



2022 NSS CONVENTION PROGRAM GUIDE

RAPID CITY, SD

JUNE 13-17, 2022





National Speleological Society 2022 NSS Program Guide

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2022 NSS CONVENTION PROGRAM GUIDE

RAPID CITY, SD

JUNE 13-17, 2022



CONVENTION CHAIR
CHRIS PELCZARSKI

PROGRAM CHAIR
PAT KAMBESIS

Howdy everyone, and welcome to South Dakota!

I am super, SUPER stoked to see the NSS Convention come to the Black Hills this year! While I've only been involved with the caving community here for a few short years, I can tell you these guys and gals are some of the friendliest and best people you'll ever have the pleasure of meeting. When I was new to the caving world, they welcomed me into their midst without question before they even knew who I was or what I had to offer. It was almost as if I had been waiting for this opportunity my whole life without realizing it, and that I just belonged there with everyone. It was a new beginning for me, and an amazing world was opened up to me right here in the Black Hills – a place I never knew existed until recently. Before I found caving and all of my local friends, I was nothing. Now it's like my life has purpose and intent, and it's all thanks to these great folks who I am proud to call my friends – the same great people who have spent the last few years putting this awesome convention together for you all! I can't list every single person involved, because there's too many, but rest assured, their hard work and dedication in making this event a success has not gone unnoticed! It takes a small army to put on an NSS convention and it's wild to think it's all done with VOLUNTEERS! Incredible!

Not only are the people here amazing, but the caves are unbelievably awesome. I have to say the cavers here are proud of their accomplishments in preserving and protecting the caves in the hills through some newly created preserves, and their relationship with private landowners and federal agencies that manage caves in this local area. But they are most proud of their accomplishments in pushing the frontier of exploration (the theme of the convention this year) in some of the longest caves on the planet! When I hear about all of the new discoveries being made underground in the Black Hills, it just blows me away (or sucks me in, depending on the barometric pressure). It's really incredible, folks – and I'm sure you'll hear more about this topic as the week of convention goes on. There's A LOT of stuff happening here for such a small community of cavers in a geographically small area. Like I said, I've only been involved for a short time, but I've had the distinct opportunity to be in places where no other being has ever been before – right here beneath our feet! It's hard to imagine that places like that still exist, and right here in our local area! It can take a little determination and perseverance to work up to cave trips where you're on the frontier making all the new discoveries, but it's worth it! My best advice is to stick with it, show the cave who's boss – don't get cocky or push too hard – make virgin passage come to YOU!

Here in the Black Hills you'll also find a wealth of opportunities above ground as well as below. Rock climbing? Check! Hundreds of miles of hiking? Check? Sight-seeing, beer tasting, going on scenic drives? You got it! And if you're a history nut, there's plenty of that to go around – the entire Black Hills area is rich in historical context, with some of the more famous names from the wild wild west making an appearance throughout the area – Calamity Jane, Wild Bill Hickock and Crazy Horse to name a few! There's so much to see and do here, no wonder it's such a destination hot-spot. A word of caution, though – you might find some of our local attractions, places of interest and eateries overcrowded this time of year. We tried to schedule the convention during the earliest possible time on the edge of our busy local tourist season to avoid this as much as possible, but it is inevitable that you'll run into crowds somewhere. My best advice is to be as patient as you can – take it all in, go with the flowstone and remember that you're here to enjoy yourself. If you run into any issues, grab one of my friends, a helpful convention staff member and be sure to mention my name – Jeb – to let them know I directed you their way. They can help you out with whatever you need – directions, advice, medical assistance, best breweries to visit. You need it? They got it. And no need to thank me, either – I'm just happy to be a part of it all.

I don't know if I'll be at convention or not – I've got a lot of stuff going on this summer, and it always feels like I'm being pulled in multiple directions. I'll try my hardest though! So you might see me out on the dance floor cutting loose, or giving directions at the registration building. Maybe we'll run into each other underground while you're here, or perhaps you'll hear me speak during the storytelling session during the week. Whether I make it to convention or not, I'll definitely be there in spirit. This is a once-in-a-lifetime opportunity and I'm proud to be a part of it. Thank you all for coming to visit us here in our great state and enjoy your week of cave-related activities!

Jeb Casey
Convention logistics / Morale Chair

2022 Program Guidebook

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VENDORS

NSS Bookstore

Speleobooks

On Rope One

Black Hills Parks and Forests Association

Guadalupe Mountain Lampworks

Inner Mountain Outfitters

Caver Co-op

Mercy's Beads

Final Frontier Sports

EXHIBITORS

Cave Conservancy of Hawai'i

Northeastern Cave Conservancy

SCCI

Cave Conservancy Foundation

Cave Conservancy of the Virginias

Friends of Wind Cave

Black Hills Cave and Nature Conservancy

Appalachian Cave Conservancy

NCKRI

Visit Rapid City

TicketSpice

2023 NSS Convention

The Mammoth Site

NSS CONVENTION STAFF

Our convention volunteers have given countless hours to make this event a success.

Please take a moment to tell them "Thanks"!

Adam Weaver.....	NSS Administrative Vice President Fellows Reception Coordinator
Carol Tiderman.....	NSS Convention Division Chief
Chris Pelczarski.....	Convention Chair
Marcy Dimond.....	Event Manager Food Service Director
James Parr.....	Campground Manager
Dean Faust.....	Chair of Finance and Revenue
Lydia Austin.....	Chair of Publications
Pat Kambesis.....	Chair of Programs
Colin Keeler.....	Chair of Registration
Rene Ohms.....	BHCNC Carnival Coordinator
Roy Berke.....	Banquet Coordinator
Kevin Chase.....	Howdy Party Liason
Brayden Richardson.....	Sound Engineer
Andy Belski.....	Music and Sound Coordinator
Jay Clark	Legal Services
Thang Nguyen.....	Merchandise Logistics
Brad and Connie McKinney.....	Daily Newsletter
Jeb Casey.....	Logistics/Publications/Morale
Kaden Franke.....	Advertising and Social Media
Connie Putnam.....	Sponsorship Development
Blake Jordan	Salons Director
Sarah Booth	JSS Coordinator
Dave Socky.....	Audio Coordinator
Geary Schindel.....	Luminary Series
John Scheltens.....	Lightning Talks Speleo-rodeo Coordinator
Bill Steele.....	Storytelling
Sarah Keenan.....	Field Trips Director
Karl Emanuel.....	Hydrology Field Trip
Sharon Weaver.....	Paleontology Field Trip
Riannon Colton.....	Volunteer Coordinator
Sierra Heimel.....	Transportation Coordinator
Christy Starr.....	NSS Bookstore Travel Coordinator
Kelly Mathis	Cave Trip Coordinator
Andy Armstrong	Sketching and Survey Competition
Mike Warner and Emily Davis	Vendors Coordinator
Gary Bush.....	Rigging Consultant
Terry Chamliss.....	Consignment Sales
Matt Mordfin.....	Website Coordinator
Tor Seinke.....	JSS National Coordinator
Kurt Waldron.....	JSS Vertical Liaison
Gene Harrison.....	Ham Radio and Staff Communications

SPONSORS

Each NSS Convention enlists sponsors to assist with keeping our costs down for attendees, as well as reminding us they are here for us. Please take a moment during the week to stop by their booths, visit their shops, or peruse their websites. Let them know we appreciate the extra support they provide to the NSS mission and to our annual convention.

DIAMOND LEVEL (\$5,000+)

NorthFace EU
Lost Cabin Beer Co.
Rush Mountain Adventure Park
Black Hills Institute of Geological Research

PLATINUM LEVEL (\$1,000 - \$4,999)

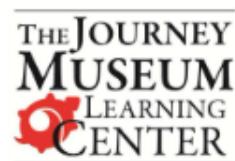
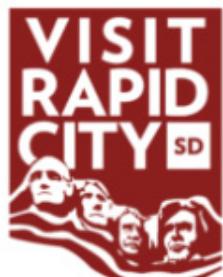
CampUSA
TicketSpice

GOLD LEVEL (\$500 - \$999)

Cave Conservancy Foundation
Cave Conservancy of the Virginias
Black Hills Parks and Forest Association
The Journey Museum
South Dakota School of Mines - Geology Department
Friends of Wind Cave
Scurion

SILVER LEVEL (\$250 - \$499)

Visit Rapid City
The Mammoth Site







Event Facilities

- Sessions and Events
- Special Events
- Campgrounds
- Food and Vendors

Workshops

Showers

Parking

Unused

To School of Mines



Secured Entry Point



Staff Only Gate



Restrooms



First Aid



100 50 0 100 Feet

SUNDAY
JUNE 12, 2022

Field Trips (Sunday, June 11th)

Type
Hydrology
Geology
Paleontology
Cave Trips (all week)

Weeklong Activities		
Art Salons Viewing		Fine Arts
Cartographyjy Salon Display		Events Center
Cave Sim		Outside Soule
Cave Trip Planning		Registration Building
Convention Office		Registration Building
First Aid		Registration Building
Food Trucks		Lions Parking Lot
Junior Speleological Society (JSS)		See JSS Schedule
Open Cash Bar		Events Center
Registration		Registration Building
Sketching Contest (Monday & Tuesday)		Registration/Caves
Vendors		Events Center

The Mammoth Site welcomes NSS Conference attendees!

STEAM Education

Active Research

Accredited Museum

2021 Travelers' Choice

Tripadvisor

BEST OF THE BLACK HILLS WINNER

www.mammothsite.org | 605-745-6017

SUNDAY
JUNE 12, 2022

Leader	Meet-up Place / Time
Karl Emanuel	Midco Tent- 9:00 AM
Sarah Keenan	In front of Registration Building - 9:00 AM
Sharon Weaver	Midco Tent- 9:00 AM
- Kelly Mathis	Registration - Sign up Sheets available First come basis

The CAVE Collective

Join us for a "SORT OF EARLY" Welcome Party!
~Sunday, June 12th~

MoonCats
7:00 p.m.
\$5 DONATION

PLEASE NOTE THE CAVE COLLECTIVE IS
ALCOHOL FREE



Rapid City | 406 5th Street | 605.939.0280

GENERAL SCHEDULE

MONDAY
JUNE 13, 2022

From	To	Soule Center	Bridger Steel	Fine Arts 2	Creative Arts
8:00 AM	8:15 AM				
8:15 AM	8:30 AM				
8:30 AM	8:45 AM	Opening Ceremony (8:15-8:45)			
8:45 AM	9:00 AM				
9:00 AM	9:15 AM				
9:15 AM	9:30 AM				
9:30 AM	9:45 AM				
9:45 AM	10:00 AM				
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4:30 PM	4:45 PM				
4:45 PM	5:00 PM				
Geology and Geography		See detailed Geology and Geography session schedule on next page (9:00 - 12:00)	Preserves Meeting (9:00 - 11:30)	Carlsbad Caverns Volunteers Meeting (9:00 - 12:00)	Bog Meeting (Open Session) (9:00 - 12:00)
Geology and Geography		Lunch and Geology and Geography section meeting (12:00 - 2:00)	AVP Department - All Hands Luncheon (11:30 - 1:00)	International Year of Caves and Karst (12:00 - 1:00)	BOG Meeting (Closed Session) (1:00 - 5:00)
Geology and Geography		See detailed Geology and Geography session schedule on next page (2:00 - 5:00)	Project Underground (1:00 - 5:00)	See detailed Cave Diving section schedule on next page (1:00 - 5:00)	

Evening Activities

5:00 PM	7:00 PM	Howdy Party Dinner and Social - In the Circus Tent next to Midco Stage
7:00 PM	9:00 PM	Howdy Party with the MoonCats at Rush Mountain Adventure Park -- Buses begin departing from the event center parking lot
9:00 PM	12:00 AM	Late night band - Pert Near Sandstone on the Midco Stage

Weeklong Activities	Art Salons Viewing		Fine Arts
	Cartographhy Salon Display		Events Center
	Cave Sim		Outside Soule
	Cave Trip Planning		Registration Building
	Convention Office		Registration Building
	First Aid		Registration Building
	Food Trucks		Lions Parking Lot
	Junior Speleological Society (JSS)		See JSS Schedule
	Open Cash Bar		Events Center
	Registration		Registration Building
	Sketching Contest (Monday & Tuesday)		Registration/Caves
	Vendors		Events Center

GENERAL SCHEDULE

	Lions Building	Round Building	Event Center (warm-up room)	Event Center
Communications and Electronics	See detailed Communications and Electronics session schedule on next page (9:00 - 12:00)			Vertical Setup (8:30 - 12:00)
Video Section	Com's and Electronics Lunch (12:00 - 1:00)	Speleology for Cavers (9:00 - 5:00) Pre-registration required - Sold Out	Self-rescue Techniques for Cavers (12:30 - 4:30) Pre-registration required - Sold Out	Vertical Contests and JSS Vertical Practice (12:00 - 4:00)
	See detailed Video Section schedule on next page (1:00 - 5:00)			Photography Workshop: Bethlehem Cave Meet at Midco Stage (11:00 - 5:00) Pre-registration required - Sold Out

arking lot at 5:45 pm.

GEOLOGY AND GEOGRAPHY SESSION

SOULE CENTER

Session Chair: Katherine Schmid

The Geology and Geography Session includes a variety of topics on caves and karst including karst hydrogeology, speleogenesis, cave morphologies, cave meteorology, geochemistry, and cave inventory and monitoring and geological education. The session features studies in a variety of caves including limestone, lava, glaciovolcanic, and shale.

Time	Speaker	Topic
8:00-9:00	Set-up	
9:00-9:20	Lee Florea	The origin and morphology of glaciovolcanic caves
9:20-9:40	Gretchen M. Baker	Melting Away: Ice in a High Elevation Nevada Cave
9:40-10:00	Sarah Arpin	Hydrogeology of Silvertip Mountain, Bob Marshall Wilderness area, Montana
10:00-10:20	Issam Bou Jaoude	Why Lebanon is Rich in Caves
10:20-10:40	BREAK	
10:40-11:00	Douglas Medville	Cave Development in the Mancos Shale, Colorado: Processes and Mineralogy
11:00-11:20	Lee Florea	Caves as polygenetic features
11:20-11:40	Hazel Barton	Exothermic speleogenesis: Microbes making caves from the outside in.
11:40-12:00	Louise D. Hose	Proposed Speleogenesis of Lehman Caves, Great Basin National Park, Nevada
12:00-2:00	LUNCH AND SECTION MEETING	
2:00-2:20	Victor J. Polyak	Elemental signatures of the last millennium in a stalagmite from Carlsbad Cavern
2:20-2:40	Gregory S. Springer	Empirical determination of Manning roughness coefficients for moderate floods: Fullers stream canyon, Culverson Creek Cave System, West Virginia
2:40-3:00	K. M. Emanuel	The Black Hills Karst Inventory Initiative: An Application of LiDAR Data Analysis to Identify and Inventory Surficial Karst Features within the Black Hills and surrounding Region.
3:00-3:20	Wiles, Michael E	An update of surface and subsurface geological mapping at Jewel Cave National Monument
3:20-3:40	BREAK	
3:40-4:00	Sarah W. Keenan	Integrating Black Hills caves into undergraduate geology research at South Dakota School of Mines and Technology
4:00-4:20	Max Appelbaum	An exploratory case study of the internal atmospheric response of Tumbling Rock Cave (Jackson County, Alabama) to surface meteorological conditions
4:20-4:40	Jack Wood	Taking a crack at it: Monitoring and quantifying fracture dynamics within the walls of a lava tube, proximal to an active volcano
4:40-5:00	Christina L. Ferguson	Source water investigation of the Snowy River deposit within the Fort Stanton-Snowy River Cave System, Lincoln County, NM

CAVE DIVING SECTION

FINE ARTS 2

Session Organizer: Jason Richards

This meeting will involve informal discussions of cave diving projects that attendees are working on and also includes topics such as sump rescue.

Time	Presenter	Topic
1:00-1:30		Introductions - Gear Pokey
1:30-1:50	Jason & Chrissy Richards	Exploration of Neal Cave, Tennessee
1:50-2:20	Charles Walker	Exploration of Roaring River Cave, Missouri
2:20-2:40	Richard Jack (remote from Seattle)	Exploration of Reappearing River Cave, BC.
2:40-3:00	Jason Richards	Exploration of Hole in the Wall Cave, BC
3:00-3:30	Ryan Hoffman (remote from Iraq)	Exploration of Bamboo Cave, Alabama
3:30-4:00	Michael Raymond	Sump Rescue in North America
4:00- UTC	Michael Raymond	Sump Rescue Practical Exercise

COMMUNICATIONS AND ELECTRONICS SECTION

MEETING/SESSION

LIONS BUILDING

Session Chair: John DeRoo

The Communications and Electronics Session covers all applications of electronics in caving including surveying, photography, wired and wireless communications, lighting, data logging and radio locations and also Ham radio demonstrations and applications.

Time	Speaker	Topic
9:00		Sign in and introductions
9:30-10:00	Brian Pease	A Miniaturized radiolocation beacon With a Ferrite Core Antenna for Easier Deployment in Caves

VIDEO SECTION MEETING

LIONS BUILDING

Session Chair: Dave Socky

1:00-5:00pm

The video Section Meeting will be an informal get-together of anyone who is interested in doing caving videos of any kind. After a short business meeting in which the current officers will be railroaded into running again (5 minutes), we will have informal discussions on video techniques, cameras, lighting, editing, postproduction, or anything else related to making cave related videos.

D E T A I L E D S E S S I O N S

Fun on all Levels



JUNE 13TH HOWDY PARTY



You don't want to miss this!

Help us kick off the 2022 NSS Convention in style. Join us for an Old Western Chuck Wagon dinner from 5-7 pm. Busses will begin transporting people to Rush Mt. Adventure Park at 5:45. Come explore Rushmore Cave and Adventure Park. While there try our specially brewed cave beer "Stalag-Lite" provided by Lost Cabin Brewery, and listen to music provided by The MoonCats. To continue the party, join us back at the Central States Fairgrounds and listen to music provided by "Pert Near Sandstone" on the Midco stage from 9-Midnight.

**Chuck Wagon Dinner 5pm-7pm
Central States Fairgrounds**

**After Party
9pm-Midnight Central States
Fairgrounds**

**Rush Mt. Adventure Park 6pm-9pm
music by the MoonCats**

**Music by
Pert Near Sandstone**

**Beer provided by
Lost Cabin Brewery**

Transportation Provided

OFFICIAL BEER OF THE 2022 NSS CONVENTION



STOP BY OUR RAPID CITY TAPROOM!

FRESH BEER • FOOD TRUCKS
OPEN DAILY AT NOON!

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LOSTCABIN.BEER

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BEER CO.

Rapid City, South Dakota



#findlostcabin
44°05'01.5"N, 103°14'33"W

TUESDAY
JUNE 14, 2022

GENERAL SCHEDULE

From	To	Soule Center	Bridger Steel	Fine Arts 2	Creative Arts
8:40 AM	9:00 AM				
9:00 AM	9:15 AM				
9:15 AM	9:30 AM				
9:30 AM	9:45 AM				
9:45 AM	10:00 AM				
10:00 AM	10:15 AM				
10:15 AM	10:30 AM				
10:30 AM	10:45 AM				
10:45 AM	11:00 AM				
11:00 AM	11:15 AM				
11:15 AM	11:30 AM				
11:30 AM	11:45 AM				
11:45 AM	12:00 PM				
12:00 PM	12:15 PM				
12:15 PM	12:30 PM		Lunch Break (12:10 - 1:00)		
12:30 PM	12:45 PM				
12:45 PM	1:00 PM				
1:00 PM	1:15 PM	Luminary Speaker Series: John Scheltens (1:00 - 2:00)			
1:15 PM	1:30 PM				
1:30 PM	1:45 PM				
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4:15 PM	4:30 PM				
4:30 PM	4:45 PM				
4:45 PM	5:00 PM				
5:00 PM	5:10 PM				

Evening Activities

6:00 PM 7:30 PM NSS Fellows / New Members Reception held at the Journey Museum

7:45 PM Closing NSS Auction - Held in the Soule building until the auction is completed

9:00 PM 12:00 AM Open Mic Night on the Midco Stage

Weeklong Activities	Art Salons Viewing		Fine Arts
	Cartographyj Salon Display		Events Center
	Cave Sim		Outside Soule
	Cave Trip Planning		Registration Building
	Convention Office		Registration Building
	First Aid		Registration Building
	Food Trucks		Lions Parking Lot
	Junior Speleological Society (JSS)		See JSS Schedule
	Open Cash Bar		Events Center
	Registration		Registration Building
	Sketching Contest (Monday & Tuesday)		Registration/Caves
	Vendors		Events Center

GENERAL SCHEDULE

Lions Building Round Building Event Center

Convention Planning
(2:00 - 5:00)

Cave Formation Repair Workshop
(2:00 - 4:00)

Rebelay Course
(10:00 - 4:00)

Vertical Contests
(9:00 - 4:00)

Sketching Contest
In-Cave

U.S. EXPLORATION SESSION SCHEDULE

SOULE CENTER

Session Chair: Pat Kambesis

The U.S. exploration session is where cavers working in U.S. cave and karst lands report on their activities and accomplishments. This day-long session features new explorations and reconnaissance as well as ongoing projects.

Time	Presenter	Topic
8:40-9:00	Niles Lathrop, Heather Veerkamp, Joel Despain	Caving in the McCloud Limestone, Shasta County, California 2019-2022
9:00-9:20	Dan Lamping	Continuing Exploration in Carroll Cave, Missouri
9:20-9:40	Hazel Barton	Revenge Fantasy: Extensions off the west edge of Wind Cave, Wind Cave National Park, South Dakota
9:40-10:25	Philip Schuchardt & Pete Johnson	Discovery and Exploration of the 6th Deepest Cave in America
10:25-10:35	Break	
10:35-10:55	Derek Bristol	The Resurvey and Continued Exploration of Great Expectations Cave in Wyoming
10:55-11:20	John Lyles	Fort Stanton Cave in 2020-22
11:20-11:40	Bill Steele	Exploration and mapping of Texas' Honey Creek Cave Has Resumed
11:40-12:10	Dan Austin	Continuing Exploration in Jewel Cave, South Dakota
12:10-2:00	Lunch Break	
2:00-2:20	Lee Florea	Caves of the Tsala Apopka, Florida
2:20-2:40	Jason & Christina Richards	Exploring Limestone Caves in Hawaii
2:40-3:00	Peter Bosted	The Delissea System in Hawaii
3:00-3:20	Garry Petrie	Caves of the Big Lava Bed, Washington
3:20-3:30	Break	
3:30-3:50	Greg Springer	Dry Cave, West Virginia: Anything but dry and crawling toward 10 miles long
3:50-4:10	Nicki Fox	West Virginia Makes History with Two 50-Mile Caves!
4:10-4:30	Dave Socky	McClung Cave, WV – 20 miles in 3 years
4:30-4:50	Nick Socky	The 18th Mile of Windy Mouth – A Survey Milestone and Update
4:50-5:10	Paul Walko	Newberry's Connection Exploration

CAVE CONSERVATION & MANAGEMENT

BRIDGER STEEL

Session chair: Val Hildreth-Werker, Moderator NSS Conservation Division Joint Chief

Conservation Tuesday Talks include cave and karst conservation and management, minimum-impact-science-based decisions, stewardship, education/outreach, karst aquifer watershed protection, spelean habitat ecosystem findings, bat study updates, clean-caving ethics, WNS decon systems, as well as advancements in cave restoration, speleothem repair, and low-impact caving methods. Join us for lively speleological presentations and discussions exploring state-of-the art conservation solutions and current best practices.

A Special Workshop on methods for the repair of speleothems starts at 2:00 PM. (See below). This Cave Formation Repair Workshop by Mike Mansur offers a hands-on introduction to repair techniques in the classroom. An opportunity for in-cave practice will follow on the next day.

Time	Speaker	Topic
9:00-9:20	Pat Seiser	Update on status of the NPS Cave and Karst Program and NCKRI's programs.
9:20-9:40	Georgia Schneider	CKRIT: The Cave and Karst Resources Information Tracking Database
9:40-10:00	Andy Armstrong	Cave Pool Water Chemistry Analysis Reveals Beneficial Impact to Speleothem Growth Resulting from Microclimate/CO ₂ -Focused Management of Cave Tours
10:00-10:20	Erin Lynch	Removal of Potentially Hazardous Material from Cave C-18, Carlsbad Caverns National Park: Logistics and Lessons Learned from a Multi-Agency Operation
10:20-10:30	BREAK	
10:30-10:50	Ceth Parker	The Urgent Need for Extraterrestrial Subterranean Conservation
10:50-11:10	Ethan W. Oleson	The Conservation in Rushmore Cave, Black Hills – Show Cave Conservation Lesson
11:10-11:30	Kate Forel	Characterizing Air Quality and Health Concerns in Tumbling Rock Cave: An Exploratory Study
11:30-11:50	Charles and Catherine Bishop	James Cave and Coach Cave Restoration
11:50-12:10	Ray Keeler	NSS-USFS Cooperation Initiatives: Stepping Up to Better Understand, Access, and Manage Caves in the National Forests
12:10-12:30	Arun Bista	Nepal: Patal Bhuvaneshwar Cave
12:30-12:50	Lilliana Wolf	Bats as a viral vector: implications for conservation and pandemic preparedness
12:50-2:00	BREAK	
2:00-4:00	Mike Mansur	Cave Formation Repair Workshop

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CULTURES OF CAVING SESSION

FINE ARTS 2

Session Organizer: Dr. María Alejandra Pérez

Session Chair: Dr. Joseph Douglas

Whenever “anthropology” and “caves” are mentioned together, it is usually in the context of archaeology. There is good reason for this, since caves have been and continue to be important sites to examine the past, not just of humans and their ancestors, but also of other living beings and even of the earth itself. Yet, caves continue to be very active spaces of human cultural activity. We suggest that a focus on caving itself, including speleological research, be examined as a cultural activity, and that this examination be put in the broader context of the study of humans and caves (See Pérez’s Chapter 26 of the 4th edition of Caving Basics for a more thorough exposition on this view). Cavers explore, they discover. Most cavers survey and map while doing so. They also gather into groups, they tinker with and design their tools, and they establish certain rules (explicitly or implicitly) about who to share their information with and how. On this point, cavers sometimes fight with each other. The many ways cavers deal with territorial politics is a fascinating and complex area that is teeming with insights into how humans establish relationships among each other and the earth. Caver ideas on conservation and cave modification are intriguing evidence of the complex ways humans behave culturally and shape nature. In other words, cavers have culture, or, to be more precise, cavers cave culturally. This session is an invitation to think of caving itself from a cultural and historical perspective, and to examine what has changed and what has remained the same when it comes to humans exploring cave passages. After almost three years of an ongoing pandemic and the rise of creative uses of virtual and other technologies—many in support of the International Year of Caves and Karst—it is a good time to stop, reflect, and ponder on new ways to expand/change the ways we cave, together.

Time	Presenter	Topic
9:00-9:10	María Alejandra Pérez	Session Introduction (virtual presentation)
9:10-9:40	Montserrat Peralta Méndez	Folklore of the Caves of the Huautla de Jimenez, Oaxaca, Mexico Area
9:40-10:10	Joe C. Douglas	Weaver Caverns and Historic Native American Use of Caves in Eastern North America
10:10-10:40	Kai Bosworth	Cave Conservation: A Perspective from Human Geography
10:40-11:00	BREAK	
11:00-11:30	Devra Heyer	If You Learn How to Cave, What Else Do You Learn: A Pedagogical Look At Caving
11:30-Noon	María Alejandra Pérez (Virtual)	The Power and Potential of a Radical Speleology
Noon-12:30pm	General Q/A Discussion	



A Special Sponsorship from The North Face

In the early summer of 2021, some concerns were raised by speologists about the actions of professional North Face climbing athletes, featured in a magazine climbing a large flowstone formation. In that climb, every effort was made to minimize damage to that formation, and no long-term impact was made to the cave, but The North Face still took these concerns seriously. Following the many messages they received from cavers across the globe, the North Face began working with the NSS to better understand the merit of those concerns.

An extensive series of correspondences began between these professional climbers and cave experts, culminating in a presentation by NSS AVP Adam Weaver and NSS Director Pete Johnson for the North Face athletes. This presentation focused on general cave conservation and cave climbing ethics, as well as public perception of caving activities. The outcome of this was that their athletes gained an understanding of the concerns that were raised and some additional resources when attempting to do work underground. As a show of this partnership between the North Face and the NSS, the North Face is sponsoring “Conservation Tuesday” of the 2022 NSS Convention.

On behalf of the 2022 Convention staff, we are proud to have The North Face as a sponsor, and hope that the friendship between the NSS and The North Face, as well as their commitment to cave conservation, continues for years to come!

A handwritten signature in black ink, appearing to read "CP".

