Beneath the Forest

Volume 11, Issue 1 Spring 2018

Beneath the Forest is a biannual newsletter published by the Forest Service of the U.S. Department of Agriculture.

Edited by Johanna L. Kovarik, Minerals and Geology Management

Inside this Issue…and much more! **Page**

Cave and Karst Calendar of Events

White-Nose Syndrome National Meeting

June 12 - 14 2018

Tacoma, WA

National Speleological Society Convention

July 30 - August 3 2018

Helena, Montana

http://nss2018.caves.org/

National Cave Rescue Commission

Small Party Assisted Rescue Seminar

September 19 - September 23

Redmond, Oregon

For questions, contact Eddy Cartaya:

pacificnorthwest@ncrc.info

Geological Society of America Conference

November 1 - 7 2018

Indianapolis, Indiana

http://community.geosociety.org/gsa2018/home

Editor's Notes:

I am pleased to present our very special 20th issue of *Beneath the Forest,* the Forest Service cave and karst newsletter, published twice a year in the spring and in the fall. This is our tenth year! Special thanks go to Phoebe Ferguson, our GeoCorps Participant in the MGM WO, for the celebratory artwork on the logo of this issue.

Articles for the Fall 2018 issue are due on October 1 2018 in order for the issue to be out in November. We welcome contributions from stakeholders and volunteers as well as forest employees. Please encourage resource managers, cavers, karst scientists, and other speleological enthusiasts who do work on your forest to submit articles for the next exciting issue!

Cover art: The National Cave and Karst Management Training course pauses while heading into the Mammoth Cave Historic Entrance.
Image: Kurt Olson

Contributors and Entities represented in this issue:

Eddy Cartaya
Deschutes National Forest

Gabriella Eaton
Big Forks High School Cave Club

Ryan Mikulovsky
Mendocino National Forest

Jim Nieland
Pacific Northwest Region/ Gifford Pinchot Nation-al Forest (retired)

Deanna Stever
Salmon-Challis National Forest

Adam Weaver
Black Hills National Forest

Editor's Note: Celebrating Ten Years of *Beneath the Forest*!

Johanna Kovarik
Minerals and Geology Management

Welcome to the 20th issue of *Beneath the Forest*! Whether you are a new subscriber or have been with us since that first issue in 2008, I hope you have found the content of the newsletter interesting, useful, and enlightening over the past ten years. The range of articles submitted to the newsletter highlight the amazing partner participation with the U.S. Forest Service's cave and karst resources, as well as the wide range of agency involvement with these resources. Through *Beneath the Forest* we learned together about exciting new events in agency history, and it has also served as a platform for keeping us apprised of important issues such as White-Nose Syndrome. In the beginning of *Beneath the Forest*, it was our primary means of communicating projects and news about the program around the agency. The program has grown over the past ten years to include the cave and karst email list, a SharePoint site filled with reference information, and a new external website. We have strengthened our partnerships with other agencies as well as NGOs, resulting in far-reaching educational efforts such as the Junior Cave Scientist Booklets and most recently, CavesLIVE.

Beneath the Forest has spanned quite a bit of change to the National Cave and Karst Program including three different national program leads. Landmarks that occurred prior to the start of the newsletter in 2008 include the passing of the 1988 Federal Cave Resource Protection Act (FCRPA) and the efforts to get regulations and directives on the books. As a special two-part article, these events are covered by retired National Program Lead, Pacific Northwest Program Lead, and Gifford Pinchot National Forest Cave and Karst Manager Jim Nieland. Part II of this article will feature in our second issue this year, Fall 2018.

