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AMERICA'S CAVING
MAGAZINE



NSS NEWS

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National Speleological Society Headquarters

6001 Pulaski Pike NW, Huntsville, AL 35810
(256) 852-1300

email: nss@caves.org; website: <https://caves.org/>

Please contact the office for address changes or back issues.

NSS EXECUTIVE COMMITTEE

President

Kristine Ebrey
South Pittsburg, TN
(423) 991-3034
president@caves.org

Operations VP

Maureen Handler
Sewanee, TN
(423) 605-5569
ovp@caves.org

Administrative VP

Emily P. Davis
Tennessee
(912) 655-0781
avp@caves.org

Secretary/Treasurer

David Oase
Tucson, AZ
s-t@caves.org

Executive VP

Scott Engel
Knoxville, TN
(225) 281-3914
evp@caves.org



Managing Editor

Joel Despain
nssnews@caves.org

Production Editor

Adam Weaver
nssnews@caves.org

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DEPARTMENT EDITORS

American Caving Accidents

Adia Sovie
aca@caves.org

Spelean Spotlight

April Gocha
april.sandy.gocha@gmail.com

Conservation

Val Hildreth-Werker
conservation@caves.org

Underground Update

Ian Reuter
ianreuter@aol.com



THIS MONTH

THIS MONTH'S COVER

James Newell and Vivek Zilpelwar clean and vacuum dirty flowstone with Dustin Schulz cleaning in the background near the Crystal Pools in a northern California Cave.

From our story on page 14.
Photo by Michael Stark

CALENDAR OF EVENTS

April 10 to 19, 2024

21st International Symposium on Vulcanospeleology, Puerto Ayora, Galapagos Islands, Ecuador. Pre-Symposium caving April 10 to 13 for exploration, survey, photography, and science. Sessions on April 15 & 16. Field trips from April 17 to 19. To register: <https://tinyurl.com/54x29crx>

April 19 to 22, 2024

The Spring MVOR will be held on Earth Day at the Shriener Campground in Buckhorn, Missouri. See: <https://www.facebook.com/groups/486274632413719>

April 20th, 2024

The Tennessee Cave Survey spring presentation meeting will be held in the Bell Hall Auditorium at Tennessee Tech University at 9 am Central Time. Contact Jon Zetterberg for more information or to sign up to present. See: <https://fb.me/e/3zWiQfaDx/>

May 17 to 19, 2024

Spring MAR Field Meet at McClure Bean Soup Festival and Fairgrounds, McClure, Pennsylvania. Sponsored by the Bald Eagle Grotto. Website at: <https://baldeaglegrotto.weebly.com/spring-mar-2024.html>

June 6, 2024

International Day of Caves and the Subterranean World

July 1 to 5, 2024

NSS Convention in Sewanee, TN.
<https://caves.org/convention/2024-nsss-convention/>



August 9 to 11, 2024

60th Annual Hodag Hunt at Prairie Island Campground, 1120 Prairie Island Road, Winona, Minnesota. Sponsored by the Wisconsin Speleological Society. Website at <https://wisconsincaves.org>

Aug. 29 to Sept. 2, 2024

The 73rd annual Old Timers Reunion, themed caves, cavers and caving will be held in Dailey, West Virginia. Website at: <https://www.otr.org>

Sept. 29 to Oct. 3, 2024

International Show Caves Association Conference at Mulu National Park, Malaysia.

October 6 to 10, 2025

National Cave and Karst Management Symposium in Ely, Nevada, and hosted by the Western Cave Conservancy. This is the nation's top forum for promoting, advancing and sharing concepts in the effective management of cave and karst resources. See: <https://ely2025.nckms.org/>

January 21 to 25, 2025

85th Anniversary of the Speleological Society of Cuba, International Congress. At Playa Los Bajos Gibara, Holguín, Cuba. See more details at: <https://www.fealc.org/index.html>

July 20 to 27, 2025

19th International Congress of Speleology in Belo Horizonte, Minas Gerais, Brazil.

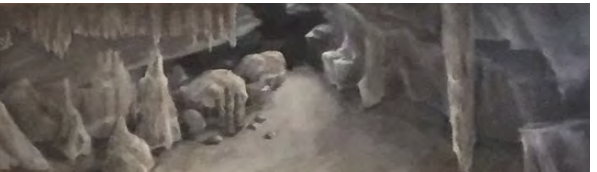
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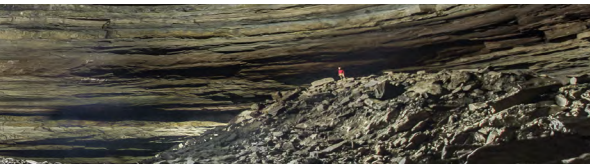
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BACK COVER

Ethan Donahue and Jessica Leila clean in a northern California Cave. From our story on page 18.
Photo by Joel Despain

THIS ANNUAL NSS NEWS CONSERVATION ISSUE

IS LOVINGLY DEDICATED TO THE MEMORY OF JIM C. WERKER
NSS #31653CL CM-2007, CO-2012, FE-1997

by Val Hildreth-Werker, NSS Conservation Division Chief

Jim C. Werker (1939-2023) - His Way with Caves

Jim Werker was all about taking care of caves. Jim looked at caves in a holistic way; as unique systems filled with interdependent organisms, features and processes. Believing that caves serve as nature's archives, he strove to protect and perpetuate cave and karst systems.

Jim's first memory of caving was in the mountains east of Albuquerque. As a small boy out on his horse looking for his dad's cows, Jim noticed a straight pine trunk leaning to make a perfect ladder up to a hole in the cliff face. He climbed it and entered what was then known as Sandia Man Cave. This cave piqued his curiosity, and Jim went for any dark hole he found in the Sandia Mountains and beyond.

Jim Werker lived an outdoor life with extreme adventures along the way. He loved being out in the natural world, the more remote the better and in any ecosystem, the more extreme the better. During his almost 84 years, Jim witnessed arrogant disregard and ignorant destruction of important natural systems and habitats. Those special places managed themselves just fine until humans came along and interfered, leaving their marks on the landscape, water and biota. He grieved it: The loss of habitat, the decline of abundant wild animal populations and the spurring of wanton recreational promotions. Jim realized that, for caves, he could do something about it.

He brought his research and development background to cave and karst conservation. With 34 years at Sandia National Labs as a mechanical engineer in nuclear research, tooling design, fabrication, pressure safety and materials, Jim conceived and developed minimum-impact methods in cave inventory, restoration, speleothem repair and caving ethics.

Val is honored to be his partner in caves, conservation and life for almost 29 years. They literally first met in a cave, twice. Both times were in notable caves in southeastern New Mexico, Cottonwood and Endless. Jim and Val were each already involved in leading cave repair and restoration work, re-

spectively. Their work together started in New Mexico and then extended throughout the Western US, east to Mammoth (Floyd Collin's Crystal Cave) and on to international venues.

In the early 1990s, Jim discovered and gated a deep cave in the Guadalupe Mountains of New Mexico. Involved with early microbiology studies in Lechuguilla Cave and disgusted by the expanding "elephant trails" of early exploration, Jim developed a vision. He was able to work with federal agencies and declare the new cave a microbial preserve, where science establishes first-entry studies as new passages are discovered. The steps of survey, mapping, and further exploration come second.

When Jim wanted to initiate baseline photo monitoring in the new cave, he shared the vision with Val. She described her ideas for streamlining the process and reducing the redundant impacts associated with traditional environmental photo monitoring. Jim understood the concept, built a stainless steel prototype, and showed up for a caving trip a week later, ready to try it out. These photo monitoring installations facilitate easy replication of the same image, today, tomorrow or in fifty years.

Jim and Val installed their first photo monitoring system in Endless Cave during the 1993 National Cave and Karst Symposium in Carlsbad, New Mexico, where Jim presented his work on sustainable materials and techniques for speleothem repair.

A year later, a caver-jeweler made their wedding rings, representing rimstone dams and cave pearls. A caver-chef made them a wedding cake decorated in columns, stals, rimstone dams and cave pearls of icing. A caver ceramist created a cake topper of stalagmites and two cavers rappelling down the side, Jim with his cowboy hat, and Val with her ponytail and lace boots hanging off her cave pack. A caver drove his limo with a carbide light hood ornament and swept them away to a caver barbecue where the swimming pool was heated to hot tub temp. Jim and a caver-machinist fabricated small, titanium Gibbs-like ascenders as wedding

presents.

During the early years of marriage, Jim and Val completed a science-first cave management plan with minimum-impact protocols for first-entry microbial sampling studies in each newly discovered passage of La Cueva de Las Barrancas. The plan was approved, establishing the cave as a microbial preserve and paving the way for designation as a subterranean Mars prototype study site. Supported by NASA Institute for Advanced Concepts funding, the cave became a testbed for developing studies and techniques to avoid cross-contamination, support the search for extraterrestrial life, and develop robotic communication systems.

Jim and Val launched into three decades of sustainable monitoring, exploring, conserving, restoring, repairing, photographing and advocating for cave systems. They continued to design and install environmental photo monitoring systems for surface and subsurface environments across the Western U.S.; performed a 15-year infrared photo monitoring study on the Mexican free-tailed bats in Carlsbad Cavern to analyze population trends; coordinated and led over 40 expeditions into Lechuguilla for science, restoration, and photo monitoring; designed and fabricated lightweight caving gear; provided field support to a variety of cave science and administration projects; consulted for and executed difficult speleothem repairs around the country; and conducted domestic and international workshops in cave conservation management and restoration for government agencies, institutions and non-governmental organizations.

Serving the National Speleological Society (NSS) as Conservation Division Joint Chiefs since 1999 with more than 150 published papers. Jim and Val coordinated and edited a comprehensive, award-winning NSS volume describing field-proven techniques in state-of-the-art cave conservation, restoration, speleothem repair, and low-impact caving ethics. Both are Fellows of the NSS, received Certificates of Merit for their work on the book, and were recognized individually as recipients of the Victor A Schmidt Conservation Award. Members of the Australasian Cave and

Karst Management Association, Inc. granted the inaugural award for "Outstanding Contribution to Cave and Karst Management" to Val Hildreth-Werker and Jim C. Werker for their "editorship of and contributions to the fine book, *Cave Conservation and Restoration*, with congratulations to the NSS on the breadth and excellence of this volume" and described the work as the "bible of cave conservation." The 600-page peer-reviewed tome is now a living book available for free download—each chapter is a portal to ever-evolving best practices. Find the full manual, *Cave Conservation and Restoration* (Hildreth-Werker and Werker) at <https://caves.org/conservation/> or <https://caves.org/wp-content/uploads/2022/06/CCR-Book.pdf>

As a first generation American born to a former Dutch military officer and a British mother who taught him to love strong black tea with milk, James Craig Werker had the privilege of living life in many different ways—as a cowboy, rodeo bareback bronc rider, outfitter-guide, hound trainer, and rancher while doing R&D at the Nevada Underground Test Site. He knew how to balance intense team work and purposeful recreation. Jim was most content outside of four walls—ranching, breaking horses, hunting, fishing, camping, backpacking, kayaking, hik-ing, diving, ridgewalking and caving. On April 13, 2023, Jim went caving with Jesus. Following a ventral hernia surgery in March of 2022, Jim survived a stroke. After an intense year of in-patient treatment and out-patient rehab for the stroke, post-stroke seizures, and then Covid, Jim made his final ascent. Showing his typical Jim Werker resilience, he tackled recovery with strength and determination. Jim succeeded in the rehab game many times through-out his lifetime. At age 7, he blew off a couple of fingers with dynamite he found in a mine; got an eye shot out at 15; got stomped by a rodeo bull; got a replacement anvil and hammer in an ear; got sober in 1981; fell off a 30-foot cliff in 1993 (he repurposed the titanium from his broken legs and pelvis for stalactite repairs in Carlsbad

Cavern); and lost his left arm in a roll-over accident in 2012. He kept caving, and in his cowboy humor, Jim claimed he was leaving parts and pieces behind as he looked for more caves.

Jim was remarkable at balancing painful rehab work with healing rest. In the end, a Covid lung infection turned on him. With grace and courage, Jim relaxed and peacefully welcomed the onset of his ultimate eternal adventure. I miss him. When caving, I forget and turn to check on him. I miss giving each other so many beautiful sunsets. I am grateful for Jim's way with caves. I am grateful for our amazing, sustaining time together. Cave softly ... cave on, Jim.

A Memorial Celebration honoring Jim's life was held on Sunday, June 11, 2023 in Hillsboro, New Mexico (a charming historic mining town of the old west). Events included: Jim's Life Celebration at Hillsboro Union

Church; a mile of walking procession to the cemetery, led by local musicians following a 1955 green Chevy pickup carrying Jim's cowboy coffin that was lovingly crafted of oak and cedar by a local neighbor; pallbearer caving friends lowering Jim with a dozen knotted ropes of royal blue static line under the direction of a fellow Sandia engineer/caver; and live music during a New Mexico Red/Green Chile Wake with open-mic sharing of Jim's stories. Family, local friends, and cavers from afar honored Jim's cowboy-caver style, wearing their comfy denim with western shirts and hats for the hot sun.

