals, such as raccoons and rats) is another source of energy to the cave system. The heterotrophic decomposition of this material is successional and somewhat predictable as is discussed by Lavoie (1981a). For further information on dung ecosystems see (1980, 1981b).

As fecal material is broken down and as allochthonous materials are transported into the cave, they accumulate as sediments as well as various muds, clays, etc., from dry or upper levels contain varying amounts of organic matter that can and are utilized directly and indirectly as energy sources for some cavernicoles. Most organisms, however, are not supported by organic materials from sediments and have evolved strategies for coping with seasonal fluctuations in organic input (see Kane et al., 1978, and Kane and Poulson, 1976).

Although cave trophic webs are comparatively simple and are known for various caves and cave systems, it is difficult to work out complete energy budgets for most systems. The paucity of tropical troglobites may be a reflection of the higher energy input into tropical caves which lessens selection pressures for energy-economising troglobitic adaptations (Mitchell, 1969). This is reflected in less complex food webs in tropical cave communities. For representative cave food webs see Mohr and Poulson (1966), Moore and Sullivan 91978), and Hill (1981).

Final Comments

The cave environment supports complex communities although it is generally regarded as "simple" and "predictable" when compared to epigean environments. Even with its comparative simplistic character, the cave collectively is represented by an assemblage of varied habitats. Simpson (1964), MacArthur et al. (1966), and Poulson and Culver (1969) indicate that increased habitat diversity often increases the number of species. Culver (1970) suggests that in a cave the best available measure of spatial heterogeneity is length of the cave (number and complexity of levels are also measures), as greater length increases the probability of varied habitats occurring. Many other factors undoubtedly affect the complexity of cave communities: species diversity (including richness and equitability); food (quality/caloric availability, quantity, predictability); environmental variability and rigor (e.g., flooding—degree and predictability); resource partitioning (competition, niche breadth, niche overlap among species); reproductive and feeding strategies evolved by cavernicoles; and relative age and overall comparative stability of the cave, to mention a few. Finally, it should be stressed that the unique cave environment, although stable, is a sensitive one. With increased ground water pollution and greater utilization of caves by sport cavers, many caves are showing negative (and long-term) effects. Problems of ground water pollution and "over-utilization" of caves are not unique to the United States and should be immediate concerns for all speleologists.

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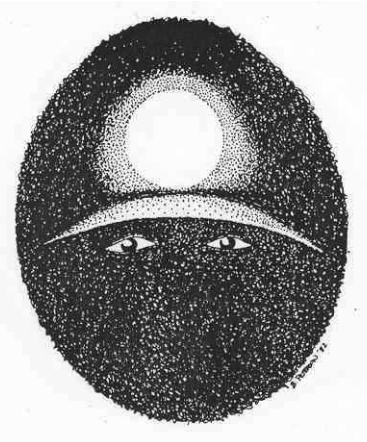

Majestic Splendor

Down in the bowels of the earth below
Is a majestic splendor that few behold.
And to the few who come and seek
Down in uncanny worlds beneath
Is allowed a memorable glance
Of this beauty as frail as glass
To emerge from this view
Enchanted and captivated anew.

You will see and come to love
This beauty well matched to that above
An long to return
To behold this vast urn
Of majestic splendor contained underearth.

S. Allen Kronk

Originally printed in:
Pholeos Vol. 10 (2)

Down Under

How can I explain

Why I am driven underground

Where my body shares secrets with the damp
or dusty earth

When I could be hiking in the sunshine
or going for a country drive

What primordial chord has been struck?

Unknown Author

Originally printed in:
Pholeos Vol. 5 (1)

Down

Hidden gateway to darkness beyond,
down we slither through the narrow throat.
Warm carbide glow,
black curtain of night nudged aside.

Silken dry dust billows up with each movement,
parched throat and watered eyes.
Course air rasps deep through my lungs,
teeth grinding gritty.

Bats hang benignly from their hard rock niches,
water trickles sweetly far off,
muffled through thick walls.
And deeper we push.

Down, deep down,
deep in the bowels of this cave,
air lies still and heavy.

Moisture laden vapor,
flows thickly through nostrils.
Breath issues forth like fog,
with each exhausted gasp.

Clammy wetness permeated the walls,
seeping coolness through layers of clothing.
Moist clay clings slimy to flowing rock,
and still we crawl on.

Eight inches low,
our bodies fill the passage.
Countless tons lay heavy upon my tortured body,
enfolding womb of living stone.

Up we corkscrew squeeze,
up to volcano room above.

From the guts of earth we burst forth.
Fragrant breezes envelop me,
I breathe the moonlight,
I drink the air.

Michael Flynn

Originally printed in:
Pholeos Vol. 1 (1,2)

A Cave is More

A cave is more than just a hole,
with hallways winding to and fro.
A river stream, it gently flows,
the water cares not where it goes.

Some caves are deep and others long,
for beauty's still a hope.
A pit goes down, but still is found,
a caver with a rope.

The mud is deep, the passage wide,
the crawls will make you groan.
The carbide lantern lights the way,
to wonder made of stone.

Formations grow, ever so slow,
years and years it seems.
The water carries mineral down,
for sights most oft of dreams.

"Take nothing but pictures," the motto goes,
enjoy it as you can.
"Waste nothing but time," is what they say,
that message holds a plan.

A rimstone dam, though made of stone,
is fragile to the touch.
A misplaced foot, a jolt, a jar,
and damage, oh so much.