Today, the National Cave and Karst Program is primarily housed out of the Minerals and Geology Management Washington Office (MGM WO) with program support and assistance from the Recreation, Heritage, Volunteer and Services Washington Office (RHVR WO). This interdisciplinary program boasts regional coordinators and field managers from disciplines across the National Forest System (NFS). Wildlife biologists, geologists, hydrologists, recreation planners, archaeologists, and wilderness managers all come together to manage our unique and beautiful cave and karst resources across 100 national forests and grasslands. We have won local and national awards, and received recognition for partnership projects. We have worked together through national data calls to designate thousands of our agency's caves as significant as per the FCRPA, and welcomed millions of visitors in agency show caves, directed recreation sites such as Blanchard Springs Caverns, Ape Caves, El Capitan Cave, Leon Sinks trail, and Rick's Spring.

I would like to take a moment to thank everyone who has made this newsletter a success over the past ten years including Jim Baichtal, Sonja Beavers, Courtney Cloyd, Melody Holm, Cynthia Sandeno, the staff at the University of South Florida Karst Information Portal, and all of our partners, co-workers, and friends who have taken the time to submit articles and media over the years. I hope you will celebrate with me and the rest of our Forest Service cave and karst family on this 20th issue of *Beneath the Forest*!▪

Program Notes: Management Training, CavesLIVE.

Johanna Kovarik
Minerals and Geology Management

Top Image: Instructors and staff from the cave and karst management course at Mammoth Cave National Park. L-R: Dale Pate, Rick Toomey, Joel Despain, Paul Burger, Tamara Bilewski, Pat Kambesis, Johanna Kovarik, and Gretchen Baker. Image: Phoebe Ferguson

Bottom Image: Students from Rippon Elementary, Agency Scientists, and the CavesLIVE production cast celebrate in Luray Caverns. Image: Kim Winter

National Interagency Cave Training: Mammoth Cave National Park 2018

The U.S. Forest Service partnered with the National Park Service and Western Kentucky University to offer a week-long national cave and karst management training at Mammoth Cave National Park April 29 - May 2. The last week-long training course offered in conjunction with the Department of Interior was in 2014 in Cody, WY with the Bureau of Land Management (BLM). The course this year was different in format, with mornings in the classroom and afternoons in the field. Optional sessions were offered in the evening and included cave cartography, dye tracing, biological inventory, and more. The Geology and Minerals Training Office (GMTO) provided support for the course, including the use of iPads for each student to view course presentations and handouts. The Cave Research Foundation provided low -cost housing as an option for students as well as a field location, and the Training Center at the national park provided a great meeting space. The course instructors came from across the partnerships, and are looking forward to adapting the course in future years.

CavesLIVE LIVE from Luray Caverns, Virginia March 14 2018

CavesLIVE's second phase including a 45-minute question-and-answer live, interactive program with scientists, was webcast live on March 14, 2018 from Luray Caverns in Virginia. Three scientists answered questions on camera during the program, while an impressive panel of 10 experts from various disciplines answered questions online. This interactivity allowed students to engage directly with scientists to have their questions about caves and karst answered. There were almost 400 questions submitted during the live program from 37 classes in 18 states. Approximately 19,682 – 23,882 students and others watched and participated. A classroom of students from Rippon Elementary in Virginia traveled to Luray, Virginia to view the live broadcast and ask questions on camera. The previously taped program as well as this and all the other great resources will be available at www.CavesLIVE.org.▪

The historic autograph of Prof. Thomas Condon is found under a coating of flowstone in Oregon Cave. Condon is considered the "Father" of Oregon Geology. Leaving one's name in a cave was common and accepted at the time. Image: Jim Nieland

U.S. Forest Service Cave Management: A Brief History

Jim Nieland
Gifford Pinchot National Forest, Retired

The U.S. Forest Service has managed caves since the agency was first established in 1905. Early cave management focused upon recreational use of caves. In the early days of the Forest Service only a few caves attracted management. Historical management of caves followed a common pattern. Oregon Caves National Monument exemplifies this history.