View the obituary, videos, and memorial tributes at the Kirikos website <https://kirikosfamilyfuneralhome.com>. Memorial donations can be made in Memory of Jim Werker to the NSS Save-the-Caves Fund <https://secure.givelively.org/donate/national-speleological-society/save-the-caves>.



JIM C. WERKER, 1939-2023. PHOTO BY VAL HILDRETH-WERKER

Cowboy Jim's Last Rodeo - by P.J. Boston, June 2023

*You were always tough as nails,
With a soft center occasionally seeing the light of day for those of us
Who could really see through the leather skin
bestowed on you by the sun.*

*A once-rodeo rider not afraid to break out the sewing machine
In pursuit of ever better caving gear,
You gifted your engineering mind to bestowing delicate care
On fragile crystal beauties in sad need of triage and tender repair.
Many are the speleothems that thank you in their dreams.*

*Your final rodeo was a tough one,
robbing you of your perpetual motion machine,
But perhaps allowing reflection in your dark interior
not reachable in the whirlwind.*

*You have left us, and there is a cave in our hearts
where you used to reside.
Your spirit now washes across arid plains and stark
mountains,
Across the globe in the places that you touched, To find its
abiding home in the dark, deep places of the Earth.*



SOCIETY NEWS

Western Kentucky University Cave and Karst Field Studies Classes set for 2024

The Cave and Karst Field Studies classes from Western Kentucky University (WKU) in cooperation with Mammoth Cave National Park and several other organizations return again in 2024 with a slate of courses that can be taken as a workshop, for undergraduate or graduate credit. Classes this year are Karst Hydrology, May 19 to 24, 2024, taught by Dr. Chris Groves and Lee Anne Bledsoe from WKU; Exploration of Mammoth Cave, June 16 to 24, 2024, by Bruce Hatcher from the Cave Research Foundation; Cave and Karst Data Visualization, June 18 to 23, with Dr. Pat Kambesis from WKU, and Cave and Karst Resource Management, June 24 to 28, 2024, with Joel Despain, retired Cave Management Scientist from the National Cave and Karst Research Institute. For more information, see the web page at <https://www.karstfieldstudies.com/courses>.

The 2025 National Cave and Karst Management Symposium

Plans are firming up for the next National Cave and Karst Management Symposium. It is slated for Ely, Nevada, home to the 2016 NSS Convention, Great Basin National Park and many fine caves, October 6 to 10, 2025.

The National Cave and Karst Management Symposium (NCKMS) Steering Committee unanimously approved a bid from the Western Cave Conservancy to host the symposium. These bien-

nial events are week-long conferences dedicated to promoting, advancing and sharing effective management concepts for cave and karst resources. This event serves as a valuable platform for land managers and natural resource scientists to network and exchange insights into current trends and ideas in the research and management of these delicate ecosystems.

Ely and the national park offer scenic beauty that has drawn cavers for decades. Nestled in the expansive Great Basin, the region boasts breathtaking landscapes characterized by rugged mountain ranges, vast desert vistas, unique geological formations, hot springs and caves. The pristine beauty of the national park complements Ely's charm, featuring ancient bristlecone pine forests, majestic Wheeler Peak and very well decorated Lehman Cave. See the web page at: <https://ely2025.nckms.org/>.

Wanted: NSS Convention Sites

The NSS is looking for sites and host groups for the 2027 NSS convention and beyond. Did you know there has never been an NSS convention in Arkansas, Arizona, Georgia, Ohio, Utah or Wisconsin? These are all states with significant caves and other worthwhile attractions. When I am asked about hosting, I often hear, "our caves are sensitive." I believe that all caves are sensitive, it's just a matter of degree and for conventions, proper planning. We never ask a host to allow access to any particular or sensitive cave. Wouldn't it be great to plan a vacation around Flagstaff, Arizona, Hot Springs, Arkansas

or maybe Salt Lake City, Utah? The last time we were invited to have an NSS convention in Maryland was in 1952, Iowa 1974, Massachusetts 1979, Minnesota 1980, Wyoming 1984, Kentucky 1985, Oregon 1993, Virginia 1995 and Idaho 1999. These were great locations and folks had a wonderful time. Please give some thought to inviting us back.

If you have ever attended an NSS convention and enjoyed the experience, please consider being a host and inviting about 1,000 of your close friends. You will be provided with guidance and support from first contact until the very end of the convention. For more information, please contact Carol Tiderman at ctiderman@caves.org

Another Legacy for Jan and Herb Conn

Black Hills caving and climbing legends Herb and Jan Conn have expanded their legacy with a \$351,000 grant to Black Hills State University in Spearfish, South Dakota. Jan passed away in May 2023 and Herb in 2012. The grant will create the Sara N Dipity III Scholarship for students in the music program at the university. Herb and Jan mapped more than 65 miles in Jewel Cave, setting the stage for the cave to be the third-longest on Earth, now, with more than 220 miles mapped. They also put up dozens of rock climbing routes in the Hills and many other locations, and wrote the classic caving book, "the Jewel Cave Adventure." Jan was a musician and a composer, as well as a caver and climber. She played the flute, was in a folk music band and often taught music.

2024 - 2025

Charles W. Maus Fellowships in Karst Studies

Doctorate Fellowship	\$20,000
Master's Fellowship	\$10,000
Undergraduate Scholarship	\$6,000

A broad range of karst and cave related research is considered for funding. All applications due June 1, 2024.



804 - 798 - 3432

Information on how to apply for graduate fellowship and undergraduate scholarships may be found at www.caveconservancyfoundation.org



THE PRESIDENT'S COLUMN

BY KRISTINE EBREY

Finally, spring! I hope so, anyway. Our volunteers and BOG members are slowly emerging from the winter break, so a lot of things are popping.

BOG Happenings

Last month, members of the BOG attended the lecture series, Tales from Dark Places. This year it was in conjunction with the National Speleological Foundation and the NSS board meetings the following Sunday, March 10th. I would like to thank the Explorers Club for allowing us to have our meeting at their headquarters and Chris Nicola for organizing the meetings and Tales from Dark Places.

Our agenda is quite exciting, but as I am writing this article on March 1, I am unsure of the outcome of the motions with the BOG. We have been taking big steps towards hiring an executive director. There is a motion on the agenda that will finalize the hard work performed by our Bylaws Committee. As many may know, we have spent over a year working on refining, altering and removing irrelevant material from our 500+ page BOG manual to account for the executive director role within the NSS. Many of our directors and volunteers have worked hard on this process. But I would like to shout out to Stephen Gladieux for being the organizer of the momentous task. Other items on the agenda include the 2024 to 2025 operating budget, operational plans created in conjunction with the strategic plan, creation of a fund for investment on large donations and voting on the upcoming recipients of the NSS awards at this year's convention. You can find the agenda and the supporting documents at caves.org/member-page. Once you log into the members page, via the Member Login link located at the top of the webpage, scroll down to NSS Governance for BOG agendas, officer reports, meeting minutes, etc.

Speaking of the 2024 NSS Convention! This year's convention is in the heart of TAG in Sewanee, Tennessee. The con-

vention is from July 1 to 5 and packed full of sessions, cave trips, field trips, workshops, parties and everything else that makes NSS conventions so awesome. For more information or to register, please visit us at <https://caves.org/convention/2024-nss-convention/>.

The NSS does offer financial support to full-time students who would like to attend the NSS Convention. The sponsorship will pay up to 50% of the registration fee. Please email conventionsteering@caves.org by April 10 to apply, or if you have any questions. A valid student ID is required.

The US Forest Service Master Participating Agreement (MPA) has been finalized! I have published the MPA in the business documents section of our website (the same place you will find the agenda and minutes). An article is being written as we speak by the authors and collaborators of the MPA. This is a very exciting advancement in our relationship with the US Forest Service and other government agencies. Keep an eye out for the article to be published soon in the NSS News.

2024 NSS Director Election is underway. All ballots must be received by April 15. If you have not voted, please do so asap! We will announce the new directors on April 21, 2024, via email and social media. Our new directors will take office on July 1, 2024. I would like to thank all those who are running for a position on the NSS BOG. The NSS would not exist without the dedication of our volunteers and folks willing to step up. Thank you!!

Membership

Our current membership is at 8,121 members on March 1, 2024. That is a net decrease of 43 members since January 1, 2024. This is the first decrease we have seen in the membership numbers. Good thing our membership committee was just rebooted!

Explore
Protect
Study

Donate or bequeath to
the NSS permanent
endowment fund

**SUPPORT
THE
NSS**

President@speleofoundation.org



MEET THE 2024 US CAVE ANIMAL OF THE YEAR, THE NORTHERN CAVEFISH

By Matthew L. Niemiller, Kurt Helf and Dante B. Fenolio

The 2024 Cave Animal of the Year is dedicated to the memory of Dr. William D. Pearson. Bill was a Professor of Biology at the University of Louisville for 39 years where he taught classes on ecology, ichthyology, fisheries management and biospeleology and mentored 28 graduate students. Kurt first met Bill in the mid-1990s when he began attending Mammoth Cave National Park's science conferences as Dr. Thomas Poulson's graduate student. Kurt ended up assisting Bill many times with his cave aquatic biota (CAB) surveys at Mammoth Cave. Bill surveyed CAB throughout the central and northern portion of the Interior Low Plateau. His field notebooks from these trips are being transcribed, so their valuable data can be extracted and analyzed. Bill was an excellent scientist, a generous colleague and a caring, affable person. He is missed.

2024 is the fifth year of the US Cave Animal of the Year program that brings attention to the amazing animals that occur in caves and associated subterranean habitats. Many animals live underground in the thousands of caves that occur in the United States. As cavers, we are the visitors to their domain, and it is good to get to know our hosts better. What animal is the focus this year? The 2024 US Cave Animal of the Year is the Northern Cavefish, *Amblyopsis spelaea*.

The Northern Cavefish belongs to the family Amblyopsidae, which includes five other cavefish species found in the Ozarks and Interior Low Plateau karst regions of the central and eastern US. This small family of freshwater fishes is the most diverse family of cavefishes in the US. It also includes two species that are sometimes but not always found in caves, the Spring Cavefish and Shawnee Hills Cavefish, and a surface-dwelling nocturnal species (Swampfish) that occurs in backwater habitats of the Coastal Plain in the southeastern US. The Amblyopsidae has long intrigued biologists, and these fishes have been an important model system for studies of cave adaptation.

What Does a Northern Cavefish Look Like?

The Northern Cavefish was the first stygobiotic (obligate cave-dwelling) fish described in the scientific literature by James DeKay in 1842, based on specimens collected from River Styx in Mammoth Cave. Northern Cavefish are larger cavefishes reaching up to 12.5 cm (five inches) in length as adults. They lack externally visible eyes and have extremely reduced pigmentation, making them appear white to pinkish and translucent. The head is large and flat with a protruding lower jaw, tubular nostrils and a series of ridges lined with specialized sensory structures called neuromasts that are part of the lateral line system. The lateral line

system is used to detect movement, vibrations and pressure gradients in the surrounding water to help cave fish detect their surroundings, predators, prey and each other. Northern Cavefish have tiny or no pelvic fins. Unlike most fishes, the vent (external opening to the reproductive and digestive tracts) of Northern Cavefish and other amblyopsids is positioned in the throat rather than closer to the pelvic fin.

Where Can I Find Northern Cavefish?

The Northern Cavefish is known from several caves in the Pennyroyal Plain of central Kentucky from near the Ohio River southward to the Mammoth Cave System in Breckinridge, Edmonson, Hardin, Hart and Meade counties. Because Northern Cavefish inhabit subterranean streams that often cannot be accessed, it is likely that the species occurs at other sites inaccessible to humans. Two of its known main populations are separated by the Rough Creek Fault Zone, which is thought to be a barrier to dispersal.

These fish live in deep pools and shoals in cave streams, smaller tributaries and rimstone pools. These habitats typically have little to no current, with silt to sand substrates, and abundant organic matter to support their food base. Most sites with Northern Cavefish appear to support small populations, however, a hundred or more have been observed in a few caves during aquatic surveys.

The largest populations occur in base-level streams with deep pools and shoals with ledges, overhangs, break-down boulders and side channels that serve as refugia during flood conditions. Northern Cavefish co-occur with Southern Cavefish (*Typhlichthys subterraneus*) in Mammoth Cave. However, Southern Cavefish are also found in higher level streams that are the drains of vertical shafts, whereas, Northern Cavefish only inhabit deeper water at base level, farther downstream.

Getting to Know More About the Northern Cavefish

Northern Cavefish are carnivorous and feed on a variety of prey such as copepods, isopods, amphipods, small crayfishes and small salamander larvae. Larger adults may even cannibalize smaller fish. Reproduction may be triggered by the seasonal flooding of cave systems during late winter and early spring. Females produce about 65 eggs per reproductive episode, but likely do not reproduce every year. Females in some populations have been observed branchial brooding their eggs. This rare form of parental care consists of eggs developing and hatching within the protection of the gills. Compared to surface-dwelling fish, Northern Cavefish take a long time to reach sexual maturity, five to 10 years, and may live well over a decade, perhaps much longer.