Chris Pelczarski

2022 NSS Convention Chairman

WEDNESDAY
JUNE 15, 2022

GENERAL SCHEDULE

From To

8:30 AM	8:45 AM
8:45 AM	9:00 AM
9:00 AM	9:15 AM
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4:30 PM	4:45 PM
4:45 PM	5:00 PM

Soule Center

International Exploration

See detailed
International Exploration
session schedule on next
page
(9:00 - 11:50)

International Exploration

See detailed
International Exploration
session schedule on next
page
(2:15 - 4:30)

Bridger Steel

Cave Paleontology

See detailed Cave
Paleontology session
schedule on next page
(9:00 - 12:00)

Cave Paleontology

See detailed Cave
Paleontology session
schedule on next page
(1:00 - 5:00)

Creative Arts

NSF Investment
(closed session)
(9:00 - 12:00)

Speleophilatelic
Section Meeting
(12:00 - 1:00)

Congress of
Grottos
(2:00 - 5:00)

Evening Activities

5:00	TBD	Sketching Contest Judging inside Event Center
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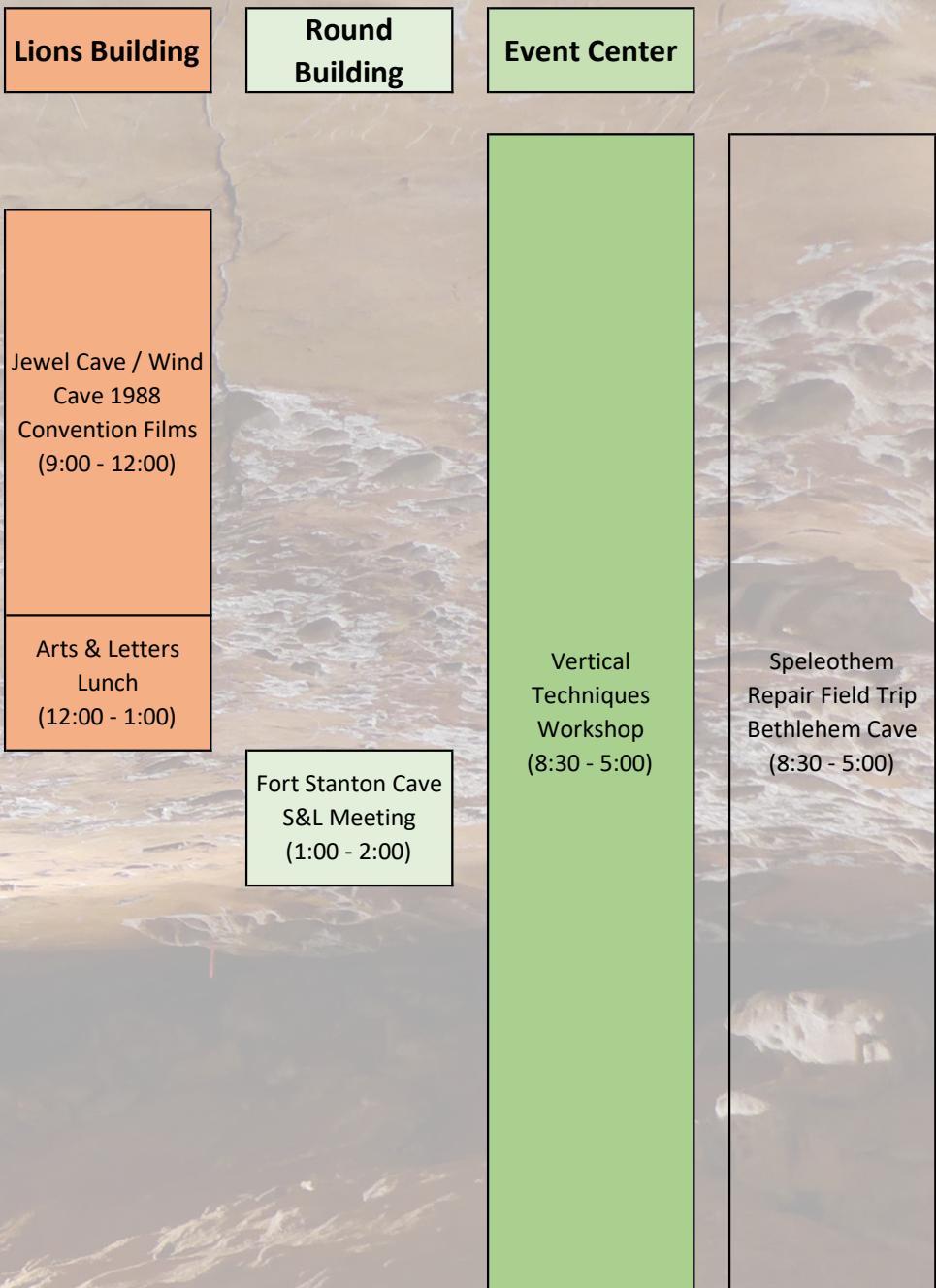
5:00	6:00	NSS Explorers Club Meeting in the Lions Building
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6:00 PM	9:00 PM	Speleo-Rodeo inside Event Center at rodeo arena
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8:30 PM	12:00 AM	Campground Party and music at the Midco Stage
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WEDNESDAY
JUNE 15, 2022

GENERAL SCHEDULE



Weeklong Activities	Art Salons Viewing	Fine Arts
	Cartographhy Salon Display	Events Center
	Cave Sim	Outside Soule
	Cave Trip Planning	Registration Building
	Convention Office	Registration Building
	First Aid	Registration Building
	Food Trucks	Lions Parking Lot
	Junior Speleological Society (JSS)	See JSS Schedule
	Open Cash Bar	Events Center
	Registration	Registration Building
	Sketching Contest (Monday & Tuesday)	Registration/Caves
	Vendors	Events Center

INTERNATIONAL EXPLORATION SESSION

SOULE CENTER

Session Chair: Cyndie Walck

The International Exploration Session features presentations on exploration, mapping, expedition reports and updates and the study of caves outside of the U.S. Many of the presenters have been recipients of the NSS International Grants Program. Featured locations include Vietnam, Mexico, Canada, Belize, Montenegro and Lebanon.

Time	Speaker	Topic
9:00-9:30	Dean Wiseman	Phon Na Kebong, Vietnam
9:30-10:00	Bill Steele	PESH 2022 Expedition Proyecto Espeleologico Sistema Huautla
10:00-10:20	Jim "Crash" Kennedy	Laguna de Sánchez, Nuevo León, Mexico --- The caves keep popping up!
10:20-10:30	BREAK	
10:30-11:00	Sean Lewis	USDCT 2021 and 2022 Cheve Expeditions
11:00-11:30	Bryce Smith	The Desert Pits of Muzquiz, Coahuila, Mexico
11:30-12:00	Ron Delano	Proyecto Cerro Verde, Mexico
12:00-12:10	Norm Thompson	3D Slide show – Proyecto Cerro Verde, Mexico
11:50-2:15	Lunch Break	
2:15-2:35	Philip Schuchardt	Exploration of Kučka Korita, Montenegro
2:35-3:05	Katie Graham	White Rabbit- A Canadian cave found during a Caribou survey
3:05-3:25	Zeb Lilly	Huautla Resurgence
3:25-3:35	BREAK	
3:35-4:05	Carol Vesely	Panti Pit, Belize: Drops, Boreholes, Mud and Bad Air
4:05-4:30	Issam Bou Jaoude	An Introduction to the Caves of Lebanon

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CAVE PALEONTOLOGY SESSION
FAUNAS FROM CAVE AND KARST TOPOGRAPHY: A WORLD-WIDE VIEW
BRIDGER STEEL

Session Chairs: Dr. Sharon Weaver and Dr. Jim Mead

The discovery of fossils in caves and karst landscapes can be traced back to the beginning of paleontology. This session highlights new developments in this field, with authors contributing a variety of interdisciplinary views on faunal assemblages from around the globe.

Time	Speaker	Topic
9:00-9:20	Sharon Weaver	Jefferson's Ground Sloth (<i>Megalonix jeffersonii</i>) from ACb-3 Cave, Colbert County, Alabama
9:20-9:40	Wang et al.	Evolution and biochronological sequence of Plio-Pleistocene mammalian faunas from Jinyuan Cave at Luotuo Hill in Northeast China
9:40-10:00	Bushell, Schubert	Fossil Cat Tracks from Chilly Bowl Cave, Arkansas
10:00-10:20	White, Morgan	Natural traps, shelters or what remains of dinner: Why are fossil pronghorns (Mammalia: Antilocapridae) found in caves?
10:20-10:40	Morgan, Czaplewski	Cave and Karst Deposits and the North American fossil record of bats (Mammalia: Chiroptera)
10:40-11:00	Santucci et al.	National Park Service Cave Paleontology: Inventory, Discovery, and Stewardship
11:00-11:20	Schubert	Fossils from Caves: A Guide to Recognizing, Documenting, and Preserving Paleontological Resources
11:20-11:40	Socky et al.	The Petra Project: Excavation of a Large Cat Skeleton from Burja Cave (Virginia, USA)
11:40-12:00	Hastings et al.	The Petra Project: Taphonomy of a New Record of a Large Cat Skeleton from Burja Cave (Virginia, USA)
12:00-1:00	LUNCH BREAK	
1:00-1:20	Schap et al.	Changes in small mammal community composition over the last 25,000 years across multiple western North American cave localities
1:20-1:40	Mead et al.	Pleistocene faunas from caves and karst sinkholes, Black Hills, South Dakota
1:40-2:00	Fox, Johnson	How low should you go? Determining minimum screen size requirements for microfossil acquisition at Wind Cave National Park, South Dakota
2:00-2:20	Graham, Christine	Taphonomic Implications of Ontogenetic Age Distributions for Field Mice (<i>Peromyscus</i> sp.) Populations from Two Debris Cone Deposits, Parker's Pit, Black Hills, SD
2:20-2:40	Jass et al.	Cave Paleontology and Radiocarbon Dating in the Canadian Rocky Mountains
2:40-3:00	Lujan	Richards Spur: A Fissure Fill Preserves a Unique Highland Ecosystem from the Early Permian
3:00-3:20	Shore	A New late Pleistocene/Holocene Fauna from a cave in Uvalde County, Texas
3:20-3:40	Skwarcan	Review of late Pleistocene and early Holocene vertebrate faunal records from central Texas caves and contextualization within paleoclimatic and archaeological contexts
3:40-4:00	Carpenter, Mead	Canids from two caves in Grand Canyon National Park, Arizona
4:00-4:20	Czaplewski et al.	Late Pleistocene vertebrate fauna and guano deposit of La Tetera Cave, Arizona: a preliminary report
4:20-4:40	Bruce, Mead	Quaternary badger (Taxidea; Mustelidae) from Snake Creek Burial Cave, Nevada
4:40-5:00	McDonald, Chatters	Cenotes and Sloths: Pleistocene Sloth Diversity on the Yucatan Peninsula, Mexico

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GENERAL SCHEDULE

THURSDAY
JUNE 16, 2022

From	To	Soule Center	Bridger Steel	Fine Arts 2
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11:00 AM	11:15 AM	Photo salon show prep		
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12:30 PM	12:45 PM			
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1:15 PM	1:30 PM	Luminary Speaker Series: Dave Springhetti (1:00 - 2:20)		
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3:30 PM	3:45 PM	Photo salon show prep		
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4:45 PM	5:00 PM			

Evening Activities

5:00 PM	9:00 PM	Black Hills Cave and Nature Conservancy Carnival in the big tent
5:00 PM	7:30 PM	Human Bone Identification Workshop in the Round Building
6:00 PM	7:15 PM	Photo Salon Short Show/Salon Awards in the Soule Center
7:30 PM	10:00 PM	Full Photo Salon/Salon Awards (Long Show) in the Soule Center
8:00 PM	12:00 AM	Storytelling Contest at the Midco Stage

GENERAL SCHEDULE

Creative Arts

Lions Building

Round Building

Event Center

Vertical Section / Awards
See detailed
Vertical Section
Meeting / Awards
session schedule
on next page
(9:00 - 1:00)

NSS Awards
Committee
(9:00 - 12:00)

Sketching workshop
(9:00 - 12:00)

NCKMS Steering
Committee
(12:00 - 1:00)

NSF Trustees Open
(2:00 - 5:00)

Cave Digging

Schedule TBD: see
next page for
details

Convention
debrief at the
Event Center bar
(2:00 - 5:00)

Sketching
Workshop In-Cave
(1:00 - 6:00)

Weeklong Activities	Art Salons Viewing	Fine Arts
	Cartography Salon Display	Events Center
	Cave Sim	Outside Soule
	Cave Trip Planning	Registration Building
	Convention Office	Registration Building
	First Aid	Registration Building
	Food Trucks	Lions Parking Lot
	Junior Speleological Society (JSS)	See JSS Schedule
	Open Cash Bar	Events Center
	Registration	Registration Building
	Sketching Contest (Monday & Tuesday)	Registration/Caves
	Vendors	Events Center

THURSDAY
JUNE 16, 2022

DETAILED SESSIONS

BIOSPELEOLOGY SESSION

BRIDGER STEEL

Session chair: Dr. Sarah Keenan

The Biospeleology Session includes presentations that highlight the latest research in Biospeleology. These presentations cover a variety of topics ranging from cave microbiology, biogeochemistry, species inventories and diversity and cave ecosystem ecology.

Time	Speaker	Topic
9:00-9:10		Introduction and Welcome
9:10-9:40	Hazel A. Barton	The Weird Microbiology of the Mulu Caves, Borneo
9:40-10:10	Kathleen Lavoie	UVC to control WNS: limitations and effects on microbial communities in caves
10:10-10:40	Reilly Blackwell	More than Speleothems: Measuring and Maximizing Microbial Calcium Carbonate Precipitation
10:40-11:00	BREAK	
11:00-11:30	Annette S. Engel	Hawaiian Lava Tube Biology along the Space-Time Continuum, the Next Generation
11:30-12:00	Diana E. Northup	The Effects of Surface Wildfires on Microbial Communities in Lava Caves
12:00-2:20	LUNCH BREAK	
2:20-2:50	Robert Weck	Life history patterns of the Enigmatic Cavesnail, <i>Fontigens antroecetes</i> , revealed through captive breeding under simulated cave conditions
2:50-3:20	Hannah R. Rigoni	Microbes of the Barton Springs Segment of the Edwards Aquifer, Texas
3:20-3:50	Benjamin Schwartz	Hyporheic stygobiont diversity and distribution in Texas, USA
3:50-4:20	Hazel A. Barton	The Microbiology of the Grottedal Caves of Greenland

CAVE PHOTOGRAPHY

FINE ARTS 2

Session Chair: Eugene Vale

All who are interested in cave photography from beginner to expert are welcome to attend.
Presentations cover in-cave, processing and post processing techniques.

Time	Speaker	Topic
2:00-2:05	Eugene Vale	Introduction to Cave Photography Section
2:05-2:25	Dave Bunnell	Focus Stacking techniques for cave photography: in-camera versus post-process in Photoshop
2:25-2:30	Break	
2:30-2:50	Peter Bosted	Cave Documentation with Photography
2:50-2:55	Break	
2:55-3:15	Michael McEachern	3D to 2D Conversion
3:15-3:45	Eugene Vale	Business meeting
3:45-4:05	Kenneth Ingham	Using the Godox AD200Pro
4:05-4:10	Break	
4:10-4:30	Eugene Vale	Photographing Bats
4:30-4:35	Break	
4:35-5:00	Eugene Vale	Photography Close-up

THURSDAY
JUNE 16, 2022

DETAINED SESSIONS

SPELEAN HISTORY

FINE ARTS 2

Session Chair: Dean Snyder

The American Spelean History session presents papers on the study, interpretation, and dissemination of information about speleal history, which includes folklore, legends, and historical facts about commercial and wild caves throughout the world, and the people who are associated with them. The section's annual Business Meeting will follow the session's presentations in the same room.

Time	Speaker	Topic
9:00-9:20	Adam Weaver	Exploration of Black Hills Caves
9:20-9:40	Gordon L. Smith Jr. and John M. Benton	The National Cave Museum & Library, Park City Kentucky
9:40-10:05	Joseph C. Douglas and Marion O. Smith	Pre-1820 Historic Graffiti in Mammoth Cave, Kentucky
10:05 - 10:15	BREAK	
10:15-10:25	Dr. Cato Holler	Jules Verne and the Ruhmkorff Lamp: a Brief History of Underground Lighting Devices
10:25-10:45	Kailey Alessi	A Cave Through Time: Historic Archaeology at Mammoth Cave, Kentucky
10:45-11:05	Catherine Bishop	How to Grow a Cave History Book
11:05-11:25	Donald G. Davis	Colorado's Cyclopean Cave "Hoax": Where History Went Wrong
11:25-12:05	Bert Ashbrook	The Maps of Mammoth Cave from the 1810s
12:05-12:15	BREAK	
12:15 - 1:00pm	Annual Business Meeting of the American Speleal History Association	Business meeting will extend into lunch

DIGGING SECTION MEETING/SESSION

LIONS BUILDING

Session Chair: Benjamin Brown

Thursday, June 16, 2022

The Digging Section meeting is open to anyone interested in finding new and expanding existing caves. Cave digging is a legitimate exploration technique when used in a responsible and appropriate manner. There will be a short business meeting and election of section officers followed by presentations on a variety of dig projects and techniques.

Time	Speaker	Topic
2:00 – 2:30		Business Meeting / Election of Officers
2:30 – 2:50	Eric Sutterlin	Sandland Tunnels
2:50 - ??	Any Cave Digger	Walk-in presentations
After presentations	Ben Brown / Chris Pelczarski	Discussion of post-convention dig project

VERTICAL SECTION BUSINESS MEETING & SESSION

CREATIVE ARTS

Section Chair: Gene Harrison (Business & Awards),

Technical Session Chair: Hazel Barton

The Vertical Section business meeting will formally conduct the official business of the Vertical Section, including reports about the Section's finances, Section activities, new initiatives, and the annual election of officers and Executive Committee Members.

The Vertical Technical Session will be held immediately after the Business Meeting. The Session allows participants to present new vertical techniques and equipment.

Climbing Contests Awards Ceremony: Climbing contest award certificates and prizes for winners in each category and age group will be presented. Award winners must be present or send a representative to receive their prizes. Join in congratulating the winners of the Vertical Climbing Contests that were conducted on Monday and Tuesday of this week.

Time	Speaker	Topic
9:00-10:00		Gene Harrison: Vertical Section Business meeting
Hazel Barton – Technical Session Chair – 10:00-11:10 am		
10:00–10:30	Ron Miller	NSS Vertical Training Commission: Developing a National Vertical Training Program for U.S. Cavers
10:30–10:50	Reilly Blackwell	Educational Factors in American Vertical Caving Incidents, 2000-2020
10:50–11:10	Kurt Waldron	A Self Belay Climbing System
11:10-1:00		Gene Harrison: Business Meeting continued including Vertical Section Awards & Prizes (starting at 11:30am)

LOCAL CAVERS IN ACTION

In 2020 **Black Hills Cave and Nature Conservancy** (BHCNC) acquired 46 cave-rich acres west of Rapid City, SD to create Dahm Springs Preserve, the 20th NSS nature preserve.



Join us:

- Wed., June 15 – **guided hike** of Dahm Springs Preserve
- Thurs., June 16 – **"Buy-a-Cave" FunRaiser Carnival** at the BHCNC tent, 5 – 9 pm

Find out more about BHCNC at:

- the BHCNC table in the Exhibitor Area
- www.blackhills caves.org/buy-a-cave



BHCNC, a 501(c)3 non-profit organization, strives to advance the conservation, restoration, and preservation of caves and natural resources in the Black Hills region through land ownership, scientific research and public education.

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LOCATION OF THE PAHA SAPA GROTTO MEETINGS

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GENERAL SCHEDULE

FRIDAY
JUNE 17, 2022

From	To	Soule Center	Bridger Steel	Fine Arts 1
8:00 AM	8:15 AM			
8:15 AM	8:30 AM			
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10:45 AM	11:00 AM	Lightning Talks (9:00 - 1:00)		
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2:45 PM	3:00 PM	Banquet prep (1:00 - 4:30)		
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Evening Activities

5:30 PM

NSS Awards Banquet at the Soule Center

8:30 PM

After Party with Muchos Garcias at the Midco Stage

FRIDAY
JUNE 17, 2022

GENERAL SCHEDULE

Fine Arts 2

Creative Arts

Lions Building

Round Building

Writer's Workshop / Poetry Corner (9:00 - 4:30)

Bog Meeting (Open Session) (9:00 - 12:00)

BOG Closed Lunch Meeting (12:00 - 1:00)

BOG Meeting (Closed Session) (1:00 - 4:30)

Cave Ballad Critiques (9:00 - 12:00)

Survey and Cartography Section Lunch (12:00 - 1:00)

See detailed Survey and Cartography session schedule on next page (1:00 - 5:00)

Arts and Letters Corner (All Day)

Weeklong Activities

Art Salons Viewing		Fine Arts
Cartographhy Salon Display		Events Center
Cave Sim		Outside Soule
Cave Trip Planning		Registration Building
Convention Office		Registration Building
First Aid		Registration Building
Food Trucks		Lions Parking Lot
Junior Speleological Society (JSS)		See JSS Schedule
Open Cash Bar		Events Center
Registration		Registration Building
Sketching Contest (Monday & Tuesday)		Registration/Caves
Vendors		Events Center

SURVEY & CARTOGRAPHY SESSION

LIONS BUILDING

Session Chair: Carol Vesely

The Survey and Cartography Session provides an opportunity for cavers interested in cave mapping to learn about new techniques, tools, and software related to mapping and cave surveying. Presentations may be on any topic related to any aspect of cave mapping such as: keeping cave mud off your survey instruments (while still going into the cave), resolving survey blunders, large project management, new tools for mapping or cartography, representing complex caves cartographically, comparisons of various programs for survey data processing, map drawing and data visualization, or integrating cave survey data with surface and GIS data.

Time	Presenter	Topic
12:00-1:15	Business Meeting	Lunch meeting of the Survey and Cartography Section
1:15–1:45	Bert Ashbrook	The Sarah Furnace Cave Survey
1:45–2:15	Philip Schuchardt	CaveWhere – From sketch to 3D cave maps
2:15–2:35	Derek Bristol	An Efficient Cave Cartography Workflow – Updating the Sistema Cheve Map
2:35–2:55	Zachary Normile	GeoSLAM LiDAR and Digital Elevation Models as a Tool for Georeferencing and predicting Subsurface Voids
2:55–3:10	BREAK	
3:10–3:40	Bill Koerschner	Experiment with Out-of-Cal DistoX
3:40–4:10	Philip Schuchardt	MapWhere – Offline Data Collection, Mapping and Synchronization App
4:10–4:30	Lee J. Florea and Sarah Asha Burgess	Illustrating the complexities of karst systems using geologic block diagrams
4:30–4:50	moderated by Carol Vesely	Open Forum: What's New in Surveying and Cartography

VIDEO SALON VIEWING

BRIDGER STEEL

(9:00 – 12:00)

Watch the full-length programs from the Video Salon in a theater setting on the big screen in the Bridger Steel building. All programs will be shown and repeated as time allows.

LUMINARY SPEAKER SERIES

SOULE CENTER

JOHN SCHELTENS - TUESDAY 1:00 P.M.

Caver – Cowboy – Cave Conservationist

A ubiquitous adventure of Past NSS President John Scheltens from exploring one of the world's largest caves (Wind Cave) and one of the US deepest caves (Great 'X' Cave), to hosting a unique NSS Conventions on his ranch in South Dakota. An adventure that has taken him from caving in the former Soviet Union to the halls of Congress in Washington, DC for the passage of the Federal Cave Resource Protection Act (FCRPA).

Along this journey there have been many twists, turns and surprises. However the best part has been sharing the path with so many colleagues and sincere close friends as a direct result of being a member of the National Speleological Society. A unique journey that could not have happened anywhere else.



JOHN MYLROIE - WEDNESDAY 1:00 P.M.



Born in 1949 in Philadelphia, PA, John's first cave was Meramec Caverns, Missouri in 1956 during a family road trip vacation. Then it was Howe Caverns, New York in 1959 after moving to upstate NY in 1957. The first wild cave was Hailes Cave in Thatcher Park, NY in 1965. The seed was set, and a trip to Onesquethaw Cave, NY in the summer of 1967 with John's girlfriend's little brother had a huge impact; the girl is long gone but the cave fever remains. The Syracuse University Outing Club made caving in upstate NY routine, and John's new girlfriend, Joan Saxon, was soon also a participant. John and Joan married in 1970; she graduated in 1970 but John, a year younger, graduated in 1971 and with a low draft number, ended up in the US Navy for a year. Returning to civilian life in Scotia, NY, John and Joan joined the NSS (12514 and 12515), John worked at SUNY Albany as an electronics lab technician, and caved all the time. When the caves ran out, which was quick in the Northeast, he started looking for new ones, with a lot of minor discoveries and a few notable ones. Meeting Dr. Art Palmer in 1968, John understood that becoming a geology professor was a way to get paid to go caving. He entered Rensselaer Polytechnic Institute in the fall of 1974 and graduated with a PhD on the caves of Schoharie County, NY in the spring of 1977. Murray State University in Kentucky hired him for the fall, 1977 academic year and he and Joan moved west and south. Legendary caver Mike Dyas had recently established the Western Kentucky Speleological Survey, and John began a lot of cave exploration, survey and science in the area west of Mammoth Cave National Park, long ignored by cavers as it was all sinkhole plain caving. John involved many undergraduates and published a series of annual reports for the project. At the same time, John and Joan began to teach a field course on San Salvador Island, Bahamas, and discovered the joys of warm, tropical island caving. In 1982, Joan and John started a family, and by November 1983 had three boys. To provide a better living for the new family, in 1985 John accepted the Department Head position in Geology and Geography at Mississippi State University. While at MSU advised many undergraduate research projects, and graduate theses and PhDs on karst. He retired as Professor Emeritus in 2014; John and Joan still continue to do caving and cave science around the world. On islands, of course. John credits the National Speleological Society for establishing the camaraderie, conservation, and science of caving, which propelled him to both professional and personal success.

DAVID SPRINGHETTI - THURSDAY 1:00 P.M.



After taking commercial cave trips into Bethlehem Cave and Wind Cave with his parents as adolescent, David began his cave crawling career in 1963 at the age of 13 going off trail in Wild Cat Caverns with his older brother who worked there. He was able to tag along on other wild cave trips because his brother was a member of the Explorer Scouts and rules were loosely enforced at the time. He joined the Paha Sapa Grotto while attending college and became club president in 1970, started exploring and mapping in Wind Cave during the Windy City Grotto expeditions where he became lifelong friends with John Scheltens. During this time, David helped collect data for scientific research papers, caved throughout the Black Hills and Wyoming and helped gate Horse Thief Cave in Wyoming.

After surviving the 1972 Rapid City flood and graduating from college, David moved to Texas where he joins the Dallas Fort Worth Grotto and later the Greater Houston and caved with their members in West Texas. David returned to the Black Hills in the fall of 1977, rejoined the Paha Sapa Grotto and met up with John Scheltens who had also recently returned to the area, thus fulfilling a promise made 4 years earlier to continue exploring and mapping Wind Cave. David was co-chair, guidebook editor and accountant for the 1988 NSS Convention in Hot Springs, SD and later helped film and star in the Wind Cave The World Below NSS video.

In addition to many years devoted to exploring and mapping Wind Cave, David has mapped in Jewel Cave, various caves in Wyoming including Great X Cave. He was also instrumental in establishing the Black Hills Cave and Nature Conservancy and the Dham Springs Preserve. He designed and built gates for several caves to keep them from being blasted shut by their owners as well as other to help managers protect their resources. He continues to be an active member of the Paha Sapa Grotto and continues to explore and map in Wind Cave, Jewel Cave, Stage Barn and Bethlehem caves.

David is also an avid rock climber, bicyclist, SCUBA diver and above ground and underwater photographer.

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SPELEO-RODEO

Wednesday, June 15th: 6:00 - 9:00 p.m.

The Speleo-Rodeo combines South Dakota cowboys with NSS cavers. It's an unusual mix designed to have a good time with some fun competition. This will be team competition. Each team will have 3 cavers on foot with 1 cowboy on horseback.

There will be 4 timed events. The team with the lowest combined score of all 4 events will be crowned the world champion speleo cowboy!

- Team Calf Roping:
Starts out like a normal Rodeo event. A calf comes running out of a chute and the cowboy ropes it. Then the three cavers come out and tackle the calf, tie 3 legs, then brand the calf (just water soluble paint) with the NSS logo.
- Wild Hide Race:
One of the cavers lies down on an old cowhide and the cowboy drags the hide behind the horse in a race against other cavers for the fastest time around the arena.
- Calf Sorting/Penning:
All the calves are released in the arena. The team now needs to sort out one calf with the right number of it and get it captured into a separate pen.
- Wild Cow Ride:
Another member of the caver team will try and ride a cow with one hand for as long as possible.

SIGN UP TO COMPETE AT REGISTRATION!

LIDAR AND PHOTGRAMMETRY CAVE MODEL SHOWCASE

Come explore high resolution simulations of two park service caves without ever leaving the convention grounds. Virtual Tours are available through a signup form by the booth, first come first serve.

IN-CAVE PHOTOGRAPHY WORKSHOP

This will be a hands on photo workshop based at Bethlehem Cave about an hour from the Convention site. Its passages are largely walking size in the areas we'll access. Participants should have their own cameras and ideally a tripod. A standard digital camera with some manual control will give you options for both flash and LED lighting. Its not necessary but you can also bring flashes or LED illumination. The instructor will have plenty of both though. With LEDs we will start by picking light sources by matching their color temperatures to avoid off color lighting. A cellphone app to help with this will be demonstrated. Likely we will split into two groups, one focusing on multiple flash photos using radio slaves. The second group would focus on LED-based illumination and those using cellphones equipped with night modes will especially benefit from this. A second photographer will assist by working with one of the groups. People will be given a chance to work with both scenarios.

JUNIOR SPELEOLOGICAL SOCIETY (JSS)

The Junior Speleological Society (JSS) has scheduled number of activities for members throughout the week. This includes part of a day caving with the NSS President, various field trips, vertical training and of course caving trips. See the JSS schedule for more details on what they will be doing all week

ADDITIONAL INFO

VIDEO SALON VIEWING

Friday, June 17th

Watch the full-length programs from the Video Salon in a theater setting on the big screen in the Bridger Steel building. All programs will be shown and repeated as time allows. **VIEWING WILL TAKE PLACE FROM 9 TO NOON ON FRIDAY.**

VIDEO SALON KIOSK

Monday, June 13th - Thursday June 16th

The Video Kiosk is a self-serve viewing station for those who want to watch any of the Video Salon entries when it is most convenient. Sit down and enjoy the great caving programs at your convenience. **THEN ATTEND THE THURSDAY NIGHT SALON AWARDS TO FIND OUT WHICH ONES WON AWARDS. THE VIDEO KIOSK WILL BE OPEN MONDAY THROUGH THURSDAY MORNING IN FINE ARTS 1.**

AUTHOR BOOK SIGNING

All Week Long on Vendors Row near the bookstores

Authors and times TBD. Will be announced in Oh, Manganese!

SKETCHING CONTEST

This will be the first ever competitive sketching contest at an NSS Convention. Participants will sketch a pre-determined section of Rushmore Cave to be submitted to the sketching contest. The cave will be available for participants on Monday June 13 and Tuesday June 14, 2022. The sketches will be assessed by a panel of 3-4 judges and results will be announced at the Arts Salon Program on Thursday June 16, 2022. A sketching critique will be held in conjunction with the Cartography Salon critique on Friday June 17, 2022. Details and instructions will be available at Registration.

ARTS AND LETTERS CORNER

On Friday of Convention, Michael Ray Taylor and Jo Schaper, co-chairs of the Arts and Letters Salon, will reprise the Writer's Workshop/Reading Corner from 9 am to noon with a break for lunch, then continue into the afternoon. Both the morning and afternoon will be a mix of instruction and performance. If you would like to present on a topic, contact Jo. If you want to read, or talk about your own writing or publication, come prepared for a fifteen-minute slot. Text Jo at 636 667 4162, or email jo.a.schaper@gmail.com.