So next adventure, recall this,
it's an inkling that should grow.
A cave is more than just a hole,
with hallways winding to and fro.

Dan Alsmeyer

Originally printed in:
Pholeos Vol. 10 (1)

A description of Sheriden Cave

Wyandot County, Ohio

Horton H. Hobbs III (WUSS #0001; NSS #12386 HM, CM, SC, FE)
and
Kevin M. Kissell (WUSS #0530; NSS #54578 RE)

Introduction

It was a windy and chilly 20 December 1978 when one of us (HH), accompanied by a small group of WUSSes, hunted down Richard ("Dick") Hendricks at the Post Office in Vanlue, northwestern Wyandot County, Ohio. Not only did we obtain permission to enter **Indian Trail Caverns** (=Wyandot Indian Cave) but he gave us the grand tour. This show cave, located northwest of Carey, was commercialized originally in 1927 as "Wyandot Caverns" but the business failed and the cave was closed and subsequently vandalized (Simpson 1975). Dick Hendricks recognized additional karst features on the property (Winchell 1873) and in the early 1960's he began several industrious digging projects to enlarge known passages in Indian Trail Caverns as well as to investigate various sinkholes that were on the property. By 1964 Dick had excavated glacial till from one of the sinkholes to the north-northwest of Indian Trail Caverns and intersected two generally horizontal passages, thus discovering **Hendricks Cave** (Figure 1). In the process of digging in that cave he uncovered human remains (at least 14 distinct bodies; radiometric assay of a charcoal sample yielded a date of 2,543 B.C.) and numerous bones of a diverse vertebrate fauna (McKenzie and Prufer 1967; Pedde and Prufer 2001, 2006). McKenzie and Prufer (1967) produced a general map and Hobbs and Trent (1987), with the aid of Dick's son Keith, resurveyed Hendricks Cave and presented more detail in both plan and profile views.

These discoveries generated much interest and excavation proceeded there as well as in Indian Trail Caverns. By the mid 1970's Dick had excavated the passages of Indian Trail Caverns to a depth that allowed for ample walking, put in concrete steps, installed lighting, and reopened the cave for tourist visitation. With the aid of Dick, Keith, and a few

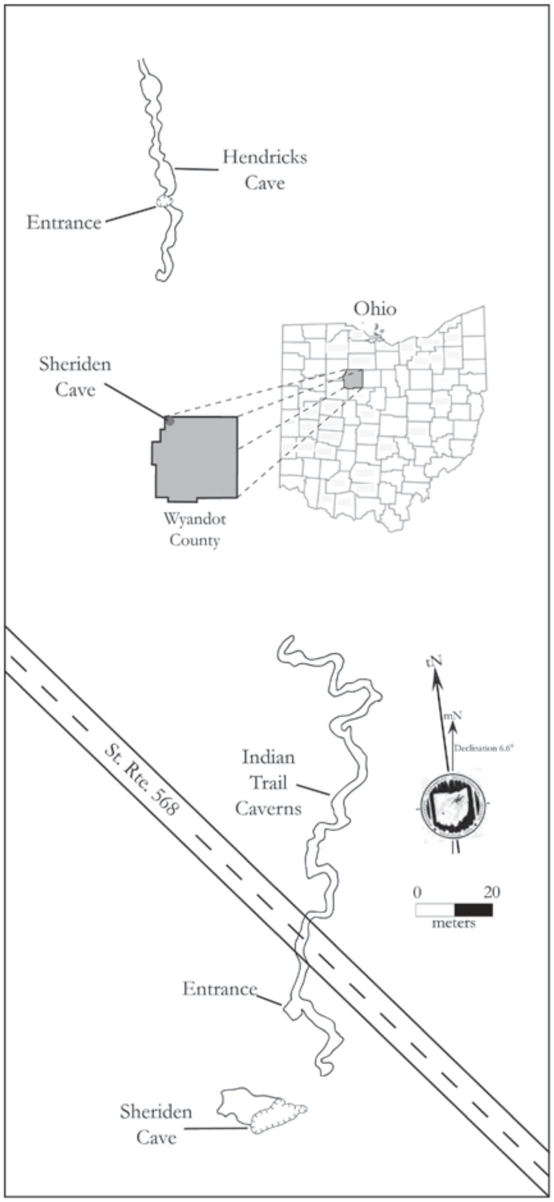

Figure 1: *Locations and simplified plan views of Sheriden Cave, Indian Trail Caverns, and Hendricks Cave (modified from Redmond and Tankersley 2005).*

members of the Central Ohio Grotto, Simpson (1975) produced the first map of the cave. A second survey was made when WUSSes Hobbs and Michael Flynn (WUSS #0021) returned to the cave on 11 July 1980 (Tarulli 1982).