Threats to Northern Cavefish

Populations of Northern Cavefish, like many stygobionts, face several threats. Groundwater pollution is perhaps the most significant stressor impacting the species. This pollution comes in many forms dependent upon the land use within a cave's recharge basin and can include acute pollutants such as a toxic chemical spill, or chronic pollution occurring over many years or decades, such as agricultural runoff. In agricultural areas, pesticides, herbicides and fertilizers are the primary contaminants of groundwater, whereas sewage effluent, heavy metals and hazardous chemical contamination are more prominent in urban areas. In addition to groundwater contamination,

land development can alter surface hydrology, which can influence water volume, water velocity and levels of sediment flowing into karst cave systems. Other threats to Northern Cavefish populations include construction of impoundments on surface rivers and streams, pumping of groundwater for agriculture and consumption, climate change, and potential over-collection of cavefishes for the aquarium trade or scientific purposes. For example, there are reports of Northern Cavefish being sold or given away as a novelty item during the 1800s.

Conservation of Northern Cavefish

Biologists continue to monitor populations through periodic surveys and threat assessments. Some populations occur on properties owned and managed by local, state or federal agencies and are afforded some protection; however, many occur on private lands where their protection is less certain. The Northern Cavefish is considered Imperiled to Vulnerable (G2G3) by NatureServe, as Near Threatened by the International Union for the Conservation of Nature (IUCN), and as Threatened by the American Fisheries Society and Southeastern Fishes Council. A recent 12-month petition finding by the US Fish and Wildlife Service concluded that the Northern Cavefish is not in immediate danger of extinction and does not warrant listing as an endangered or threatened species under the US Endangered Species Act at present.

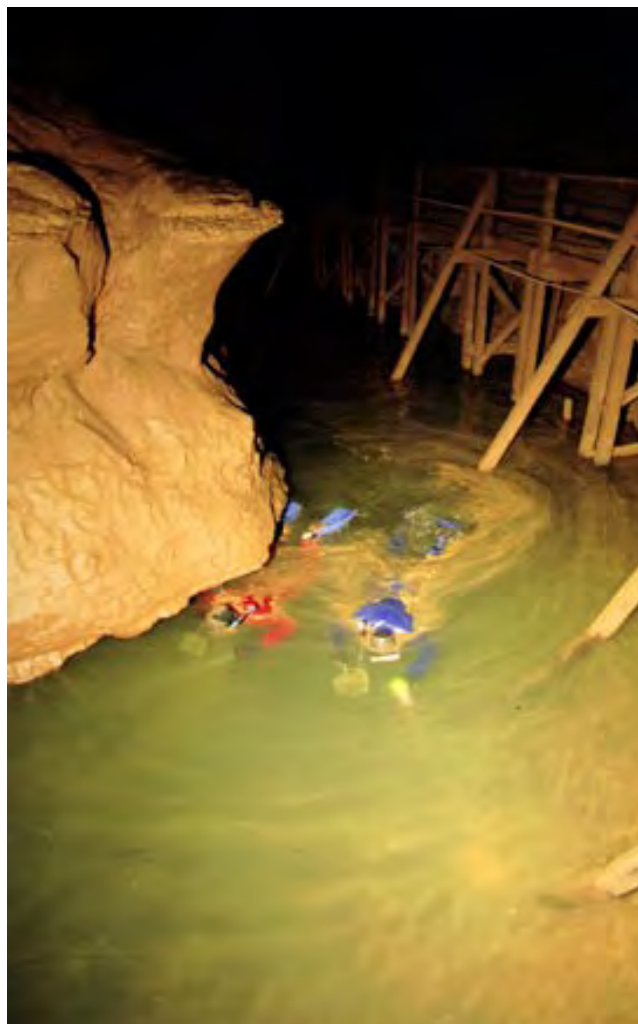
Why are Cavefishes Important?

Cavefishes are critical components of aquatic subterranean ecosystems, acting as top predators in many cave systems. Protecting cavefishes and their groundwater habitats is crucial for not only preserving subterranean biodiversity but for safeguarding an important

resource that we, as humans, are becoming increasingly reliant upon. The troglomorphic traits and adaptations and resistance to several diseases, such as cancer and diabetes.

How Can You Can Participate?

We need your help spreading the word about the Cave Animal of the Year. First, please visit the website: <https://caves.org/conservation/caveanimaloftheyear>, where you will find additional information about caves as habitats, Northern Cavefish, and past Cave Animals of the Year. Please share the website address with friends and on your grotto social media posts. If you are lucky enough to find a Northern Cavefish or one of its relatives while caving, help others see it and learn about these cave species. We invite you to take a photo of the cavefish and post it on the USA Cave Animal of the Year Facebook page. In addition, we encourage cavers to report sightings of cavefishes to state biologists that are tracking and studying these species. Have another great year of learning about and helping to conserve habitat for the fascinating animals that make caves their homes!



Photos Provided by Authors:

Right: Helf and Pearson Cave Snorkel Survey

Page 8, Right: Amblyopsis spelaea, Websters Cave, Breckinridge County, KY, April 2012

Page 8, Left: CAY 2024 Logo Sticker

ANIMALS OF THE BALCONES CANYONLANDS PRESERVE, AUSTIN AND TRAVIS COUNTIES, TEXAS

ARTWORK AND TEXT BY BARBARA ATTWELL

Editor's Note: The Balcones Canyonlands Preserve is a system of set-aside land in and around Austin, Texas that totals 32,000 acres. The preserve was created to protect water quality in delicate karst watersheds and to protect rare animals listed under the Endangered Species Act both in caves and on the surface. Artist Barbara Attwell has captured many of these unique and amazing animals. Her work is displayed in the Austin Airport, providing the public with a rare opportunity to learn about cave animals and to appreciate and enjoy cave artwork.

Kind-of-a-Scorpion, *Tartarocreagri spp*

It looks scary, but it does not have a stinger, and cannot bite something as big as a person. Its pincers are used only to grab on to food. It does not even have eyes as it lives in total darkness – but has feeler hairs all over its body instead. This psuedoscorpion is so small it would fit on the end of an eraser.



Texas Cave Cricket, *Ceuthophilus secretus*

Leaving the cave at night to feed much like bats, these gymnasts bring back vital nutrients that support an otherwise nutrient poor system. Since so many cave-dwelling species rely on these crickets, they are known as a keystone species. Protecting them is vital, and includes protecting the landscape around the cave where they forage.



Tricolored Bat, *Perimyotis subflavus*

A tiny and beautiful bat with several colors in each strand of hair - brown, beige, and rust. This species has suffered greatly due to a fungal disease called White-nose Syndrome. Our caves tend to be warmer, so these bats may not migrate, but instead enter a semi-hibernation known as torpor - a kind of sleep that allows them to conserve energy during the cold months.



Golden-cheeked warbler, *Setophaga chrysoparia*

This delightful bird nests only in central Texas, nowhere else in the world, and is endangered due to loss of habitat. It needs a community of oak and Ashe Juniper trees (commonly called cedars), as it peels the juniper bark to make its nest in the oak. Ashe Junipers are much maligned for incorrect reasons - they don't use extra water, they don't crowd out other trees. They just make some of us sneeze - we can handle that.



Cave Harvestman, *Texella mulaiki*

Just like its well-known relative, the Daddy Long-leg, this is not a spider - having no fangs, no venom, and no spinnerets to weave a web. Living only in the dark, it also has no eyes. Little is known about this delicate, long legged, transparent harvestman, generally observed slowly moving about on the cave floors and walls.



Bandit Cave Ground Beetle, *Rhadine austinica*

This beetle, found in caves in South Austin, has a long, narrow head and body that allows it to poke into holes to harvest cricket eggs. Although totally blind, you can see the vestiges of where an eye once was, no longer needed in the cave darkness.



Black-capped Vireo, *Vireo atricapilla*

These songbirds nest in the Edwards Plateau and are disappearing due to development and parasitism by the Brown-headed Cowbird. They nest in rangeland where they flit around continuously in the well-spaced clumps of brush.



Jollyville Plateau Salamander, *Eurycea tonkawae*

Named after the Tonkawa tribe that inhabited Central Texas until the 1850's, this salamander lives only in the springs that run through areas of northern Travis and southwest Williamson Counties. Salamanders are canaries of the aquifers, as they can only live in pristine, sparkling pure water. If they have disappeared, it is time to clean up. Unlike land salamanders, these have lovely feathery gills to absorb oxygen from the water.



Cave Silverfish, *Texoreddellia texensis*

Also known as a bristletail, this insect has three long tails and moves fast. Adapted to darkness, it has no eyes and is transparent. An animal that is adapted to cave life is called troglotic. To survive in the darkness, troglobites have highly developed senses of touch and smell.



WORKING WITH PARTNERS

AND THE VALUE OF INVENTORY DURING CAVE SURVEY

By Dawn Ryan, Mystery Cave Manager at the Forestville/Mystery Cave State Park, Minnesota

Mystery Cave, managed by the Minnesota Department of Natural Resources, is located in southeast Minnesota in what is known as the Driftless Area near the town of Preston and is part of Forestville/Mystery Cave State Park.

The first survey of the cave was in 1965, and the 1984 version of the map, while good for its time, didn't show any detail. The second resurvey of Mystery Cave began January 8, 2005. Park management, at that time, relied on park staff and volunteer cavers to accomplish the work.

White-Nose Syndrome arrived to Mystery in 2016, and access was changed to help protect bats. Instead of year-round access, access was limited to May through October. Limited access and reduced interest stopped the survey for five years, until a solution was found. The Minnesota Department of Natural Resources (MN DNR) was able to work out an MOU agreement with the Cave Research Foundation (CRF) allowing the survey to resume. With the help of CRF, new cavers are being taught to sketch and use instruments. It has really brought back to life the interest to make a map of the longest cave in Minnesota.

With the new survey project, new park management felt that inventorying the resources was important. The cave has interesting mineralogy, similar to what is found in Carlsbad Caverns, New Mexico. Iron and manganese oxides are common cave deposits in Mystery; calcite cave formations with an iron oxide core derived from oxidation of nearby pyrite are prevalent. Raft cones tell the hydrologic history of the many cave pools. Fossils found in the cave, such as cephalopods, confirm what we know about Ordovician seas. A good map helps management maintain a comprehensive inventory of these resources for further research and helps people understand climate trends, as an example. During the project, we began finding animals. Other than bats, Minnesota caves aren't known for their cave-adapted animals. But we began finding Raghididae, a type of mite and polydesmid, a type of millipede.

The MN DNR had commissioned research resulting in publications on bats by Nordquist and Birney (1985), and aquatic inventories by Schmidt (1994), Peck and Christiansen (1990), and Montz (1993). But there were no studies that identified cave adapted invertebrates in Mystery Cave. Then, the MN

DNR contracted with Zara Environmental to inventory Goliath and Woodchuck caves in Cherry Grove Scientific and Natural Area, Mystery and Old Mystery Caves in Forestville, and the spring orifices at Seven Springs Wildlife Management Area, and Big Spring and Deep Lake Spring in Forestville. These two springs are resurgence for Mystery and Goliath Caves and flow into the state park. Prior to Zara arriving and under their direction, park staff placed glue and drop traps baited with Limburger cheese and anchovy paste in the caves. Mop head traps were placed in the spring orifices and later retrieved for investigation.

What did we find? "101 aquatic animals were collected from the three springs and 121 animals were collected from the four caves," according to the Zara report. In 1990, Peck and Christiansen reported two troglobitic amphipod species from the Driftless Areas of Illinois, Iowa and Wisconsin but not Minnesota, *Stygobromus iowae* and *Stygobromus putealis*. Now they are known from Mystery Cave. These collections are the first amphipod records from the Park. Montz (1993) even made a special note referencing the absence of amphipods in Mystery Cave.



CAVERS WORKING ON THE BIOLOGICAL INVENTORY IN MYSTERY CAVE, MINNESOTA. PHOTO BY JEAN KRECJA

LIFE IN MYSTERY CAVE
PHOTOS BY JEAN KRECJA



Millipede in Mystery Cave, Minnesota.



Amphipod in a gravel, sand and silt bottomed drip pool, photo taken in situ in Old Mystery Cave



Cave-adapted amphipod collected in Mystery Cave, Minnesota, a range extension for this species.



A dipluran. These animals are often seen in the cave, but the recent study was the first to document these animals.



Cave-adapted symphyla collected in Mystery Cave, Minnesota.



Nesticidae spider from Mystery Cave

Other animals found during the Zara inventory include:

Bathynellacea: This collection represents the first record of Bathynellacea from the park and is a groundwater adapted species, therefore cave and aquifer limited.

Diploda: Common but hasn't been documented in the park caves until this inventory.