GEOLOGY AND GEOGRAPHY SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

AN EXPLORATORY CASE STUDY OF THE INTERNAL ATMOSPHERIC RESPONSE OF TUMBLING ROCK CAVE (JACKSON COUNTY, ALABAMA) TO SURFACE METEOROLOGICAL CONDITIONS

Max Appelbaum, max.appelbaum@uga.edu

It has been known to cavers for many years that “if it blows, it goes,” but to date there has been little widespread research into the mechanisms behind the “blow.” This study aims to take the first step towards classifying the atmospheric characteristics of Tumbling Rock Cave in Jackson County, Alabama. Tumbling Rock is a large, well-known karst system that is under the care of the Southeastern Cave Conservancy, Inc. (SCCI), with more than 6.5 miles of surveyed horizontal passage, and a newly surveyed vertical section which will be open for permit application soon. There is only one known entrance that is roughly 1 meter by 1.5 meters. Surface meteorological conditions data was collected with a standard professional-grade weather station located roughly 50 meters from the entrance. Cave temperature data was collected with HOBO pendant temperature loggers placed in discrete locations throughout nearly all of the accessible horizontal passages of the cave. Early results of this study through the winter of 2021-2022 show a pronounced temperature response to surface changes near the entrance, and a slow, but notable response further into the cave. Future studies aim to broaden the range of data collected within the cave to be better able to understand the mechanisms at play behind the airflow and temperature of Tumbling Rock Cave. It is hoped that this research can expand to cover more caves of various sizes to be able to have a broader understanding of the dynamic interactions of caves and the surface atmosphere.

HYDROGEOLOGY OF SILVERTIP MOUNTAIN, BOB MARSHALL WILDERNESS AREA, MONTANA

Sarah M Arpin, Alan E Fryar

Dept. of Earth and Environmental Sciences, University of Kentucky, Lexington, KY Corresponding sarah.arpin@uky.edu

Mountain hydrologic systems are the “water towers” of the world, supplying freshwater to downstream regions. The presence of karst aquifers in mountain hydrologic systems increases their complexity, but also their capacity to store water and sustain baseflow. The goal of this project is to understand the contributions of different water storage components to discharge of spring(s) in the understudied alpine karst aquifer of Silvertip Mountain, located in the Bob Marshall Wilderness Area of northwestern Montana. Alpine environments are particularly susceptible to the impacts of climate change. Water storage is vital to regional water availability, but year-round snowpack may disappear with a warming climate, reducing the contribution of recharge from that source. At more than 1.5 million acres, the Bob Marshall Wilderness is one of the largest wilderness areas in the USA outside of Alaska. As human activities continue to reduce pristine environments around the globe, areas not significantly impacted by these activities become more important to understand and protect. In examining the water storage dynamics of Silvertip Mountain, this project aims to answer two main questions: 1) where is water stored, and 2) over what time scales? Winter precipitation is stored as snowpack and recharges groundwater reservoirs on Silvertip Mountain. Seasonal changes shift water storage between frozen components (snowpack, permafrost, rock glaciers) and liquid components (talus, epikarst, karst aquifers). Spring meltwaters move surface snowpack through the various groundwater storage components, slowing discharge to sustain baseflow until precipitation increases again in winter. Hydrologic measurements, geochemical sampling, tracer tests, and continuous monitoring are being used to understand the Silvertip karst aquifer. Initial logging at the outlet spring suggests a diurnal temperature signal, which may be associated with meltwater pulses. Solute and C isotope analyses, together with solute speciation modeling, indicate that groundwater chemistry reflects meteoric recharge modified by carbonate weathering, as expected.

MELTING AWAY: ICE IN A HIGH ELEVATION NEVADA CAVE

Gretchen M. Baker, Great Basin National Park, Baker, NV, USA Gretchen_Baker@nps.gov

Nevada is the hottest and driest state in the United States, but due to its varied terrain contains several high elevation caves containing permanent ice. Long Cold Cave in eastern Nevada is the deepest known cave in Nevada, at 133 m (436 ft) deep and is located at an elevation of approximately 3000 m (9900 ft). The surface temperature at this elevation just outside the cave entrance averages 5.2° C, yet the cave contains perennial snow and ice, starting at about 35 m (120 ft) below the surface. Each time we visit the cave, the ice appears slightly different, but the 2021 trip showed large changes in the ice, especially at the bottom of the cave. Dataloggers recording hourly temperature show that the temperature in the cave decreases as distance from surface increases. The deepest area of the cave has an average temperature of 0.4°C, while the middle of the cave is about 0.0-0.1°C on average over two to four years of data collection. While small changes in temperature in caves usually do not have much effect, when those small changes occur near the freezing point, they can very much alter the cave. Although we are not likely to be able to do anything to change the ice melting, as the cave is located in a wild part of Great Basin National Park, we can study and record it as much as possible before it disappears.

EXOTHERMIC SPELEOGENESIS: MICROBES MAKING CAVES FROM THE OUTSIDE IN.

Presenter: Hazel A. Barton, bartonh@uakron.edu

Co-Presenters: Ceth W. Parker, John M. Senko, Augusto S. Auler, and Ira D. Sasowsky.

The tropical regions of Brazil, including Carajás, Iron Quadrangle (IQ), and Southern Espinhaço Range, contain some of the most extensive landscapes of Proterozoic banded-iron formation (BIF) deposits in the world and host the largest iron ores deposits in the world. These iron landscapes are covered in a ferruginous duricrust known as canga, which can range in thickness from a few centimeters to 30 m. The weathering-resistant nature of these landscapes suggests that karstification would be limited, but the contact between canga and the underlying BIF represent some of the most cave-rich areas of Brazil. We have been studying the processes that lead to the development of caves at this contact. Our data suggest that these iron formation caves (IFCs) are formed by iron-reducing microorganisms that reduce the iron-oxides to soluble Fe(II), increasing porosity and allowing the mass transport of Fe(II). This process occurs behind an iron-richcrust that forms on the walls, generating a paste-like material called sub muros. Over time, the accumulated sub muros destabilizes the crust-like walls of the cave, leading to an inward collapse and enlarges the cave passage. We call this novel mechanism of speleogenesis, where passage enlargement is caused by material collapsing from behind the walls into cave void, exothermic speleogenesis.

WHY LEBANON IS RICH IN CAVES

Issam Bou Jaoude

Cave and Karst Science Specialist

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With more than 700 documented caves and thousands of dolines, in an area of 10,425 km², Lebanon is considered a country rich in caves. Several factors have contributed to the development of this high density of caves, including lithology, structure, topography, history and depth of karstification, and precipitation. Limestone rocks are spread along an exposed stratigraphic column. Starting with the 1,500-m thick Jurassic limestone and dolomite, then the Cretaceous 900-m limestone and marl, passing the Eocene 600-m thick crystalline nummulitic limestone, followed by a 300-m thick sequence of Miocene limestone and carbonaceous conglomerates, finally ending with the variable thickness of Quaternary calcareous sands and calcareous glacial deposits. About 65% of the stratigraphic column is limestone and 65% of the surface area of the country is covered with karstic limestone. Structurally, Lebanon is located along a restraining bend in the central segment of the N-S trending Dead Sea Transform Fault. This created two mountain chains (maximum height 3018 m asl), a small coastal plain and an inland valley. The mountains capture humidity from the Mediterranean Sea resulting in an average precipitation of around 1,000 mm/year. It changes from rainfall along the coast to thick snow cover, as deep as 7 m in high mountainous areas. Major geological events, such as tectonism in the Jurassic, Cretaceous and more recent periods, associated volcanism and migration of oil from those units, accompanied by sea level fluctuations have generated favorable conditions for the development of karst to depths reaching the lower units of the Jurassic and as old as the Jurassic period. One of the major events that played an important role in the karstification of Lebanon is the Messinian Salinity Crisis, resulting in a deep sea level drop. These combined factors have created favorable conditions for the development of a country rich in caves.

THE BLACK HILLS KARST INVENTORY INITIATIVE

AN APPLICATION OF LiDAR DATA ANALYSIS TO IDENTIFY AND INVENTORY SURFICIAL KARST FEATURES WITHIN THE BLACK HILLS AND SURROUNDING REGION.

K. M. Emanuel. lpgandmc@gmail.com

Karst and Geo-Hazards Specialist: USFS

A systematic Inventory of karst and cave related features for the Black Hills region was initiated approximately 4 years ago using a combination of high resolution aerial photography and the then newly available LiDAR coverage which was released for the northern part of the uplift during late 2018. Since that time, well over 20,000 surface karst features have been identified, catalogued and prioritized for Initial field verification. The methodology employed until quite recently has concentrated on manual canvassing of hillshade, slope and hydrologic fill models at scales of 1:1,500 or less and assigning points in 3D space associated with each. The results of ground truthing efforts for key test areas have been highly encouraging, and have resulted in the identifications of a number of significant subsurface systems. To date, only a small fraction of the predicted features have been possible to visit but the number of cave verifications to date indicates that this endeavor has been well worth the effort. In the last few months, Lidar coverage has become available for the remaining portion of the Black Hills and for parts of the Bighorn uplift, as well. An updated and improved methodology relying on the same base-models is now being employed to expand the inventory. A semi-automated predictive methodology is now being used to identify closed sinks as 3D polygons using 1m resolution 3DEP LiDAR data along with the Priority Flood Algorithm (Hydrologic Fill), Minimum Bounding Geometry and Zonal Statistics tools in ArcGIS Desktop and ArcGIS Pro. This process has proved to be an even more effective tool set for identifying sinkholes and collapse entrances to endokarstic features (i.e. caves). It is particularly helpful for locating these highly important karst features in areas with dense forest and brush coverage. Preliminary estimates for the total number of features present in the uplift now appears that it will be well in excess of 30,000.

ABSTRACTS

ABSTRACTS

MONDAY
JUNE 13, 2022

CAVES AS POLYGENETIC FEATURES

Lee J. Florea & Sarah Asha Burgess

mr_chaos@hotmail.com

Multigenerational cave development is a common thread that connects hydro-geochemical processes across the history of the host rock. These processes leave stratigraphic, morphologic, and chemical fingerprints in varying degrees of visibility and discoverability. The title of this talk conveys a large scope; however, the content is selective of personal examples by the authors. We are aware of many others. In south Florida, overprinting generations of syngenetic cave development are clearly evident in rocks less than 125,000 years old. The first generation dates to the last glaciation and sea-level low-stand and the second generation formed entirely in the past 6,000 years. Broadly available evidence outlines repeated generations of syngenetic cave development in south Florida and elsewhere during the cyclic sea-levels and carbonate sedimentation of the Quaternary. In west-central Florida, Tertiary carbonates were repeatedly exposed to meteoric groundwater circulation, leaving paleokarst between depositional cycles. This is most prominently displayed where Miocene-age siliciclastics infiltrated caves of Eocene and Oligocene age and cemented. Since the Pliocene, sea-level fluctuations have resulted in multigenerational eogenetic caves both guiding and being guided by aggressive geochemistry along the potentiometric surface. These 'modern' caves exhume earlier paleokarst generations. In the Mitchell Plateau of Indiana, sulfur in groundwater has played a significant role in the evolution of telogenetic caves in Mississippian-age carbonates. Where hydrocarbon-sourced sulfides rise as hypogenic fluids through fractures, sulfuric acid enhances cave development, especially during early fracture enlargement. Later meteoric flushing likely overprints this early hypogenic generation with epigenetic features. Finally, the Cumberland Plateau of Kentucky combines aspects of the other examples in this presentation. Hypogenic fluids, rich in sulfur, have influenced epigenetic cave development since the late Miocene. These observable telogenetic caves have exhumed paleokarst composed of eogenetic caves from early in the rock history later filled with sediment, tectonized by distal orogens, and mineralized by hypogenic fluids.

THE ORIGIN AND MORPHOLOGY OF GLACIOVOLCANIC CAVES

Lee Florea, Christian Stenner, Sarah Burgess, Linda Sobolewski, Artur Ionescu, Andreas Pfletsch, Eduardo Cartaya

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Glaciovolcanic caves are exceptionally dynamic; they originate from the transfer of heat between superimposed media. Contrasting with caves embedded in extrusive igneous rocks and sedimentary carbonates; they evolve and decay in conjunction with variations in climate, weather, and volcanic heat. In short, glaciovolcanic caves, even those which have endured for decades, are ephemeral landforms. As a corollary to the thermal gradients of glaciovolcanic caves, limestone caves form from dissolution along chemical gradients. Drawing upon the language from studies of limestone caves, but substituting thermal gradients for chemical gradients, glaciovolcanic caves are hypogenic features where the kinetics that drive their formation are from below. Completing the analogy, moulin and subglacial conduits are epigenetic features where the kinetics originate from the surface. The significance of this statement arises from the implied connection to the surface; glaciovolcanic caves can form independent of surface processes - entrances are not obligatory. Yet, like their bedrock counterparts, cave size is limited by the magnitude of the driving kinetics and the rate at which the byproducts of speleogenesis are removed. Aside from these generalizations, studies of the characteristics of glaciovolcanic caves are rare, perhaps in part due to challenges getting to the sites by crossing icefields or climbing mountains, all in remote locations. Both the challenge of access and difficulty of exploration limit the size of expeditions, the transport of research equipment, the lifespan of monitoring equipment, and the scope of samples. Yet these collective factors make glaciovolcanic caves excellent analogues for the planning and application for missions to other worlds, including the design of the sensor, survey, sampling, analysis packages for planetary missions, and the robotic mobility systems for landers.

SOURCE WATER INVESTIGATION OF THE SNOWY RIVER DEPOSIT WITHIN THE FORT STANTON-SNOWY RIVER CAVE SYSTEM, LINCOLN COUNTY, NM

By Christina L. Ferguson, Johanna M. Blake, and Keely E. Miltenberger

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The Fort Stanton-Snowy River Cave, located in the eastern foothills of the Sierra Blanca Mountains in south central New Mexico, is entirely developed within the Permian San Andres Formation. This formation consists of limestone with minor gypsum beds. The Snowy River deposit is a unique calcite deposit that resembles a white riverbed within the cave. The calcite deposit has been mapped to over 11 cave miles in length, making it one of the longest speleothems in the world. Because of its unique and delicate nature, its preservation is of great importance to cave and natural resource managers. However, the source of the super-saturated water that deposits the calcite is unknown. Flooding of the Snowy River portion of the cave has been roughly correlated to large precipitation and run-off events within the local watershed area. Three small creeks in the area, Rio Bonito, Little Creek, and Eagle Creek, have been hypothesized as possible sources of water to the cave. To understand if these creeks contribute to subsurface water, major and trace elements and isotopes of water and strontium were analyzed in both surface waters and groundwater. To compare with the water samples, the same constituents were also analyzed from local rock samples and cores from the Snow River calcite deposit.

Geochemical analyses of the waters show that cave waters are similar in composition to Rio Bonito and Eagle Creek water and nearby groundwater, and dissimilar to Little Creek water. Analyses of the rock samples and cores show similarities between the calcite core samples and the limestone collected from the lowest member of the San Andres Formation. These results indicate that the groundwater is mixing with the surface water as it enters the subsurface, likely within the lowest member of the San Andres Formation, before it enters the cave and deposits the Snowy River calcite.

PROPOSED SPELEOGENESIS OF LEHMAN CAVES, GREAT BASIN, NATIONAL PARK, NEVADA

Louise D. Hose, University of Nevada – Reno, hose@drkarst.net

Harvey DuChene, Karst Waters Institute

Daniel S. Jones, New Mexico Institute of Technology and National Cave and Karst Research Institute

Zoe Havlena, New Mexico Institute of Technology

Gretchen M. Baker, Great Basin National Park, National Park Service

Recent investigations within Lehman Caves, Great Basin National Park, have documented extensive and compelling evidence of its hypogenic origin, probably between 10-8 Ma. Bubble trails, ceiling channels, cupolas, boneyards speleogens, and pseudoscallops, all relics of hypogenic processes, abound throughout the cave. Furthermore, gypsum crusts, hollow coraloidal stalagmites, probable metatyuyamunite ($\text{Ca}(\text{UO}_2)2\text{V}_2\text{O}_8 \cdot (5-8)\text{H}_2\text{O}$) – a mineral associated with several sulfuric acid speleogenesis—SAS–caves), and, most compelling, an ancient acid pool support the likelihood that this cave formed from sulfide-rich, rising waters. Studying the original speleogenesis of the cave is, however, challenged by the extensive overprint of Pliocene through modern calcite speleothems. Fortunately, a mostly impermeable cover of meta-quartzite helped protect the Gypsum Annex passage, which reveals the strongest evidence of hypogenic-SAS origins. Lehman Caves is in the Middle Cambrian (~520 Ma) Pole Canyon Limestone, which was buried thousands of feet by subsequent deposition through the Pennsylvanian and experienced low-grade, burial metamorphism. About 28.5 Ma, the youngest of the region's granitic intrusions cooled and is now just a few hundred meters west of the cave. Some thermal metamorphism is reported in the cave bedrock. The major geologic event in the area was the (~17.5 Ma) Snake Range Décollement, which locally metamorphosed the Pole Canyon into a mylonite and obliterated all earlier features. Basin and range uplift and extensional faulting fractured and uplifted the Southern Snake Range between 17-8 Ma and was most active in this area between 10-8 Ma, forcing the water table to drop prompting active speleogenesis.

Integrating Black Hills caves into undergraduate geology research at South Dakota School of Mines and Technology

Sarah W. Keenan, Michael Cyrier, Sawyer Hagen, and Aynsley Melancon*

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Research experiences for undergraduate geology students can provide an important and transformative educational opportunity. One factor that motivates students to enroll in a geology-based degree is the ability to explore and study in the field. At South Dakota School of Mines and Technology our proximity to the Black Hills, including world-renowned karst areas, presents us with the opportunity to integrate field-based research into the undergraduate curriculum through capstone research projects. For the last 3 years, students have studied various aspects related to mineralogy, geochemistry, and microenvironments in several caves, including Rushmore Cave, Keystone, SD, a regional tourist cave. These efforts have provided new insights into CO₂ ventilation, speleothem (and drip water) geochemistry, and speleothem growth fabrics in an understudied karst region. From 2019 to 2022, CO₂ within Rushmore Cave exhibited typical trends expected, with seasonal ventilation in the winter/early spring, and closed system behavior in the summer. Sampling during summer 2020 when tourism halted due to COVID-19, followed by the return of tourists in 2021 and 2022 indicate that in Rushmore Cave, tourism results in a 66% increase in CO₂ concentrations, reaching a maximum of ~12,500 ppm. In terms of speleothem geochemistry, individual layers within six speleothems varied significantly, particularly with respect to strontium concentrations, and were enriched compared to host rock composition. Growth fabrics of speleothems indicate periods of interrupted growth at the microscale, evident by accumulations of siliciclastics, as well as periods of dissolution at the individual crystal and laminae scale. This presentation will provide an overview of the past and current research projects by South Dakota Mines geology students currently taking place in Black Hills caves.

CAVE DEVELOPMENT IN THE MANCOS SHALE, COLORADO: PROCESSES AND MINERALOGY

Douglas Medville

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A pseudokarst on the Cretaceous Mancos Shale in western Colorado contains a 300m long vadose cave, entirely within the shale. Swelling soils allow meteoric water to reach the shale beneath the regolith and oxidize pyrite in the shale, producing sulfuric acid which in turn, reacts with calcite in the shale to produce gypsum. The gypsum wedges apart the shale beds and allows surface water to flow through openings in the shale, removing it via corrosion and ultimately resulting in enterable voids. A seasonal stream enters the cave at the distal end of a blind gully. Based on local incision rates of about 0.5 mm/year, ceiling heights, and the age of Pleistocene terrace gravels, the cave age is probably on the order of 6-12 ka. The cave contains extensive sulfate mineralization including 2-4 cm dia. globular deposits at water level, crusts on passage walls at the high water mark, subaqueous white deposits, dry crusts on passage floors, and needle-like extrusions on passage walls. The sulfates are a mixture of thenardite and blodite with lesser amounts of gypsum,

hexahydrite, and possibly konyaite, as per powder XRD. Na⁺, Mg²⁺, and SO₄²⁻ ions in the cave stream are derived from soluble salts in Mancos soils with measured concentrations of up to 7000 mg/L. As cave pools evaporate, concentrations of these ions increase until saturation is reached and the sulfate minerals observed at water level are deposited as crusts, coatings, and accretions.

ELEMENTAL SIGNATURES OF THE LAST MILLENNIUM IN A STALAGMITE FROM CARLSBAD CAVERN

Victor J. Polyak¹, Yemane Asmerom¹, Zhongxing Chen², and Charles Langmuir²

¹Radiogenic Isotope Laboratory, Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131; polyak@unm.edu

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Elemental analyses in speleothems are routinely studied, and their significance can be complicated. Important elements are Mg, Sr, and Ba due to their abundance, but advances in mass spectrometry allow for a large list of elements that can be measured precisely and accurately. Application of elemental analyses towards short-lived events, exemplar to volcanic eruptions seen as sulfur peaks in ice cores, can particularly be of value in speleothems. This is especially the case for laser ablation ICP-MS elemental studies that can produce higher resolution time-series. Here we show elemental time-series results for stalagmites from the Guadalupe Mountains in the southwestern United States that (1) mimic some stable isotope time-series, (2) show historic events related to Carlsbad Cavern, and (3) reveal short-lived events from volcanic eruptions. Of particular importance are a prominent peak of multiple elements coincident with the Tambora eruption, the atmospheric Pb peak, and variations of elemental changes accruing at the initiation of mining and commercialization of Carlsbad Cavern. Identifying short-lived events such as volcanic eruptions would help place speleothem chronologies that are further back in time to within a few years.

EMPIRICAL DETERMINATION OF MANNING ROUGHNESS COEFFICIENTS FOR A CAVE FLOOD: FULLER'S STREAM

CANYON, CULVERSON CREEK CAVE SYSTEM, WEST VIRGINIA

Gregory S. Springer, Department of Geological Sciences, Ohio University, Athens, USA, springeg@ohio.edu, presenter

Lydia T. Albright, Department of Geological Sciences, Ohio University, Athens, USA, lydiatalbright@gmail.com

Open conduit modeling of cave stream floods can yield useful information about water velocities and shear stresses, which can in turn be used to estimate sediment transport capabilities. All such calculations require roughness coefficients for estimating energy losses and a priori knowledge of either discharge or flow depths to set model boundary conditions. However, the difficulties associated with observing in-cave floods generally preclude measuring discharge and roughness coefficients must be assumed based on channel properties. To overcome these challenges, we monitored stream flow depths in Fuller's Cave, Greenbrier County, West Virginia using pressure transducers, and simultaneously measured stage and discharge in a karst window immediately upstream of the cave. The five pressure transducers were deployed opportunistically along a 93-meter-long reach in a 10+ meter high canyon averaging 1.5 to 3 meters wide. Stage-discharge relationships were determined with an electromagnetic flow meter. The observational data was used to obtain the empirical Manning's roughness values (*n*), head losses, and energy gradients for a flood with peak discharge of 1.66 m³ s⁻¹. Calculated floodwater velocities are comparable to values obtained from scallops on passage walls. Major energy losses were observed where breakdown partially occludes the passage (*n* ≥ 0.069) and cobble-floored canyons had *n* values of ~0.055 at peak discharge. As expected, roughness declined exponentially with increasing discharge in all reaches with *n* generally >0.1 for discharges of ~0.5 m³ s⁻¹. Our empirical roughness coefficients can be applied to similar cave passages and future work will allow us to tie flood hydraulics to sediment transport regimes in the cave.

AN UPDATE OF SURFACE AND SUBSURFACE GEOLOGICAL MAPPING AT JEWEL CAVE NATIONAL MONUMENT

Wiles, Michael E.

Jewel Cave National Monument

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Jewel Cave has over 210 miles (340 km) of mapped passages, representing three percent of the entire cave system.

This project seeks to establish clear relationships between surface and subsurface geological features, to eventually help predict the location of unknown cave passages based on the surface geology. The Jewel Cave fault zone consists of linear features, beginning with a few high displacement faults at its east end. To the west, it progressively splinters into subordinate faults that cross Hell Canyon before disappearing on the west side. Passages in the Main Cave section are within a downthrown block that shows only minor internal structural deformation. Surprisingly, even the straightest passages don't consistently align with a single joint, but run diagonally to it – until the joint ends and the passage jumps to the beginning of a nearby, sub-parallel joint. Many of joints are actually low-displacement faults. The walls on the

upthrown side are more intensely fractured, producing a distinctive spalling effect – while the downthrown side is more intact. The park has created a spreadsheet to calculate the strike and dip of unreachable planar surfaces by using three shots from a DistoX at a common reference point, allowing extensive strike and dip measurements. The bedrock typically dips 8 to 10 degrees across the passage, toward the south. The overall impression is that the cave formed along the faulted dip-slope of the southern limb of an east-west anticline. These observations provide new tools for understanding the origin and extent of Jewel Cave

TAKING A CRACK AT IT: MONITORING AND QUANTIFYING FRACTURE DYNAMICS WITHIN THE WALLS OF A LAVA TUBE, PROXIMAL TO AN ACTIVE VOLCANO

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The U.S. National Park Service (NPS) has several 1000s of documented caves within 99 of the 423 management areas. There are 17 NPS units known for lava tubes, including Hawai'i Volcanoes National Park. Nāhuku (Thurston Lava Tube) is a basaltic tube within the park and is ~5 km from Hale Ma'uma'u Volcano Crater, the active center of Kilauea. Nāhuku was likely formed during a shield-building event approximately 500 years ago. It is now publicly accessible via a paved trail into and between two collapse features. The large 2018 eruption of Kilauea generated over 60,000 shallow earthquakes, causing a partial but dramatic collapse of the crater, and minor but appreciable rockfall within Nāhuku. Lidar scans conducted in 2019 detail passage geometry and allow for the estimation of ceiling thickness, with some sections measuring ~1m between ground surface and the passage. In 2020, digital vibrating wire extensometers were installed, spanning two different through-going fractures on the cave ceiling. These devices sense both fracture width variation and expansion velocity, properties which could portend failure. Nearly two years of data show fractures have brittle and elastic behavior, and that alterations in fracture geometry are not fully correlated with earthquake occurrence. This suggests that thermal processes are potentially underestimated and wedging through mineral or particulate intrusion may have an underappreciated role in fracture propagation. The permanent deformation recorded by the crackmeters may result when enough rock bridges between micro-fractures break, the accumulations of a hundredths of a mm deformation, through episodic stressors such as earthquakes and propagated over time by gravitational tension. Understanding the dynamics of fractures within lava tubes can better inform safety and management decisions within the NPS while possibly gaining new insights for the processes in basalt caves preceding roof collapse.

ABSTRACTS

COMMUNICATIONS AND ELECTRONICS ABSTRACTS

(listed in alphabetical order by presenting author)

A MINIATURIZED RADIOLOCATION BEACON WITH A FERRITE CORE ANTENNA FOR EASIER DEPLOYMENT IN CAVES

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Traditional underground radiolocation beacons use rigid wirewound loop antennas with a typical diameter of 1 -3 feet (1/3 - 1 meter) that must be carried through the cave by hand to the location point. Alternatively, a folding wire loop with a folding frame can be carried in a cave pack, but must be assembled before use. In either case, a separate box holds the electronics and a separate battery (typically 12 Volt lead acid) must be connected to it.

This small 3496Hz beacon has both the loop antenna and the electronics contained in a waterproof PVC housing 12" long (30 cm) and 2" (5 cm) diameter that easily fits in a cave pack. It weighs a bit over 3lbs (1.4 kg). It is powered by a little 2-cell 18650 rechargeable lithium pack designed for Sten helmet lights that should run it for about 5 hours. It automatically stops running before the voltage becomes low enough to damage the battery. The magnetic Moment is ~5.3 A-T-m². It is designed to work with my "DQ" receiver. and should easily penetrate 250 ft (76m) of rock.

US EXPLORATION ABSTRACTS

(listed in alphabetical order by presenting author)

CONTINUING EXPLORATION IN JEWEL CAVE, SOUTH DAKOTA

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Exploration has continued at a steady pace beyond the Southwest Splinter in Jewel Cave. Since July of 2018, volunteer cavers have added several more miles to the Splinter section and have made major new discoveries. Several new lakes have been found, including one over 50 feet deep called Lake Inferior. While the cave dips below the water table in this location, the vertical extent of the passages and signs of airflow indicate that the air-filled portion of the cave extends far beyond the known lakes. In fact, cavers are routinely traveling more than an hour from the lakes to arrive in the further reaches of the cave, with no sign of an end. Further discoveries in the western branch of the cave have yielded promising leads beyond the Brr Hole on the western edge of the cave. Strong air and continuing passages suggest either a connection to the south in the Splinter Section or virgin cave further west. Additionally, a major discovery was made in the southeast branch of the cave, near the end of the Mind Blower where 80-foot tall passages continue off the edge of the map. As of July 2018, more than 30 miles of passages have been discovered in the Splinter Section, and over 15 miles have been added to the total length of the cave. Jewel Cave is now 210.8 miles in length, and each successive exploration trip adds more questions to be answered on future trips.

REVENGE FANTASY: EXTENSIONS OFF THE WEST EDGE OF WIND CAVE, WIND CAVE NATIONAL PARK, SOUTH DAKOTA

Hazel A. Barton, Nick Anderson, Derek Bristol and Adam Weaver

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In 1993, a small breakthrough was made via a 60 foot pit off of the western edge of Wind Cave that appeared to push past a fault that had prevented westward progress. The area was called the Lunatic Fringe and over a mile of cave was discovered, characterized by a profusion of spectacular aragonite. Given the delicate nature of the area and need to carry vertical gear, interest in the area had waned by 1995. In 2019, a team returned to push a remaining lead with strong air, that disappointingly tied back into known cave, although it did negate the need for vertical gear. A small, aragonite-lined lead was also found that opened into a passage heading northwest, off the edge of the known cave. The COVID pandemic stopped exploration in March 2020 after 1.5 miles of cave had been discovered and resumed in August 2021, when another mile of cave was found. By December, day trips were becoming quite demanding, with five hours of travel time to reach the leads. With NSS and private sponsorship, the team bought the equipment needed to establish a new, permanent camp in Revenge Fantasy. Subsequent trips carried out the camping gear and built a drip-collector for drinking water, and the first camp trip took place in February 2022. This camp allowed the team to be more rested for pushing the small and miserable leads that characterize Wind Cave, allowing almost half-a-mile of new cave to be added in three days. The Revenge Fantasy extension continues to make the first significant changes to the shape of Wind Cave in over 30 years, and given the strong airflow, perfusion of animal skeletons, and general trend towards Persistence Cave, it is hoped that this area may add another entrance to the world's seventh longest cave.