Meanwhile digging continued in other sinkholes on the property and unfortunately the price for doing so was high for Dick who suffered with intense back pains. Regardless, his hopes of extending Indian Trail Caverns not only to the north toward Hendricks Cave but also to the south in the direction of a large sinkhole remained high. By 1989 the southern sinkhole excavation had progressed considerably and in 1990 he hired a crane operator to speed up the process. The more aggressive excavation did not produce a connection to Indian Trail Caverns (although they likely once were) nor did it intersect any significant horizontal or vertical passages, but it did result in the discovery of one of the most important archaeological and paleontological sites in Ohio! It now is designated as **Sheriden Cave** [=Sheriden Pit, Sheriden Pit Cave, and even Indian Trail Caverns by Hansen (1992a, b)] and contains a deep stratigraphic sequence of unconsolidated late Pleistocene and early Holocene deposits. Careful excavations resulted in the discovery of the disarticulated remains of more than 60 vertebrate taxa (see Hanson 1992a, b; McDonald 1994; Bills and McDonald 1998). The dating of these fossils in the Late Pleistocene (Younger Dryas stadial - ca. 11,000 – 10,000 B.P.) corresponds with the wave of extinctions of many large mammals, some of the remains of which were discovered in the cave (Table 1). Additionally, the occurrence of artifacts and cultural remains suggests that Sheriden Cave was the site of one or of a few, short-term occupations by a small number of Paleoindians, which is coincident with the timing of the large mammal extinctions, a cause and effect relationship proposed by Martin and Klein (1984) (see Redmond and Tankersley 1998, 2005; Tankersley and Redmond 1999; Redmond et al. 2002).

Figure 2: *Entrance to Sheriden Pit with chain link fence and vegetation surrounding it; west gate visible (photograph by Horton Hobbs)*

Table 1. Pleistocene vertebrate remains of extinct species identified from Sheriden Cave (for more complete listings of identified fauna see Hansen 1992a, b; Bills and McDonald 1998; Redmond and Tankersley 2005).

Vertebrate Taxa	Common Name
Castoroides ohioensis Foster 1838	giant beaver
Platygonus compressus LeConte 1848	flat-headed peccary
Mylohyus nasutus (Leidy 1868)	long-nosed peccary
Arctodus simus Cope 1897	short-faced bear
Cervalces scotti (Lydekker 1898)	stag moose

Cave Description

Like Underground River Cave (White 1926, Hobbs and Flynn 1981) and Fredritz Pit (Hobbs and Flynn 1981), Sheriden Cave as well as Hendricks Cave and Indian Trail Caverns are developed in the Niagaran (Silurian) dolomite. These solutional features are situated in the Stony Ridge Karst Region (Hobbs 2009), a bedrock high point that reappeared as the Wisconsin Glacier retreated northward around 12,500 B.C. (Goldthwait 1959, Forsyth 1975). Sheriden Cave is located in the northwest corner of Wyandot County in Section 2, Ridge Township, approximately 40m southwest of St. Rte. 568, and about 25m south of the tourist entrance to Indian Trail Caverns (Figure 1) at an elevation of 270m. This area is a remnant of an extensive prairie and is dominated by grasses with spotty stands of oak, hickory, sassafras, beech, elm, hazel, pawpaw, and ash trees. The terrain is relatively flat and thus all entrances (and skylights) of the caves are nearly flush with the ground surface. The entrance to Sheriden Cave is surrounded by a chain link fence with an entry gate on its western and southern sides and various trees whose branches extend over and into the pit (Figure 2); various objects used for excavation and lighting also are found in the entrance area. After passing through the southern gate a sturdy set of metal stairs descends the 8.5m open air pit entrance that measures 7m wide by 18m long (Figure 3, Cover photo).

Figure 3: *Open air entrance pit of Sheriden Cave with metal stairs and tree branches descending into the pit (photograph by Nate Pfeffer)*

A 30cm diameter corrugated plastic pipe was stuck in the ground towards the northeast corner of the pit, its purpose is unknown but it did have water in it at the time of the survey. The excavated portion of Sheriden Cave extends towards the west for 12m, which constitutes the bulk of the archeological and paleontological focus and encompasses one large room, 12m by 10m, and a secondary smaller room, 3m square, in the southwest corner of the cave (Figure 4). The entirety of the cave is downward sloping away from the entrance and consists of a compacted, soft sediment floor. The ceiling height ranges from 4.5m at its tallest point, near the entrance, to two meters tall at its lowest in the very back of the cave; some small soda straw speleothems occupy sparingly in the ceiling (Figure 5).

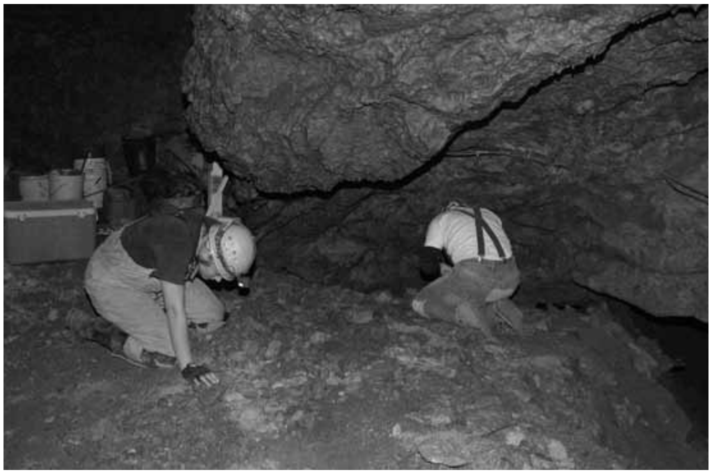

Figure 4: *Excavated room west of open air pit (photograph by Nate Pfeffer)*

The cave was very dry with no dark zone and a twilight zone only in the excavated part of the cave west of the pit. No cave-adapted fauna were noted on the day of the survey; numerous trogloxenes consisting of tangle web spiders, millipedes, springtails (*Tomocerus* sp.), mycetophilid, heliomyzid, and culicid flies, as well as an American toad (*Bufo americanus*) were seen on 25 July 2008. Evidence of a shrew (*Blarina brevicauda*) also was observed.