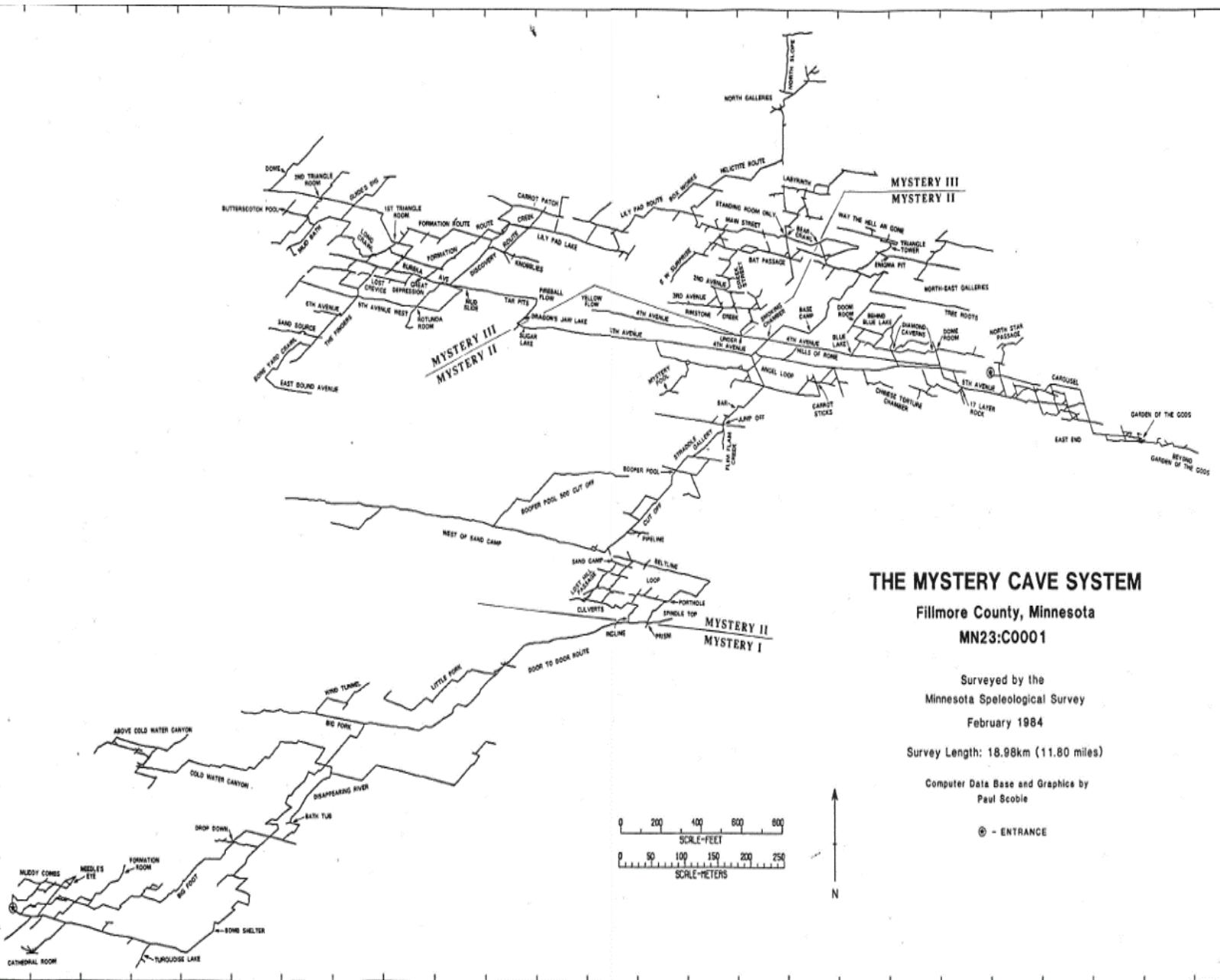
Nesticidae: According to a researcher who is mapping spider distribution in Minnesota from Bethany Lutheran College, this is the first record of this spi-

der in Minnesota.

Rhagidiidae: Have been recorded from caves in the United States, this represents the first record of Rhagidiidae from the Park.

A summary of the inventory provided by Zara states: "This study expands upon less comprehensive efforts to document cave fauna from Forestville/Mystery Cave State Park and provides range extensions into previously undocumented localities. Perhaps the most valuable part of this study is the several hundred vials from the four caves and the springs that certainly contain even more diversity than we realized. Many species records in this study have not been previously reported from the park, so these specimens may be important range extensions or could even represent a new taxon. The Bathynellacea and amphipods, particularly, as these are groups with cave adaptations, previously known only from other places in the country."

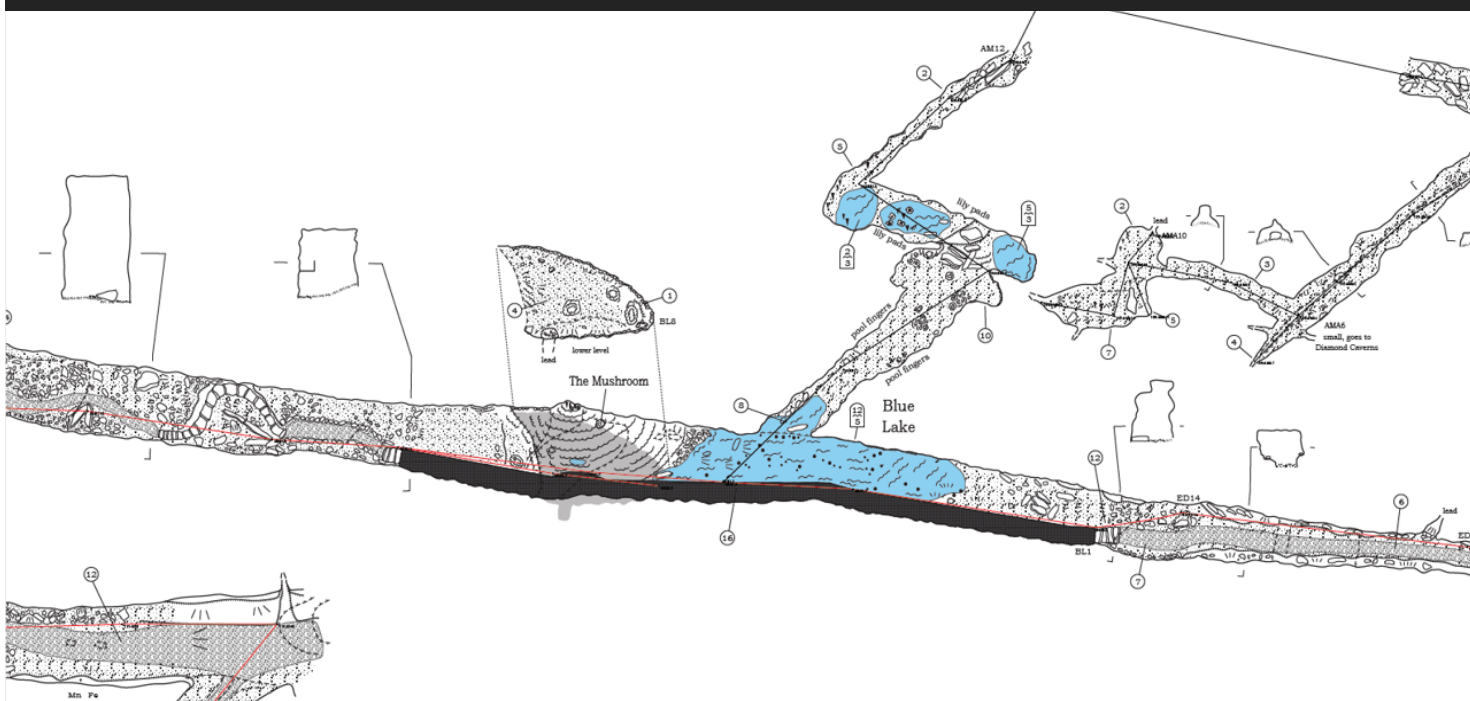
The inventory provides a management tool and the map, with the help of the CRF, supports the effort of protection and management. None of this work would have been accomplished without developing partnerships with cavers.



1984 MYSTERY CAVE MAP



BLUE LAKE, MYSTERY CAVE, MINNESOTA. PHOTO BY JEAN KRECJA



ABOVE: BLUE LAKE NEW map: A CLOSE-UP VIEW OF THE DETAIL IN THE NEW MYSTERY CAVE MAP.
BELOW: ADDITIONAL PHOTOS FROM MYSTERY CAVE. PHOTOS BY JEAN KRECJA



CAVE EDUCATION OUTREACH IN THE SOUTHEAST

By Dave Jackson and Val Hildreth-Werker

In the fall of 2023, CaveSim, a simulated cave created to teach cave conservation, set out on a cross-country adventure from Colorado to the east. Our goal was to bring cave conservation and education to school children and the public with events in Tennessee, Alabama, Georgia and Oklahoma.

Sewanee Elementary

We headed to Sewanee Elementary School in Guntersville, Alabama, where 120 fifth-grade students loved the all-day CaveSim program. The kids learned to carefully explore the mobile cave with its 60 feet of cave passage, numerous speleothems, cave paintings, artifacts and cave biota. The CaveSim system provides participants with a computer-based score reflecting how carefully they explore, which allows kids to compete for the honor of Most Careful Caver.

To learn about vertical caving, the students watched Single Rope Technique (SRT) demonstrations on the 12-foot tall CaveSim SRT tower. Pulley systems on the tower, in both 1:1 and 5:1 arrangements, allow students to work cooperatively to lift classmates in mock

vertical cave rescue scenarios, while learning physics and math concepts. And students enjoyed playing bat migration and echolocation games to learn about bat behaviors, threats to bat populations and the many ways that bats benefit humans.

Special needs students also loved the program and were able to participate fully because of the accommodations included in the CaveSim trailer. One special education teacher wrote, "I appreciate Dave and his team for being so welcoming and accommodating for us. I felt it was a very inclusive activity. I was further impressed that they were already thinking ahead on how to make it more inclusive for students with physical limitations, including those with wheelchairs."

Perhaps the best experience of the day was working with a student who spoke Spanish. The school did not appear to have any staff who could communicate in Spanish, and the young boy was confused and had a hard time with the activities. Once we explained CaveSim to him in Spanish, he became very focused and did an outstanding job of participating. As his class was leaving,

he came up to tell us what a good experience he had had. And Lima Soto, Forest Service National Coordinator for Caves and Karst, has offered to send the school a batch of Junior Cave Scientist books in both English and Spanish.

Land Trust of North Alabama

Thanks to a grant from the Tennessee Valley Authority, the Land Trust of North Alabama was able to host the CaveSim program at the Chapman Mountain Preserve. The event was even more popular than it was several years ago, with approximately 500 kids and adults attending. We were busy all day, and had outstanding help from Dave Hughes and Stephen Estevez.

National Cave and Karst Management Symposium

From Huntsville, we made a late-night drive to Chattanooga, where John Hickman helped us navigate the CaveSim trailer into the venue of the National Cave and Karst Management Symposium (NCKMS). NCKMS 2024 was an outstanding conference, and we were able to provide the CaveSim program to the public, as a free event during four



KIDS ARE ECSTATIC AFTER SUCCESSFULLY EXPLORING CAVE-SIM! PHOTO BY VAL HILDRETH-WERKER

days of the symposium with excellent help from Zenah Orndorff.

American Cave Conservation Association

After the symposium, we took a detour to visit the American Cave Museum in Horse Cave, Kentucky with Crash Kennedy and David Foster of the American Cave Conservation Association, and then headed west to Edmond, Oklahoma where we put on two more days of CaveSim school programs before heading home.

CaveSim in 2024

After a short break for the holidays, CaveSim kicked off 2024 with a strong start. CaveSim staff and volunteers conducted 13 straight days of programs in San Francisco and Los Angeles in January. They next made a visit to Great Basin National Park, which is home to a brand-new version of the CaveSim trailer, and then Texas, starting in Corpus Christi. We have events scheduled around the country for the next nine months, and we hope to see you on our travels. If you would like to learn more about CaveSim check out www.cavesim.com.



TEST PERSONAL LIMITS AND HAVE FUN WITH THE CAVE SIM SQUEEZEBOX WHILE LEARNING MEASUREMENT AND MATH SKILLS. PHOTO BY VAL HILDRETH-WERKER



CAVE SIM SETUP. PHOTO BY VAL HILDRETH-WERKER

THE LAND TRUST OF NORTH ALABAMA

A PARTNER IN CAVE AND KARST MANAGEMENT WITH THE NSS AND THE HUNTSVILLE GROTTO

BY JULIE SCHENCK-BROWN

In 1987, the citizens of Huntsville, Alabama embarked on a mission to preserve the slopes of Monte Sano, a mountain on the east side of town. Their drive and dedication resulted in the preservation of that land and the establishment of the Land Trust of North Alabama (LTNA). Now, 36 years later, the trust has preserved more than 10,000 acres of important natural lands in north Alabama and offers more than 80 miles of public trails to relax, exercise and connect with nature at one of their 10 preserves. And they own 55 caves that are accessible to NSS members via a permit system.

Recognizing the need to partner with such an amazing organization, I approached the LTNA in 2018 about a memorandum of understanding (MOU) with the NSS to promote the education and management of cave and karst resources at their preserves. Since that time, progress has been sustained through relationships established with LTNA staff and their Resource Advisory Committee (RAC) members, who continue to be incredibly supportive and enthusiastic about the work of the NSS and the Huntsville Grotto.

Serving as the NSS – LTNA Liaison, I attend bi-monthly LTNA RAC meetings. We focus on cave science, cave conservation and access, as well as preserve management when evaluating management plans or potential land acquisitions. I also assist with permitting cave exploration, science and survey trips at LTNA preserves. NSS member Jon Zetterberg assists with geo-referenced LiDAR maps and metadata for potential acquisitions, as well as use on existing LTNA preserves. It's an ideal role for Jon, since he also completes those responsibilities with the NSS Preserves and Acquisitions Committee.