THE DELISSEA SYSTEM IN HAWAII

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We have continued to explore, map, and photograph the volcanic caves on the north slope of Hualalai Volcano, on the Big Island of Hawaii. The most interesting find in recent years is an up-slope continuation of Shangri-la cave. Due to the unusually steep terrain, splattering lava has created many speleothems, including stalactites, helictites, fine hairs, and multi-colored flowstone-like features. We have continued to find bones of now-extinct flightless birds. The total length of the system is now over 74 miles, with the longest contiguous segment about 30 miles long, with several long segments very close to connecting in. The vertical extent of the system is about 1500 m for the full system and 1100 m for the contiguous section. Hundreds of leads remain to be checked.

THE RESURVEY AND CONTINUED EXPLORATION OF GREAT EXPECTATIONS CAVE IN WYOMING

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Great Expectations Cave (Great-X) is one of the longest and deepest caves in Wyoming and one of the few western NSS Cave Preserves. It was originally discovered by cavers in the 1970's and survey work ended in the mid-1980's. The Great Entrance was acquired by the NSS in 2003 to protect both the cave and access for cavers. Since that time recreational trips happen just a few times a year, and infrequently (about once every five years) a through-trip is conducted that is widely considered one of the most difficult and dangerous cave trips in the US. This through-trip involves a more than 1400-foot elevation loss, traversing roughly five miles of cave passages, many vertical rope pitches, negotiating miles of waterfalls and plunge pools in 38-degree water, and a 1000-foot long belly crawl in arctic water to survive the "Grim Crawl of Death". It is a serious trip that requires fitness, very specific gear, knowledge of the logistics required, and familiarity with the route. In 2018 an effort to resurvey the cave was undertaken by western cavers with the goals

of generating a more detailed map with a profile view, and to restore tie-in stations that would be the foundation for additional exploration. This talk will discuss the scope of the project, give a status on recent trips and expeditions, review the strategies being employed to explore such a wet and cold cave, and layout plans for future trips.

CAVES OF THE TSALA APOPKA, FLORIDA

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The Withlacoochee River Lowlands of Citrus County, Florida are composed of a chain of open lakes, cypress swamps and grass marshes that average 11 m above mean sea level (amsl) interspersed with islands and ridges of hardwood hammock and live oak scrub that reach 25 m amsl. Called the Tsala Apopka, "bass eating place", by the Seminole, these expansive wetlands spread over 250 km², are rich in wildlife, and host important archaeology and paleontology. Interactions between the nutrient-rich surface waters and the Upper Floridan aquifer are punctuated by estuaries, alternating seasonally between groundwater springs during the dry season and sinking streams when water levels are high. More numerous are extensive caves developed in the Eocene-age Ocala Limestone, which is exposed in the low ridges and islands of this region. In this presentation, detailed surveys of four of the larger known caves in this region are shown, comprising 750 m of surveyed passage. Collectively, the maps, scientific study, and resource documentation have revealed important details on their origin and development: To summarize, these caves 1) have a position and scale facilitated by the lateral penetration of organic-rich surface waters and respiration of those organics at the water table; 2) have a morphology that alternates between tabular and enlarged fractures; 3) are biogeochemically active and host rich macro- and micro-biologic communities; 4) are multigenerational features with enlargement during multiple phases of the Pleistocene; and 5) host sites for important paleontological reserves aggregated during their development. Access for the exploration, study, and conservation of these caves is tenuous, with most on private land and the remainder requiring specific permits.

WEST VIRGINIA MAKES HISTORY WITH TWO 50-MILE CAVES!

Nikki Fox

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Two groups of cavers, which are members of the West Virginia Association for Cave Studies, made history in extending two known classic Greenbrier County, West Virginia, caves past the 50-mile mark. Technically, the cavers involved in this friendly, and undeterred playful rivalry, crusade were not entirely separate groups as several people have contributed years to brutal trips into the depths of each cave system. What are these caves? I'd thought you'd never ask. They are the Friars Hole Cave System and the Great Savannah Cave System (GSCS). Friars boasts 11 entrances, about half of which are not usable for various reasons, spans two counties, contains one of the largest rooms in West Virginia, and the caves resurges are in the Spring Creek basin, which drains 59 square miles, of Greenbrier County. The GSCS has three entrances that are separated by a sump between Historic Maxwelton and Historic McClung caves that was dove in September 2019 to create the system, boasts a staggering number of 13 known sumps, and resurges 12 miles away at Davis Spring, which is West Virginia's largest spring. The two caves very vastly in the basic features and development, such as in hydrology, structure, and stratigraphy. Both systems share a rich history in the local lore and among cavers who became obsessed with each cave's unknown and exploration.

CONTINUING EXPLORATION IN CARROLL CAVE, MISSOURI

By Dan Lamping

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Carroll Cave is a nearly 21 mile long cave system developed in Ordovician dolomite near south central Missouri. Carroll Cave is the 3rd longest cave in the state and the longest known cave in the cave dense Salem Plateau. The cave is rich in biodiversity. The history of Carroll Cave is intertwined with the history of organized caving in Missouri as the initial efforts to map the cave began with the first meeting of the Missouri Speleological Survey in 1956. In 1998 the Carroll Cave Conservancy (CCC) was established to regain access to the cave via an artificial entrance after multiple decades of cave closure. In 2002 the Backdoor Entrance was created via a 120 ft shaft, with a resurvey project that followed. This talk will review the resurvey project over the past 20 years and will highlight recent explorations and discoveries.

ABSTRACTS

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**TUESDAY
JUNE 14, 2022**

CAVING IN THE MCLOUD LIMESTONE, SHASTA COUNTY, CALIFORNIA 2019-2022

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In the last three years, renewed efforts at ridgewalking and cave surveying have paid off in the McCloud Limestone of Shasta County, California. On the eastern edge of the Klamath Mountains, this early Permian and fossil rich limestone is found between McCloud and Redding California. It is well known for forming large gray cliffs above the McCloud Arm of Shasta Reservoir, home to the show cave, Lake Shasta Caverns. The region has seen extensive use of caves by Native Americans and some ridgewalking by cavers, so in many cases we are not discovering caves, just merely re-finding them. To date, we have re-found about 25 undocumented caves and have a half dozen blowing digs. Accomplishments include the survey and mapping of Tardis, Lost Pot, Maiden Hair Fern, Kings, Dawson, February Pit and other smaller caves. Most of these maps have been drafted. Other finds include Pipevine Cave, which contains a pit 144 feet deep. Rileys Cave was extended to more than a thousand feet in length due to digs and climbs. The biggest find so far, however, is the very scenic October Caves, a multi level canyon complex with very nice speleothems and outrageous popcorn. Some of this work will be included in the CRF Klamath Mountains Project Report due out this summer.

FORT STANTON CAVE IN 2020-22

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Fort Stanton Cave in Lincoln County is the second longest cave in New Mexico. Over the past decade, 26.7 additional miles have been discovered and mapped. New discoveries slowed as wetter years brought flooding along the miles-long calcite-floored Snowy River borehole. In recent years, lengthy paleo passages have been discovered with climbs above Snowy River, closer to the entrance to avoid the flooded southern half. In 2018 Bliss Borehole was 2.84 miles long with going passage remaining. The upper Capitan Caverns complex had added 6.36 miles by 2019. Flooding resumed for months but cavers finally returned to survey in September, 2020. 5121 feet was added to Bliss, ending in a rappel back down to a flooded Snowy River near Rough Country. Bliss created the longest loop in the cave, with 3.81 miles of upper trunk. A bypass route was discovered off Snowy River in a lead that had been walked by for 17 years. This 0.6 mile route gets around the dreaded Mud Lizard crawl that sumps when the cave floods. Black Rock Bypass has reduced the risk of entrapment camping in the two southern camps. In October of 2020 mop up added 0.51 miles in Rough Country and The Letdown. Mop up in 2021 added a modest 726 feet in Capitan Caverns. In the historic portion of the cave, a small discovery was mapped during restoration, and resurvey was accomplished. A short passage was mapped near Black Rock Bypass in May, before flooding returned. The cave length is 42.3 miles. The winter of 2021 is drier than recent years and has us incentive to return to the leads at the south end. A radiolocation is planned for May, at the MJ camp, which hasn't been seen in eight years. Expeditions are planned to return to walking leads.

CAVES OF THE BIG LAVA BED, WASHINGTON

Garry Petrie

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The Big Lava Bed in Washington is the, "most primitive, untracked, least explored and least known areas remaining in the South Cascades," Marge and Ted Mueller, Guide to Washington's South Cascade Volcanic Landscapes. The Big Lava Bed is about 20 square miles of broken lava from an eruption about 8000 years ago. It is a smaller part of the Indian Heaven volcanic field that produced the large caves around Trout Lake, WA. The consensus was the Big Lava Bed could not support lava tubes. People were warned compasses were offset by localized magnetic fields and risked getting lost venturing on to the field. The enigma remained, with only two caves, Downdraft and the Dog Caves, found in the past fifty years, until technology enabled another approach. In 2018 the State of Washington published the lidar data for the Big Lava Bed. The images revealed a complex landscape of boulder fields, deep fissures and acre sized lava rafts. Even without any trails, it became possible to walk the field and return safely. In addition, individual cave entrances as small as a meter could be identified. The advent of paperless cave survey, exemplified by Topodroid, enhanced productivity. During the next three years, members of the Oregon Grotto walked over fifty cross country treks, totaling over 200 miles and found over 220 caves with 4.5 miles of passages. Caves worthy of mention include, Big Huckleberry, Westside, Eastside, Pans Labyrinth, Big Lava Bed, Level Up, Rainy Day, Chamber Maid and Wits End.

EXPLORING LIMESTONE CAVES IN HAWAII

Jason and Christina Richards

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The volcanic origin of the Hawaiian Islands leads to the belief that the only caving in Hawaii consists of miles and miles of lava tubing. Though there are definitely amazing and beautiful lava tubes on most of the Hawaiian Islands, there are also limestone caves. We spent three years in Hawaii mapping, photographing, and exploring the limestone caves of Oahu, Kauai'i, Maui, and lava tubes on the big island of Hawai'i. The unique development of limestone in Hawaii produced cumulative miles of limestone caving along the shores of the islands, mostly underwater. Though many of these caves are known locally as "swim throughs" by local divers, they frequently have extensions too small for divers in normal gear to enter that led to extensive cave systems. Some of the caves serve as grim reminders of how dangerous caves in ocean surf can be.

DISCOVERY AND EXPLORATION OF THE 6TH DEEPEST CAVE IN AMERICA (2 PARTS)

Philip Schuchardt, Pete Johnson, and/or Robin Thomas

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This talk will cover five years of work by the Bridger Teton Caving Project in Western Wyoming, including the discovery and exploration of Loaded Dice, the 6th deepest cave in the United States, as well as Jackpot Drop, a 547' pit within Loaded Dice. Over the last 50 years, the Teton area has attracted many cavers searching for one thing: finding the next big deep alpine cave. They went there with good reason. With over a hundred miles of karst terrain, the Bridger Teton National Forest has significant cave potential. But limitations in technology, the remote nature of the area, and the sheer size of the potential karst presented significant obstacles to realizing that potential. In 2017 the USFS and the Northern Rocky Mountain Grotto partnered to form the Bridger-Teton Caving Project. By combining a new approach to ridge-walking, modern technology, and the public-private partnership, the BTCP was able to inventory 61 caves. In addition to Loaded Dice, this talk will also discuss significant and still going alpine caves in Tosi Basin, a 10km², karst plateau at 10,000ft of elevation. Both of these highly vertical caves, known as Solo Glory and Don Quixote Gros Ventre, have over 2200 feet of depth potential. Topics to be covered include history of the area, geology, data-centric ridge-walking, rigging in wilderness, and of course the future potential of both pushing known caves but finding new ones as well.

McCLUNG CAVE, WV – 20 MILES IN 3 YEARS

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In February of 2019 we knew the connection between Maxwelton Sink Cave and McClung Cave in Greenbrier County, WV was imminent via a sump dive (The combination of the two caves is called the Great Savannah Cave System). It was decided that to have an accurate and up to date length for McClung Cave a resurvey was necessary. This was important because the combination of the two caves could very well result in the longest cave in West Virginia. So, in February of 2019, the resurvey of McClung Cave was started. Fast forward to April 2022, only 3+ years later – the resurvey is now at 20 miles and the known length of McClung is 23.34 miles.

This program will highlight some of the best photos from recent survey trips, document some of the new passage that's been found, and show some of the very nice borehole passage of McClungs. The cave is not really known for nice formations, but plenty of pretties have been found during the resurvey. Some comparisons between the old map and new map will be shown plus statistics on trips, surveys, and participants will be presented, giving some idea on how to survey a large multi mile system in just 3 to 4 years.

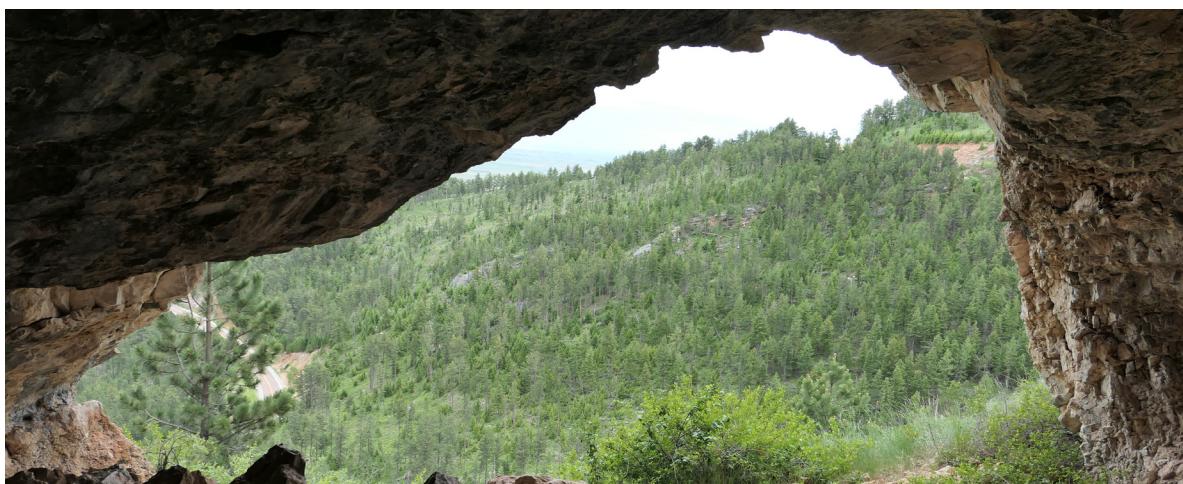
THE 18TH MILE OF WINDY MOUTH – A SURVEY MILESTONE AND UPDATE

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Scene - It's a cool morning and the fog is rolling off the upper valley plateau of Southern Greenbrier County down into the Greenbrier River. A pleasant hike downstream starting at the mouth of Second Creek brings you to a dipping red shale that dives into the river as a large limestone head-wall rises above. Nestled halfway up this head-wall is the entrance to Windy Mouth Cave, the 9th longest cave in West Virginia and a treasure to all cavers. The original survey took place from the early 1950's until the late 1980's, with a few additional "push" trips to find a connection to Scott Hollow Cave in the 1990's. With missing data, lost notes, low detailed sketches, and exceptional optimism Windy Mouth was estimated to be 18 miles in length. Unfortunately, final map was never produced. On April 11th, 2015 prompted by rising interest, the resurvey of Windy Mouth began.

Well known for its famous "900 Foot Entrance Crawl", Windy Mouth offers not only more crawling, but also large trunk borehole, sporting vadose canyons, and amazing formations shaped by the wind in the cave. Over the past 7 years, 100 survey trips have been completed with many hours and miles spent crawling to bring the actual length of Windy Mouth over 18 miles. With the resurvey complete, there are still over 100 leads left with hopefully more crawling passages to be discovered. So come crawl with us, and see some of the recent survey highlights of Windy Mouth Cave.



ABSTRACTS

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**TUESDAY
JUNE 14, 2022**

DRY CAVE, WEST VIRGINIA: ANYTHING BUT DRY AND CRAWLING TOWARD 10 MILES LONG

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Ohio University, Department of Geological Sciences, West Virginia Association for Cave Studies

Greenbrier County, WV is home to many long caves, but Dry Cave is by any measure unique with spectacular formations, unusual geology, and strike-oriented stream passages extending over 2.5 miles from the entrance. Two generations of cavers led by Phil Lucas surveyed a combined 3 miles of mostly stream passages from the 1960s to 1980s in the steeply-dipping and otherwise cave-poor Tonoloway Limestone, but Greg Springer and the West Virginia Association for Cave Studies took renewed interest in 2011 and have brought the cave's length to 8.76 miles. The cave is anything but dry and WVACS has resurveyed most of the known passages and discovered extensive upper levels and new sections. The stream level is overloaded with stalactites, stalagmites, and columns, but the upper levels have spectacular displays of aragonite, triangular calcite crystals, massive popcorn speleothems, and the only known square soda straws in the world. However, while upper-level leads exist throughout the cave, their sizes and apparent potentials had steadily declined until 2019 when Nick Socky checked an obscure hole and discovered The Better End, which has proven to be a major upstream continuation of the cave that abounds with leads and potential. The most intriguing lead is about 2.5 miles upstream of the cave entrance and consists of waterfall sounds emitted by a small crawl needing pushed. Unfortunately, the mainstream was found in 2021 to end in an upstream sump, but overpasses are being sought. The ultimate length of the cave is unpredictable because the sources of the cave's water are entirely unknown with no known sinking streams or potential upstream entrances. Nonetheless, a final length in excess of 10 miles is expected based on known leads alone.

EXPLORATION AND MAPPING OF TEXAS' HONEY CREEK CAVE HAS RESUMED

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Texas' longest cave is 21 miles long and has 170 remaining leads. Cavers started swimming in its deep water, exploring and mapping, in the early 1980s. Most of its length was reached and mapped in the 1980s and early 1990s. By the mid-1980s the cave had been explored far beyond the four-hour swim with fins through the first three miles of it. Leg cramps were a challenge when doing the swim both in and out again, so a shaft entrance was constructed three miles into it, 30" in diameter and 145' deep. It's been used safely for 37 years, with one exception, when a caver was stranded at the bottom of the shaft until the next morning, a story worth hearing. Starting around 2005, tank hauls were organized in support of cave divers pushing the main upstream sump. This series of upstream sumps continue on. A few years ago, the pristine nature of the cave was threatened by a developer who applied for a permit to build 1600 small lot homes in the upstream drainage basin of the cave and flush 500,000 gallon daily of treated sewage into Honey Creek. Cavers rose to the occasion, spoke passionately at public hearings, the Texas Cave Management Association entered a MOU with the ranch owners, and cavers mobilized the Texas Nature Conservancy which entered a conservation easement with the cave owners. The cave is now protected. Exploration and mapping of the cave has resumed to address the remaining leads. The four grottos based in Austin, Dallas, Houston and San Antonio are asked to field two fully wetsuited and properly equipped survey teams each, as well as capable dome climbers. This is functioning smoothly with four weekends planned annually into the future. The longest cave in Texas is getting even longer.

NEWBERRY'S CONNECTION EXPLORATION

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Newberry's Cave System is located in Skydusky Hollow, Bland County, VA and is part of a collection of several caves in the area. This talk focuses on the connection of 2 of these caves: Newberry-Banes and Buddy Penley's. Survey originated in Skydusky Hollow in the 1950s and has been ongoing ever since, including a resurvey of Newberry-Banes and Buddy's starting in the 1980s. The Newberry's and Banes Cave connection was discovered in 1954, with a thru-trip completed in 1964. Fast-forward to 2018, Reilly Blackwell and Philip Moneyhun completed a dome climb that led to a large breakout, including the Gold pit (130 ft), heading directly towards Buddy Penley's Cave. It wasn't until 2020 that the connection was discovered after several survey trips to the back of Newberry's and Buddy Penley's. I didn't get involved until summer 2020 and was still fairly new to project caving, when we did a 14 hour trip to the Newberry's connection area. Following this trip we were much more motivated to explore the Buddy's side where the theoretical connection was closer to the entrance. Myself, Eric C. Landgraf, and Jason Delafield completed a recon trip into Buddy's to check out some leads and one in particular stood out as having fantastic air and a promising high lead. We went back the next week and broke out to a completely blank spot on the map! It took a few more trips until Jason found muddy boot prints and several more after that to survey the connection. Finally, in 2021, a crossover/thru-trip was completed taking 4 hours including several vertical obstacles. Survey is still ongoing, with the eventual goal to connect all the caves in the Hollow!

CAVE CONSERVATION AND MANAGEMENT ABSTRACTS

(listed in alphabetical order by presenting author)

CAVE POOL WATER CHEMISTRY ANALYSIS REVEALS BENEFICIAL IMPACT TO SPELEOTHEM GROWTH RESULTING FROM MICROCLIMATE/CO2-FOCUSED MANAGEMENT OF CAVE TOURS

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Scientists from the U.S. National Park Service and Western Kentucky University recently completed a ten-year analysis of two cave pools at Timpanogos Cave National Monument in Utah. Hansen Lake is a relatively large, isolated body of water at the end of Hansen Cave, while Hidden Lake is smaller and adjacent to the tour route. Analysis of 2008-2018 geochemical data from the pools showed that the calcite saturation index (SI_{Ca}) for Hidden Lake stood out with surprising results among the many parameters studied. SI_{Ca} data from Hidden Lake showed that the water in the pool changed rather abruptly from undersaturated to saturated conditions in 2013 and has remained so since that date. Unknown at the time, a new cave management plan implemented in 2013 appears responsible for this change. To mitigate physical and temperature impacts from large tours, the cave management plan limited tours to 16 visitors and added a “cool down” period of 15 minutes between tours. An unforeseen result was a reduction of CO₂ in the cave atmosphere with fewer people in the cave breathing. This management change returned the pool to oversaturated conditions, resulting in precipitation of calcium carbonate speleothems. Due to COVID-19, Timpanogos Cave was closed to visitors in 2020, allowing summer baseline microclimate and CO₂ conditions to be recorded without visitors inside the cave for the first time in the monument’s 100-year history. Preliminary data confirms our hypothesis that the additionally lowered CO₂ would further drive increased SI_{Ca} and mineral precipitation rates.

JAMES CAVE AND COACH CAVE RESTORATION

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Restoration activities to remove some of the impacts of commercialization have been a ten-year project in James Cave and Coach Cave. Located in Edmonson County, Kentucky just south of Mammoth Cave National Park, both caves are critical hibernacula for gray and Indiana bats whose presence has been documented since the mid-1800s. The caves were commercialized in the early 1960s to attract tourists to the Park Mammoth Resort located near Park City. Gating of the caves and winter disturbance by commercial tour groups had a significant negative impact on the hibernating bats. Winter tours in the caves were ended in the early 1980s, and all tours were discontinued by the late 1980s. Numerous bridges and stairways made from treated lumber had been constructed on tourist trails, and by the mid- 2000s these structures had deteriorated, creating a hazard for the cavers and biologists monitoring the bats. It was also suspected that the crumbling wood was releasing toxic chemicals into the cave air and water. Members of the James Cave Project set a long-term goal to remove all man-made structures and materials from the caves, and in 2015 the NSS Mammoth Cave Restoration Group became involved with the restoration effort. This group brought significant manpower to the effort, helping with deconstruction activities and moving tons of wet wood through the cave. Other groups involved in the ongoing project have been property owners, biologists from U.S. Fish and Wildlife Service and Kentucky Department of Fish & Wildlife, and members of The Nature Conservancy’s Kentucky chapter. This presentation will provide some history of the caves and their bat populations along with a progress report on the restoration project.

NEPAL: PATAL BHUVANESHWAR CAVE

Arun Bista, Chairman, Patal Bhuvaneshwar Cave

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Patal Bhuvaneshwar Cave is the deepest cave in Nepal and might also be the deepest in Asia. Morris Deuseen (French), president and cave expert of the International Center for the Exploration of the Himalayas conducted a preliminary survey of the cave and reached a depth of 800 meters. The cave is located within a 700-acre tract of forested land and on February 23, 2020, a local team was elected to work on developing and promoting the area. An additional 26 caves were also discovered within a two-mile radius of the cave. The Government of Nepal has funded more than \$200,000 for infrastructure development to make it a major tourist destination. The Nepal Tourism Board also allocated funds for the research purposes but the work could not be done because of COVID. This presentation will highlight Patal Bhuvaneshwar Cave. As chairman of the management team I am planning to promote this area as a Village of Caves and invite cavers worldwide to conduct research there.

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**TUESDAY
JUNE 14, 2022**

CHARACTERIZING AIR QUALITY AND HEALTH CONCERN IN TUMBLING ROCK CAVE: AN EXPLORATORY STUDY

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An estimated two million people visit caves each year, but little is known about their potential exposure to environmental hazards. This is an exploratory study to examine the use of citizen science tools to characterize air quality within caves. We aim to quantify exposures that cavers experience in subterranean environments and extrapolate these exposures into a human health risk assessment. A PurpleAir air quality monitor was placed inside Tumbling Rock Cave (located in Jackson County, Alabama, USA) for approximately 24 hours. The instrument collected real-time measurements of temperature, humidity, dewpoint, pressure, and particulate matter (PM). During this period, there was an average temperature of 49.42°F, average humidity of 50.26%, average dewpoint of 31.31°F, average pressure of 1006.2 millibars, average PM2.5 concentration of 4.33 µg/m³, and average PM10 concentration of 4.80 µg/m³. Interestingly, there was an unexplained spike in PM at midnight, reaching measurements of 36.69 µg/m³ PM2.5 and 41.23 µg/m³ PM10. The 24 hour exposure limits for PM2.5 and PM10 are 35 µg/m³ and 150 µg/m³, respectively. If these limits are exceeded, they could contribute to respiratory and cardiovascular health issues. Future studies will place the PurpleAir monitor in different locations within the cave, as well as use other instruments to measure additional air quality parameters, including CO₂, CO, and radon. This type of citizen science technology has the potential to transform cave management and allow cavers to be more aware of potential health risks they may face while caving.

NSS-USFS COOPERATION INITIATIVES: STEPPING UP TO BETTER UNDERSTAND, ACCESS, AND MANAGE CAVES IN THE NATIONAL FORESTS

Ray Keeler, NSS Government Liaison

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Over the last several years, and in several areas of the United States, the access to caves on our national forests has become limited. This has led to some strained caver/land manager relations. The spread of WNS and resulting management orders have contributed to the problem. Meanwhile in other parts of the country, NSS-USFS relationships have remained in excellent condition.

To address the problems, over the last 18 months, several focused long-term NSS and USFS efforts have been initiated to improve, repair, and address multiple issues on multiple levels. These include setting up agreements between the Washington Office, Regional Offices, and individual Forests with the national NSS, as well as NSS regions and individual grottos. Most important of these is the new, five-year USFS-NSS MOU (signed June 2021) which allows the USFS to transfer FOIA exempt information to NSS IOs and individuals when local agreements are in place. This talk goes over the accomplishments, tools that are now available, agreements, and mechanics that will help with better understanding, access, and management of the caves. This talk will also touch on several issues that remain and possible ways to address them.

REMOVAL OF POTENTIALLY HAZARDOUS MATERIAL FROM CAVE C-18, CARLSBAD CAVERNS NATIONAL PARK: LOGISTICS AND LESSONS LEARNED FROM A MULTI-AGENCY OPERATION

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The FBI, working with the New Mexico State police and Bureau of Alcohol, Firearms, and Explosives, assisted the National Park Service to assess the contents of several containers labeled "blasting caps" in a sensitive area of Carlsbad Caverns National Park. Cave C-18 was known to have historical mining operations and the containers are estimated to be 100 years old. A unified command was established for the incident, NCRC-trained responders were pre-notified, and preliminary response plans were developed for a range of scenarios. The cave's vertical entrance pit complicated access for personnel and transport of specialized equipment. A high-line and hauling system were pre-rigged for the dual purpose of removing potential explosives and rescue preparation. Differing agency standards for vertical access techniques were addressed through training exchange prior to descent of the pit. X-rays of the boxes revealed that they were empty, and the boxes were removed without incident. The operation concluded successfully.

CAVE FORMATION REPAIR WORKSHOP

Instructed by Mike Mansur, NSS26393CL FE

Round Building

There are untold numbers of broken cave formations in the world's caves. The majority of these were caused by human impact, with a small amount resulting from natural causes. We, as cavers and scientists, want to do as much as possible to repair, restore and conserve these damaged resources. The Cave Formation Repair and Restoration Workshop will help train and educate people on techniques and tools that we use to make formation repairs.

THE CONSERVATION IN RUSHMORE CAVE, BLACK HILLS – SHOW CAVE CONSERVATION LESSONS

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Rushmore Cave, located near Keystone, South Dakota, is a privately-owned show cave with annual attendance that rivals that of the nearby National Park Service caves that have been running cave tours for 93 years. In 2019, Rushmore Cave started a Cave Conservation program that was one of the first in the nation in its scope and goals for private show caves. This program facilitated a full-time position with the goals of monitoring, maintenance, cave science, resources, collaboration, and education. Throughout this program's life, it has created new management procedures, new methodology, and new collaborations that continue to be developed. This case study focuses on lessons learned from applying and adapting state-of-the-art conservation and restoration techniques to a show cave budget and resources, as well as future goals and recommendations.

THE URGENT NEED FOR EXTRATERRESTRIAL SUBTERRANEAN CONSERVATION

Ceth Parker, NASA Jet Propulsion Laboratory, California Institute of Technology

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The entrances to more than 2,500 extraterrestrial subterranean features (ESF) have been discovered via satellite identification of Subsurface Access Points (SAPs) across our solar system. They are assumed to be entrances to lava tubes, caves, subsidence 'sink-hole' like features, fissures, and yet to be described subsurface formations. These SAPs have thus far been identified on the Moon (221), Mars (1,036), Titan (1,297), Enceladus (100), Triton (3), Pluto (2), and Charon (1). On planetary bodies with minimal geologic activity and/or minimal ice-shell turnover, some ESF could be 1-4 billion years old. These features may contain evidence of climatic evolution and serve as records of environmental change over immense time periods. Additionally, it has been proposed that some ESF could contain remanent biosignatures of extinct life or even serve as habitats harboring extant life today. Semi-autonomous robotic architectures are being designed and built to explore these subsurface features, with the first lunar SAPs to be explored robotically within this decade, Martian SAPs to be explored within the next, and Ocean-Worlds soon to follow. Unfortunately, there is minimal communication between cave scientists and the robotic engineers designing and building these near-future subterranean explorers. The risk of irreparable damage to billion-year-old subsurface features is high without improved communication between the disciplines. Here we aim to start the crucial dialogue between cave explorers, cave scientists, and roboticists about approaches, high sensitivity features, robotic architectures, and management plans for ethical subsurface exploration. As with all conservation efforts, extraterrestrial subterranean conservation must be a delicate balance between scientific discovery and the preservation of natural features. Indeed, ESF could contain some of the most ancient and fragile geologic features in our solar system, and potentially shelter evidence of non-terrestrial life. These features require ethical considerations and protection plans developed well in advance of their exploration.