All of the caves and other karst features mentioned are on private property and no attempt should be made to visit any of them.

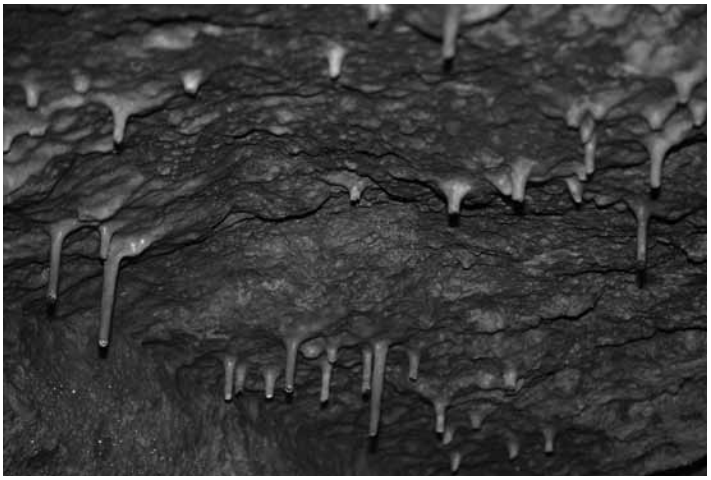

Figure 5: *Soda straw speleothems, up to 4cm in length, on ceiling of excavated portion of cave (photograph by Nate Pfeffer)*

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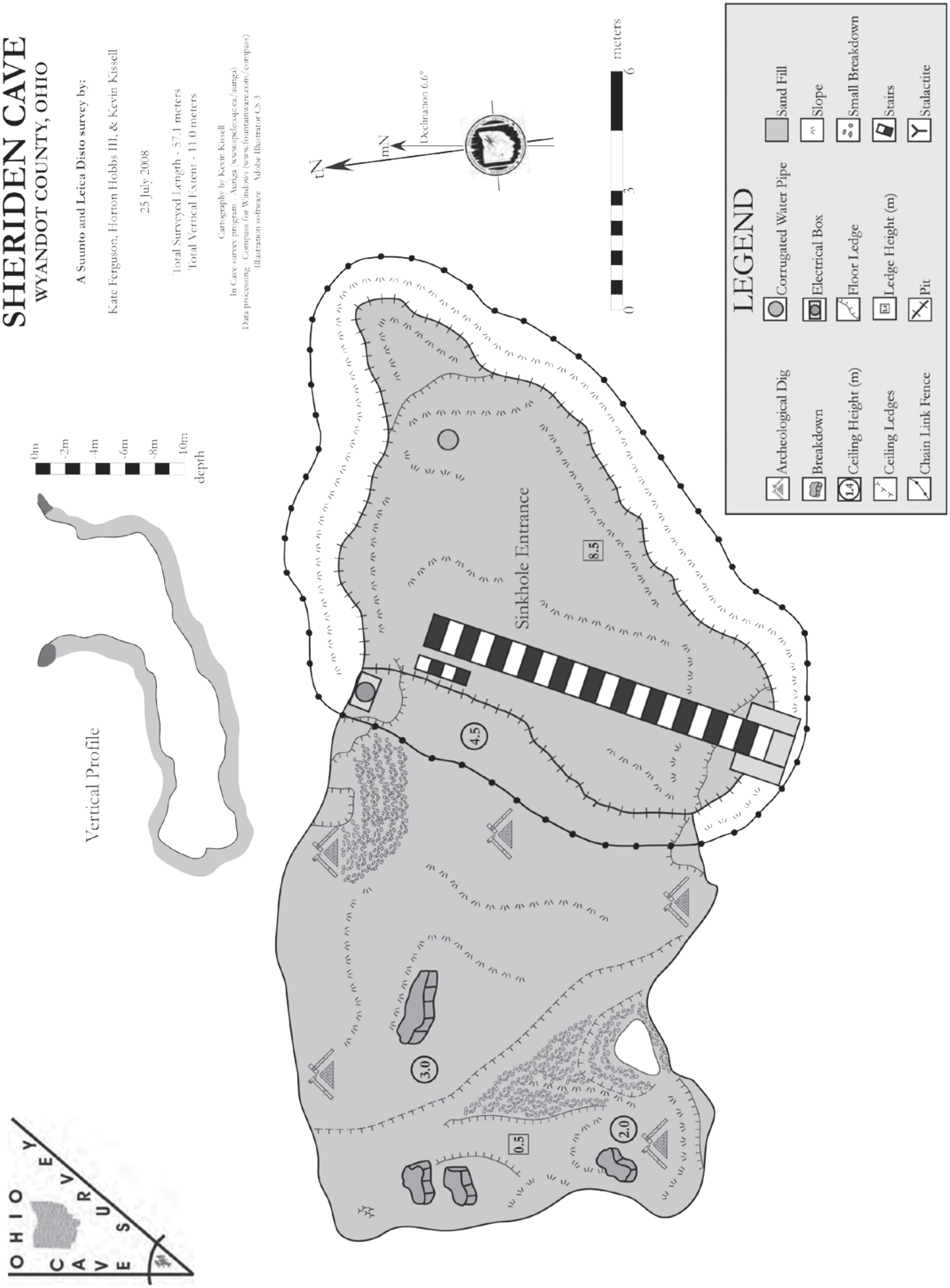


Wittenberg University Speleological Society

Cliff Cave

Carter Caves State Resort Park, Kentucky

Caleb Heimlich (WUSS #0539, NSS #55745)
Kevin Kissell (WUSS #0530, NSS #54578)