When the Huntsville Grotto Executive Committee (EC) set their goals for the year, I suggested a workday at the LTNA Bethel Springs Preserve. We know that NSS and grotto members, who volunteer their time, help further the mission of both organizations. They would be excited to continue the dedicated efforts to protect the Keel Mountain watershed, which had been started

in 2019. The EC was very supportive, and we agreed that early to mid-fall would be an ideal time to enjoy this task in the mature deciduous forest with fall colors.

To prepare, I led Becky Williams and Chris Cargal on a hike to assess the preserve for project assessment. We discovered an old hunting blind that was 4 feet by 8 feet and fully enclosed that needed to be removed. We decided this was perfect, as it would allow cavers to access an area of the preserve that is typically closed, while protecting the karst terrain. As a bonus, we could use sledgehammers and other implements of destruction to bring down the old structure and restore the beauty of this area.

Becky led the project with great enthusiasm and passion, talking about our plans at the Huntsville Grotto meeting and encouraging participation from our new members. Becky and Chris also assessed the area for debris removal strategies over the karst landscape. After obtaining permission from Andy Prewett, LTNA Land Manager, we were set. And when October 28th rolled around, we had 11 grotto members show up and volunteer.

Our cast of characters who worked on the demo and removal of the hunting blind included Becky Williams, Chris Cargal, Michael Johnson, Maxwell Grisham, Jimmy Farrar, Joe McCulley, Sikes Richardson, Keith Gilmore, Josh Morehouse, Mark Ostrander and Julie Schenck-Brown. Saws, hammers, pry bars and wheelbarrows were transported up a few hundred feet of elevation and across rugged terrain to the blind. Having a team of NASA engineers and physicists was comical when the zeal for the demolition had to be re-directed a few times to discuss the structure's construction and the best way to proceed safely. When the main frame finally collapsed, everyone was jubilant. The energy never dissipated, as teams of two started to carry the materials down the hillside and towards a collection point established by Andy that was more than a mile away.

As we finished, I reflected on my friend-

ship with the late Doris McGee who deeded her 330-acre property to the LTNA to ensure perpetual protection of the caves and surrounding forest. Over several years before her untimely death, we shared a friendship. Mrs. McGee taught me about the history, geology and hydrology of Keel Mountain. Central to these discussions were her reflections on the need for land preservation and conservation. That day, I knew Mrs. McGee would be pleased that we cared so much about cave conservation and preserve management. I'm looking forward to the Huntsville Grotto continuing our work to preserve and protect the caves and karst of Keel Mountain, as well as the LTNA who support cave conservation, exploration, access and research.

Please note that access to caves on LTNA preserves does require a permit. If you plan to visit the caves, please contact both Julie Schenck-Brown, at LTNALiaison@caves.org and Andy Prewett, LTNA Land Manager at andyp@landtrustnal.org at least three days in advance of your trip.



DEMO OF THE HUNTING BLIND
BY HUNTSVILLE GROTTO MEMBERS

CLEANING AND PROTECTING AN OUTSTANDING NORTHERN CALIFORNIA CAVE

BY JOEL DESPAIN

It was not a good day to be a caver. There we stood before a pile of smashed cave curtains, broken apart across the cave floor like shards of fine, crystalline china. And these had been particularly wonderful curtains – orange, white and translucent, a dense cluster some four feet long. After a hiatus of decades, the crystal miners and vandals had returned to an amazing northern California cave. It was an awful day, but sometimes a bit of good can come from the bad.

This very scenic, vertical cave, with the largest room in the state and fantastic speleothems, has a sad and unfortunate history with local people actively mining outstanding calcite crystals from several locations inside in the early 1990s. But it had been a long time since this had been an issue. Not surprisingly, when the vandalism happened again in 2022 cavers and officials from the US Forest Service (FS), who own and manage the cave, moved into action. The first order of business was a new gate. The old one had been breached, and the barrier to entry needed to be made more secure.

James Newell, from the Shascade Caving Society (an NSS grotto) led the charge on the caver side. He worked

with members of the Shasta Area Grotto and the Cave Research Foundation, Klamath Mountains Project to get it done. James did what cavers do: He led multiple trips up the mountain to the entrance to make measurements, contacted gate vendors, attended meetings with the FS, recruited cavers to help, worked on gate designs and much more. It took months, but in the end, the FS did the gate in-house using a cave gate expert, an outstanding welder on the forest staff and one of the fire crews to help the cavers carry the hundreds of pounds of metal and gear up the steep slopes to the entrance.

But that was just the start of the project. Keeping up with a hard-to-manage cave takes a lot of time and equipment. After decades, the cave needed a clean-up. Thousands of feet of plastic trail flagging had aged and broken apart into pieces across the flowstone; old and new mud had accumulated in some locations; the vandals had wandered around tracking mud; earlier break-ins had also contributed to the dirt on the flowstone; some muddy spots had been inadvertently missed in earlier clean up work; old gear had been left in the cave for various reasons and there were problems with a second interior gate. All of this was complicated by a

bat colony in the upper parts of the cave that made clean up trips a no-go for six months of the year.

As of spring, 2024, the clean-up project is ongoing with great progress being made and with cavers from across California coming to help. Cavers have taken on embedded mud in very porous, white calcite, tiny flagging splinters stuck on tiny crystals, new bolts, hauling old gear, and spraying gallons and gallons of water. There were multiple clean-up trips in February and March 2024. But the bats will return by April, ending work until the fall.

Caver participants in these projects have been: Kit McKinley, CJ McKinley, Tessa Richards, Katrina Smith, Becca Rogers, Steve Hobson, cave gate specialist Mark Jones, James Newell, Felipe Roz Barscevicius, Spencer Haggard, Joyce Muk, Heather Veerkamp, Dustin Schultz, Vivek Zilpelwar, Michael Stark, Ethan Donohue, Jessica Leila, Evan Peairs and Joel Despain.

And a big thanks to the Shasta-Trinity National Forest, led by “Keeper of the Caves,” Brad Rust, and the fire crew that helped with gate installation, Dennis the welder and the National Recreation Area maintenance crew.



photo by Dave Bunnell



BEFORE

photo by Joel Despain



AFTER

photo by Joel Despain

SPELEAN SPOTLIGHT

OF ANNA PEARCE

BY APRIL GOCHA



How did you first get interested in caving?

Anna: Besides playing outside as a kid, I wasn't an outdoorsy person. But when I was in college, I had a friend who introduced me to flat-water kayaking. From there, it opened up my world. I started whitewater kayaking, rock climbing, bouldering, hiking, backpacking — one hobby led to another. One day I was climbing, and I decided I wanted to go caving. So I planned a trip to a commercial cave, Cathedral Caverns in Alabama. Cathedral was beautiful, and then the next day I did my first wild cave trip to Tumbling Rock.

Where have you been caving?

Anna: I primarily cave in TAG, and I actually just moved to TAG for that reason. I left my home, and everything I knew of 30 years, and moved to Dalton, Georgia, where I got a teaching job. So, now I cave pretty much every single day. I haven't done a lot of caving outside of TAG, but I've been in Arizona, did some project caving in Wyoming in Fossil Mountain Ice Cave, and also went caving in Minnesota, where they dig open all of their glacier-filled caves. And I am planning to go to Huautla in April. I speak Spanish and teach English to speakers of other languages, so I can help translate.

You have dropped a lot of pits in TAG—can you tell us more about that?

Anna: Once I had visited about eight or nine horizontal caves, I thought I should probably keep a list, so I can keep up with where I've been and maybe any significant details. In December 2022, I realized I was about to hit 100 caves, and from there I developed a passion for visiting new-to-me caves. From there, I just wanted to hit all these new caves, so it kind of became a numbers thing after that. It's not a competition, but I love seeing new caves. Before I moved to TAG, I was driving from LaGrange, Georgia every weekend. That's 3.5 hours one way, and I put 60,000 miles on my truck in a year. It was not sustainable. So I moved, and now it's gotten to the point that I cave nearly every day after work. So in December 2022 I had hit 100 pits, and in February

2024 I hit a big milestone of 300 caves. I don't have a target, I truly just love it — my goal is just to cave as much as I can because it makes me happy.

Why do you choose to devote your time, effort, resources to caving?

Anna: I used to be very well-rounded doing things like white water climbing, backpacking and other outdoor activities. And I still do to some extent, but caving has definitely absorbed most of it. All of the outdoor communities are fantastic, all very encouraging, active and typically very intelligent. But the caving community is so different — it is very much like a family, and I love that. I love how educated the community is — it's full of teachers and scientists and engineers and is such a collective community. So much knowledge from different people.

I moved from LaGrange during a rough time in my life because I lost my husband — we were together since I was in high school, so we grew up together. When I moved, everybody asked me if I was afraid to just leave my hometown and family and everyone I've known. But I knew so many people in the caving community where I was moving. And to some extent they're more like my family than my own, just because we have such common interests. In caving, our lives are in each other's hands. When I joined NSS and got heavily involved with the grotto, I loved that there were so many people that probably stopped caving many years ago but that still come to grotto events and still volunteer. Even when they're done with the sport, the community is forever, and I love that. It's just so much more tight-knit than anything I've ever experienced.

Can you tell us more about the NSS positions you have held?

Anna: About two years ago, NSS was searching for someone to serve as the Nominating Committee Chair. I already was volunteering with Dogwood City Grotto and also as the TAG Youth Activities Coordinator. I was doing a lot, so the position seemed perfect since it's not too heavily involved and is not

too big of a time commitment. If you're looking to slowly ease your way into getting involved within the NSS, this is a good position. So I served as Nominating Committee Chair for two years. Now this year I am running for the Board of Governors and plan to shadow Maureen Handler as the Operations Vice-President of the NSS Headquarters.

What strengths or skills do you bring to the caving teams that you're on?

Anna: I have a lot of energy and spend my days doing CrossFit and any type of outdoor physical activity that I can. I will gladly carry gear and ropes. I feel very proficient in rigging considering I am often rigging on most of my trips and was lucky enough to learn SRT in October 2020. In addition, I took a sketching and cartography course with Dr. Pat Kambesis at Western Kentucky University and have learned a lot about survey, sketching, and cartography, although the cartography aspect has been the biggest challenge for me. However, I love to participate in projects and have been more open to having my own projects here lately. Lastly, I recently learned to dome climb and topped my first 55-foot dome. Because my passion for caving is so deep, I like to be well-rounded and learn it all, so I can help in many different ways.

What tools do you use to mitigate risk in caving?

Anna: I have the best mentor, Darien Dopp, who taught me everything I know. I took a two-day vertical training class with him in October 2020. They teach you all the knots you need, rigging, ascending, descending, changeovers. Then, the next day, you put the skills to use. He is very safety-oriented, as he also is a technical safety manager for the rope access company, Over the Edge. I recently got certified, so I'm also a part-time rope access technician for him with Over the Edge.

In January 2021, shortly after I got vertical, myself and my late husband, Darien, Kendall Morris, and Josh Bonds went to South Pittsburgh Pit, which is a 160-some-foot pit in South Pittsburgh,

Tennessee. We had two ropes rigged, and everyone rappelled down. Darien, Riley and Kendall got out of the fall zone, and Josh and I rappelled down about 40 or 50 feet. We were talking to each other, and all of a sudden I heard his rappel speed up. At that point, I was twisting, and when I turned around, he free fell 100 feet and died. It was extremely tragic, and it took me a few weeks to even get back on rope. There was nothing that he did wrong — there was no gear malfunction, he simply got really nervous and passed out on rope. I had noticed he was a little shaky at the top. As if I wasn't already very safety oriented and conscious of those things, that really changed me.

Then not even a year and a half later, my husband, Riley, died at DeSoto Falls, a big waterfall in Mentone, Alabama. It's a touristy place with hiking and swimming. Our grotto organized a picnic there, and we rappelled off of a 165-foot cliff into the water. We set a little short rope that was about 15 feet off the water, and then we set up a rope that went all the way to the water. So you could short rope and fall in, and then climb back out. That day, we had set multiple routes because we had 30 to 40 people there. My husband rappelled down and swam over to the rope set at the waterfall, and on the swim over, he drowned.

So unfortunately, I have seen many deaths and injuries in all of the hobbies I participate in — caving, whitewater kayaking, swimming and climbing. These are tragic accidents, but they have taught me a lot and made me more safe and proficient. I am always very conscious and aware, especially of my gear and rigging. I am constantly inspecting my gear and the gear of people caving with me. As I deploy the rope and coil it, I am always checking for abrasions and bad spots in the rope. I'm always very mindful of rub points and make sure to pad those or set a re-belay or redirect to eliminate rub. And I'm always inspecting rigging and looking for ways to improve my own rigging.

And as someone who gets cold easily, I make sure to bring plenty of layers and wear neoprene when entering a wet cave. As all cavers should do, my bag is always full of water, batteries, back-up lights, and snacks in case of an emergency.

Do you have a favorite piece of caving gear?

Anna: Definitely the rack. I've tried multiple different descenders and I just love the standard rack. It's such an excellent device that gives you so many

different modes of friction. My second favorite is probably the adjustable cow's tail.

If you could have one superpower to help you explore caves, what would it be?