CKRIT: THE CAVE AND KARST RESOURCES INFORMATION TRACKING DATABASE

Georgia Schneider, CKRIT Intern, NPS

Secret Agent Intern for the NPS

The NPS is moving into the 21st century and creating a geocentric database for NPS units with caves and karst resources. The Cave and Karst Resources Information Tracking database (CKRIT pronounced secret) development is in its infancy. The goal of the national database will be to provide a secure database for geocentric management of cave resources to individual parks. The challenge will be to develop a comprehensive but flexible database that is secure for each cave resource office while providing upper level management information for reporting purposes (numbers and types, but not locations).

NPS: NATIONAL CAVE AND KARST PROGRAM COORDINATOR

NCKRI: DIRECTOR OF CAVE AND KARST MANAGEMENT SCIENCE

Patricia E. Seiser, PhD

Geologic Resources Division, US National Park Service, Natural Resource Stewardship and Science Directorate

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Update on status of the NPS Cave and Karst Program and NCKRI's programs.

BATS AS A VIRAL VECTOR: IMPLICATIONS FOR CONSERVATION AND PANDEMIC PREPAREDNESS

Lilianna Wolf, DC Grotto

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Mention to someone that you are a caver in 2022, and you will be asked a suite of curious questions. Many you have heard before and are entirely prepared to answer. The most recent and common one, however, you might need some freshening up on. "Why do bats carry so many viruses? Isn't it dangerous to be around them?" The response to this question should be more of a discussion than an answer. Bats play a complex role in the public health and ecosystem health of our global environment. They are uniquely adapted for flight in a way that does allow them to host and transmit many viruses. Their ecology and proximity to human activities also increase their ability to act as a zoonotic threat. But

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again, nothing in ecology or zoonotic epidemiology is quite so simple as “good guys” and “bad guys.” Biology, human development, and politics all roll together in answering this question: in the wake of the Covid-19 pandemic, how should we consider the human-bat interface?

CULTURE OF CAVING SESSION ABSTRACTS

FOLKLORE OF THE CAVES OF THE HUAUTLA DE JIMENEZ, OAXACA, MEXICO AREA

Montserrat Peralta Méndez (NSS 71182)

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I am an indigenous Mazatec woman from Huautla de Jimenez, Oaxaca, Mexico. My ancestors have lived in the Sierra Mazateca for thousands of years. I am pleased to say that most of what is known about my ancient ancestors comes from archaeological studies done in the caves by speleologists. My people are grateful for this.

Before cavers first arrived in Huautla in the mid-1960s, cave entrances were known and entered a short distance by ancient Mazatecs, limited by their lack of good lights and other equipment. However, one entrance puzzles modern cavers as to how it was reached by the ancients without ropes. Modern cavers reached it by rappelling 100m down a cliff face and inside the cave discovered a stone altar and 2,000-year-old footprints.

There are many stories and beliefs about the caves that have been handed down from one generation to the next for an unknown number of years. For example, there are beliefs in dwarfs living in the caves, and there are strong beliefs in cave spirits.

Along with telling the stories about the beliefs and legends of the Huautla area caves that I have collected as my contribution to the speleological project, I will show photos of the many wall murals located in the area that depict our stories and legends. I will also show photos of cavers taken during their moments of silence and respect at cave entrances.

Cavers with the Proyecto Espeleológico Sistema Huautla (PESH) respect the beliefs of my people. At the start of PESH expeditions they have gathered with a spiritual Mazatec person who has requested that the cave spirits give them safe passage in the caves. My people appreciate this. Cavers are reverent at cave entrances before going caving, they are quiet and respectful, and my people, the modern Mazatecs, are thankful.

WEAVER CAVERNS AND HISTORIC NATIVE AMERICAN USE OF CAVES IN EASTERN NORTH AMERICA

Joseph C. Douglas (Volunteer State Community College), Kristen Bobo (Tennessee Cave Survey), Lacey*

Fleming (Tennessee Division of Archaeology), and James R. Honaker (Kentucky Technical Solutions)

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Weaver Caverns is a short (205 meters) but spacious cave located on the western escarpment of the Cumberland Plateau in central Tennessee. Developed in the Monteagle Limestone, the cave was reported in 1987 as a moonshine site. Field research in 2011 and 2021 confirmed the moonshine usage and revealed other historical interactions: graffiti from recreational visitation, possible evidence for saltpeter activity, and a Native American component consisting of charcoal and “stoke marks” from torches of bundled river cane (*Arundinaria* sp.). Although radiocarbon dating for the recent past is confusing due to wiggles in the calibration curve, two AMS radiocarbon dates on two different cane charcoal deposits were obtained. They yielded conventional radiocarbon ages of 200 +/- 30 BP and 270 +/- 21 BP. When calibrated, this likely places the Native American presence in the 17th and 18th centuries, although an early 19th century date (for the first assay) and a 16th century date (for the second assay) are also possible. There is no evidence for mortuary, extractive, or ritual use involving art; the cave is currently interpreted as an ‘exploration’ site, although the possibility of non-materialized ritual exists. There are now post-1600 14C dates from 18 different caves in eastern North America. Weaver Caverns and similar-aged cave sites provide important evidence for Native American cave utilization following the Spanish entradas and throughout the era of increasing entanglements.

CAVE CONSERVATION: A PERSPECTIVE FROM HUMAN GEOGRAPHY

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Human geographers study how different groups of people understand and value the environment in different ways based on their relationships with media, culture, local history, and the particular landscapes in which they live, work, and play. Nonetheless, we still sometimes make assumptions about what counts as “nature” and environmental protection, focusing on conventional living ecosystems and the impacts of pollution and environmental degradation. This talk asks: how might practices of cave conservation challenge some of the assumptions made about conservation and environmental protection? Do the experiences of cavers and their knowledge of conservation practices require different forms of description than analyses of other sorts of environmental concern, such as habitat, stream, energy or climate change? If so, why? In this talk, I hope to provide an introduction to these questions through a discussion of my past research on controversy surrounding the proposed Dewey-Burdock ISL uranium mine in nearby Edgemont, South Dakota. I show how those who opposed this mine drew on tourist, amateur, and expert knowledge of Black Hills caves. And I hope to describe and get feedback from the NSS community as I begin to develop a research project tentatively called “The environmental politics of the underground.” Eventually, I hope to speak to several communities who raise concerns

about caves, mines, sinkholes, urban pipelines, abandoned oil wells, impacts to aquifers and groundwater sources around the United States. I think that the care cavers display for underground spaces is exemplary and significant in part because it refuses many of the traditional and restrictive styles of US environmentalism—and I'm interested to hear if you all agree!

IF YOU LEARN HOW TO CAVE, WHAT ELSE DO YOU LEARN: A PEDAGOGICAL LOOK AT CAVING

*Devra Heyer (National Cave and Karst Research Institute)
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Just as someone learns music, they implicitly learn fractions. As we learn how to cave, we gain knowledge and techniques from other content areas. This talk is more of an overview of general caving skills and knowledge. While the focus is on becoming an expert in working in the environment of caves other common activities done in the caving environment will be discussed. There will be comparisons of skills utilized by cavers with evaluative criteria of Emergency Management Institute (EMI), Rope Access (SPRAT), Common Core Mathematics and Next Gen Science standards. Cavers have a cross curricular skill set that utilizes communication/organization skills commonly used in emergency services, while implicitly learning math, physics, biology, geology and rope access concepts and techniques.

HOW CAVES GATHER: THE POWER AND POTENTIAL OF A RADICAL SPELEOLOGY

*Maria Alejandra Pérez (West Virginia University)
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Caves gather, both literally and metaphorically, multiple dimensions of life and earth across time. Speleology reflects this ample range of dimensions and scales, albeit through the dominant and sometimes limiting lens of Eurocentric science. Emphatically, speleology includes but also exceeds geologic and scientific lens; and thanks to the participation (and often leadership) of non-academics in speleological groups, we are reminded of the value of explorations of the earth that are not bound by academic disciplinary affiliations. Moreover, grasping the degree to which and what caves gather varies immensely—these attributes can only be fully revealed through exploration and the collective eyes, ears, and touch of humans attuned to different attributes. This is one of the features that makes participation in caver grottos or larger speleological organizations so exciting. Drawing on recent insights from anthropology, geography, and philosophy, I illustrate these points with cases from Cuba, Venezuela, and Puerto Rico, whose speleologists push the boundaries of the “for what, how, and for whom” of speleology. In conclusion, I suggest ways of affirming speleology’s transformative potential, leading to a radical speleology in which caves not only gather but also open up new and necessary ways of being in the world with others.



Spearfish Canyon | Spearfish SD

ABSTRACTS

INTERNATIONAL EXPLORATION SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

PROYECTO CERRO VERDE, MEXICO

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The Proyecto Cerro Verde was established in 2012 by Herb Laeger, Edd Keudell and Ron DeLano with the mission of studying the caves, karst and hydrology of the Cerro Verde massif in the Mexican State of Oaxaca. Located in the storied Rio Domingo Valley, Cerro Verde has received scant attention by cavers in comparison to its famous neighbors: Huautla, Cheve and Cerro Rabon. Over the last ten years, this small project has had success in locating more than seventy-five caves not previously known to the caving community. While all limestone caves, these caves are interesting and varied. The project has encountered caves with very large passage over 40 meters wide, pits up to 165 meters deep and caves that are quite hydrologically active. Many caves are well decorated, have important archeological resources and have interesting cave adapted creatures including fish, insects and crayfish. This presentation will emphasize discoveries made from 2019 to 2021. These include the newly discovered Cueva de Octavio Salinas which boasts spectacular formation areas and archeological resources. A 200-meter swim in Paco's Ranch Cave led to continuing passage and large , decorated chambers. Exploration in Roadside Cave continued with an uphill extension to a divisible sump and a lower extension that includes a lovely rimstone dam area called Fabio's Grotto. A new cave called "Resumidero Seco" was found to have large canyon passage and lovely formations. The project visited a remote cave deep in the jungle, Cuarto Enorme, that had impressive formations and many human bones. A fluorescein dye trace experiment proved a hydrological link between Cueva Cemetario and Rio Cave more than a kilometer downslope. Future prospects for the project will be discussed. The project is thankful for the NSS exploration grant that supported these activities and for the excellent photographic documentation by Norm Thompson.

WHITE RABBIT- A CANADIAN CAVE FOUND DURING A CARIBOU SURVEY

Katie Graham k8mgraham@gmail.com

White Rabbit is a magnificent marble cave laced with rubies and garnets and has the potential to be the deepest in Canada, yet it does not require an SRT kit. Current discoveries and plans for this project along with a couple other gems of the north will be presented.

Laguna de Sánchez, Nuevo León, Mexico --- The caves keep popping up!

Jim "Crash" Kennedy, NSS 26791 FE, LIFE cavercrash@gmail.com

What started as a weekend trip to help a fellow bat biologist in 1997 (with only three known caves in the area) has since ballooned into 19 additional cave survey expeditions, the most recent three during the COVID pandemic. We now have documented over 230 caves in the area, and find more each trip. None of these will make Bob Gulden's Long and Deep cave lists, but the sheer number, variety, and ease of access makes this a great first Mexico trip for many cavers (124 total so far!). Plus, the place is simply gorgeous. During this talk we'll update listeners on the most recent trips and discoveries.

USDCT 2021 and 2022 Cheve Expeditions

Sean Lewis (sealewis@gmail.com), Bev Shade, Bill Stone

US Deep Caving Team (USDCT)

In 2021, the 4-month US Deep Caving Team expedition to Sistema Cheve in 2021 was a great success, truly a triumph of execution and testament to the dedication of 69 cavers from 9 countries involved. The expedition mapped more than 20 km, most of which was at the new bottom of the cave, with the limit of exploration an extraordinary 4 days of loaded travel from the nearest entrance. The northernmost extent of the cave was pushed past the previous boundary of Sump 2, the first significant northward extension since the discovery of Sump 1 in 1991. This was a monumental effort, a total of 3,156 person days on site were required 1,531 person days spent in 8 underground campsites and ~1000 person days spent hauling. National Geographic filmed a 1-hour documentary called "The Deepest Cave", which airs in early June this year on Disney+. In 2022, a smaller expedition returned to Cheve and San Miguel Santa Flor with two objectives: to push leads in the upper reaches of Cheve via the Peña Negra entrance and search the middle karst for a new route to Cheve's northern frontier. With about 500 person days in the field, Cheve 2022 still managed to map 5.5 km in the upper sections of Cheve. We did extensive ridge walking in the middle karst over the current end of Cheve, and pushed Cueva Agua Pajarito 120 m deeper to a total depth of 370 m. We mapped nearly 700 m in new caves near San Miguel Santa Flor and other caves of the area. A shorter route into downstream Cheve remains elusive, but there are several possible options. Sistema Cheve is now 80.9 km long and 1,530 m deep.

EXPLORATION OF KUČKA KORITA, MONTENEGRO

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In 2017, a small multi-national group of cavers began the exploration of akarst area in east-central Montenegro, located on the border with Albania. This area consists of a relatively flat carbonate plateau which, on the southeast drops into a steep, approximately 1,200 meters deep Cijevna Canyon. The plateau is comprised of a thick sequence of limestones dipping northwestward at 15 to 30 degrees. Following a brief 2017reconnaissance, annual summer expeditions of

3-week duration have been fielded to the area. In total, more than 100 new caves have been documented. Two caves(C95 and Vrijema za Pivo) are currently continuing with great promise.C95 was discovered in 2018 and is currently 1.07km in length and 267 meters deep, with a large windy canyon passage continuing at the limits of exploration. Vrijema za Pivo was discovered near the end of the 2019expedition and was quickly pushed down to 134 m deep and 251 m in length. Exploration was suspended in 2019 at the top of a large 50 m shaft and a continuing tall canyon, with strong airflow in both leads. A return to the area is planned for July 2022

THE DESERT PITS OF MUZQUIZ, COAHUILA, MEXICO

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In the arid Sierra del Burro mountain range of Northern Coahuila, lies an indisputable paradise for vertical cavers. Amongst all the unfriendly vegetation, there are hundreds of blind pits, some explored, some virgin. For decades, cavers based out of Texas (accompanied by friends from other states and Mexican nationals) have been combing the desert mesas for deep pits. Most are gunbarrel-like shafts that drop less than 100 meters, while others plunge 300+ meters down into the limestone. Caves like these have kept cavers busy surveying, rigging, and exploring for years... Until a cave was found that changed the game...

In 2018, Kraig Fenton, an Austin caver found what is now known as Cueva Arroyo Duermiente, one hot afternoon. What makes this cave special amongst so many huge pits is the sump. No other cave in the area has reached a water table, but Duermiente had further secrets to reveal. Within the sumped passage, the Mexican Blind Catfish was found to be thriving. This discovery expanded the range of this mysterious species and made us all wonder what else this marvel in the desert has to offer.

PESH 2022 EXPEDITION PROYECTO ESPELEOLOGICO SISTEMA HUAUTLA

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In 2013 Tommy Shifflett and Bill Steele organized PESH with a goal to conduct annual expeditions for a decade (2014-2023 now due to the Covid pandemic and skipping 2020 and 2021 extended to 2025) to continue exploring and studying Sistema Huautla, Huautla de Jimenez, Oaxaca, Mexico and other non-integrated caves in the Huautla drainage basin. The 2021 expedition was the seventh of these. PESH's goals include conducting all speleological studies: cartography, geology, hydrology, biology, paleontology, archaeology, anthropology (studying the local Mazatec Indians' beliefs in cave spirits) and also gear development and testing. PESH has an ongoing public relations program to educate local people about the caves beneath their homeland. Mexican cave scientists are invited to participate and are supported. Huautla cavers have a 50 year-plus record of published findings. PESH is an official project of both the NSS and the U.S. Deep Caving Team. Expeditions carry the flag of The Explorers Club. The presentation will include the results of the 2022 expedition and discuss international speleological project management. Prior to this year's expedition Sistema Huautla stood as the deepest cave in the Americas, tied as 9th deepest cave in the world, 89 km long (55 miles) and 1560m deep (5,118 feet). Sistema Huautla is often referred to by speleologists who have visited it as one of the world's most magnificent caves.

PANTI PIT, BELIZE: DROPS, BOREHOLES, MUD AND BAD AIR

Carol Vesely

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On the last day of the 2009 XMET expedition to Belize, team members gave a ride to a local farmer who told them about a small hole in his front yard that formed a water geyser during Hurricane Mitch. Digging open the hole revealed a short crawl leading to a pit, blowing air. Over the next couple of years Panti Pit was explored down a series of eight wet, muddy drops. After reaching a vertical depth of approximately 360 feet, the cave opened into horizontal borehole going both ways. In 2012, the XMET leaders made it clear that they were not interested in continuing explorations in Panti Pit. Five years later, Doug Billings and Brian Pease founded the Boundary Fault Cave Project to continue the exploration and survey of this promising discovery. Since then, team members have surveyed over six kilometers of mostly linear borehole cave during five expeditions. Extremely nasty mud, bad air, a low air space crawl and other nuisance obstacles complicate exploration. The water in Panti Pit has been dye traced to multi-kilometer-long Barton Creek Cave. About 75 meters of breakdown separate the two caves at their closest points. Heading in the opposite direction, a huge room with a stream at the bottom was discovered on the last day of the last pre-COVID expedition. This year's trip promises more exciting discoveries in this intriguing and challenging cave.

UPDATE ON EXPLORATION AND SURVEY OF CAVES IN OR NEAR THE TIGER CAVE SYSTEM, PHONG NHA-KÈ BÀNG NATIONAL PARK, VIETNAM

Dean A. Wiseman (jazzpilot@mohodisco.com), Steven W. Frye, Uy Jang Jong, Le Luu Dung

Exploration of the karst and cave resources in Phong Nha-Kè Bàng National Park, Vietnam, has been a decades-long multinational effort and has yielded some extraordinary cave discoveries. Importantly, these discoveries have opened the door to a new source of sustainable economic development in an area that has traditionally relied on primarily on resource extraction and subsistence farming. In the Spring of 2019, we were invited to explore, survey, and generally assist local outfitters in the Tiger System. This included the Kong Doline and Great Saudi Cave segments, which had originally been identified by British cavers of the British Caving Research Association (BCRA). In addition, we took an inventory of incompletely explored, or newly discovered areas of Over and Pygmy Caves, two major caves in the Tiger

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System, also originally surveyed in the early 1990's by the BRCA. To date we have initiated survey and karst inventory of the southern edge of the Kong Doline, including discovery of a new significant cave, named Python Cave. In addition, we successfully established a pull-down route through a cave, where one entrance comprises a ~600-foot-high vertical solution feature, nicknamed the "Eye of Kong." We have also identified several areas which will add significant additional length to Over cave and significant discovery opportunities in Pygmy Cave, and our long-term goal is to update and extend the mapped areas of these caves. Following a COVID-19 induced hiatus, we are again returning the region in 2022, and this presentation will include additional exploration updates to the Tiger Cave System and another nearby Tra Ang doline. We will attempt to convey the extraordinary potential for new and significant cave discoveries that await this magnificent karst resource.

PALEONTOLOGY SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

QUATERNARY BADGER (TAXIDEA; MUSTELIDAE) FROM SNAKE CREEK BURIAL CAVE, NEVADA

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Here, we report the occurrence of late Quaternary badger (*Taxidea*) fossils from Snake Creek Burial Cave (SCBC) in eastern Nevada, USA. Linear measurements of SCBC badger fossils were recorded and compared to extant badger specimens for size comparison. We provide a map of Quaternary fossil localities across western North America. Sites with badger fossils are concentrated in the Southwest along the US-Mexico border and decrease in number and density from south to north. Some researchers have suggested that *T. taxus* was larger during the Rancholabrean such as several other Ice Age survivors (*Bison*, *Martes*, *Ovis*). Pleistocene-age badger fossils from SCBC do not surpass size ranges observed in extant forms. SCBC has not yielded fossils of *Cynomys*, a known common prey item for extant *Taxidea*, however, colonial ground squirrels, lagomorphs, and arvicoline rodents are among the most common fossil remains recovered from the natural trap deposit. The diet of extant *Taxidea* varies based on its geographic distribution, but its primary prey item is typically the dominant burrowing rodent within a region. Thus we surmise that the main food source of local badgers in the central Great Basin was colonial ground squirrels. Additionally, SCBC has yielded fossils of various other carnivores including other mustelids, wolves, coyotes, foxes, bobcats, and skunks. With such an abundance of small mammals alongside carnivores in this southwestern Lake Bonneville basin, it is apparent that SCBC badgers would have had considerable dietary overlap with all carnivores.

FOSSIL CAT TRACKS FROM CHILLY BOWL CAVE, ARKANSAS

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Preserved cat (*Carnivora, Felidae*) tracks are relatively uncommon in the fossil record. Felid trackways from Chilly Bowl Cave, Arkansas represent two, large, late Pleistocene cats. Chilly Bowl Cave is located within the Boston Mountains of the Ozarks in northern Arkansas. The identity of these tracks is the subject of this research. Based on size and morphology, the larger trackway could represent *Panthera atrox*, the American lion. These tracks are similar in size to another set of tracks from Missouri assigned to *P. atrox*, and trackways identified as *Panthera spelaea* from Germany. *Panthera atrox* was an especially large cat, estimated to be 25% larger than the modern lion and weighing over 700 lbs (>315 kg). This is the only potential evidence of the species in Arkansas, and the second set of tracks that could represent this extinct species. An additional trackway is also known from the same area in Chilly Bowl Cave. These tracks are smaller than the trackways suggestive of *P. atrox* but are similar to modern and fossil pawprints interpreted to be Pleistocene jaguar, *Panthera onca*. The smaller prints are larger than cougar (*Puma concolor*) tracks with some morphological differences such as shape of the digital pads. The possibility that the smaller tracks were created by an adolescent *P. atrox* is also present. Additionally, both trackways show a distinct difference to those attributed to machairodont sabertooth cats such as *Smilodon* or *Homotherium*. The Chilly Bowl Cave tracks retain the typical sub-triangular or circular interdigital pad of most felines while the "Machairodont tracks" instead have a kidney bean shaped interdigital pad. The tracks from Chilly Bowl Cave represent the first of their kind in the state of Arkansas and contribute to the record of Pleistocene felid tracks of North America.

CANIDS FROM TWO CAVES IN GRAND CANYON NATIONAL PARK, ARIZONA

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The Redwall Limestone formation is a well-known massive cave-forming unit exposed throughout the 277 river miles of the Grand Canyon. In the eastern, up-river region, Stanton's Cave is located 45 m above current Colorado River level in Marble Canyon and was investigated for both archaeological and paleontological remains in the 1970s. Of the many skeletal remains of extinct mountain goat (*Oreamnos harringtoni*), bighorn sheep (*Ovis canadensis*), numerous birds, and small mammals was a fragmented lower jaw of a fox (GRCA 76272) originally identified as the extant gray fox (*Urocyon cinereoargenteus*). Morphological comparisons of this fossil indicate that the mandible is consistent with the red fox

(*Vulpes vulpes*) and not the gray fox. Today the red fox is known only in the northwestern-most portion of Arizona, outside of the Grand Canyon. This is the first fossil record of the red fox in the Grand Canyon and for all of Arizona. Shrine Cave located farther down-river from Stanton's Cave was investigated in the 1990s. Typical of the Grand Canyon dry caves, this grotto contained numerous plant, dung, and skeletal remains readily exposed on the surface, some dating to the late Pleistocene. In a crevice in the entrance chamber was a completely mummified carcass of a coyote (*Canis latrans*; GRCA 69062). Radiocarbon dating of a sample of the hide indicates an age of 2,250+50 yr BP (Beta-80631). Entrance into the cave from the room opening to the side canyon is a sheer drop of over 100 m which implies that the coyote may have entered from another opening elsewhere on the mesa.

LATE PLEISTOCENE VERTEBRATE FAUNA AND GUANO DEPOSIT OF LA TETERA CAVE, ARIZONA: A PRELIMINARY REPORT

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La Tetera is a cave formed in the mid-late Paleozoic limestones of the Rincon Mountains of southern Arizona. The cave was sealed since the late Pleistocene and preserves a small vertebrate fauna reflecting the Rancholabrean NALMA including two extinct large mammals, horse (probably *Equus conversidens*) and giant llama (*Camelops*), as well as an extinct vampire bat (*Desmodus stocki*). Additional recovered biotic remains under study include hackberry endocarps (*Celtis*), charcoal, and bones of toads, large tortoise (*Gopherus*), squamates (at least *Heloderma*, *Phrynosoma*, *Crotalus*), roadrunner (*Geococcyx*), wren (*Salpinctes*), heteromyid and cricetid rodents, rabbits, *Myotis* sp., and shrew. Further investigation will likely reveal additional biotic remains. Preservation of bone is relatively poor, probably due to as-yet-undetermined, corrosive geochemical processes. Fossils occur as isolated skeletal elements scattered sparsely in several areas of the small cave or those recovered by screening of unconsolidated cave floor sediments (in which the vampire bat is the second most commonly recovered taxon, after toads). A large, stratified paleoguano deposit in one room promises the potential to recover ancient environmental DNA from the bats, their dietary sources, and autochthonous and allochthonous microorganisms. A sample of the guano deposit gave a calibrated radioisotopic age of 23 ka, confirming a late Pleistocene age for the deposit and placing it within late Wisconsinan full glacial time and within Marine Isotope Stage 2. Several of the fossil vertebrates reflect a desertscrub fauna similar to that of the region today.

HOW LOW SHOULD YOU GO? DETERMINING MINIMUM SCREEN SIZE REQUIREMENTS FOR MICROFOSSIL ACQUISITION AT WIND CAVE NATIONAL PARK, SOUTH DAKOTA

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Microvertebrate, invertebrate, and plant fossils less than 1 cm (hereafter microfossils) are critical to understanding many paleontological patterns and processes. Due to their size, microfossils are difficult to detect using conventional field excavation methods and are often acquired by washing and sorting sediments using stacked screens of decreasing mesh size (screening). Screening protocols vary and can have a substantial impact on fossil yields. For example, minimum mesh size of the lowest screen will determine the smallest materials captured. The Museum of Geology houses a large collection of microfossils and microfossil-bearing sediment, but it does not have a standardized microfossil screening protocol. A pilot study was therefore conducted in summer 2021 to determine the minimum mesh size needed to capture all microfossils in the Museum's fossil-bearing matrix. Sediments from the Beaver Creek Rock Shelter, a cultural locality at Wind Cave National Park, were selected for this study due to the abundance of microfossils within. Sediments were washed prior to the experiment and sorted into 4 mesh fractions: >4mm, 4-2mm, 2-1mm, and 1-0.5mm. The four mesh fractions were then picked for microfossils by four student interns. Microfossil abundance, microfossil diversity, and processing time was evaluated per mesh fraction. Results show that processing time increases significantly with decreasing mesh size and that microfossils are present in all mesh fractions down to 1-0.5mm. Contrary to expectations, the smallest (1-0.5mm) mesh fraction captured the greatest abundance of microfossils and the 4-2mm mesh fraction captured the greatest diversity of fossils. This pilot study suggests that sediments down to ~0.5mm must be screened to acquire the full microfossil assemblages at Wind Cave National Park. We plan to refine this study in summer 2022 by experimenting with minimum mesh sizes between 1mm and 0.5mm and applying other techniques to reduce processing time without limiting microfossil acquisition.

TAPHONOMIC IMPLICATIONS OF ONTOGENETIC AGE DISTRIBUTIONS FOR FIELD MICE (*PEROMYSCUS SP.*) POPULATIONS FROM TWO DEBRIS CONE DEPOSITS, PARKER'S PIT, BLACK HILLS, SD

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Fossil bones can accumulate in caves in a variety of ways and these modes of deposition can introduce different biases that must be understood before the fossil assemblage can be interpreted. We studied the ontogenetic age distribution of individual specimens of the field mouse, *Peromyscus*, based on tooth wear to determine potential biases from fossil bone

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assemblages from two different talus cone deposits in Parker's Pit in the Black Hills of SD. Main Cone has accumulated under the modern 12 m vertical pit entrance throughout the Pleistocene and Holocene. The pit trap does not permit escape. The Red Cone has formed in an old, closed entrance with an acute slope that allowed animals to enter and exit the cave. Differences in the age distribution of these two populations is statistically significant. Maine Cone individuals show a wider and generally older age distribution than those from the Red Cone. We interpret these differences as a result of individuals surviving the vertical fall onto the Main Cone and living into old age facilitated by organic debris washed into the cave. The Red Cone population is much younger and probably represents accumulation from predation, possibly by weasels, *Mustela* sp., as independently documented by tooth marks on the bones. Hence, the Main Cone fossil assemblage is derived from a random process (i.e., falling into a pit); whereas, the Red Cone sample is biased by predator selection. Therefore, the entire Main Cone fossil assemblage, not just *Peromyscus*, may represent a random, local sample that can be used for paleoecological analyses. Isotopic studies of other rodent species suggests they were also derived locally which tends to eliminate owl predation. On the other hand, the predator biased Red Cone sample is not amenable to paleoecological interpretations but does provide information on predator-prey interactions.

*Deceased

THE PETRA PROJECT: TAPHONOMY OF A NEW RECORD OF A LARGE CAT SKELETON FROM BURJA CAVE (VIRGINIA, USA)

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Through the Ice Ages of the Pleistocene Epoch, large cats were a fundamental part of the Appalachian ecosystem, yet there are relatively few records of them. A team of eleven cavers recently extracted an incredible new specimen of a large cat from Burja Cave in southwestern Virginia. The skeleton, nicknamed Petra, was found lying on its left side, with near perfect articulation of nearly every bone element. Left and right limbs were held together and fully extended from the body, and the tail was held straight out from the body. Full preparation in the lab is needed to properly identify Petra, but during fieldwork it appeared most similar to the American Cheetah, *Miracinonyx inexpectatus*. Other known large cats from the Ice Ages of Appalachia include the American Lion (*Panthera atrox*), the Saber-toothed Cat, (*Smilodon* spp.), the Ice Age Jaguar (*Panthera onca augusta*), and ancient members of the living species of Mountain Lion (*Puma concolor*). Of these, *Smilodon* can be ruled out based on the much smaller canines, and the skull shape is not nearly as robust as *P. atrox*. Preparation at the Virginia Museum of Natural History thus far has been largely mechanical, using pin vices under high magnification, but digital and chemical methods are currently being explored. The Petra Project was made possible with the support of the Cave Conservancy of the Virginias, Virginia Department of Conservation and Recreation Division of Natural Heritage, Virginia Museum of Natural History, Science Museum of Minnesota, U.S. Forest Service, and caver volunteers.