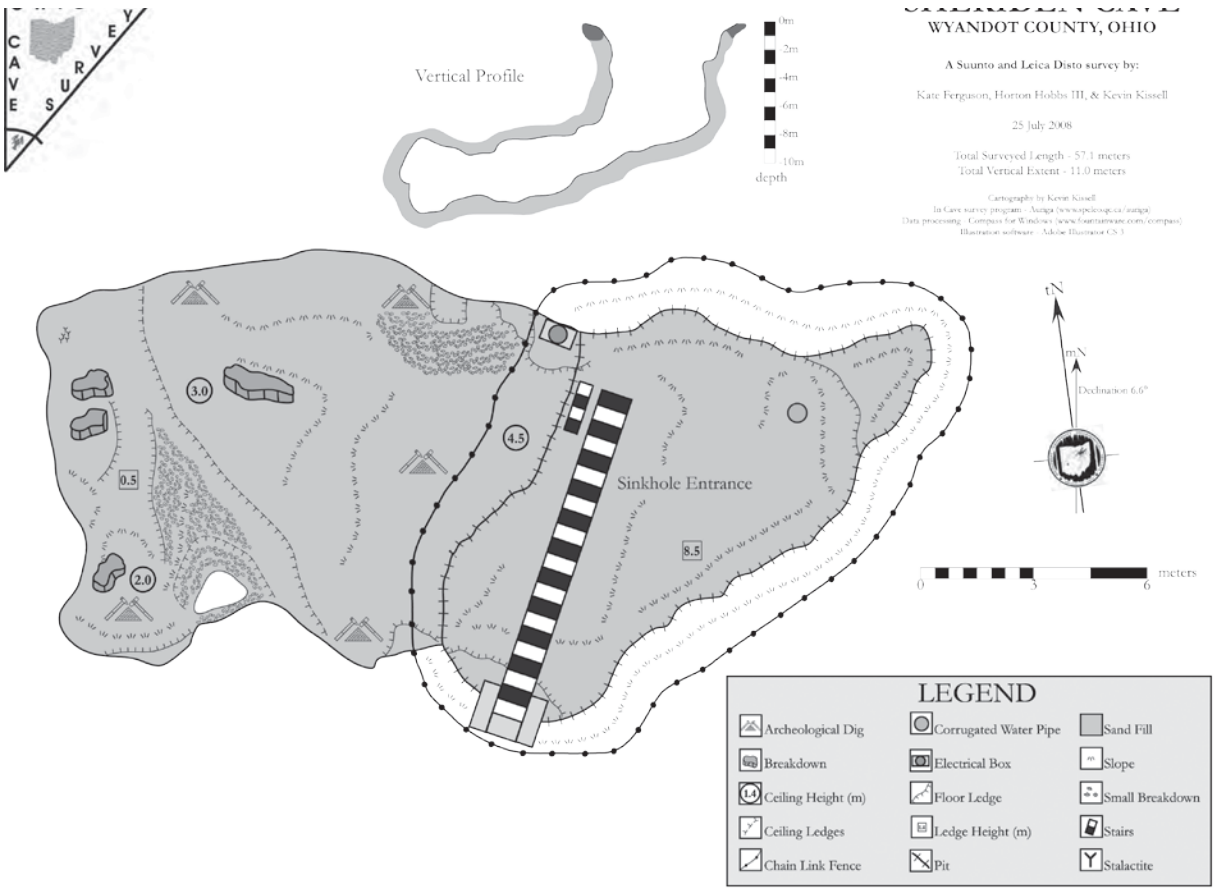


Figure 1: *Cliff Cave requires a five meter rappel from the top of a limestone cliff; here a surveyor happily poses before swinging into the cave. Photo by C. Heimlich.*

Cliff Cave is a limestone cave formed in the Ste Genevieve limestone of Carter Caves State Resort Park in Carter County, Kentucky. The entrance to Cliff Cave is in a small outcrop of limestone approximately 5 meters below the top of the cliff. A short rappel from the topside arrives at the small entrance of approximately 1.5 meters in height and one meter across. Cliff Cave is small, with a total surveyed length of 11.8 meters, and a vertical extent of roughly three meters. The entrance leads to a tiny room large enough for two people to sit in. The passages off the room narrow quickly and trend in roughly opposite directions. Leaf litter and other organic matter were observed in the passage trending east by southeast, possibly indicating fractures that reach the ground above though none are large enough to admit a person.

Figure 2: *Caleb Heimlich works the instruments while hanging out of the cliff entrance of the cave; note the duel safeties. Photo by K. M. Kissell.*