Anna: The ability to get through impossible squeezes. I'm already tiny enough and can fit in most squeezes, but sometimes I wish I could just disappear and then reappear on the other side.

Do you have a caving-related accomplishment that you're most proud of?

Anna: I recently dug open my first pit, which has sparked an interest. We were on our way to Fiery Top Drop in Marion County, Tennessee. On the way there, I saw a tiny little sink and little hole covered by debris. We kept going and found the big open entrance of Fiery, and I rigged it up and let my friends go down. While I was waiting, I thought I might as well go look at that sink we had passed. So I walked over there, moved everything, and put my hand down and felt warm air blowing. I was so excited that I just started digging. I looked like a dog. That was the first time I really felt like I found something. I dug on it a lot that night and made significant gains. I probably dug through six to eight feet of soil over a period of a few days. I kept going back, and I was leaving work every day to dig. I finally got a big rock in there, and it took two or three seconds before I heard the boom. I got really excited.

Just a few days ago, we finally got the pit open, and it's beautiful and open and 91 feet deep. My fingertips are still raw. Everybody knows how tiny I am, about 4 feet 11 inches and 100 lbs, so I named the pit Two Annas Shy because it's about two lengths of me shy of 100 feet. It was so exciting, and I was proud to have found it. But I also want to thank Kelly Smallwood, Jesse Bucher, Jason Hardy, Judd Pearce and Harold Geyck for their assistance in getting the pit

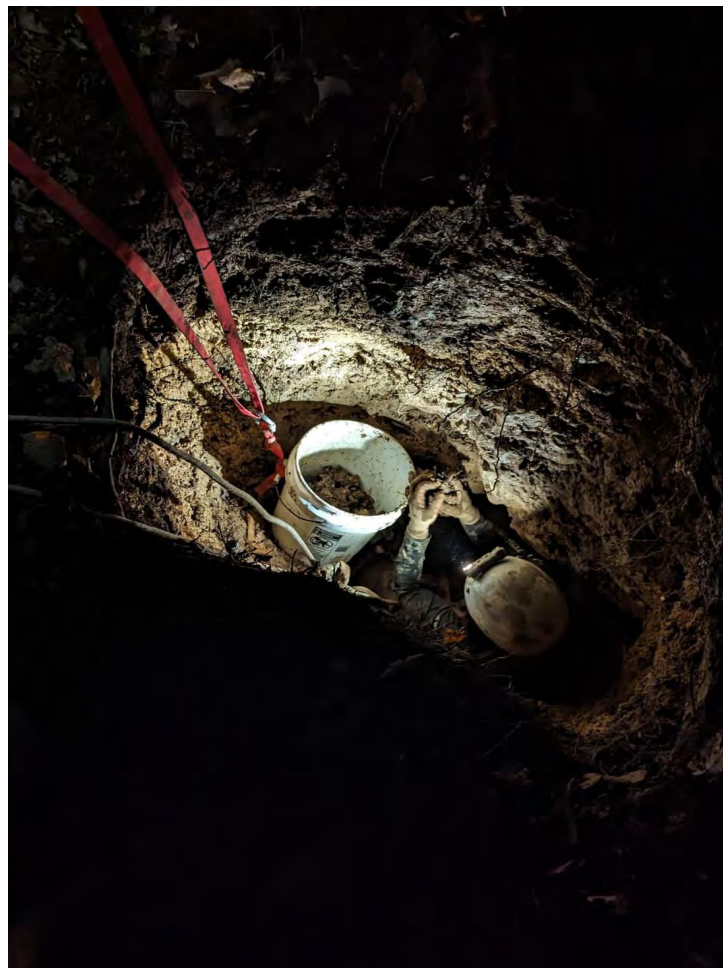
open and helping with the survey and sketch.

Do you have a favorite thing to do inside caves?

Anna: Rope work — I just love all rope work, whether that's rappelling and climbing short drops or long drops. I love the very technical rope work. But my favorite thing to do is just look for things in caves. I'll get down to the bottom of a pit, and people laugh at me because I'm always looking on the ground for life, for fossils. I just went to Moonshine Cave, where I did my first dome climb, and I've never seen so many fossils in my life. I love just seeing all the things down there that make caving so unique.

Do you have advice for other cavers and explorers?

Anna: I remember how difficult it was as a beginner caver because it's such a tight-knit community, so it can feel a bit difficult to get in. I was lucky because I took the course with Darien Dopp, and he introduced me to a lot of other cavers. If you're a beginner, it's just good to get involved in a grotto. Go meet other cavers, volunteer to help landowners, just put yourself out there.



Anna digging on the new entrance to the 91-foot pit she found. Photo by Judd Pearce

RESTORATION EFFORTS IN THE BUREAU OF LAND MANAGEMENT, ROSWELL, NEW MEXICO, FIELD OFFICE



BY KNUTT PETERSON, ROSWELL FIELD OFFICE CAVE AND KARST SPECIALIST

The restoration and cleanup of damaged caves and karst features has been a high priority for the BLM Roswell Field Office for decades. With the support of the Field Office cave program, volunteers have devoted countless hours and resources to restoration efforts. The cave program's focus over the past 10 years has been the restoration of nearly a century of damage to formations in Fort Stanton Cave and more recently restoration of sinkholes in the gypsum plains in the northern part of the field office area.

Throughout the past 170 years, visitation to the historic section of Fort Stanton Cave has been relatively unchecked, and early visitors often took a memento from their visit home with them or roamed off trail. Crystal Crawl passage, which is about 30 feet wide and 750 feet long, had a carpet of 6-inch-long selenite needles in the 1800s. Over time, visitors and museums collected most of these needles, leaving only a few small

patches on the edges. In the Lake Room, stalactites and stalagmites were broken, often with chisels and sledgehammers, and many of the broken pieces were taken out of the cave. Graffiti has always been an issue at Fort Stanton. Starting in the 1850s, soldiers from nearby Fort Stanton inscribed their names in the limestone to commemorate their visit; later cavers used carbide soot to mark their presence, and spray paint became fashionable from the 1970s onward. Careless visitors tracked mud onto pristine flowstone in search of a new route and dumped their carbide indiscriminately. All this damage is the result of the caving ethics of the time.

Over the last 25 to 30 years, a new understanding of how rare and irreplaceable these resources are is fueling a new caving ethic, a restoration movement and new management strategies. Cavers have been at the forefront of this new ethic, and are continually refining restoration practices from techniques

that were developed by folks like Jim Werker and Val Hildreth-Werker, and many other conservation-minded cavers.

Until 10 years ago, Fort Stanton had heavy unchecked visitation, which led to much of the impacts we are dealing with today. Some of the damage, like the soldiers' names, is now considered historic under the federal Antiquities Act and can't be removed. However, recent graffiti, dirty formations, and broken formations can be cleaned up and repaired. Whatever your perspective on recreational closures by agencies to stem the spread of White Nose Syndrome in bats, there has been one positive: It has given these caves a rest from heavy visitation, and allowed cave managers to implement restoration projects and consider alternative future visitation strategies.

Early restoration efforts at Fort Stanton focused on graffiti, usually by covering



RESTO TEAM CLEANING FORMATIONS IN FORT STANTON CAVE, NM.

it up with a thin layer of dirt and or washing it off with lots of scrubbing. Current restoration efforts focus on repairing broken formations, cleaning up carbide dumps and cleaning mud from flowstone. Carrin Rich is leading the flowstone cleanup project and Mike Mansur is heading up the formation repair work. Carrin's project, building on prior restoration led by Jen Foote, has cleaned some 520 square feet of delicate, velvet flowstone since 2022, and marked or removed numerous trails to help avoid future impacts. Mike's Cave Formation Repair Project has repaired 110 broken formations in the Lake Room since 2020 and assessed formation repair needs throughout the cave's New Section. The Roswell Field Office cave program has made significant investments in restoration supplies and supports these projects through permitting and coordination.

In addition to restoration efforts at Fort Stanton Cave, the Roswell Office cave program is spearheading sinkhole cleanups in the gypsum plains. The cave program has partnered with several New Mexico cavers, the National Cave and Karst Research Institute (NCKRI) and local ranchers to facilitate these cleanups. A brochure was developed by NCKRI to hand out to ranchers with information on the project, how they could become involved, and the role of sinkholes on the landscape they ranch on. Sinkholes are identified for cleanup

by cavers, then National Environmental Policy Act assessment is done by BLM. Each season, sinkholes are identified and scheduled for cleanup. These are usually smaller projects that can be cleaned up in a day or two. The Field Office hires large roll-off dumpsters to be delivered and picked up; tools and personal protective equipment are also provided. Word has spread throughout the volunteer caving community, and a great time and sense of accomplishment is had by all at these cleanup events. The ranching community has taken note and is starting to become involved. In its first two years, this project cleaned up three sinkholes and removed more than 22,000 pounds of trash. Larger projects are contracted to professional environmental cleanup companies. Outreach and education on the part of volunteer cavers and federal land managers have gone a long way in changing mindsets and ingrained practices within the ranching community.

The Roswell Field Office cave program encourages new and old cavers alike to participate in restoration projects to learn just what it takes to clean up impacts from careless caving. Participating in restoration projects helps cavers understand how and why these impacts happened and how they can reduce their impacts while caving. Supporting and participating in restoration projects helps cave managers find new ways to mitigate impacts

while still facilitating recreational and project caving. The Roswell Field Office thanks all the cavers who volunteer their time to make these restoration and cleanup projects happen!



FORMATION REPAIR IN FORT STANTON CAVE, NM.
ALL PHOTOS IN THIS ARTICLE PROVIDED BY KNUTT PETERSON.



BEFORE AND AFTER
RESTORATION PHOTOS

SPELEOTHEM RESTORATION IN FANTASTIC CAVERNS, MISSOURI

By Jonathan B. Beard

Editor's Note: The following article presents some uncommon techniques and ideas that some may question. It is a chance for NSS members to consider for themselves what is and what is not appropriate in cave conservation. Running this article in the News is neither an endorsement of the techniques shown below, nor a criticism. The article raises questions. The results may be a form of caver art? Is this sort of re-creation appropriate along a tour trail in a show cave? But many will wonder about the introduction of foreign substances into a cave environment, about the long-term consequences of abundant anthropogenic materials, about the lack of a holistic approach in support of the cave ecosystem, about the longevity of the repairs, and about the concealment of vandalism that could be a powerful lesson to the cave's visitors. What do you think? Please see the accompanying sidebar article on materials for cave conservation.

I have undertaken restoration in more than 100 caves in the Ozark Mountains of Missouri, Arkansas and Kansas since 1983, with trash and graffiti removal as well as reconnecting broken speleothems. Rejoining speleothems always involved finding a speleothem piece, hunting for its "matching" stump on the floor or ceiling, drilling matching holes to install a threaded pin with epoxy and using more epoxy to reattach the piece to its original location.

However, I embarked on a different kind of speleothem repair. In the early autumn of 2022, I was contacted by the Fantastic Caverns marketing director, Hubert Heck, who asked if I would restore some important speleothems along the tour route of the popular show cave, famous as America's only ride-through cave. On November 4, he and I walked the gravel road in

the cave, where Hubert pointed out some major draperies that had been vandalized decades ago, most only being half or less of what they once were. And I noted countless smaller draperies and stalactites, as well as a few stalagmites, that had been broken by souvenir hunters of the past. As we made our trek through the cave, I took several photographs of target speleothems. I estimated there were at least 300 that could be rejuvenated, repaired or possibly made whole again. Hubert emphasized that the management wanted the big stuff fixed, not every speleothem.

I began the actual work on November 8, using my collapsible little red wagon to transport equipment and supplies to a dark corner just inside the ingress to the cave. I wasn't sure how I would re-invent the large draperies and many stalactites. In years past, I

was reattaching broken pieces. In the case of Fantastic Caverns, the pieces were gone, having been pilfered as souvenirs decades ago. Doesn't every speleothem taken out of caves eventually end up being discarded? I had to imagine, having about 50 years of caving experience to guide me, the original appearance of the speleothem before it was intentionally broken — its shape, size, and coloring. I was there to attempt to reinvent the wheel, so to speak, to give a new tip to the stumps of speleothems.

I studied some of the widest remnants of what were large, impressive draperies just inside the eastern entrance, where the jeep tours enter the cave. On the eastern wall, some were mere fractions of themselves, hardly noticeable because there was so little of them remaining. I imagined how glorious they were in their prime. Others on

Jonathan Beard repairing broken speleothems in Fantastic Caverns. photo by Alicia Beard



Large stalactite repair showing the close up of the texture and edge of the reconstruction. photo by Johnathan Beard





FINAL REPAIR AFTER COLORING OF THE DRAPERY CLOSET. PHOTO BY JOHNATHAN BEARD

the right side of the trail were missing their lower halves. Worse yet, they weren't dripping onto the large, rounded stalagmites they had helped to create. The stalagmites were a chalky light gray, having been denied drip water for several decades. Not only was I expected to make the draperies appear to be whole again, I needed to somehow shape them so they would once again drip onto the stalagmites below.

I was intimidated by the challenges before me. In the past 40 years, I had reattached and rejoined broken speleothem pieces to their original places. Although "gravity is your friend" when repairing stalagmites, the opposite is true for stalactites and draperies. It is more enduring to drill one or more holes in the broken surface and set anchor pins into the holes. Some of the break edges of the draperies in Fantastic Caverns were half-an-inch thick or less.