CAVE PALEONTOLOGY AND RADIOCARBON DATING IN THE CANADIAN ROCKY MOUNTAINS

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Vertebrate remains and radiocarbon dates from eight new cave deposits (Anticline Arch, Brazeau Cave, Disaster Point Cave, Goat's Nest Cave, Ice Trap Cave, Moose Mountain Cave, Procrastination Pot, and Sheep Catcher Cave) in the Canadian Rocky Mountains highlights the potential of caves to contribute to the Quaternary biological and geological history of higher elevations in mountains and foothills of Alberta. Initial field research at Disaster Point Cave permitted recovery of intact, albeit geologically recent, sedimentary sequences in some cave deposits, and spurred additional investigations at other localities. Subsequent research at other cave sites focused specifically on preliminary sampling of vertebrate remains and radiocarbon dating.

Radiocarbon dates from the new localities and new radiocarbon data from a known sites (e.g., Rat's Nest Cave) range from infinite to modern, but are largely restricted to the Holocene. We interpret the consistency of Holocene ages in most records as a reflection of geologic processes associated with deglaciation, although some variability occurs across the region as a whole. Vertebrate remains recovered from the new localities are consistent with the existing biota of the region, suggesting relatively early post-Last Glacial Maximum establishment of modern biotas at higher elevations for some parts of western Canada. Preliminary evaluation of recovered plant remains highlight a potentially under-evaluated source of palaeoecological data from cave deposits in the Canadian Rocky Mountains.

RICHARDS SPUR: A FISSURE FILL PRESERVES A UNIQUE HIGHLAND ECOSYSTEM FROM THE EARLY PERMIAN

Andre Lujan

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The Richards Spur locality north of Lawton, Oklahoma, preserves a unique combination of environments from the early Permian of North America. The majority of sediments from this time and place record life in lowland floodplains. Richards Spur preserves fauna from both a highland environment as well as a cave in an ancient fissure. The highland fauna consists of smaller animals dominated by the captorhinid reptile *Captorhinus aguti* and includes dwarf forms of larger species (*Dimetrodon*, unidentified diadectid). These fossils reveal a full ecosystem with herbivores, predators, and other niches. These fossils were preserved in a cave deposit that bears its own assemblage of suspected cave dwelling forms. These deposits have been commercially mined for limestone since 1932, which is responsible for the fossils coming to light. The quarry remains active to this day. Recent work by Texas Through Time has recovered hundreds of individual fossils as well as rock containing articulated remains. Remains of rare taxa such as *Oromycter* and *Bolosaurus* have been found, as well as exceptional adult and juvenile specimens of the trematopid amphibian *Acheloma*. Continued quarrying of the site promises to expose older deposits, which have the potential for new taxa and data on how this highland ecosystem changed over time.

PLEISTOCENE FAUNAS FROM CAVES AND KARST SINKHOLES, BLACK HILLS, SOUTH DAKOTA

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The Black Hills of southwestern South Dakota are a geological inselberg surrounded by a ‘sea’ of prairie grasslands that are all part of the extant Northern Great Plains Ecoregion. As such, they are an ideal location to assess the extent of latitudinal, longitudinal and elevation-related biogeographic shifts of animal taxa in response to climatic and environmental changes through the numerous glacial and interglacial regimes of the Quaternary. Although Pleistocene faunas are well known to the west in the Intermountain West region and to the east in glacial and pro-glacial terrains, the Black Hills Pleistocene record was unexplored until the discovery of the Mammoth Site deposit in 1974. The karst sinkhole contains the skeletal remains of at least 60 mammoths (*Mammuthus*) along with lesser amounts of other vertebrates. The age of the deposit is now known to date to about 110,000 years old at the top (culmination) of the sinkhole and approximately 200,000 at the 8 m depth of excavation, but another 13 m of deposit remains to be assessed. The Black Hills are a well-known ‘caving paradise’ with extensive exposures of karstic limestone. The Mammoth Site research team is collaborating with local cavers to find and better understand the faunas that are being discovered in these caves. Regional karst/cave deposits preserve unique faunal assemblages and chronologies spanning the most recent 300,000 years. On-going research at several caves (Persistence, Wind, Salamander, Parker’s Pit, Stage Barn, and others) provide insight into biological changes in the Black Hills from the Ice Age–Recent.

CENOTES AND SLOTHS: PLEISTOCENE SLOTH DIVERSITY ON THE YUCATAN PENINSULA, MEXICO

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Knowledge of the fossil record of the tropics is extremely limited reflecting the high rate of decomposition of organic matter and general rarity of conditions that contribute to its preservation as fossils. One of the primary exceptions to this pattern occurs in tropical karstic regions when vertebrate remains accumulate in caves. An excellent example is the Yucatan Peninsula which is an approximately 181,000 km² (70,000 sq mi) area of low relief, almost entirely composed of porous limestone. Processes ranging from acidic water welling up in a semi-circle around the Chicxulub crater, which outlines impact of an asteroid at the end of the Cretaceous, to brackish water dissolving weaker limestone during elevated sea levels of MIS 5e produced extensive karst and cave systems. During the Pleistocene, with the lowering of sea level resulting from formation of the continental glaciers, the water table of the Yucatan Peninsula also was lower. Many of the caves were then open and accessible to Pleistocene megafauna, either as water sources or potential den sites. With the subsequent decline of the glaciers and rise in sea level many of these cave systems became flooded. The development of SCUBA and improvements in technology for cave diving has permitted the exploration of these flooded caves and the discovery of a diversity of Pleistocene fauna. This includes new species as well as taxa from South America not previously known to be present in North America.

One of the better represented groups found in the caves is the ground sloths. Multiple species and individuals of sloths have been found in the near-coastal cave systems of Quintana Roo. In Outland Cave of the Sac Aktun system, the floors of three primary submerged passages »12 m below sea level converge at a 62 m diameter circular collapse chamber, named Hoyo Negro, that drops to depths up to 50 mbsl. Skeletal material of sloths and other species have been found in this natural trap, 600 m from the nearest entrance when it was a dry cave. Articulated skeletons of sloths have also been found in the individual passages. Sloth remains from the Yucatan include representatives of four families, Megalonychidae, Nothrotheriidae, Mylodontidae and Megatheriidae. With at least two genera, Nohochichak and Xibalbaonyx, megalonychids are the most common in number of individuals and taxonomic diversity. The single nothrothere is Nothrotheriops, best known from dry caves in the southwestern United States, which was not expected to be found in the tropics. A single mylodont sloth is also known. It has not been formally identified, although *Paramylodon* has been previously reported from other caves in the Yucatan. While the megathere, *Eremotherium*, is primarily found

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in terrestrial deposits there is one record from a cenote in Belize. Currently, five genera of sloths are known from the Yucatan, giving it a higher diversity of Pleistocene sloths than any other location in North or Central America. This diversity may reflect niche portioning of the tropical environment and changes in species ranges as the vegetation upon which sloths fed shifted in distribution in response to changing Pleistocene climates.

CAVE AND KARST DEPOSITS AND THE NORTH AMERICAN FOSSIL RECORD OF BATS (MAMMALIA: CHIROPTERA)

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Bats are the group of mammals most closely associated with caves. More than half of the 50+ living species of bats from temperate North America (NA) are cave-dwellers in the families Vespertilionidae, Molossidae, Phyllostomidae, and Mormoopidae. Bats that inhabit caves also die in caves, leaving behind their skeletons to become preserved in fossil deposits on the cave floor. During the latter half of the Pleistocene epoch (~1.5 million [Ma] to 10,000 years ago), bats have an excellent fossil record in North American caves, primarily vespertilionids, the most common living bats in temperate NA. A few bats in the other three families are also represented in NA Pleistocene cave deposits, including the extinct vampire bat *Desmodus stocki* (Phyllostomidae), identified from about 10 caves in the southern US. The oldest NA cave deposits containing fossil bats are early to middle Pleistocene (~1.5–0.5 Ma), including an extinct species of free-tailed bat *Tadarida constantinei* (Molossidae) from Hamilton Cave, WV, Mammoth Cave, KY, and Slaughter Canyon Cave, NM. NA Pleistocene cave deposits contain no other extinct bats and otherwise mostly document extant bat species found within their modern ranges. The NA Pleistocene chiropteran fauna tells us little about deep-time bat evolution, such as...When did bats first begin using caves? The majority of NA fossil deposits older than early Pleistocene that contain bats are concentrated in peninsular Florida and are derived from various types of karst deposits, including sinkhole fills, fissure deposits, and isolated sediment pockets. These karst deposits originally formed in caves, but the caves have since been destroyed by erosion. Highlights of the Florida fossil chiropteran record from karst deposits include: Inglis 1A (earliest Pleistocene, ~2 Ma), a fissure fill with seven species of bats, including the oldest NA record of *Desmodus* and the only eastern NA record of the pallid bat *Antrozous*; Thomas Farm (early Miocene, ~18 Ma), a sediment-filled sinkhole containing nine species of bats, including *Primonatalus*, the oldest record of the cave-dwelling, funnel-eared bat family Natalidae; and two Oligocene (~30–28 Ma) fissure fills, I-25 and Brooksville 2, with seven species of bats, including *Koopmaniacteris*, the oldest member of the cave-dwelling bat family Mormoopidae, and *Speonycteris* representing an extinct family (Speonycteridae) of primitive cave-dwelling bats. Although caves and karst deposits are widely distributed in NA, these karst regions, except Florida, lack pre-Pleistocene bats. Our suspicion is that older karst deposits with bats exist elsewhere in NA (as on other continents) but have yet to be discovered, and we solicit cavers throughout the US to help us find them.

NATIONAL PARK SERVICE CAVE PALEONTOLOGY: INVENTORY, DISCOVERY, AND STEWARDSHIP

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The first inventory of paleontological resources associated with National Park Service (NPS) caves was published in 2001. This inventory documented the scope, significance, distribution, and management issues associated with diverse fossils from caves within 35 NPS units. In the two decades since the original inventory was completed, many new and significant fossil discoveries have been made in NPS caves. Highlights include: the first paleontological inventory of Carlsbad Caverns NP, which documented both Permian fossils in cavern bedrock and bones of Quaternary megafauna; reassessments of Quaternary fossils, particularly avifauna, from rock shelters and caves of Channel Islands NP; discoveries of thousands of mummified ice age bats and cranial remains of the extinct Pleistocene American Cheetah at park caves of Grand Canyon NP; documentation of extinct or locally extirpated taxa from caves in Great Basin NP; discoveries of abundant Mississippian fossils, particularly sharks, in cave strata of Mammoth Cave NP and Natchez Trace Parkway; the relocation of the Port Kennedy Bone Cave site in Valley Forge National Historical Park; and an inventory of Neotoma middens from caves across the NPS. The rise of photogrammetry as an investigative technique has been key to facilitating study of in situ specimens in these challenging cave settings. Paleontological resources in caves are now considered as a matter of course during any paleontological inventory work in NPS units. We can expect that many more exciting discoveries will be made in the decades to come.

CHANGES IN SMALL MAMMAL COMMUNITY COMPOSITION OVER THE LAST 25,000 YEARS ACROSS MULTIPLE WESTERN NORTH AMERICAN CAVE LOCALITIES

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Natural Trap Cave (NTC) is an 80-foot deep karst sinkhole located at the base of the Bighorn Mountain range in Wyoming, USA. An exceptional fossil record of microfaunal remains are found from well-stratified layers in the cave stretching back 30,000 years ago, before the end-Pleistocene megafauna extinction, up until a few hundred years ago. While

many studies have examined how communities respond to environmental changes in a single location through time, few have observed how community responses vary across different habitats. We compared standardized richness, evenness, and relative abundances, using NISP (number of individual specimens), of the small mammal communities from NTC, Samwell Cave, Two Ledges Chamber, and Homestead Cave to observe how small mammal communities shifted through time across diverse landscapes. Results from a PCoA found that NTC and Samwell Cave were more similar to each other than to Homestead Cave and Two Ledges Chamber. Despite differences in local environments, open and arid at NTC and closed and forested at Samwell Cave, small mammal accumulation at both these caves are the result of packrat midden collection. Richness and evenness were then compared between NTC and Samwell Cave. We found that evenness decreased at both caves from the Late Pleistocene to the Late Holocene. Richness also decreased through time at Samwell Cave but increased through time at NTC, though this may be influenced by small sample sizes in the Late Pleistocene. High evenness and richness are good indicators of a stable community, meaning small mammal communities may be threatened in the modern.

FOSSILS FROM CAVES: A GUIDE TO RECOGNIZING, DOCUMENTING, AND PRESERVING PALEONTOLOGICAL RESOURCES

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From large cat tracks to giant ground sloth skeletons, dire wolf dens to packrat middens, and natural traps to massive piles of guano, caves provide a wealth of information about past life. In fact, if it weren't for caves and other fossil bearing karst deposits, our understanding of terrestrial life over time would be severely hampered. Some of this life, such as most of North America's megafauna, went extinct near the end of the Pleistocene Epoch. Other life survived this extinction event, but climatic and environmental changes led to dramatic shifts in animal distributions, and these too are recorded in caves. Of particular interest from a cave perspective, many of the large mammals that are now extinct actually inhabited caves, using them for dens or to extract resources. Thus, the cave life we observe today is depauperate, a reduced fauna that coexists with fossil remnants of its greater diversity, exemplified by bones and other traces from the past. Despite the importance of these paleontological resources for science, most paleontologists that work on cave faunas are not cave explorers themselves. Instead, new discoveries are typically made by cavers and cave divers who encounter remains or traces of animals while exploring or surveying voids in the subterranean world. Although such encounters are relatively common, many of these explorers are uncertain how to record and report paleontological discoveries when they occur. This presentation targets cave explorers, and reviews the general types of fossils found in caves. In addition, standards are provided for recording, reporting, and preserving these resources for future generations and scientific research.

REVIEW OF LATE PLEISTOCENE AND EARLY HOLOCENE VERTEBRATE FAUNAL RECORDS FROM CENTRAL TEXAS CAVES AND CONTEXTUALIZATION WITHIN PALEOCLIMATIC AND ARCHAEOLOGICAL CONTEXTS

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The Edwards and Stockton plateaus in central Texas have been the subject of extensive paleoclimatic, paleoecological, and archaeological investigation since the mid-twentieth century, with the efforts of this work yielding over 700 publications that include information from hundreds of different sites. Of this multitude of localities, 29 are caves containing some sort of late Pleistocene or early Holocene vertebral faunal component. I compiled published data from these vertebrate cave faunas across the Edwards and Stockton plateaus as well as records of invertebrate faunas, palynology, and archaeology from the plateaus. I also compiled relevant paleoclimate reconstructions from across the state of Texas with the goal of synthesizing those records and reconstructions to understand if and how climate had an impact on the flora, fauna, and past human settlements in central Texas during the late Pleistocene and early Holocene. Though numerous records of vertebrate fauna, invertebrate fauna, pollen, human settlements, and paleoclimate in central Texas exist, only a small percentage are temporally extensive or in well-dated contexts. In addition, the different methods for age constraint (e.g., U-series, radiocarbon, faunal assemblage, archaeological style) and periodization of time make actual comparisons between these records and reconstructions nontrivial. Ultimately, more work to resolve the temporal disparities among these various types of records is needed before plateau-wide comparisons and contextualization can be completed.

A NEW LATE PLEISTOCENE/HOLOCENE FAUNA FROM A CAVE IN UVALDE COUNTY, TEXAS

Doug Shore

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Texas is well known for its great number of limestone caverns. Over the last century a large number have been demonstrated to contain late Pleistocene faunas, including Friesenhahn Cave, Inner Space (Laubach) Cavern, and Eagle Cave. Recent work by Texas Through Time has led to the discovery of a new Pleistocene/Holocene fauna in a cave on Ox Ranch, Uvalde County. The cave consists of a single expansive chamber with a single massive debris cone and a secondary chamber branching off. Presumed Holocene subfossils have been found on and just below the surface. A test pit uncovered older fossils in a deeper layer dated to ca 45,000 year BP through geo luminescence dating. The Holocene remains recovered consist of reptile, avian, and mammal remains consistent with the modern local fauna. Older remains recovered thus far include snake, bat, rodent, and lagomorph. A tooth and limb fragment attributed to Equus sp. (horse)

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as well as a large unidentified fragment indicate the potential for macro fauna in the assemblage. This new assemblage has the potential to further illuminate our understanding of life in the late Pleistocene of the southern United States and how it has changed through time. Future plans are to excavate the known deposits further as well as search for others in yet unexplored sections of the cave.

THE PETRA PROJECT: EXCAVATION OF A LARGE CAT SKELETON FROM BURJA CAVE (VIRGINIA, USA)

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In 2016, deep within Burja Cave, cavers discovered a nearly complete skeleton of a large cat in southwestern Virginia. This specimen, nicknamed Petra by the cavers, would provide a key record for paleontological study, but first it needed to be removed. Multiple methods of excavation were planned; however, preservation was very different from what was anticipated. A hard crust of calcite was deposited onto the skeleton over time and some calcite was deposited within bones as well. While this further solidified the bones, it also made them impossible to separate. Controlled breaks were made to get the skeleton into sections small enough to be safely removed from the cave. Each segment of the skeleton was carefully wrapped in layers of toilet paper and foam, then either placed within a hard case or extra layers of thick foam braced with splints. A team of eleven cavers transported materials and the cat from Burja Cave to its final destination at the Virginia Museum of Natural History, where study of this incredible specimen could begin. The Petra Project would not have been possible without the tremendous support of the Cave Conservancy of the Virginias, the Virginia Department of Conservation and Recreation Division of Natural Heritage, the Virginia Museum of Natural History, the Science Museum of Minnesota, the U.S. Forest Service, and, most importantly, the cavers.

EVOLUTION AND BIOCHRONOLOGICAL SEQUENCE OF PLIO-PLEISTOCENE MAMMALIAN FAUNAS FROM JINYUAN CAVE AT LUOTUO HILL IN NORTHEAST CHINA

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The Jinyuan Cave at Luotuo Hill, discovered in 2013, is enormous in size with a sedimentary thickness of over 40 m. Systematic excavations of the Jinyuan Cave deposits conducted by the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences during the past few years have yielded abundant, diverse, and well-preserved vertebrate fossils from multiple layers. Based on a combination of biostratigraphic and geochronological evidence, the fossil assemblages from Jinyuan Cave are divided into four successive faunas that span the Late Cenozoic (ca. 3.60–0.35 Ma): the Wanghai fauna from upper unit (Middle Pleistocene, 0.78–0.35 Ma), the Jinyuan upper/lower fauna from middle-lower unit (Early Pleistocene, 2.58–0.78 Ma) and the Luotuoshan fauna of the bottommost unit (Late Pliocene, 3.60–2.58 Ma). Accordingly, the mammalian faunal evolution of Jinyuan Cave has also been divided into four temporal stages from the Late Pliocene to the Middle Pleistocene. The diverse fossil assemblages from Jinyuan Cave provide an outstanding opportunity to conduct multidisciplinary studies combining traditional paleontology, paleoanthropology, geochronology, and paleoenvironmental sciences.

JEFFERSON'S GROUND SLOTH (*MEGALONYX JEFFERSONII*) FROM ACB-3 CAVE, COLBERT COUNTY, ALABAMA

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Jefferson's Ground Sloth (*Megalonyx jeffersonii*) is one of the most geographically dispersed giant ground sloths with a range from northern Mexico into the Yukon. Many individuals have been discovered of *M. jeffersonii*, but only a handful of sites have contained more than one and even fewer sites from caves. Excavations in the mid-1980s of ACb-3 Cave in Colbert County, Alabama, by the Red Mountain Museum of Birmingham, uncovered the remains of multiple *M. jeffersonii* individuals. The original excavation team suggested as many as sixteen, but a subsequent minimum number of individuals analysis indicated only 7. This, however, still represents a large sample of individuals from one locality. Not only is it unique in number of individuals, but the sloths ranged in age from infant to adult. Now residing at the McWane Center in Birmingham, Alabama, four individuals of *M. jeffersonii* from ACb-3 Cave representing four different age classifications were chosen for study. These individuals were fully prepared, described, and examined for pathologies. The sloths were then compared to one another to determine what morphological changes are exhibited in the osteology from birth through maturity. This included a direct comparison of an infant and adult ground sloth skulls. Statistical morphometric software was used to visually depict these changes in morphology showing a unique shape change in mammalian growth. A nearly complete adult ground sloth was also compared to ground sloths from other North American localities to get a better understanding of how it relates to other *M. jeffersonii*. Due to pathology evidence and the range in age of individuals, ACb-3 Cave may provide the best-known evidence of cave denning and possible maternity use by *M. jeffersonii*.

NATURAL TRAPS, SHELTERS OR WHAT REMAINS OF DINNER: WHY ARE FOSSIL PRONGHORNS (MAMMALIA: ANTILOCAPRIDAE) FOUND IN CAVES?

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We examine the record of fossil pronghorn (Mammalia: Antilocapridae) bones found in caves throughout the intermontane western United States and in Mexico, noting the species present and their distribution in time and space. We review previously published explanations for pronghorn fossils found in caves. We then examine population structures, taphonomic factors, preservation biases, and abundance in order to identify patterns in the record which can resolve those different explanations. We focus on Pleistocene (Ice Age) sites known from Arizona, Colorado, Nevada, New Mexico, Texas, Wyoming, and in Mexico for the broader perspective and on three species of pronghorns from late Pleistocene (Rancholabrean) sites in particular for a narrower perspective: the extinct Stock's pronghorn *Stockoceros conklingi* from Papago Springs Cave in Southern Arizona and San Josecito Cave in Nuevo Leon, Mexico, the extant pronghorn *Antilocapra americana* from Natural Trap Cave in Wyoming, and the dwarf pronghorn, *Capromeryx furcifer*, from multiple sites.

CKRIT: THE CAVE AND KARST RESOURCES INFORMATION TRACKING DATABASE

Georgia Schneider, CKRIT Intern, NPS

Secret Agent Intern for the NPS

The NPS is moving into the 21st century and creating a geocentric database for NPS units with caves and karst resources. The Cave and Karst Resources Information Tracking database (CKRIT pronounced secret) development is in its infancy. The goal of the national database will be to provide a secure database for geocentric management of cave resources to individual parks. The challenge will be to develop a comprehensive but flexible database that is secure for each cave resource office while providing upper level management information for reporting purposes (numbers and types, but not locations).

NPS: NATIONAL CAVE AND KARST PROGRAM COORDINATOR

NCKRI: DIRECTOR OF CAVE AND KARST MANAGEMENT SCIENCE

Patricia E. Seiser, PhD

Geologic Resources Division, US National Park Service, Natural Resource Stewardship and Science Directorate
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Update on status of the NPS Cave and Karst Program and NCKRI's programs.

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SPELEO-RODEO



BIOSPELEOLOGY SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

THE WEIRD MICROBIOLOGY OF THE MULU CAVES, BORNEO

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During the 2019 Mulu Caves Expedition in Borneo, we carried out a preliminary assessment of a number of unusual features common to these caves to determine whether microbial activity was involved in their formation. This initial work was geared at examining four formations: phytokarst and phytokarren (the curved stalactites at cave entrances), white encrustations, and a unique fluted erosion. Of these features, only the phytokarst and phytokarren had a demonstrably significant biogenic component, while the white encrustations were either calcite or nitrate deposits. The most interesting feature unique to the Mulu caves were the fluted surfaces, which appear to form through the microbial decomposition of swiftlet guano. This decomposition appears to produce a strong acid, possibly nitric, that leads to highly aggressive dissolution of the host rock. Such acid production may also explain the rapid degradation of nylon ropes rigged in the caves. These preliminary field observations suggest that there is a significant, but undescribed microbial ecosystem within the caves, driven by the temperatures, humidity and uniquely high levels of organic carbon input by swiftlets.

THE MICROBIOLOGY OF THE GROTTEDAL CAVES OF GREENLAND

Hazel A. Barton, George J. Breley, M. Paul Smith and Gina E. Moseley

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During the Northeast Greenland Caves expedition to Grottedal, Kronprins Christian Land, at 80°N, over 20 caves and dissolutional features were identified. Despite the sub-freezing temperatures, desiccating conditions, and poor organic content of these caves, we examined them for evidence of microbial activity and found significant evidence of microbial activity, dominated by photosynthetic species in near-entrance zones. This included the presence of extremophilic green algae (chlorophytes), along with cyanobacteria that formed photokarren. Other microbial activity was observed indirectly, including microbialites and iron-oxide deposits, which may indicate microbial contributions to speleogenesis when the region was warmer and cave development was occurring. The Grottedal area and caves have several environmental features in common with Mars: a polar desert under desiccating, low-light conditions and could provide an important testbed for future astrobiological investigations and instrument development.

MORE THAN SPELEOTHERMS: MEASURING AND MAXIMIZING MICROBIAL CALCIUM CARBONATE PRECIPITATION

Reilly Blackwell, George Breley, Hazel A. Barton

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Pure calcium carbonate is a valuable material for a wide variety of industrial uses and is primarily sourced by mining or quarrying, which is costly and environmentally destructive, and it threatens karst all over the world. There is an alternative: microbially influenced calcium carbonate precipitation (MICP) produces very pure calcium carbonate (CaCO_3). Bacteria in caves use MICP to deal with the environmental stress of high Ca^{2+} ions when they grow, using atmospheric CO_2 to create the carbonate. We have been able to create conditions in the lab where we can make the model bacteria *Escherichia coli* precipitate CaCO_3 . Using the information we know about the cave environment, we have investigated ways to increase microbial carbonate precipitation, create new methods to determine the efficacy of precipitation, and investigate the effects of other factors such as buffers, carbon dioxide concentration, and temperature on MICP. These efforts inform the design and construction of a bioreactor (a closed system with bacteria continuously producing CaCO_3) to produce microbial CaCO_3 precipitation at an industrial scale.

HAWAIIAN LAVA TUBE BIOLOGY ALONG THE SPACE-TIME CONTINUUM, THE NEXT GENERATION

Annette Summers Engel¹, Megan L. Porter², Rebecca A. Chong², Alan G. Hudson², Michael E. Slay³,

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Hawai'i island has the longest lava tubes in the world and diverse cave-adapted invertebrate species, although most subterranean habitats remain unexplored and many species have not been formally described. New biological surveys from 2015 through 2022 (not including 2020) in lava tubes on Kīlauea, Hualālai, and Mauna Loa volcanoes uncovered new species and expanded the known geographic distributions for some taxa. Of the >1100 person-hours of search effort from 65 different lava tubes sections of different geologic ages, geographic locations, and elevations, the most common cave-adapted fauna encountered included cambalid millipedes, erebid moths, trigonidiid crickets, cixiid planthoppers, lycosid spiders, philosciid isopods, talitrid amphipods, reduviid threadlegged bugs, mesovellid cave treaders, and carabid

beetles. We also documented non-cave fauna and invasive species, which is critical for assessing potential ecological threats to the ecosystems. Exposed roots of native 'ohi'a lehua trees support the cave ecosystems, from which at least four trophic levels exist based on stable isotope ratio analyses. Of >1500 lots of specimens collected to date, at least six new species have been identified from lava tubes on Mauna Loa. Abundance surveys in root and non-root areas in 10 different sections revealed repeated spatial patterns where cave taxa were more abundant in the deep cave compared to near entrances, regardless of root occurrence. Some taxa (e.g., *Oliarus* spp.) dominated within-root communities, with nearly 20 individuals per patch. These findings reinforce that these subterranean ecosystems are complex and develop similarly across the space-time continuum. Proper identification and description of new species and population distributions are essential to discovering high-priority areas for conservation and protection.

UVC TO CONTROL WNS: LIMITATIONS AND EFFECTS ON MICROBIAL COMMUNITIES IN CAVES

Kathleen Lavoie, Anna Pittis, Christopher Gallegos, Alice MacComb-Coubrey, Eric Dinger, Rick Toomey, and Diana Northup

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The *P. destructans* fungus that causes WNS in bats is very sensitive to the effects of UVC radiation. Using UVC has several limitations; it is physically shadowed by any objects (tan lines), and is shielded by cells absorbing the irradiation. As part of a larger study of testing the potential of UVC to control *P. destructans* in caves, we also looked at the UVC sensitivity of native microbes cultured on low nutrient media from the study caves to evaluate possible collateral damage to the microbes at the base of the food chain in caves. We cultured microbes from three NPS caves: Oregon Caves National Monument & Preserve (ORCA), Mammoth Cave (MACA), and Lava Beds National Monument (LABE). We selected unique isolates from each cave (ORCA n = 83; MACA n = 84; LABE n = 89) and tested their sensitivity to UVC at doses of 0, 0.62, 1.24, and 2.48 mJ/cm². We found that the majority of isolates was very resistant or resistant to UVC, with ORCA having more sensitivities and MACA the most resistant isolates. While several bacterial genera overlapped across the three parks to differing degrees, there were 25 genera that only occurred in one park's caves. Future plans include work at three cave sites in MACA in July to field test the utility of UVC at reducing *P. destructans* in the environment while minimizing collateral damage to native microbes. Our results will shed light on the advisability of using UVC to eliminate *P. destructans* in caves.

THE EFFECTS OF SURFACE WILDFIRES ON MICROBIAL COMMUNITIES IN LAVA CAVES?

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Wildfires can cause devastating impacts on surface vegetation and soil microbial communities, but do they impact microbial communities in shallow lava caves? Lava Beds National Monument (LABE), home to over 800 hundred lava caves, experienced devastating wildfires in 2020 (Caldwell Fire) and 2021 (Antelope Fire) that burned more than 90% of the surface environment. Previous studies of the impact of wildfires on surface soil communities demonstrated dramatic shifts in the bacterial soil community composition. To test whether wildfires would impact microbial communities in lava caves that are a few meters below the surface, we sampled in four LABE lava caves in burned areas. We had previously sampled these four caves in 2017-2019 in a NASA-funded project to study analog sites for the search for extraterrestrial life. Sample sites included more microbial features (microbial mats and ooze) and more mineral features (mineral crusts, coralloids, polyps), as well as a surface soil sample above each cave. To test changes in the microbial communities, we extracted DNA and conducted Illumina next gen sequencing that targeted bacterial and archaeal inhabitants of these different sample sites, to compare them to sites sampled in December 2021. The results of our study will elucidate the impact of surface wildfire on subsurface lava cave microbial diversity.