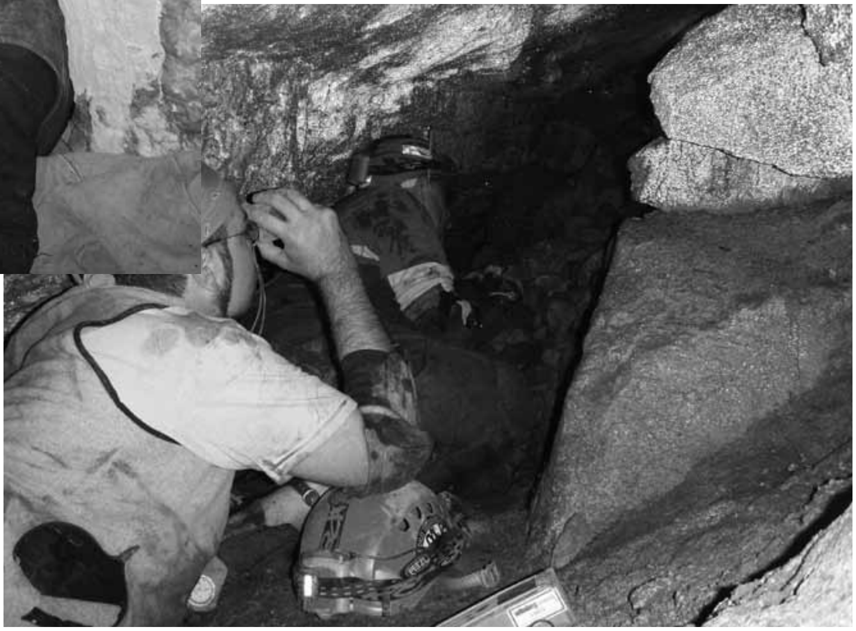


Figure 3: *The surveyors pushed the cave to the very end; this required two tight squeezes that resulted in two dead ins. Photo by K. M. Kissell.*

CLIFF CAVE

CARTER CAVES STATE RESORT PARK
CARTER COUNTY, KENTUCKY

A Suunto and Leica Disto survey by:

Caleb Heimlich & Kevin Kissell

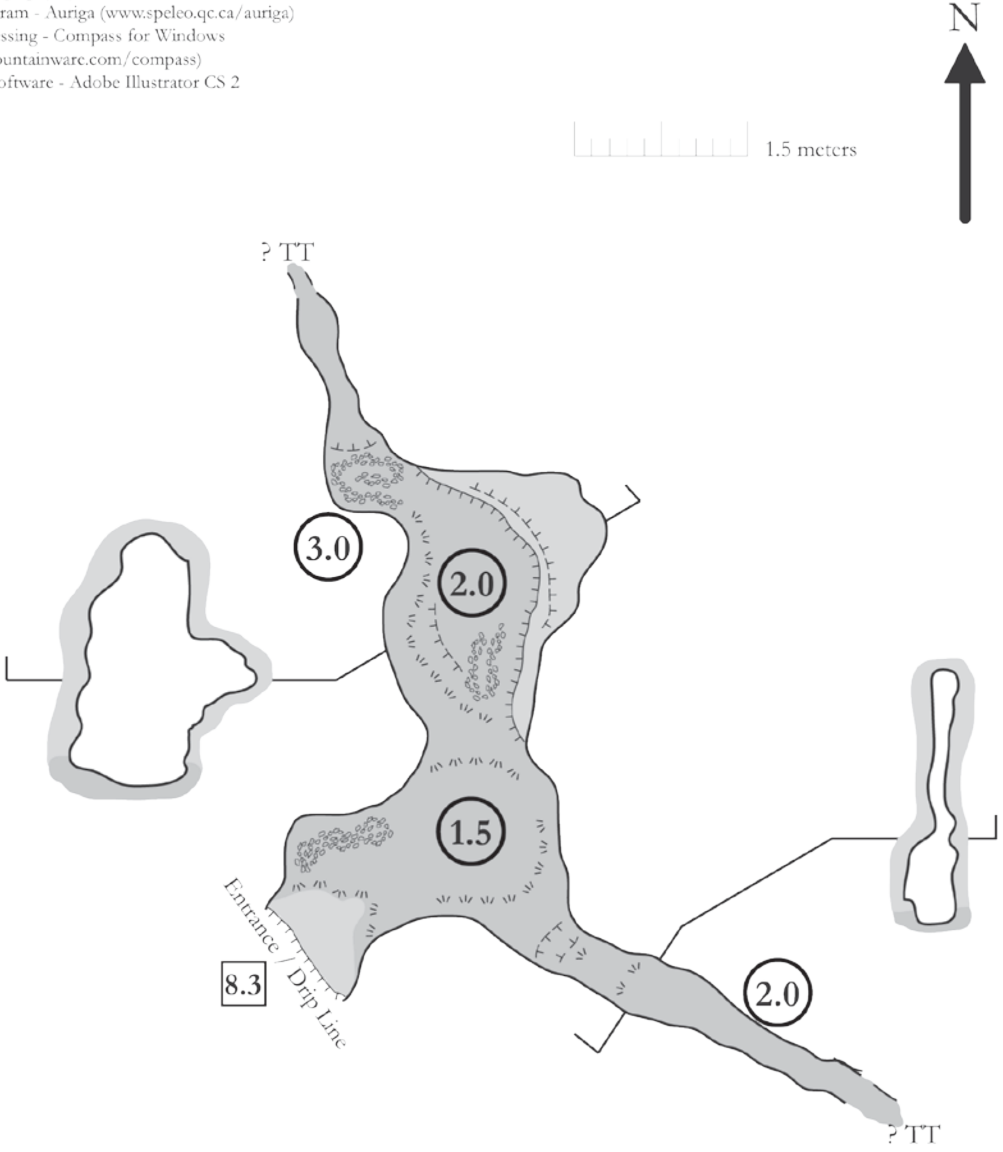
03 February 2007

Total Surveyed Length - 11.8 meters

Cartography by Kevin Kissell
In Cave survey program - Auriga (www.speleo.qc.ca/auriga)
Data processing - Compass for Windows
(www.fountainware.com/compass)
Illustration software - Adobe Illustrator CS 2