For the new project, I would be attaching a shaped piece of Magic Sculpt

putty to a speleothem stump. At first, I shaped the putty while it still had the consistency of modeling clay, then hung it on a wire hanger to cure overnight. A few stalactites were repaired this way, but the soft putty didn't quite hold its shape, requiring me to grind the business end of it to fit the broken face of the stump. This was a two-day process that left me wanting an easier, faster method. Time was money, as the caverns was paying for my time by way of a handshake agreement.

Although Magic Sculpt sags under its own weight, in a few hours, it becomes very stiff, and overnight, it becomes a very hard material. If I could use an adequate number of attachments, they would provide enough resistance to keep most stalactite and drapery tips tight against the calcite surfaces until the putty hardened.

I spent most of February and early March drilling anchor holes and fixing anchor pins into a few hundred speleothems, using duct tape to hold the pins

in place until the epoxy cured. The use of duct tape was profuse in places, showing visitors that repairs were being made. Some of the tour guides were happy to introduce me to the visitors when I was visible and not trying to be incognito.

I found that the left wall as one enters the cave, which was nearly devoid of intact speleothems, was actually profusely decorated before vandals wreaked havoc. Dozens of large, lengthy draperies once adorned the wall, not to mention dozens and dozens of stalactites. This wall is the background to the photographs taken by the cavern's photographer of every tram of visitors that passes through. Repairing these speleothems would show positive improvement in photographs given to each ticket holder.

With that methodology, I made faster progress, sometimes completing 20 or more repairs daily. Beginning in late March, the number of repaired speleothems increased dramatically. I real-

ized before long that my original estimate of 300 repairs was too conservative. I focused on the entrance passage, which contained draperies, stalactites and stalagmites on both sides of the tour path, week after week, where my equipment was stationed in one place. The cave managers would occasionally come and see the entrance passage and spoke of their amazement at the new appearance of the passage. What had been rather unattractive and forgettable was becoming something that needed more lighting to show its growing glory. At least two lights along the path that had burned out were replaced, highlighting some of the repairs.

After I had completed the Mushroom Beds, I relocated to the exit passage that includes the Breakdown Room, Hall of Giants and a short segment just before the exit door. As with the Mushroom Beds area, there were relatively few targeted speleothems, mostly stalactites. One speleothem was an impressively large drapery. Another consisted of a three-foot-tall stalagmite given to me by Bruce Herschend of Talking Rocks Cavern, 15 to 20 years ago. Hubert and I found a good place to put it — upon a 12-inch stalagmite stump.

The last area of speleothems were some large draperies and stalagmites in the Light Show. Here, I had to use a ladder to gain access to a couple of the draperies. Every time a tour group arrived, I had to take down the ladder and sit inconspicuously while the group parked at the large speleothem area to experience total darkness, a demonstration of the original electric lighting used and the modern-day lighting.

After some finishing touches on the giant stalagmite in the Hall of Giants, the project came to a close after 80 days of work over six months. Four hundred and sixty speleothems were rebuilt, the vast majority of them consisting of epoxy prosthetics, but there were a number of real speleothems utilized, and in a handful of cases, pieces were relocated to their original positions.

But in the summer, Hubert called on me again. The managers of the cave asked me if I would repair all of the remaining vandalized speleothems in the cave. September 4, I began work in the exit passage. I had not realized the extent of the damage done to this highly decorated passage that contained many of the largest columns found in the cave.

As the weeks passed, I wondered if I would work forever in just a 100-foot segment of passage! Was the original intent of the vandals many decades ago to remove tips from every speleothem in the cave?!

By the end of February 2024, I had repaired more than 900 additional speleothems including some large stalactites, stalagmites and draperies. In one area measuring four feet high, four feet wide and ten feet long, I repaired several large draperies, nicknaming it the Drapery Closet. The project was completed with a grand total of 1,400 speleothem repairs.

A big thank-you goes to those who were able to assist me. They include Sarah Peterson, my wife, Alicia Beard, Candace Kovaks, Loren Kuntz, Peter Kuntz, Heather Pyle and Eric Hertzler, who assisted me for nearly 200 hours. And also two of the cave guides, Heather and Keelie, who were curious about my project and helped with the project when I was experimenting with techniques. Another round of applause goes to the staff of Fantastic Caverns, who were very hospitable, treating me like a member of their “family.”



THE DRAPERY CLOSET BEFORE REPAIRS, AFTER THE PROSTHETICS ARE IN PLACE BEFORE COLORING.
PHOTOS BY JOHNATHAN BEARD

What We Bring into Caves -

by Jean Krejca

When considering the impact of potential contaminants we bring into caves, I recommend a holistic perspective including air, water and soil quality. Construction in an enclosed space could create gasses or vapors that are hard on cave species and not easily flushed. Water quality is easily impacted by runoff from point sources of toxic chemicals like batteries, treated wood, adhesives, walking surface treatments, or even insecticides on our clothing. Soil quality can be degraded from the same point sources even when there is no stream to transport them. Even food, or food-like items such as wood and leaf litter, may impact the distribution and ecology of cave invertebrates. Since we know very little about the tolerances of cave species to contaminants, I recommend careful consideration of the impact to microbial, vertebrate and invertebrate species when we bring things into caves, particularly with plans for permanent installations. Before-and-after studies of the actual cave community in question are a great way to test potential impacts. In many cases, a review of other datasets, for example, lethal dose studies, residence times for contaminants in groundwater or toxicology literature are good places to start understanding the impact of what we bring into caves.

MATERIAL MATTERS — A CALL TO ACTION

BY PENELOPE J. BOSTON AND VAL HILDRETH-WERKER

Introduction

Though the aesthetics of spelean beauty may be what initially draws many of us to caves, we believe that the NSS also has the responsibility to look deeper and to understand the myriad integral components of cave systems. We should reflect that ethic in supporting the vital interwoven complexities of cave and karst groundwater systems. What are the potential environmental consequences of anthropogenic substances that we introduce? We are all well-intentioned, but we are often working with little or no relevant data on the many compounds that are sometimes used to remove graffiti, to make repairs or to secure bolts.

What is the longevity of these materials in caves — not just over months, or a year or two but over decades? What are the out gassing and degradation products? How will the degradation products affect the cave water? Is a given anthropogenic product yummy or even toxic to microbial communities, insects or larger cave-dwelling animals?

We have a pressing community-wide need to systematically understand compounds and materials as they interact with cave systems. Even if a product claims to be “nontoxic, photo degradable or biodegradable,” these standards are developed for human health, not for organisms in general. Such standards do not take into account whole cave systems with unique combinations of chemical and physical factors and the unusual life living there. Safety Data Sheets (SDS or MSDS) are of limited value because they refer to studies of standard model organisms (for example, lab rats or *Daphnia*) that usually pertain specifically to human health and have limited or no applicability to cave life. Further, most toxicity studies simply measure acute lethality, which is death in response to high concentrations.

Two different but interacting aspects of materials in caves must be distinguished: 1) How does a particular material hold up both physically and chemically, and what is produced when it breaks down? 2) What are any effects of that material and its degradation products on cave life? Such data cannot be acquired in short-term limited experiments because so many of the processes that work in caves can

be slow, and their interactions with anthropogenic materials may also be slow. Further, the effects of sub-lethal exposure to deleterious materials in various organisms cannot be fully understood by short-term efforts.

We are not entirely devoid of information. For example, we know that austenitic stainless steel produces relatively few degradation by-products, thus resulting in stability over time. On the other hand, in the accompanying sidebar, Mike Spilde describes degradation and impacts from microbial activity on anthropogenic materials taken from Carlsbad Caverns.

For materials and techniques currently considered relatively safe for caves, see the peer-reviewed NSS book, *Cave Conservation and Restoration*. The full online manual, designed to be a living portal to ever-evolving best practices, is now available for free download at <https://caves.org/wp-content/uploads/2022/06/CCR-Book.pdf>

A Call to Action

Can the caving community mobilize to rigorously produce the relevant data that we need to steward our caves? A testing regime of commonly used ma-

terials would provide baseline data for determining appropriate use through the understanding of degradation, longevity and biological effects in cave environments. We can envision NSS caver teams participating in simple testing of relevant materials in cave environments. Knowledgeable materials scientists or chemists would be needed to identify likely degradation products. Compounds and their degradation products could be studied using a suite of cave-relevant test organisms by those in the biological fields. The scope for citizen scientist cavers in such an enterprise is enormous.

Obviously, this is a big ask. Not only for work in the present, but also for the commitment to long-term studies. This must be a multi-generational enterprise. Of course, we need funding and time commitments, but most critically we need an organizing body to make sure the studies can be conducted and tracked over significant periods of time. The US and global cave community have a remarkable track record of sustained multi-decadal volunteer contributions. If any group of individuals could pull off a decades-long effort to investigate the behavior of materials in caves, it should surely be the NSS.



SARAH PETERSON ASSISTS WITH THE SPELEOTHEM RECONSTRUCTIONS IN FANTASTIC CAVERNS. PHOTO BY JOHNATHAN BEARD

ORGANIC CHEMICALS IN CAVES

BY MICHAEL SPILDE

A Cautionary Note on Plastics, PVC and 3-D Printing Materials

Take caution if introducing organic compounds (that is, chemicals containing carbon) into cave environments. Artificial organic materials such as epoxies, paints, cables, pipe, 3-D printing media, and so on, are problematic because not only can they outgas into the cave atmosphere, but they may also provide a nutrient source for cave-adapted microbes. Most cave microorganisms are extremely slow growing and capable of living in very low-nutrient environments. There are, in fact, bacteria (hyphomicrobium species) that will happily survive in distilled water, and strains of these have been identified in caves. Microbes can grow in unexpected habitats in caves.

The scanning electron microscope lab at the University of New Mexico examined electrical cable samples for the National Park Service in preparation for replacing the lighting cables in Carlsbad Caverns. I examined pieces of old cables that had been in Carlsbad and also, Wind Cave in South Dakota for years, along with test pieces of various types of cables exposed to the cave environment for a few months. What I observed was surprising. Some cable samples were heavily encrusted with microbial material, including fungal and bacterial colonies, filamentous exopolysaccharides or slime, cells and biofilm, in addition to adhered mineral particles. In some cases, the cable surface underneath was deeply pitted by microbial erosion.

One material that consistently exhibited evidence of microbial activity was PVC, or polyvinyl chloride, in the form of pipes, flexible conduit and cable sheathes. This seemed counter-intuitive since some chlorine compounds are antimicrobial cleaners. A previous project undertaken in my lab for a local company examined PET plastics and other materials intentionally exposed to degradation in a bioreactor to test the bio-reactivity of the material. The PVC cable sheath materials exposed to the cave environment were degraded as much as some of the experimentally bio-reacted materials.

Several discoveries stood out in both of these projects: Rough surfaces and dirty surfaces seemed to encourage microbial colonization. Rough surfaces

provide a toehold for microbes to establish colonies. Very smooth surfaces make it more difficult for microbes to colonize. The presence of mineral material, such as dirt, clay, and carbonate dust, seem to increase the likelihood of colonization, probably because foreign material stuck to plastic surfaces may provide "hiding places" that shelter microbes and also provide attachment points for microbes.

Microbes are known to produce strong organic acids that can react with almost everything. Lichens, for example, release lichenic or fumaric acid that will break down solid rock. Organic acids released by microbes can degrade plas-

tics, such as PVC pipes, cable insulation, sculpting epoxies, or 3-D printing materials, dissolving pits into the surface. These pits provide access deep into the plastic for more microbes and organic acids, and unchecked, promote even further degradation. Epoxy containing metal fillers, such as "Liquid Metal," are particularly insidious because they often contain metallic iron. Microbes love metallic or reduced forms of iron, as iron oxidation provides them with energy. After years of analyzing rock-eating cave bacteria in Lechuguilla and other caves, one fact stands out: Microbes can thrive where you least expect them.



DRAPERY AND STALAGMITE BEFORE RECONSTRUCTION IN FANTASTIC CAVERNS SHOW CAVE IN MISSOURI. PHOTOS BY JOHNATHAN BEARD

GIRL SCOUT TROOP 10655 IS LEARNING CAVE CONSERVATION

by Michael C. Mansur

I was asked by troop leaders if I would be able to do a presentation on cave restoration and conservation for the scouts. I outlined the talk to primarily cover cave formation repair and restoration techniques that we use. I brought in my Cave Formation Repair Project (CFRP) training workstation, so the scouts could learn how to make repairs to broken formations. They all were very involved, and wanted to go to a cave and make repairs. One scout was working on her Silver Award. She wanted to know if she could volunteer to work on repairs and be able to count it towards the 50 volunteer hours she needed to qualify. I was happy to ac-

commodate her and other scouts who also wanted to participate.

I contacted my friend and long-time CFRP participant, Ellen Trautner, BLM cave specialist, to see if she had a cave where we could go. Ellen selected McKittrick Cave and set up two dates, so the scouts could go in and work. The first trip was to go in and identify broken formations that could later be repaired. I could not make the first trip. Ellen took the scouts into the cave and showed them how to identify and number broken formations.