MICROBES OF THE BARTON SPRINGS SEGMENT OF THE EDWARDS AQUIFER, TEXAS

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Understanding the microbial diversity and functional roles of aquifer ecosystems can lead to better conservation, protection, and management efforts by maintaining water quality and stygobiont biodiversity. The Barton Springs Segment of the Edwards Aquifer, in south-central Texas, has one of the most biodiverse stygobiont communities in the US, but the microbiology has not been described. The Edwards Aquifer is comprised of three hydrologically separated segments with geochemically diverse zones. In the San Antonio Segment of the Edwards Aquifer, chemolithoautotrophic microbial communities support stygobiont communities and we hypothesized that comparable chemolithoautotrophs provide energy and food for the Barton Springs stygobionts. To quantify microbial diversity, we analyzed water geochemistry, 16S and 18S rRNA gene sequences from 19 wells, four springs, and three creeks near Austin. We used metagenomics from five representative wells and springs to assess metabolic potential. Freshwater wells and springs ranged from 300 to 600 mg/L total dissolved solids (TDS) and 3.6 to 7.5 mg/L dissolved oxygen (DO), but saline wells ranged from 1,200 to 9,000 mg/L TDS and had 0 to 1.9 mg/L DO. Although the phyla Bacteroidota, Firmicutes, and Proteobacteria were present in all samples, diversity among site types (i.e., spring, creek, freshwater well, saline well) was significantly different and correlated with DO, ammonium, and sulfate concentrations. Spring microbial communities had the greatest variability. In Old Mill Springs, saline water contributes to the flow, and the microbial communities

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were more similar to saline well communities, in which Firmicutes, Nitrospirota, and Desulfobacterota dominated. Based on metagenomes, chemolithoautotrophic microbes were relatively more abundant in springs, freshwater, and saline wells than in creeks. Specifically, freshwater wells were comprised of nitrate-reducers and ammonia-oxidizers, but saline wells were comprised of sulfate-reducers, nitrate-reducers, and chemolithoautotrophs. Our results indicate that chemolithoautotrophy is present across the aquifer, but microbial diversity and metabolic potential vary with geochemistry.

HYPORHEIC STYGOBIANT DIVERSITY AND DISTRIBUTION IN TEXAS, USA.

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Previous stygobiont diversity and distribution work has primarily focused on karst aquifer habitats. Seven years of sampling in diverse hyporheic habitats across the state of Texas, USA supports the notion that stygobiont diversity and abundance are generally related to proximity to karst and sites with 'karst-like' physicochemical properties. However, stygobionts have also found in diverse non-karst groundwater-dependent and hyporheic habitats.

Hundreds of samples at 130 sites span hydrologic gradients from isolated desert and mountain-top seep springs, to large, coastal-plain rivers. These sites also represent ranges and gradients in substrate permeability, physicochemical properties, geologic substrates, hydrologic disturbance, connectivity to karst, discharge, latitude, temperature, precipitation, and anthropogenic disturbances. Current and future work includes nested reach-scale, watershed-scale, and state-wide studies, as well as microbiological characterization to identify relationships with nutrient cycling and redox conditions. We conclude that many stygobionts have larger ranges than previously documented, can be exceptionally abundant in some hyporheic samples (relative to wells and caves), and occupy diverse sites and habitats previously deemed unlikely for stygobionts. Ranges for described taxa are expanding, and new taxa are being discovered at a rate that exceeds our ability to describe them. Results of this work are needed by resource managers, for species status assessments, and for species and habitat conservation, and can be used to guide future investigations at non-karst sites.

LIFE HISTORY PATTERNS OF THE ENIGMATIC CAVE SNAIL, FONTIGENS ANTROECETES, REVEALED THROUGH CAPTIVE BREEDING UNDER SIMULATED CAVE CONDITIONS

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The Enigmatic Cavesnail, *Fontigens antroecetes*, is a cave adapted Hydrobiid snail listed as state endangered in Illinois. It is known from only one cave in Illinois, Stemler Cave, and from several caves in the eastern Ozark ecoregion of Missouri. Little is known about the snail's reproductive habits, embryological development, or growth rates. I attempted to gain basic life history information by breeding Enigmatic Cavesnails under simulated cave conditions in the laboratory. Six adult snails were collected from Stemler Cave and held in aerated containers of cave water with one or two rocks from the cave stream. Containers of snails were housed in incubators set at the average cave water temperature of 13°C. The snails produced 49 embryos in captivity over the course of 34 weeks. Eggs were deposited singly, attached to the underside of rocks within small pits or crevices. Nearly 82% of embryos developed to hatching. Mean estimated development time of embryos was 70.7 days. Survival of hatchling snails was poor. Limited data available from surviving hatchling snails suggests slow growth rates. The process was replicated with nine Enigmatic Cavesnails collected from Cliff Cave in St. Louis County MO. Captive Cliff Cave snails produced 32 embryos over 46 weeks and varied from the Stemler population in their oviposition behavior, with a majority of eggs deposited on the top surface of rocks. Cliff Cave snail embryos also had longer mean estimated development times (82.8 days).



SPELEAN HISTORY ABSTRACTS

(listed in alphabetical order by presenting author)

A CAVE THROUGH TIME: HISTORIC ARCHAEOLOGY AT MAMMOTH CAVE, KENTUCKY

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Mammoth Cave, located in southern Kentucky, is the longest known cave in the world, with 420 miles of mapped passages. In addition to being a geological wonder, it has been visited by humans for thousands of years. Many projects have focused on the prehistoric archaeology of the Historic Entrance to the cave, but none have focused exclusively on the historic archaeology of this site. This presentation will seek to shed some light on the overlooked history and archaeology of the cave's historic period. The chronology of human modifications at the Historic Entrance, from saltpetre mining in the early 1800s to the development of tourist infrastructure during the twentieth century, will be considered. Particular attention will be given to the records of an ice house located at the Historic Entrance sometime between 1839 and 1847, as well as to the fifty-foot pit referenced in Edmund Lee's 1835 map of the cave. The development of the gate and steps, from

1835 to the present, will also be discussed. Several conclusions can be drawn from this study. Firstly, historical records are often frustratingly vague. Secondly, archaeology can be used to fill in the gaps in the historical record. And finally, the history of the mundane, such as that of the steps and gates, is often lost or ignored.

Taken together, these point towards the benefits historical archaeological studies can bring to our understanding of the history of human interactions with, and modifications to, cave environments.

The Maps of Mammoth Cave from the 1810s

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The first three maps of Mammoth Cave were all made in the 1810s and reflect the evolving uses of the cave during that decade. None of the original maps is extant, but we know what each looked like from two or three contemporaneous copies. The original "eye-draught map" was made to interest investors in the cave as a saltpeter mine. The Ridgely, DuPont, and Jefferson manuscript copies of the eye-draught map were each drafted by future botanist Charles Wilkins Short, namesake and nephew of one of the cave's co-owners, and sent to interested parties back east. The "saltpeter working map" was used by saltpeter miners to assist the mining effort during the War of 1812. It was initially drafted by Aylette Buckner in 1812 and copied by Thomas Jefferson. As the miners' exploration progressed, the map was expanded by c. 1814 as shown by the Bogert manuscript copy, from which Samuel Mitchell made a woodcut that he published in spring, 1815. The Egnew manuscript copy in January 1817 added additional information. The original "Ward" map was drafted by Nahum Ward in c. April 1816, about five months after he visited the cave, to create publicity and encourage visitors from back East. Ward's map or a copy was received by a Worcester Massachusetts newspaper in May 1816, but the map's first publication was a woodcut print in the Boston Intelligencer newspaper in October, 1816. A manuscript copy of the Ward map at the American Antiquarian Society in Worcester is the most faithful copy of Ward's original map and may be the one earlier received in Worcester. The content of the copies of the three original maps, comparisons among and between them, and the circumstances of their creation all offer insight into the early historical exploration, mapping, and uses of Mammoth Cave.

HOW TO GROW A CAVE HISTORY BOOK

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If you have ever been involved in exploring and surveying a significant cave, you have probably heard the comment, "Somebody should write a book about this project!" If you enjoy writing, it might occur to you that the "somebody" should be you. Where do you start, and how do you progress to a favorable outcome? As in planting a garden, you need healthy seeds (the initial idea), rich soil with lots of nutrients (survey notes, trip reports, photographs, and first-person interviews), frequent cultivation and weeding (editors, proofreaders, critics), and plenty of time to wait for the harvest (nothing about writing a book occurs quickly, or on a rigid schedule). Once you decide to begin this venture, you may find it to be both easier and more difficult than you had anticipated, but it will certainly be interesting. Before I wrote *The James Cave Project: Sixty Years Inside Bald Knob*, a 500-page volume published by the NSS in late 2020, I gathered information from many sources, talked to lots of individuals, and spent three weekends poring over the archives of the NSS library. After at least two years, with more data constantly appearing, I put together an outline and began to write. I was fortunate to have a non-caving but tech-savvy sister who volunteered to do the layout, arrange photos, and prepare a file for the printer. It was difficult to find competent proofreaders so I did most of this myself, with the expected result of several errors making their way into print. The NSS did an excellent job of publishing, and the first 100 copies sold in just a few months. If you decide to preserve your project's history, go for it! You won't get rich, but your harvest will be invaluable.

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COLORADO'S CYCLOPEAN CAVE "HOAX": WHERE HISTORY WENT WRONG

Donald G. Davis dgdavis@nyx.net

At the very inception of organized caving in the state, we were told that Cyclopean Cave was a hoax. In 1952, in the new Colorado Grotto's News & Notes, at the bottom of the state's first cave list, Grotto founder William R. Halliday took pains to state "Cyclopean Cave and Red Cliff Cave do not exist. They were invented by a bored newspaper reporter [Orth Stein] in Leadville in the 1880's." The same judgment was made in Lloyd Parris's Caves of Colorado in 1973 in a chapter titled "Hoax, Humbug, and Orth Stein," by Lake County historians Don and Jean Griswold as late as 1996, and others. Red Cliff Cave, a.k.a Lost Ship Cave, was indeed a self-evident hoax. However, close examination of the series of articles about Cyclopean Cave, following soon after Lost Ship, has shown to the satisfaction of Richard Rhinehart and myself that Cyclopean Cave does exist. Nothing Stein wrote about it was preposterous. We found that personal names in the stories were actual Leadville citizens in credible roles, and references continue for some years afterward. The stories give sufficient location detail that we have been able to find an abandoned vertical mineshaft matching the description of the Cyclopean entrance, though proof will require digging out an air-blowing blockage at the bottom. Stein's prior Lost Ship Cave hoax set the stage for suspicion of Cyclopean, but the final nail in its coffin was a dramatic declaration in a 1910 memoir by Stein's former editor C.C. Davis that Cyclopean was "fiction from headlines to tailpiece." Subsequent historians accepted this claim and dug no deeper. But Davis wrote that 30 years later, when old and ill, without using notes or references. The original sources tell us otherwise.

PRE-1820 HISTORIC GRAFFITI IN MAMMOTH CAVE, KENTUCKY

Joseph C. Douglas (Volunteer State Community College)

Joe.Douglas@volstate.edu

Marion O. Smith (Independent Scholar)

Although Mammoth Cave has many thousands of historic graffiti, the authors have only documented about twenty-five with dates prior to 1820. They are located in the major upper-level passages, including Broadway, Little Bat Avenue, Cyclops Gateway, Gothic Avenue, Indian Avenue, the Cataract, and Ganter Avenue. On both Standing Rock and Looking Glass Rock, pre-1820 graffiti are placed near (or on top of) conspicuous Native American art panels. However, others are in less accessible areas such as the small side passages related to Ganter Avenue. Three of the wall markings, from 1798, 1806, and 1811, may be inauthentic, mismarked, or represent birth dates. Another graffito, from November 13, 1811 by George Brown is probably authentic, as are the dozen or so marks from 1812, the most in the era. We documented single inscriptions from 1814 and 1816. Multiple visitors wrote their names in 1815, 1817, 1818, and 1819. Only a few have been identified, but it appears the post-1815 cave writers were primarily tourists, while some of the earlier visitors were more closely tied to the cave, including Hyman Gratz (the co-owner) and Aylett Buckner (from Hart County), as well as members of the Slaughter, Croghan, and Gatewood families. We know the names of several other visitors on the same trips. Some early graffiti are initials, just years, or illegible. There are also undated names near the inscriptions which may be contemporaneous. No names of saltpeter miners have yet been identified, nor graffiti from early female visitors. Additional early wall markings are likely present but have been obscured by later overwriting.

JULES VERNE AND THE RUHMKORFF LAMP: A BRIEF HISTORY OF UNDERGROUND LIGHTING DEVICES

Dr. Cato Holler, NSS 7087 hollers2@frontier.com

Ever since primitive man first discovered fire and began fashioning torches of various kinds to illuminate his cave, the evolution of underground lighting has taken a long and sometimes convoluted pathway to where we are today. Torches, candles, various oil lamps, kerosene and Coleman lanterns, and carbide of course were all key steps in this early evolution of underground lighting. With the advent of electricity, things became much brighter. One of the more novel devices to come along was the Ruhmkorff lamp. Daniel Ruhmkorff, a German instrument maker, perfected, patented, and popularized the induction coil in 1851. Alphonse Dumas and Camille Benoit later took Ruhmkorff's coil and by combining it with Bunsen cells and a gas filled Geissler tube, invented a portable mining lamp. In 1858 Ruhmkorff was awarded the first Volta Prize from Napoleon III for his contribution toward the application of electricity. In 1864 (the same year in which Jules Verne's Journey to the Center of the Earth appeared) Dumas and Benoit received an award from the French Academy of Sciences for their invention, the Ruhmkorff Lamp. Verne always enjoyed incorporating the latest technology in his novels, so was quick to have his characters using the Ruhmkorff lamp in From the Earth to the Moon, also by Captain Nemo in 20,000 Leagues Under the Sea, and of course by the intrepid explorers in Journey to the Center of the Earth. In reality however, Ruhmkorff's lamp was rather dim, somewhat fragile, and expensive. The advent of the incandescent lamp paved the way for Edison's mining lamps, and such mining essentials as the Koehler Wheat Lamp. Modern LED devices are commonplace now, and I'm sure even Jules Verne would be quite impressed!

THE NATIONAL CAVE MUSEUM & LIBRARY, PARK CITY KENTUCKY

Gordon L. Smith Jr. (NSS 8847) glstis@aol.com

John M. Benton (NSS 10689) jmbenton1952@gmail.com

Groundbreaking for the National Cave Museum and Library occurred on October 20, 2015, at Park City Kentucky, on the grounds of privately owned Diamond Caverns, adjacent to Mammoth Cave National Park. Construction started June 2016 and finished in the fall of 2017. The current building has 4,800 square feet of floor space and future expansion is possible. The museum is the culmination of NSS caver Gordon Smith and his speleothem collection originally started in

1968. Thousands of cave related items are in the museum. Some examples are the William Halliday and Horace Hovey collections and the original 1812 Mammoth Cave saltpeter vat. Items on display and available for research include books, brochures, postcards, newspapers, stereo views, etc. Over 200 carbide lights are on display. There are large collections of various grotto newsletters from all over the United States. Some items are on loan to the Museum, such as the actual 26 pound rock that pinned Floyd Collins, and the restored Mammoth Cave stagecoach. The National Cave Museum is a 501(c)(3) Private Operating Foundation and it is managed by a Board of 11 Directors. The museum is funded by Diamond Caverns which is 50% owned by the Museum. It is not open to the public on a regular basis, but is available to anyone by prior appointment. The Museum is located at exit 48 on I-65 in Park City, Kentucky, and the website is www.cavemuseum.org.

EXPLORATION OF BLACK HILLS CAVES

Adam Weaver – NSS 62352RL/FE adam@caves.org

It is well known that the Black Hills contain two of the world's longest caves, (Wind Cave and Jewel Cave) each more than 160 miles in length. These caves are part of a less publicized karst landscape which encircles the Hills with hundreds of unique cave systems, each holding its own exciting discoveries and stories. This presentation will cover the exploration of caves in the Black Hills, focusing on the history of the explorers past and present. This is a non-comprehensive look at the cavers who led each era of Black Hills caving from Alvin McDonald being the main explorer of the 1890s to today with Austin/Ohms/-Emanuel/Pelczarski/Weaver, all playing different roles in exploration. While this presentation focuses on the explorers, we will also look at the sub-regions of the hills and how each era had a different focus of work, leading to what we know today. This is an effort in chronology and in many ways the personalities that shaped caving in the hills

CAVE PHOTOGRAPHY SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

CAVE DOCUMENTATION WITH PHOTOGRAPHY

Peter Bosted, ivs17hi@gmail.com

The old adage, "a picture is worth a thousand words", is particularly applicable to the underground environment. A well-catalogued photo set can provide an order-of-magnitude increase in the information available from a traditional cave map, without going to the resource-intensive procedure of photo-gramitic mapping. To be useful, each photo needs to be accompanied by meta data. My solution is to make a spreadsheet which includes the nearest survey station, which way the camera was pointing, names of models, prominent features in the image, and date, a unique code for each image, as well as if the image was taken in 3D or 2D, type of lighting, and of course, the name of the cave. I will provide some examples of how this archive has proved useful in recent years.

FOCUS STACKING TECHNIQUES FOR CAVE PHOTOGRAPHY: IN-CAMERA VERSUS POST-PROCESS IN PHOTOSHOP

Dave Bunnell, davebunnell@comcast.net

Depth of field is often problematic when shooting masses of cave formations like helictites, or especially macros of smaller crystals. Use of smaller apertures is the standard way to try and deal with this but when working close to the subject this may not be adequate. In recent years focus stacking has become a popular technique though not commonly used by cave photographers. Stacking involves shooting a series of images with the focus point varied from the closest to the furthest point in the range. This can be as simple as two photos or as complex as a dozen or more, especially if shooting a macro. The resulting images can be combined in Photoshop, with a blend mode that pulls the sharpest portions out of each image in the stack. Problems with this approach are that the camera should ideally be on a tripod and the lighting needs to be consistent across frames. In recent years some digital camera models have incorporated focus stacking into the cameras. I recently tested this out in the Panasonic LX-10 which offers in camera focus stacking in post. This talk will compare results done with the camera versus using Photoshop, and some approaches for doing focus stacking in cave photos.

USING THE GODOX AD200PRO

Kenneth Ingham, kingham@ara.com

The Godox AD200Pro is a flash that is about the same size as high-end camera speedlights, but with several times the power. It has several features that make it a great cave photography light. It is high power, can be used with a bare bulb for all-around lighting, and has power control from 1/256 through full power. A large collection of lighting modifiers are available, increasing lighting options. In this talk, I will compare and contrast with traditional speedlights, and show and demo the flashes and some of the modifiers.

3D TO 2D CONVERSION

Michael McEachern, cave3d@msn.com

Changing 3D formats can make it difficult to keep up with the technology which is moving toward the metaverse and VR. Sometimes it is more convenient to use standard 2D projection when presenting caving to the general public. The current widescreen 1920 by 1080 pixel TV and computer monitor format is a target for re-visualizing vertical, square and rectangular 3D formats.

ABSTRACTS

PHOTOGRAPHING BATS

Eugene Vale, eugenevale@socket.net

Always a challenge, special considerations due to White-Nose Syndrome and COVID-19 make photographing bats while still observing good conservation practices even more difficult. I recently participated in producing some Bat Photography guidelines for the U.S. Fish and Wildlife Service. These will be presented and some techniques demonstrated.

PHOTOGRAPHY CLOSE-UP

Eugene Vale, eugenevale@socket.net

While much time is spent on the challenges of photographing a big room, close-up photography presents its own special challenges. Poor depth of field makes focusing and getting a sharp picture difficult. On camera flash units often miss the subject entirely. Through live demonstration this presentation will explore the use of close-up/macro lenses, off-camera and close-up flash units, and other techniques for getting a properly exposed and sharp close up image.

VERTICAL SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

EDUCATIONAL FACTORS IN AMERICAN VERTICAL CAVING INCIDENTS, 2000-2020

Reilly Blackwell, Hazel Barton, Bonny Armstrong

Vertical caving has inherent risk and can sometimes result in injury or death. This risk can be mitigated with proper training and experience. The American Caving Accidents (ACA) publication collects reports of underground accidents, providing a dataset on how incidents happen and why. We examined all ACA reports of vertical caving incidents from 2000-2020 and categorized them by whether insufficient training may have contributed, based on causative factors and any background information given in the report. In two populations (experienced cavers and those with insufficient training), we have also identified trends in the most common factors contributing to incidents. This information will be used to inform the development of educational materials by the National Speleological Society's Vertical Training Commission (VTC). Understanding the most common types of vertical accidents and incidents among inexperienced cavers will help the VTC identify gaps in past vertical cave training and ensure that their curriculum covers common hazards.

NSS VERTICAL TRAINING COMMISSION: DEVELOPING A NATIONAL VERTICAL TRAINING PROGRAM FOR U.S. CAVERS

Ron Miller, Hazel Barton, and Jenny Tison

The newly established NSS Vertical Training Commission (VTC) is an exciting step forward for caver vertical training in the U.S. Building on techniques developed by the NSS Vertical Section and international caving organizations, VTC is creating a national vertical training program to help ensure that U.S. cavers can receive high quality, accessible, and affordable training in vertical caving techniques. Our goal is to create a training program that complements the activities held at convention by the Vertical Section. As stated in our charter, VTC's goal is to "improve vertical safety for cavers, while resisting efforts to develop vertical training certifications as a mechanism to limit or restrict cave access." To those ends, VTC will not provide "certification" in vertical caving techniques, and individuals and organizations who desire to offer or receive vertical training will be under no obligation or expectation to participate in the VTC program. That being said, we do hope and expect that the quality of VTC's curricula and trainers, together with the robust risk management program that we are developing, will prove attractive to grottos, trainers, and cavers throughout the U.S.

VTC's structure includes a number of elements. The board manages the overall affairs of the organization, and oversees development and implementation of the training program. The curriculum committee develops training curricula for approval by the board. Training curricula currently in development include a master-trainer course, a trainer course, and a Level 1 vertical-training course. The advisory board serves as an informal resource for both the board and curriculum committee. VTC trained-and-qualified "master trainers" will train and qualify "trainers", who in turn will train cavers in vertical caving techniques. This "train-the-trainer" model will help ensure widespread accessibility to high-quality, affordable vertical training.

A SELF BELAY CLIMBING SYSTEM

Kurt Waldron

SRT training usually occurs with a fixed rope that allows the student to climb up and down while practicing various skills. However the use of fixed ropes is, for many reasons, not well suited to help students develop the technique and cardiovascular fitness required for longer drops. Previous attempts to address this issue have either required additional people or equipment that is not commonly available. This presentation will describe a system that allows a single person to climb a rope for as long as they want, using equipment that should be available to all vertical cavers (rappel rack, pulley, 2 Prussiks, 2 carabiners) The system is ideally suited for a rope Walker climbing system but is compatible with a frog system as well. The system is relatively simple, compact and portable. It is possible to also use this as part of a cardiovascular fitness program. It is possible to construct this system wherever there is at least 7 feet of vertical space available. It has been employed in trees, decks in the back yard, garages and basements. It can work with whatever

length of rope is available. Years of operation has shown this system to be simple to operate and highly effective. It is an answer to the need for safe, effective and practical distance climbing while performing SRT training. This system should become a standard used with all SRT training that focuses on Rope Walker and Frog climbing technique. With relatively simple changes, it could be adapted to any vertical system in use today.

DIGGING SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

SANDLAND TUNNELS: DIGGING A RECREATIONAL TUNNEL MAZE CUSTOM-DESIGNED FOR VISITORS TO ENJOY

EXPLORING

Eric Sutterlin

Sandland is a maze of tunnels that friends and I are digging in the Jordan sandstone bedrock of western Wisconsin. Our purpose is to create something unique for visitors to enjoy exploring and discovering. This presentation will explain what Sandland is, how we're digging it, and why we're creating it.

I bought our deep ravine that passes through the Jordan sandstone specifically for the purpose 11 years ago. We now have about 800 feet of tunnels and counting. Visitors start by entering our three-dimensional spaghetti-bowl crawl maze featuring about 300 feet of tunnels. I designed the maze to optimize confusion. After finding their way through the maze, visitors enter the "Donut Room", with seven identical tunnels radiating from it. Some of those tunnels lead to the rooms and "Swiss Cheese" tunnels that we are presently digging.

Digging involves chiseling the poorly-cemented (soft) Jordan sandstone into sand with an electric chisel equipped with a wide blade. Sand is shoveled into buckets. Buckets are dumped into wagons. Wagons are dumped into train carts fabricated by our engineer. When the train is full, it's hauled up our ramp by a gas-powered winch. Outside, the three train carts are hoisted individually onto our zip line and released to sail across the ravine to our sand pile. We pay our local excavator to haul the sand up the hill with a loader and off the property. We haul our gear up and down the hill with an ATV or snowmobile. Everything involved in the process requires maintenance, most notably sharpening chisel blades. Balancing maintenance time and digging time is a challenge. In a sense, Sandland is the inverse of a cave dig. In caves, nature designs and we dig to discover what nature has designed. At Sandland, we design and dig to realize our design.



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SURVEY AND CARTOGRAPHY SESSION ABSTRACTS

(listed in alphabetical order by presenting author)

THE SARAH FURNACE CAVE SURVEY

Bert Ashbrook *caving.ashbrook@comcast.net*

Sarah Furnace Cave is a maze cave in northwestern Pennsylvania. Joint-controlled passages form a dense grid of two- to three-feet high crawlways. With a density of 1.6 miles of surveyed passage per acre of surface area, it may be the densest cave maze on Earth. A vein of iron ore forms the ceiling of the passages, and 1860s miners enlarged some passages into stoopways by mining this ore. The 1950s, 1980s, and 1990s saw failed attempts to survey the cave. "Team Sarah" began the current survey in 2019 when the Mid-Atlantic Karst Conservancy purchased the property. To attract surveyors, MAKC initially permitted only survey trips, and we trained sport cavers to survey. We obtained grants to purchase DistoX2 instruments, as Suuntos are difficult in tight crawlways. We conducted a day-long sketching seminar to help train new sketchers. To maintain enthusiasm, we survey as we go. Survey data is shared liberally. The working map is (usually) updated monthly. Friendly competition with another Pennsylvania cave survey has motivated both survey teams. After the lockdown, we maintained two to three trips monthly through the COVID-19 pandemic by variously requiring masks, in-cave distancing, survey pods, vaccination requirements, and/or rapid testing as conditions changed. The cave forced other adaptions. We avoid putting stations on the iron ore ceilings. Each station is marked with a unique designation to aid both navigation and data reduction. Marked trails ease navigation through the maze. A rescue plan and cache are in place for lost cavers. We use a sign-in and out system and mandatory exit times. In our first three years, Team Sarah has made 90 survey trips, involved 106 different surveyors, surveyed over 5,000 shots, closed over 1,700 loops, mapped seven miles of cave, and left 120 leads remaining.

AN EFFICIENT CAVE CARTOGRAPHY WORKFLOW – UPDATING THE SISTEMA CHEVE MAP

Derek Bristol *derekbristol@gmail.com*

The workflow for taking cave survey notes and turning them into a finished map can be confusing and daunting for novice cartographers, and often overwhelming even for those with experience. Electronic sketch, digital data management software, and vector-based drafting tools have helped speed up the process. This talk will show one such process that was used to update the Sistema Cheve map in late 2021 following a year in which the cave grew from 55 km to more than 76 km in surveyed length. Sketches were collected both on paper as well as electronically in TopoDroid on Android tablets or phones. Data entry and compiling was conducted in Walls cave survey software. Drafting was completed in Adobe Illustrator. Detailed plan and profile view maps were drafted in only one month resulting in maps that serve multiple critical purposes including communication and outreach with local communities, study and understanding of the geology and hydrology of one of the world's deepest cave systems, and providing important visual tools for planning and executing future exploration objectives. An overview of the workflow used will be given along with some suggestions on ways to improve efficiency.

ILLUSTRATING THE COMPLEXITIES OF KARST SYSTEMS USING GEOLOGIC BLOCK DIAGRAMS

Lee J. Florea *mr_chaos@hotmail.com*

Sarah Asha Burgess *sarahburgess00@gmail.com*

Communicating complex geologic concepts to the public or other scientists can present challenges. For example, while the cave map is the foundation to karst science, making these maps accessible can be difficult. In addition concerns of propriety for resource stewardship and landowner relations, the intricacies of accurate cartography do not lend cave maps to easy annotation or interpretation.

Scientific illustrations, specifically geologic block diagrams, serve an important intermediary role in this communication by presenting a stylized portion of the cave in the context of surrounding landscape and hydrogeologic framework. Examples abound in the literature and are regularly employed for educational signage. The accuracy in scale, layout, and detail of these illustrations is tailored to the needs of the author and audience on one hand balanced against the limitations of the resource manager on the other. This presentation is not about cartographic rendering of data. Rather, we use examples of mapped caves, or amalgams of multiple caves and translate those into block diagrams appropriate for scientific publications intended for audiences in geochemistry, hydrogeology, geomorphology, and glaciology. We demonstrate the process from initial concept through final figure production, including hand sketching, computer vectorizing, careful stylizing, and suitable colorizing to achieve a product to communicate the original intent.

EXPERIMENT WITH OUT-OF-CAL DISTOX

Bill Koerschner *wkoerschner@msn.com*

In an ideal world, all DistoX cave surveys would be done with a freshly calibrated instrument. Unfortunately, cavers are lazy, so most surveys are done with an instrument whose calibration is accepted as 'probably good enough'. An experiment was designed to compare the various methods of shooting DistoX to determine 'best practices' for obtaining data with an 'out-of-cal' instrument. A loop course of 8 stations (246ft) and a linear course of 12 stations (420ft) were laid out. Both courses were shot with Suuntos / fiberglass tape and with three out-of-cal DistoX. The DistoX were shot double Frst/double Bkst in each orientation (display

up, display down, display left and display right). The DistoX shots departed from analog shots by as much as 4 degrees. The data were processed using Walls cave survey software. The shots were then combined in various ways to examine the effects of survey methods on closure of the loop course and deviation from the analog survey on the linear course. All of the DistoX surveys had as good or better vertical closure than could be obtained with Suuntos, so we can conclude that calibration drift has no effect on inclination. The horizontal closures ranged from 2.2ft to 9.9ft. Averaging Frsts with Bksts dramatically improved loop closure but only when Frst/Bkst pairs were shot in the same orientation. The method of averaging a display-up / display-down Frsts was fairly effective at cancelling out calibration drift but not as good as collecting Bksts. Cherry-picking orientations in the cave to obtain better Frst/Bkst agreement makes the closure worse. Recommended best practice is to use only one instrument, shoot everything in display-up orientation and average Frsts and Bksts.