LEGEND

▢	Bedrock		Ledge
(2.5)	Ceiling Height (m)	2.0	Ledge Height
	Ceiling Ledge	▨	Sand
	Cobblestone		Slope
?	Lead	TT	Too Tight



Wittenberg University Speleological Society

KMK

Skyway Cave

Ottawa County, Ohio

Kate Ferguson (WUSS #0544, NSS #56925)

When you are on a small island, you hear a lot of rumors. During the summer of 2007, while on South Bass Island, WUSS heard a rumor about a local bar with a cave in its basement. After a few inquires we learned that the rumor was in fact true and we knew we had to check it out. So in the summer of 2008 we made arrangements to visit this unique underground habitat. Above ground, you'd never suspect the Skyway Restaurant and Lounge was anything but an exceptional dining establishment and favorite local drinking spot. But if someone in the know wanders into the basement, and moves a certain case of wine and the panel behind it, they'd find something the average patron would never even know about . . . part of the Skyway Restaurant is built on a cave!

Figure 1: *Hidden among the racks of expensive wines and liquors is the entrance to Skyway Cave. The cavers are allowed to enter but must be cautious since the rule of "if you break it you buy it" applies to all the bottles. Photo by B. Stitzel.*

Figure 2: *The entire cave floor slopes into a pool of water (seen on the left) and the ceiling height is never more than half a meter. The mysterious black rubber hose can be seen in the foreground. Photo by B. Stitzel.*

Our survey team consisted of Horton Hobbs and Kevin Kissell on instruments, myself on book, and Bill Stitzel who photographed our hard work and generally got in the way! Crawling over shelving into a hole in the wall to access a cave was a new experience for me personally. The "entrance" to Skyway Cave is manmade, and decorated with a stone arch. Once past the arch, the passage, which is supported by cement blocks, is tall enough to stand in with enough room for three, comfortably. The artificial portion of the cave is

SKYWAY CAVE
OTTAWA COUNTY, OHIO

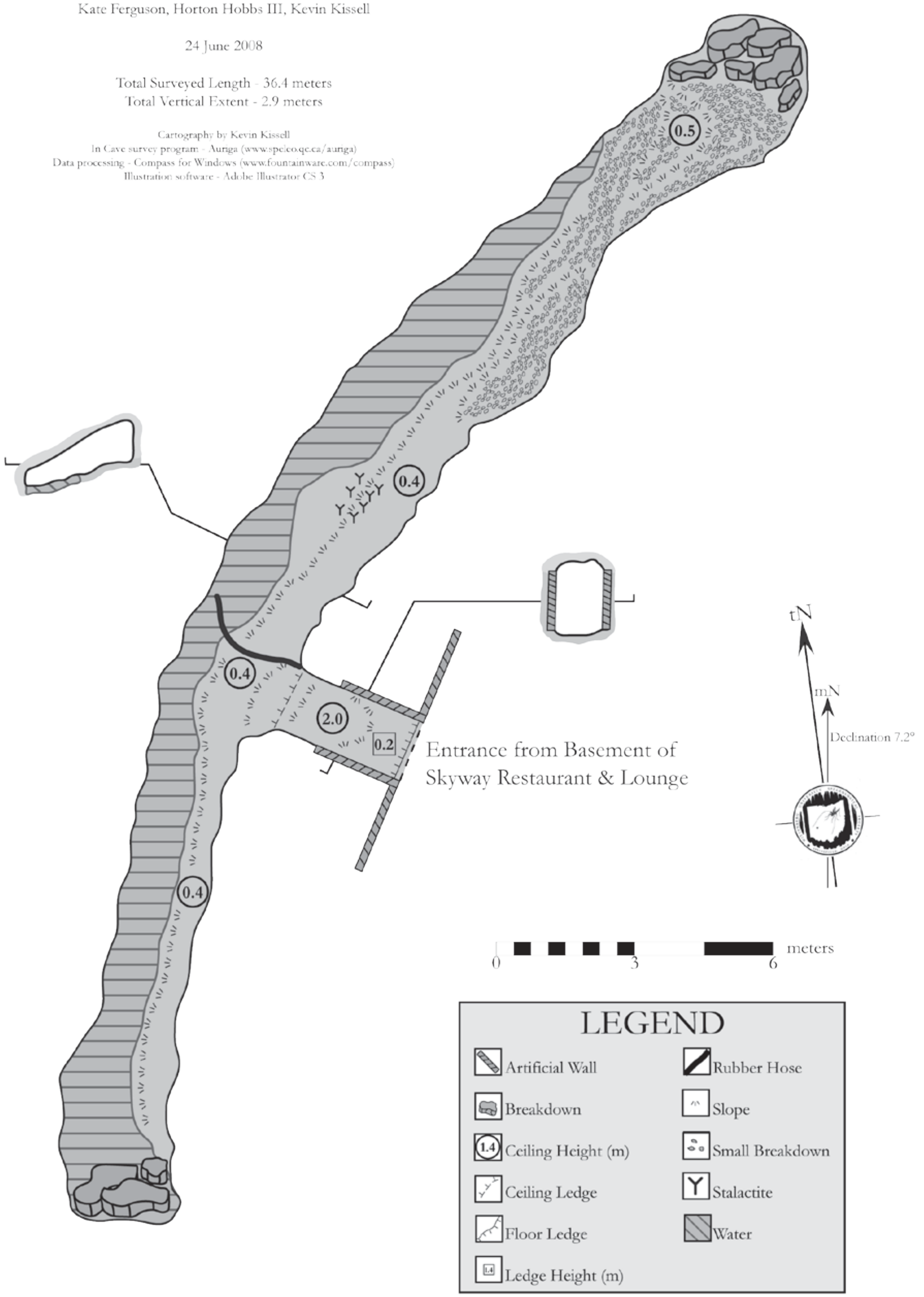
A Suunto and Leica Disto survey by:

Kate Ferguson, Horton Hobbs III, Kevin Kissell

24 June 2008

Total Surveyed Length - 36.4 meters
Total Vertical Extent - 2.9 meters

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



Wittenberg University Speleological Society only a few meters long and terminates into the natural cave entrance. Once through the entrance area the cave opens into a nice crescent about 33m long and roughly 3m across.