I went on the second trip, with hands-on training for the scouts. I had three members of the Texas A&M Aggies Grotto that had wanted to help out that came with us. The scouts ended up making repairs to seven broken formations! With minimal guidance they had fabricated their own jacks to hold the broken piece in place, applied epoxy, and set up the jacks to support the repairs that they had made. I want to thank Ellen Trautner for her willingness and enthusiasm to support this Girl Scouts, Troop 10655 project. We were very proud of the work that the scouts had completed!



MEMBERS OF GIRL SCOUT TROOP 10655 WITH THEIR COMPLETED REPAIR TO A MATCHED AND BROKEN STALACTITE.
PHOTO BY MIKE MANSUR



GIRL SCOUTS FROM TROOP 10655 SET UP JACKS TO SUPPORT REPAIRING A BROKEN STALACTITE IN MCKITTRICK CAVE, NEW MEXICO. PHOTO BY MIKE MANSUR



TEAM PHOTO: THE GIRL SCOUT, CAVER AND BLM CAVE FORMATION REPAIR PROJECT TEAM AT MCKITTRICK CAVE. PHOTO BY WENDY BROWN, CARLSBAD TIMES ARGUS

2023 NSS SPELEOTHEM REPAIR WORKSHOP

BY MICHAEL C. MANSUR, INSTRUCTOR

We had another highly successful speleothem repair workshop at the 2023 NSS Convention in Elkins, West Virginia. There were 27 participants who preregistered for the class. They all received a copy of my book, *The Cave Formation Repair Project: Restoring the Beauty of America's Great Caves*, which they will be able to use as a textbook and reference guide for future projects.

The class was taught in two parts. The first was a PowerPoint presentation which explained the project's highlights, tools and procedures, including how to start a cave formation repair project. The second half was a hands-on training with four stations: 1) Broken formation matching; 2) mixing epoxy; 3) using the equipment to hold formations firmly while students drilled holes for the steel reinforcement pins, and 4) setting up more equipment to support broken formations made from wood and concrete in an enclosed workstation. This year was the same format as the 2022 workshop in Rapid City, South Dakota

After the classroom sessions, we took the participants on a field trip to Hamilton Cave, where they were able to use the training to identify and match broken formations and make the repairs themselves. We had thirteen people participate in the field trip on Wednesday afternoon and three on Thursday.

I want to thank the 2023 NSS Convention organizers, Meredith Hall Weberg, Rich Geisler and Robert Hoke who worked with me to schedule the workshop and field trips; Nikki Fox who had found a perfect cave for the trip; and Kirsten Bahr, who helped with the training. I also want to thank the NSS John Guilday Cave Preserve for allowing us access.



804 - 798 - 3432

The Cave Conservancy Foundation has funded karst scientific research as well as conservation and education projects since 1995. Grant requests of \$1,000 or less may be submitted at any time. Applications for major grant requests must be submitted by March 1 and October 1, respectively, for consideration at the spring and fall Board meetings.

Information on how to apply for grants may be found at www.caveconservancyfoundation.org

CLEAN CAVING IN A WHITE-NOSE SYNDROME ENDEMIC WORLD

by Matthew L. Niemiller and Keith Christenson

We are quickly approaching two decades since White-Nose Syndrome (WNS) was first reported in hibernating bats during the winter of 2006 to 2007 in upstate New York. Since the initial discovery, the fungus that causes WNS, *Pseudogymnoascus destructans* (Pd), has rapidly spread across the continent, killing millions of bats and impacting populations of several cave-hibernating bat species. Bats with WNS have been confirmed in 41 US states and eight Canadian provinces, with evidence of Pd in an additional three states and two provinces.

We have learned much about the transmission, impacts, ecology and mitigation of Pd since the early years of the WNS epidemic:

- Pd can persist in cave environments for years after it is introduced by bats or people, even in caves where all the bats have died.
- Most of the time, it is bats that spread the fungus to new caves, but humans can also spread the fungus on contaminated clothing, boots and caving gear.
- Decontamination protocols have been tested and implemented to reduce the risk of people spreading Pd, while state, federal and tribal agencies, along with other organizations (including NSS) and private partners, have worked together to develop regional response plans to protect and conserve bat species.
- The fungus is already considered endemic to many states in the eastern US, with additional states likely to be added in the future. While research continues to develop effective and environmentally safe disease treatments for bats, it has become increasingly clear that Pd is here to stay in North America.

Decontaminate, even in Endemic Areas Because Other Pathogens Abound Does this mean that we, as cavers, no longer need to follow decontamination protocols in endemic areas? Our answer to this important question is that all of us should continue to regularly clean and decontaminate our caving gear after each trip.

Cleaning and decontaminating our gear is more than just a continued effort to reduce the spread of Pd and WNS impacts on bats. In addition to Pd, several other disease-causing pathogens have emerged in North America with the potential to impact cave life.

Two fungal pathogens, *Batrachochytrium dendrobatidis* (Bd), and *B. salamandrivorans* (Bsal), have emerged as major global threats to amphibians. While the highly contagious Bsal has not yet been reported outside Europe and Asia, Bd is known to infect over 500 amphibian species worldwide. Salamanders and frogs infected with Bd or Bsal can develop chytridiomycosis, an infectious fungal disease that can be fatal. Much like Pd in bats, not all amphibians infected with Bd become sick or die. However, outbreaks have occurred since the 1970s, with the worst epidemics resulting in significant population declines for many species and even possible extinctions in Australia, Mexico, Central America and the western United States. Bd has been detected in populations of cave-dwelling amphibians, such as the Tennessee Cave Salamander. Still another fungal pathogen, *Ophidiomyces ophidiicola*, causes a potentially fatal snake fungal disease and has been found in endangered Puerto Rican boas that use cave habitats. Ranaviruses have been attributed to mass die-offs in local populations of several species of amphibians and turtles, and may also impact fishes and reptiles. These are just a few of several emerging pathogens already affecting wildlife in North America.

Moreover, we don't yet know what the next emerging infectious diseases that will impact biodiversity will be, but we can be confident that it will likely appear sooner rather than later.

Early detection is critical to prevent and control the spread of these emerging infectious diseases. If you see any suspected cases of WNS in bats, infections, or even dead amphibians, or other unusual signs of infection in other cave-dwelling wildlife, please report your observations to the appropriate authorities, such as state and federal wildlife agencies, cave managers and landowners. If you are not sure who to contact, please reach out to NSS Bi-

ological Response Committee (biologicalresponse@caves.org). Members of the committee can assist with connecting you to the proper authorities.

Clean Gear Reduces the Spread of Potential Pathogens Below, we describe guidelines and recommendations. We advise staying informed regarding the latest state and federal guidelines and recommendations for preventing the spread of pathogens or species. Most cavers are now familiar with the clean caving protocols developed for WNS. Fortunately, these protocols are also quite effective at killing many other pathogens to minimize their potential spread among regions and cave systems.

Before each cave trip:

1. Check the most recent guidelines and recommendations for clean caving is at <https://www.whiteno-sesyndrome.org/mmedia-education/national-wns-decontamination-protocol-u-s>. Since caves are owned and managed by different agencies, cave conservancies, and even private landowners that may require different protocols, consult locally before trips
2. When feasible, use gear and equipment dedicated to a particular region. For example, you might have a set of gear dedicated for caving in the Ozarks and a different set that is stored separately for caving in TAG.
3. We strongly recommend using different sets of gear for international trips where the likelihood of introducing a novel pathogen is greater.
4. Use gear and equipment that can be easily and effectively cleaned and decontaminated. Rubber (for example, Wellington-style) boots are recommended footwear for clean caving, as they are the easiest to clean and can withstand most harsh decontamination products.
5. Inspect your caving gear for signs of dirt or contamination from previous cave visits, even after cleaning. Pay particular attention to straps, seams, laces and other areas on your gear, where dirt and contaminants may be trapped and are not easily cleaned.

6. When possible, visit a single cave system per day or use different sets of gear when visiting multiple caves in different areas during a single day, then decontaminate all your caving gear at the end of the day.

After each cave trip:

1. Ideally and when practical, remove your caving gear at the cave entrance and change into clean clothing and footwear to reduce the possible spread of pathogens into the environment. Always remove dirty gear and change into clean clothing before entering your vehicle to prevent the spread of pathogens into your vehicle.

2. Remove all dirt and organic matter from your clothing, footwear, and other caving gear and equipment that came into contact with the cave and water. Unlike Pd and WNS, Bd and Bsal are most easily transmitted via water. Rinsing with water and a little “elbow grease” with a stiff bristle brush, can remove stubborn dirt and mud from tread and straps.

3. Put your dirty gear into a large trash bag or dedicated dirty gear container, seal it up, and transport for later full cleaning and decontamination.

4. Clean off any excess mud and dirt that could not easily be removed in the field. A power washer is handy to quickly remove mud and dirt from your gear.

5. Disinfect your clothing, footwear, and caving gear (see below).

6. Repeat cleaning of gear as necessary. Depending on how dirty and the specific gear used, it may be required to repeat the cleaning and disinfection process more than once to ensure thorough decontamination.

7. Keep vehicles as clean as possible by taking extra precautions: Store gear in clean containers, bring a change of clothes, conduct all work outside the vehicle after visiting the cave. Decontaminate storage containers along with all other clothing, gear, and miscellaneous equipment using the appropriate decontamination products.

8. Store your caving gear in a clean container away from other gear and equipment dedicated to other regions.

Decontamination to Reduce the Spread of Pd and Other Pathogens

Unfortunately, no decontamination protocol can be universally applied

to mitigate the spread of all potential pathogens. Different approaches are needed to decontaminate clothing, ropes, vertical gear or sensitive electronics and equipment. Below are several methods that are known to be effective.

Hot water immersion

Full immersion in hot water for an extended period is effective for killing many pathogens. This method is also the safest and most environmentally benign. We recommend immersion in water that is at least 55°C (131°F) for at least 5 minutes.

Chemical solution immersion

Several household products are quite effective for decontamination, including 1) bleach (6% hypochlorite, HOCl), 2) Lysol IC Quaternary Disinfectant Cleaner, 3) Professional Lysol Antibacterial All-Purpose Cleaner, and 4) Isopropyl Alcohol (specifically 50-70%, not 90%) and others. Now not recommended is Formula 409 Antibacterial Kitchen All-Purpose. While these chemical solutions are effective for disinfecting cave gear, many are not as highly recommended because of safety concerns to humans and the environment as well as potential for degradation to clothing, ropes and

caving gear with repeated use. Rinse your gear thoroughly after removing it from the immersion bath. Clothing and softer caving gear can be run through a washing machine when using some chemical products.

Disinfecting wipes and sprays

Many of the same chemical products used for immersion also are available as sprays or wipes that can be used to disinfect gear that cannot be submerged or other items such as boots. Use wipes or sprays to disinfect all surfaces, wait 10 minutes, and then wipe dry with a clean towel or cloth.

Prolonged drying

Prolonged drying, particularly in combination with another method, is also effective. The length of time required is temperature dependent, with shorter durations required at hotter temperatures. Allow clothing and equipment to dry completely, then maintain at 15°C (57° F) for at least 8 days, 35°C (95° F) for 30 hours, or 70°C (158° F) for 15 minutes.

By continuing with clean caving practices, we can help minimize the risk of spreading WNS, Chytrid, and other potential pathogens or invasive species not yet on our radar.



CHANGES IN WNS DECONTAMINATION PROTOCOL MARCH 2024 UPDATE

Based on the White Nose Syndrome (WNS) decontamination protocol, updated March 2024

The WNS decontamination protocol outlines procedures to clean and disinfect clothing, footwear and equipment that may have been exposed to the fungus that causes WNS. Decontamination can help reduce the risk of human-assisted spread of the fungus. The recommendations are based on the best available evidence to date.

This protocol is designed specifically to reduce the risk of people moving viable fungal spores to and from bats and their habitats. But it may also reduce the risk of transporting other potentially harmful “biological hitchhikers.” The applications identified herein have been selected for their efficacy in killing the WNS fungus specifically. Efficacy against other microbes is circumstantial.

- Ethanol, Formula 409 and Hibiclens have been removed from the approved disinfection product table.
- The isopropanol concentration range has been narrowed to 50% to 70%. In the previous protocol, less than 50% isopropanol was approved. Any isopropanol above 70% can be counter-productive and is not recommended.
- The WNS management areas map is updated to reflect the current status of the fungus and WNS occurrence in the US.

Hawai’i, Alaska and Puerto Rico are added to the map of management areas.

- Guidelines for the movement of gear and when to decontaminate equipment are in a bulleted list rather than a diagram.
- Additional information is provided regarding decontamination of mist-nets, harp traps and acoustic equipment.
- Conventional cleansers like Woolite detergent or Dawn dish soap may not kill the fungus, but they aid in the removal of sediments and debris that may contain spores.
- The preferred treatment, for equipment suitable for submersion, is hot water with a temperature of at least 55° C (131° F) for a minimum of five continuous minutes, with complete submersion of all surfaces.

Access the complete March 2024, national WNS decontamination protocol update at:
<https://www.whitenosesyndrome.org/mmedia-education/national-wns-decontamination-protocol-u-s>.
 Or see the WNS disease management working group website at www.WhiteNoseSyndrome.org

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