GEOSLAM LiDAR AND DIGITAL ELEVATION MODELS AS A TOOL FOR GEOREFERENCING AND PREDICTING SUBSURFACE VOIDS

Zachary Normile zachary.normile@uga.edu

Karst conduits (e.g., caves, caverns, voids) are naturally difficult and often dangerous locations to access and research, especially using the large or delicate pieces of equipment that are often required. Current methods for mapping these underground features rely on geophysical tools that are expensive and imprecise. In partnership with the Southeastern Cave Conservancy (saveyourcaves.org), this study tests the feasibility of using GeoSLAM LiDAR equipment and software to map cave interiors in 3D and relate formations to surface topography in the 10-km Tumbling Rock Cave, located in the Cumberland Plateau region of Northeast Alabama. Digital elevation models (DEMs) and LiDAR images are used to identify landscape features (e.g., depressions, lineaments) that could be indicative of subsurface voids. The two goals of this investigation are to use this information to manage risk pathways to cave- and ground-water contaminants and to predict the presence of karst conduits based on topography. GeoSLAM LiDAR has been shown to be an effective method of mapping karst conduits in relation to surface features, but its viability as a predicting tool has not yet been proven. Future applications of this research could include predicting sinkhole formation before they form and estimating air and groundwater storage of caves.

CAVEWHERE® – FROM SKETCH TO 3D CAVE MAPS

Philip Schuchardt vpicaver@gmail.com

CaveWhere, intuitively designed survey software, enables building and visualizing underground cave maps. Using its advanced 3D engine, CaveWhere automatically morphs 2D cave survey notes into a 3D visualization using a three-step process. First, the cartographer imports or enters centerline survey data. Second, a scrap is registered by creating a polygon around a section of survey notes and entering survey stations. Finally, the registered scrap is morphed and rendered in a 3D view with a process called Carpeting. Once Carpeted, cartographers can export the 3D rendering using the combined plan, running profiles, and projected profiles into a 2D map for drafting a final cave map.

MAPWHERE – OFFLINE DATA COLLECTION, MAPPING, AND SYNCHRONIZATION APP

Philip Schuchardt vpicaver@gmail.com

All caving expeditions are limited on time, constrained by the season or time-off. Knowing exactly where cavers have been, and what they found, directs future ridge-walking efforts. As soon as a caver adds a track or creates a waypoint, the team's dataset is stale. Without the internet, the team can't synchronize new data. MapWhere is a phone mapping app, that allow teams to synchronize waypoints and tracks, offline, and in the field. New team members need to download the app before the trip. Once in the field, the trip leaders can give them access to the data through MapWhere's NoNet device. NoNet is a tiny, 23g computer with an expandable SD card and Wi-Fi network. Ridge walkers then enter new data in customizable layers, specific for your project. If you accidentally destroy the NoNet device, don't worry, your team can synchronize with the cloud after the trip. Unlike other mapping apps, MapWhere supports custom fields, layers, base maps, and can keep your team up to date, in the field, without the internet.

WHAT'S NEW IN SURVEYING AND CARTOGRAPHY?

Moderated by Carol Vesely cavesely@gmail.com

In this informal, open forum, everyone is invited to share. It's been three years since our last full in-person NSS convention so let's talk about new adaptations, techniques, and equipment pertaining to cave surveying and cartography. Some possible topics are: How did you manage your survey project during COVID? Did you tackle learning to draft maps with Therion during lockdown and what plusses and minuses did you encounter? Have you tried the new BRIC4 survey instrument and compared it with the DistoX2? There are many other possible topics. Please bring any new equipment and ideas you have to share.

ABSTRACTS

CAMPGROUND INFO

- Campground Closes:
 - Saturday, June 18th, 11:00 a.m.
- Quiet Hours are:
 - 11:59 p.m. - 7:00 a.m. - Noisy Campground
 - 10:00 p.m. - 8:00 a.m. - Less Noisy Campground
- No one allowed in without a NSS Rapid City Convention Badge
- Fires are not allowed
- No fireworks, cannons, explosives, bombs or any incendiary devices allowed, period!
- Please be respectful with excessive noise. We do have residential neighbors outside the fairgrounds
- Camp only in designated areas and please respect traffic routes
- Tarp sizes no larger than 20 ft x 30 ft
- Please use restrooms and porta johns accordingly, do not throw garbage or other foreign substances into the toilets
- Keep your campsite free of litter and debris
- Please use only designated equipment in decontamination area
- Please do not wash dishes in the bathrooms
- Please recycle all aluminum cans and plastic bottles in the recycling containers provided
- If you must use a generator, please limit the usage between the hours of 8:00 a.m. - 10:00 p.m. *NO GENERATORS AFTER 10:00 P.M.*

COMMUNICATIONS

CONVENTION HELP LINE:

Need assistance? The NSS convention hotline SPELEOWEB1 will be operational from now, through Sunday June 19th. Call +1 (773) 536-9321. This line will ring key convention staff who will be able to answer your questions or direct you to the proper person for assistance. **NO TEXTING CONVENTION HELP LINE...TEXT WILL NOT BE RECEIVED.** Please do not call outside of normal convention business hours (8:00 a.m. - 8:00 p.m.) unless of emergency. If you have an actual emergency, 911 should be your first call. We are working long hours to make this a wonderful event for everyone, but we do need to catch a little sleep once in a while.

EXAMPLES OF WHEN TO USE SPELEOWEB1:

- Need directions, field trip bus is broken down, Jeb Casey is sick or lost on one of his cave trips, or there's a cave rescue incident
- Emergency other than 911

RADIO

Some convention staff carry radios to help coordinate the daily events. If you need to track someone down across the fairgrounds complex, feel free to ask key staff members (see staff list), people who have the golf carts, the vertical section staff, medical, and registration will have handsets.

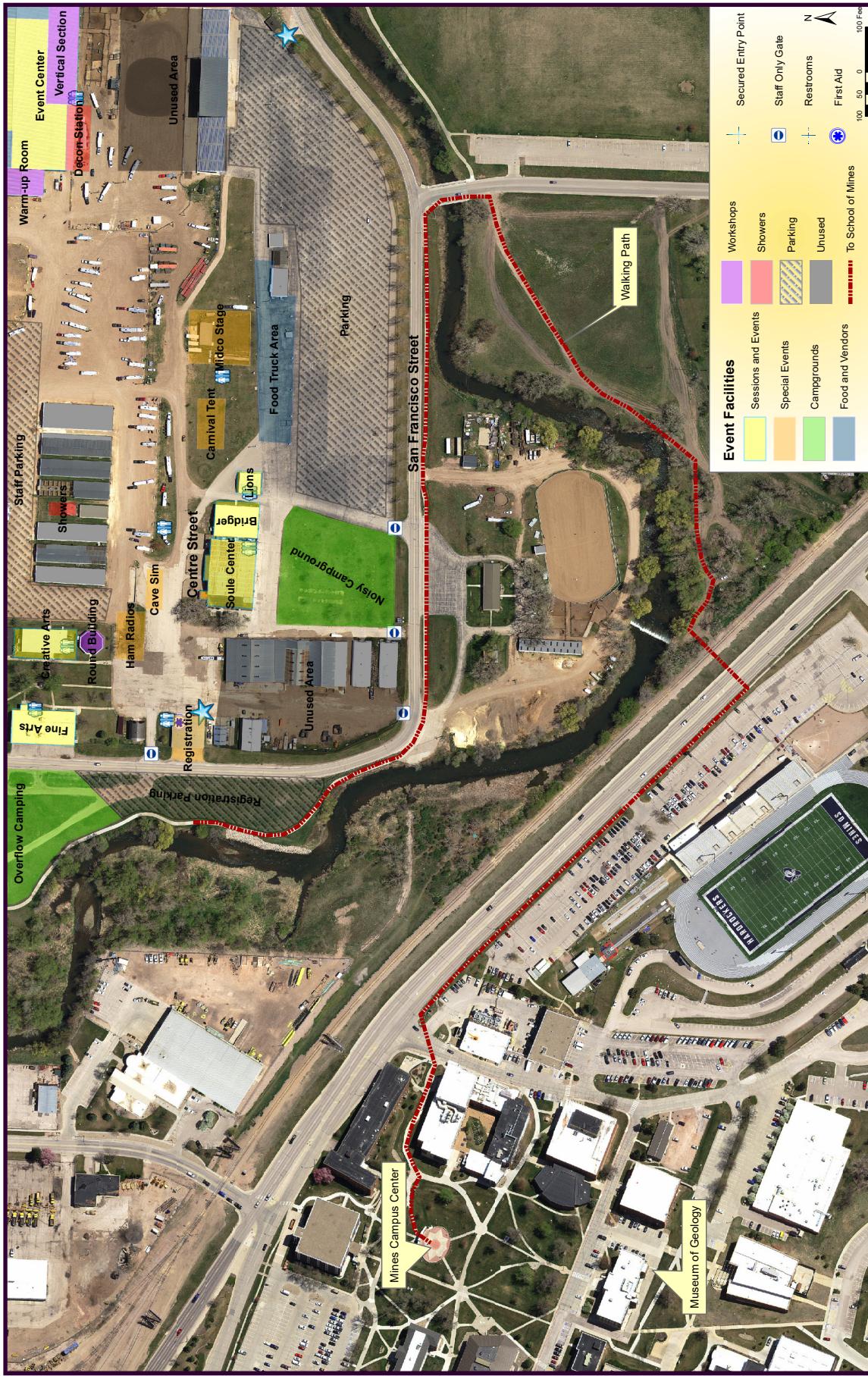
OH, MANGANESE! DAILY RAG

Oh, Manganese! Is our version of the Daily Rag. Brad and Connie McKinney will be in charge of this, and all items should be emailed to them at: bradmckinney@gmail.com
Oh, Manganese! Will come out daily via email, and will be available via the convention website at www.nss2022.caves.org. Limited hard copies will be available at registration.

HAM RADIO

Are you an amateur radio operator? Please visit the Ham Radio station for more information about getting on the air in the local convention area!

WALKING ROUTE FROM SDSM & T



MUSEUM



Black Hills Institute

We have over 900 fossils, 170 replicas, 500+ minerals, 40+ models along with signage on local geology and history. At any given time, there are around thirty skeletons on display.

MENTION AD FOR 10%
OFF ADMISSION

EVERYTHING
PREHISTORIC



Enter the Museum at
Black Hills Institute
through
Everything Prehistoric,
our one-of-a-kind
gift shop.



Downtown Hill City
www.bhigr.com
605-574-3919

CAVE TRIPS

Cave trips are available to convention attendees on a first-come first-served basis. Signup sheets for cave trips will be located in the Registration building, and will include information regarding each trip such as duration, skill level, required gear, and contact information for the trip leader (if a trip leader is required).

Keep in mind that caving in the Black Hills is different than in many other parts of the country. We use elbow pads here – for good reason! Knee pads are a requirement, and even though the caves are relatively dry, they can be chilly – around 50 degrees Fahrenheit. Be prepared to sometimes travel long distances underground. When you're moving, you might work up a sweat, but when you stop, you get chilled easily. Cave suits are overkill here, so make sure to leave them at home or at camp. Typical Black Hills caving attire is a synthetic short-sleeved shirt, running tights (or similar) with a durable pair of shorts over the top. Footwear is typically a good pair of ankle-high hiking shoes (NOTE: Absolutely no manganese-covered clothing – including shoes - may be worn in other caves besides Jewel and Jasper) We strongly recommend side-mounted packs in all of the caves here (something similar to a Paha Sapa pack – which was specifically designed for Black Hills caving). Jewel Cave in particular does not allow backpack-style caving packs at all, and it's generally more difficult to get around underground here with something on your back anyway, which is why local cavers have gotten accustomed to side-mounted packs.

If in doubt, or you have any questions about specific gear or what to bring, get a hold of the trip leader for each specific trip and they can help you out. One final note – because some caves have very specific requirements for caving, the trip leader calls the shots on what can or can't be allowed for gear or clothing.

Some of the trips that will be offered to convention attendees:

JEWEL CAVE NATIONAL MONUMENT - NPS SITE

- **HUB LOOP:** This 4-6 hour trip involves mostly walking-sized passages with numerous climbs, scrambles and chimneys, with a few slippery squeezes. You'll get to see popcorn stalagmites, the Negative Column, gypsum spiders, gypsum needles, and scintillites.
- **WILD CAVING ROUTE:** This 3-4 hour loop visits places like Hurricane Corner and the Brain Drain, and cavers get covered in manganese. Must be able to fit through an 8.5" x 24" opening.

WIND CAVE NATIONAL PARK - NPS SITE

- **CLUB ROOM:** This out-and-back trip can take up to four hours and traverses one of the primary routes out the western edge of the cave, passing through the Frostline, Hobson's Choice and Omnibus Hall before ending in the Club Room, a large room.
- **BISHOP FOWLER'S LOOP:** A short trip from the upper levels near the Fairgrounds to the middle levels near the Garden of Eden. Interesting historic items are seen along the way.

BROOKS CAVE

Brooks Cave is the largest Cave on the NSS Dahm Spring Cave and Nature Preserve. The trip is a mix of belly crawling and walking with an exposed free-climb on a steel ladder along with a few other short free-climbs. Highlights of the route are large cave rooms, some wet formations, and getting to visit the local Madison Aquifer which forms a lake at the bottom of the cave.

KING TUT CAVE

Did you ignore all the recommendations to leave your SRT gear at home or do you have a goal of getting on rope in every state in the US? This is the only vertical trip that will be offered at Convention! The cave isn't overly pretty, but it's interesting because of how much it drops in such a short distance. And where is all that air coming from? Why would anyone build a mine shaft into the cave? Did I just crawl over a dead pigeon? These are all questions you might ask yourself while you are there. Expect narrow restrictions, pigeon (poop) coated crawls, and a 50' rappel along with a few other short rappels/hand lines.

REED'S CAVE

- **TRAIN TUNNEL:** This is likely the hardest trip that will be offered at Convention. This trip will be using the Death Trap entrance, which is a bit less daunting than it sounds. If you don't like crawling, then you rather might wish you were dead. The Train Tunnel is the farthest extent of Reed's Cave. To get there, there is a lot of crawling including several pinches, the tightest is 8.5". But there's plenty to see along the way including lots of popcorn, boxwork, and a few stalactites. Once you get to the Train Tunnel you'll wonder where all that air goes and why the cave got so large only to slam shut...
- **NEW FORMATIONS:** Reed's Cave is located in an active quarry and was dug into in the 1960s. After a short trip down the ladders at the Death Trap Entrance, you will go through a mix of crawling and walking passage to see an area with a few nice wet formations and some frostwork and popcorn. This trip is a great one for families due to its length at 2-3 hours, however there are some exposed areas where parents will need to really keep a close eye on the kids.
- **Queen's Room:** This moderate trip of 3-4 hours will take you through a circuitous route of crawls and walking passages that will ultimately lead you to some nice white flowstone in the Queen's Room. Maybe you'll get lucky and skip a lot of those crawls on the way in, by taking the Worm Hole short-cut. But if you make it down the Worm Hole, you'll likely be wondering what horrors lay ahead if that was the easy way in...

BETHLEHEM CAVE

- DIAMOND FIELDS: This trip, suitable for families, goes to the largest room in the cave, the Diamond Fields. While you won't find any diamonds there, you will find plenty of walking-size passages to get there, which really is a treasure in the Black Hills caves. Along the way you'll see some historic signatures, lots of calcite spar, and plenty of boxwork.
- World's Fairgrounds: This is the more sporting trip in Bethlehem that will be offered. Along with climbs and crawls, you'll find several large rooms, small formation galleries, and lots of spar. You might even find the Duck's Nest, a basin of cave pearls that supposedly gave the room its name.

STAGEBARN CAVE – THE HALLS

Stagebarn Cave is known for one thing, crawling. Most of the cave is found in a bedding plane maze that is less than 2 feet tall. However, if you can go deep enough, you will find a level of cave that consists of large, joint-controlled passages called the halls. Behemoth Hall, Leviathan Hall and maybe even Shortrib Hall will be your rewards for the bruising, hour long crawl to get there. However, it is an out and back trip...

CAVE 41

Mapped by local legend Steve Baldwin on his 41st birthday, you'll receive your own presents on this trip in the form of areas of nice soda straws and flowstone. While there is some crawling and tight stuff, overall this is mostly walking and suitable for most cavers. Air felt in the passages indicates there might be more presents delivered in the future.

ONYX CAVE

This cave will make all the eastern cavers feel right at home. Small passages coated in peanut butter mud, coming right up. At least there are a ton of soda straws to admire while you're slithering in the muck on this 2-3 hour trip.

Davenport Cave

This cave is usually closed to visitation due to bat use, however this wasn't always the case. In the past, careless visitors and vandals left their mark on the walls of these borehole cave passages with graffiti. We are partnering with the Black Hills National Forest to begin a graffiti removal project to help restore this cave to its former glory of giant spar crystals in massive passages. Please come lend a hand.

SEE SIGN-UP SHEETS IN THE REGISTRATION BUILDING FOR THESE TRIPS!

IF YOU HAVE QUESTIONS, PLEASE CONTACT KELLY MATHIS, CAVE TRIP COORDINATOR AT 605.517.1771

WHITE NOSE SYNDROME INFO

South Dakota and the Black Hills area caves are considered White-Nose Positive. Please be aware of this when entering caves or traveling to other parts of the country. It is always best practice to enter caves with clean clothes and equipment, regardless of the presence of Pd or WNS. That being said, if you plan to go caving here during convention, we really don't want you to take Pd with you to other caves or back to your home state! Please make use of the decontamination station located along the south wall of the Event Center (the large building where the vendors are located). Some of our neighboring caving areas like the Bighorns in Wyoming don't have Pd or WNS, so please use only clean gear (not used in any other WNS-positive state) in those caves. Be courteous to our neighbors and do your part to minimize the spread of WNS. We value our relationships between cavers and private, state and federal agencies here, and we don't want to jeopardize those relationships or potentially cause irreparable harm to the bats that call this area home!

For all caves in the Black Hills – clean gear is a requirement. Decontaminate your equipment after your trip and help minimize the spread of WNS!

For Park Service caves (Jewel and Wind) – Clean clothes and equipment between caves and walk across decontamination trays following your visits. No manganese clothing worn in Jewel may be used in Wind anyway.

For Forest Service caves – All equipment and clothing must be decontaminated and clean between cave visits, and no clothing used in a WNS-positive state may be used in a non-WNS positive cave.

For privately-owned and preserve caves – Clean gear and clothing is a requirement. Beware that some caves have WNS and others do not.

Use best judgement and err on the side of caution. Decontaminate as needed.

JSS SCHEDULE

DAILY MEET-UP TIME: 8 AM, BARN 9

DAILY PICK-UP TIME: 5:30 PM, BARN 9

MONDAY

We will leave the Fairgrounds at 8:30 to make the 1 mile walk to the free Museum of Geology at South Dakota School of Mines and Technology. Please pack a sack lunch and snacks. The museum has a gift shop. We can picnic in Memorial Park on our way back around noon. We will return to the Fairgrounds for a Vertical Workshop in the Events Center from 1-5. Monday night's Howdy Party is family friendly and will include access to Rush Mountain Adventure Park at Rushmore Cave more information on page 19. Please dress for the weather and wear closed toe, walking shoes. Sandals are prohibited in Vertical Workshop.

<https://www.sdsmt.edu/Academics/Museum-of-Geology/Home/>

<https://www.rushmtn.com/>

TUESDAY

The morning will be spent at the Fairgrounds learning surveying and mapping. Please pack a lunch and snacks. After lunch, we are traveling via van to go wild caving at the local Dahm Springs Preserve. Extra drivers for the preserve trip may be needed. Please stop in and mention at registration if you are available to drive. The road is paved with parking in a grassy lot. Please follow Whitenose Decon Guidelines for the Dahm Springs Preserve as shown on page 83. Each participant will need a helmet, 3 lights, knee and elbow pads. Sandals are prohibited. Dress for caving and bring a change of clothes.

www.blackhillscaves.org

WEDNESDAY

JSS buses will head to Center Lake in Custer State Park at 8:30. There will be Ranger-led hikes, fishing, swimming, kayaking and canoeing. Pack a lunch and snacks and bring a swim suit and towel - and sunblock! Consider a change of clothes for bus ride back to Rapid City.

<https://gfp.sd.gov/parks/detail/custer-state-park/>

THURSDAY

Come for the longstanding tradition of Caving with the Presidents! Buses will head to Bethlehem Cave at 8:30. Dress for caving and follow Whitenose Decon Guidelines for Private Caves listed on page 83. Every participant needs a helmet, 3 lights, knee and elbow pads. Pack a lunch and snacks. We will have a "Lunch and Learn" surface presentation learning about cave care, conservation, and formation repair by Mike Mansur. Further discussion will follow during caving. If time and weather permit, we will stop at South Dakota Dept of Game Fish and Parks Outdoor Campus to explore the displays about South Dakota wildlife. Not-so-dirty cave clothes are welcome but consider bringing a change of clothes after caving in Bethlehem.

<https://gfp.sd.gov/toc-west/>

Friday

The JSS will load into buses and head to Hot Springs, departing at 8:30. We will tour the Mammoth Site followed by picnic lunch in the city park. After lunch, there will be swimming at Evan's Plunge Mineral Springs. Please pack lunch and snacks along with swim suit and towel. We will change into swim gear in the locker room at Evan's Plunge. Both the Mammoth Site and Evan's Plunge have gift shops.

The JSS will have their own table at Friday night's banquet if the kids want to sit together. Following dinner, the JSS will adjourn to the Bridger Steel building for a movie while the adults continue with the awards ceremony. Kids going back and forth between the movie and the awards will be discouraged. The movie should be done with kids able to be picked up at 9:30 pm.

<https://www.mammothsite.org/>

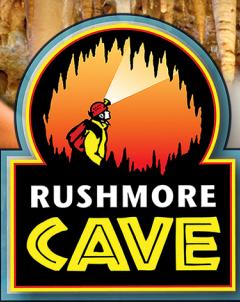
<http://www.evansplunge.com/>

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Monday	Time	Location	Tuesday	Time	Location	Wednesday
JSS (see JSS Schedule)	8am-5:30pm	Barn 9	JSS (see JSS Schedule)	8am-5:30pm	Barn 9	JSS (see JSS Schedule)
Opening Ceremony	8:15-8:45am	Soule Center	Art Salons	9am-5pm	Fine Arts 1	Art Salons
Geology and Geography Session	9am-Noon	Soule Center	US Exploration	8:40am-12:10pm	Soule Center	International Explorat
BOG Open Meeting	9am-Noon	Creative Arts	Cave Conservation & Management	9am-12:50pm	Bridger Steel	Cave Paleontology
Communications and Electronics	9am-Noon	Lions Building	NCRC Meeting	9am-Noon	Creative Arts	Vertical Techniques W
NSS Preserves Meeting	9am-11:30am	Bridger Steel	Cultures of Caving	9am-1pm	Fine Arts 2	NSF Investment (close
Carlsbad Caverns Volunteers meeting	9am-Noon	Fine Arts 2	Vertical Climbing Contests	9am-Noon	Events Center	Jewel, Wind, 1988 Co
Vertical Climbing setup	8:30-Noon	Events Center	Rebelay Course	10am-Noon	Events Center	
Speleology for Cavers	9am-Noon	Round Building	Sketching Contest	All day	Rushmore Cave	
Sketching contest		Check Registration for details				
International Year of Caves & Karst Update	Noon-1pm	Fine Arts 2	Luminary speaker -John Scheltens	1-2:00pm	Soule Center	Luminary speaker - Jo
Geo/Geog Section Lunch Meeting	Noon-2pm	Soule Center	Rebelay Course/Climbing Contests	Noon-2pm	Events Center	Arts & Letters Lunch
Speleology for Cavers	Noon-1pm	Round Building				Vertical Techniques W
AVP Department - All Hands Luncheon	11:30am-1pm	Bridger Steel				Speleophilatic Sectio
Communications and Electronics lunch	Noon-1pm	Lions Building				
Geology and Geography Session	2pm-5pm	Soule Center	Terminal Siphons Practice Room	1-5pm	Bridger Steel	Vertical Techniques W
BOG Meeting (Closed)	1pm-5pm	Creative Arts	US Exploration	2-5:10pm	Soule Center	Cave Paleontology
Cave Diving Section	1pm-5pm	Fine Arts 2	Vertical Climbing Contests	Noon-4pm	Events Center	International Explorat
Video Section	1pm-5pm	Lions Building	Convention planning	2-5pm	Lions Building	Congress of Grottos
Project Underground	1pm-5pm	Bridger Steel	Vertical Training Commission	1-5pm	Creative Arts	NSS - Explorers Club N
Vertical Climbing Contetsts	Noon-4pm	Events Center	Rebelay Course	Noon-4pm	Events Center	Fort Stanton Cave- S&
Speleology for Cavers	1pm-5pm	Round Building	Cave Formation Repair Workshop	2-4pm	Round Building	
Self-rescue Techniques for Cavers	12:30pm-4:30pm	Events Center(warm-up room)				
Photography Workshop	11am-5pm	Bethlehem Cave (meet at Midco Stage)				
Howdy Party Dinner	5pm-7pm	BHCNC Tent - Next to Midco Stage	Fellows- New Members Reception	6pm-7:30pm	Journey Museum	Speleo-Rodeo
Howdy Party - with the Mooncats	7-9pm	Rush Mountain Adventure Park	NSS Auction	7:45pm-Finish	Soule Center	Speleothem Repair Fi
Late Concert - Pert Near Sandstone	9pm-Midnight	Midco Stage	Open Mic	9pm-Midnight	Midco Stage	Campground Party
Week Long Activities			Field Trips (Sunday, June 11th)			
Art Salons Viewing		Fine Arts	Type	Leader		Meet-up Pl
Cartographiy Salon Display		Events Center	Hydrology	Karl Emanuel		Midco Tent- 9:00 AM
Cave Sim		Outside Soule	Geology	Sarah Keenan		Registration Building
Cave Trip PLanning		Registration Building	Paleontology	Sharon Weaver		Midco Tent- 9:00 AM
Convention Office		Registration Building	Cave Trips (all week) = Kelly Mathis			Registration
First Aid		Registration Building				Sign up Sheets availab
Food Trucks		Lions Parking Lot				First come basis
Junior Speleological Society (JSS)		See JSS Schedule				
Open Cash Bar		Events Center				
Registration		Registration Building				
Sketching Contest (Monday & Tuesday)		Registration/Caves				
Vendors		Events Center				



Are you the owner of a show cave or other small business with ticketing needs? Stop by the exhibitor area to meet one of our convention sponsors, TicketSpice. They would like to get to know you over a complimentary drink or two from the Events Center Bar!

	Time	Location	Thursday	Time	Location	Friday	Time	Location
	8am-5:30pm	Barn 9	JSS (see JSS schedule)	8am-5:30pm	Barn 9	JSS (see JSS Schedule)	8am-5:30pm	Barn 9
	9am-5pm	Fine Arts 1	Arts Salons	9am-5pm	Fine Arts 1	BOG Open meeting	9am-Noon	Creative Arts
ion	9am-11:50am	Soule Center	NSS Awards Committee	9am-noon	Lions	Video Salon Viewing	9am-Noon	Bridger Steel
	9am-Noon	Bridger Steel	Spelean History Session	9am-Noon	Fine Arts 2	Art Salons Critique	9am-Noon	Fine Arts 1
Workshop	8:30am-Noon	Events Center	Sketching workshop	9am-Noon	Round Building	Writers Workshop/Poetry Corner	9am-noon	Fine Arts 2
(ed)	9am-Noon	Creative Arts	Biospeleology Session	9am-Noon	Bridger Steel	Cave Balad Critiques	9am-Noon	Lions
nvention Films	9am-Noon	Lions	Vertical Section Meeting/Awards	9am-1pm	Creative Arts	Lightning Talks	9am-1pm	Soule Center
						Cartographic Salon Critique	10-Noon	Events Center
John Mylroie	1pm-2:00pm	Soule Center	Luminary Speaker: David Springhetti	1pm-2pm	Soule Center	Sketching contest critique	10-Noon	Events Center
	Noon-1pm	Lions Building	NCKMS Steering Committee	Noon-1pm	Lions	Arts and Letters Corner	All day	Round Building
Workshop	Noon-1pm	Events Center	Biospeleology Lunch	Noon-1pm	Bridger Steel	BOG Closed Lunch meeting	Noon-1pm	Creative Arts
on Meeting	Noon-1pm	Creative Arts	Spelean History Lunch	12:15pm-1pm	Fine Arts 2	Survey & Cart. Section - Lunch	Noon-1pm	Lions
						Writers Workshop Lunch	Noon-1pm	Fine Arts 2
Workshop	1pm-5pm	Events Center	Biospeleology Session	2:20pm-4:20pm	Bridger Steel			
	1pm-5pm	Bridger Steel	Convention debrief	2pm-5pm	Events Center Bar	BOG Closed Meeting	1pm-4:30pm	Creative Arts
ion	2:15pm-4:30pm	Soule Center	NSF Trustees (Open)	2pm-5pm	Creative Arts	Writers Workshop	1pm-4:30pm	Fine Arts 2
	2pm-5pm	Creative Arts	Cave Digging Session	2pm-5pm	Lions	Cave Conservancy Roundtable	2pm-4:30pm	Bridger Steel
Meeting	5pm-6pm	Lions	Sketching workshop	1pm-6pm	In - Cave	Banquet Preparation	1pm-4:30pm	Soule Center
LL Meeting	1pm-2pm	Round Building	Cave Photography Session	2pm-5pm	Fine Arts 2	Survey & Cartography Session	1pm-5:00pm	Lions
						Arts and Letters Corner	All Day	Round Building
available	6pm-9pm	Rodeo Arena	Human Bone Identification Workshop	5pm-7:30pm	Round Building			
eldtrip	8:30am-5pm	Bethlehem Cave	Photo Salon Short Show/Salon Awards	6pm-7:15pm	Soule Center	NSS Awards Banquet	5:30 PM	Soule Center
	8:30pm-Midnight	Midco Stage	Full Photo Salon/Salon Awards	7:30pm-10pm	Soule Center	After Party with Muchos Garcias	8:30 PM	Midco Stage
al Siphons			BHCNC Carnival	5:00pm-9:00pm	Tent			
			Storytelling Contest	8pm-midnight	Midco Stage			

place / Time	Buildings: (large to small descending)
- 9:00 AM	Events Center
	Soule Center
	Bridger Steel
	Creative Arts
	Barn 9
	Fine Arts
	Lions
	Other Locations
	Round Building

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Mike Wiles, Dr. Andreas Pfletsch, Dr. Hazel Barton & Dr. Olivia Hershey



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by Arthur N. Palmer



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Alvin McDonald Diary
by Alvin McDonald
An exact replica of early Wind Cave explorer Alvin McDonald's Diary. The young caver kept a journal describing his exploration of the cave and naming of the rooms and passageways. It is available exclusively from BHPFA.

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