Figure 3: *Members of the survey crew map the cave to the very end, which means piles of breakdown on both the north and south ends. Photo by B. Stitzel.*

Right in front of the artificial passage is a black hose that may have supplied water to the restaurant at some point. Since the water level in the cave is tied directly to the lake level it would have been a dependable source. The hose was long enough almost to reach the far wall, indicating that even in low water conditions it would still be able to reach water. The current owners had no information about the rubber hose so its current purpose is a mystery to us.

The southern arm of the crescent stretches twelve meters and terminates in a breakdown pile. The survey team could not reach the terminus of the southern branch since water stretched across nearly the entire passage. To the north, the bank was much wider; however near the entrance it had a higher slope and was much more slippery. I don't know how my instrument crew fared, but I had a hard time holding onto the book and my pencil while trying not to slip into the water. The bank eventually leveled out to a cobble belly crawl that terminates at a breakdown pile – no actual wall is visible, so the cave may continue past this. We found a cute little bunch of stalactites near the middle of this arm but their development may be hindered due to the fluctuation of the water level inside the cave.

The cave is in good condition and the owners only rarely allow access. We didn't

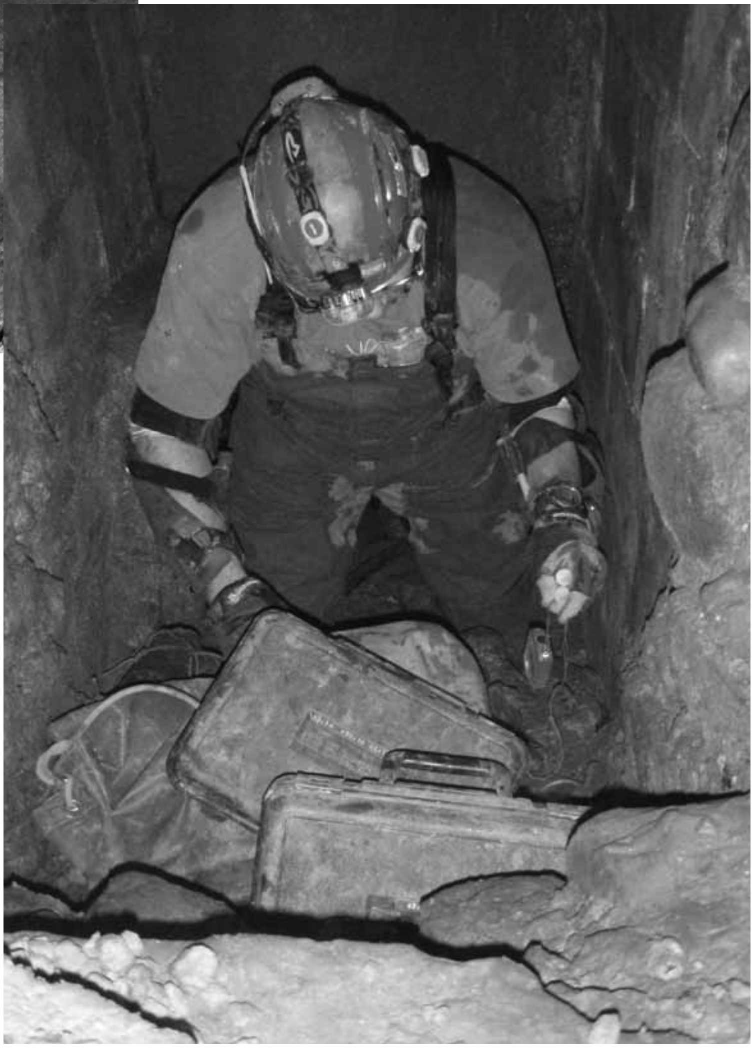


Figure 4: *Horton Hobbs slides gear up the passage which leads from the basement to the cave. The entrance passage's walls are re-inforced with concrete blocks to help support the structure overhead. Photo by B. Stitzel.*

see any life in the cave, which might also be a result of the water level fluctuating so often. In fact, the water level fluctuates so much that during wet weather it is not uncommon for the entire cave to be underwater. Hopefully the water never rises to the height of the entrance; it would be a shame for all the delicious beverages to float away!

***Figure 5:** Kate Ferguson and Kevin Kissell emerge from the cave. The trash bag in the foreground was used to protect the wine racks from the grit and grim of cavers. Photo by B. Stitzel.*

INFORMATION FOR CONTRIBUTORS

PHOLEOS
Journal Of The Wittenberg University Speleological Society

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

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

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

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

1. The *title* page should include the title, author's name, affiliation, WUSS and NSS membership number, and mailing address.
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3. The *introduction.*
4. *Methods and materials.*
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6. *Discussion.*
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   Book:

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

   Chapter:

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

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Dept. of Biology
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