In 1874, the cave was discovered by Elijah Davidson while hunting south of Grants Pass, Oregon. In 1906, the Siskiyou Forest Reserve was established.
The reserve just happened to include the cave. The cave first gained national attention in 1907 following a visit by Joaquin Miller. Miller, renowned as the "Poet of the Sierras," who wrote an article highlighting the cave's unique beauty. The article increased recreational visitation. Under authority of the Antiquities Act of 1906, a Federal site survey was ordered and completed in 1908. As a result of the survey, and continued advocacy by Miller and others prominent citizens, the cave was designated in 1909 by President William Howard Taft as "Oregon Caves National Monument." Due to its location within the Siskiyou Forest Reserve, the United States Forest Service was assigned management of the new monument.

(History continued on page 6)

A volunteer removes spray paint from a cave wall. Image: Jim Nieland.

(History continued from page 5)

The U.S. Forest Service managed Oregon Caves National Monument for 25 years following establishment. Early visitors traveled to the cave by trail. The first permanent road to the cave wasn't completed until 1922. In 1934, management was transferred to the National Park Service. Throughout both managing agencies, a cave guide was present, yet it was common for early explorers to write their names on cave walls in pencil. Visitors were also permitted to collect souvenirs from the cave. Smoky pitch torches lit the tours, although electrical Oregon Cave is one example of early awareness toward cave management in the National Forest system. In Central Oregon, Arnold Ice Cave was mined for ice before the advent of refrigeration. Timpanogos Cave National Monument in Utah has a history similar to that of Oregon Cave. Arizona's Lava River Cave has a long history of public use and remains a popular destination. Caves on public land were a resource to be utilized, not a resource to be protected and conserved.

National Speleological Society

The real story of protecting caves started in 1941 with the founding of the National Speleological Society (NSS). The NSS was founded for advancing the study, conservation, exploration, and knowledge of caves. Over time the society adopted the motto: "Take nothing but pictures, leave nothing but footprints, kill nothing but time". The motto instilled a message of conservation and encouraged members to visit caves in a responsible manner. Many members saw a gradual degradation of caves including broken formations, graffiti painted on walls, trash and ravaging of in-cave archaeological sites. By the 1960's the public began to support environmental causes. Local chapters of the NSS called "Grottos" started to organize their members to perform cave cleanups. Litter would be collected, and names scrubbed from cave walls. This was something of a new concept, but one energetically pursued. Cave advocacy increased in the 1970's, supporting active management of caves. To this end a series of National Cave Management symposia began.

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Agency managers, cave scientists, and cavers shared their experiences and knowledge. The goal of these symposia was to share issues, and to highlight the need for professional cave resource management. Hundreds of agency personnel received their first exposure to the concept of cave management at these meetings. These continue to this day as National Cave and Karst Management symposia. Many attendees have become contributing authorities.

A new player emerged in the 1980's, The American Cave Conservation Association, or ACCA. Most of it's members were also NSS members wanting to promote a stronger role in cave conservation. The ACCA engaged in a series of cave management training seminars. Thirteen seminars, held throughout the country, provided Federal and state agency personnel with strategies for managing caves. Speakers included professional hydrologists, cave biologists, recreation managers, geologists, and legal advisors. Hundreds of agency personnel received their first introduction to cave management through these seminars.

FSM 2356

In reviewing the Forest Service Directive System (FSM) of the 1980's, it became apparent that the agency had generalized use regulations, but no clear directive concerning caves. An unexpected player came upon the scene. Tom Lennon from Washington Office Recreation, attended one of the ACCA cave management seminars and developed an interest in active cave management. One of his responsibilities was managing and updating the directive system for the Forest Service's recreation office. Tom contacted the ACCA and asked if they would help him with drafting a section on caves for the FSM. Jer Thornton and I were planning on making presentations at the Elkins, West Virginia Cave Management Seminar. We were asked if we would meet Tom at the Washington Office (WO) following the seminar. We met Tom in the WO and discussed our ideas for the need and scope of cave management direction. Tom was enthusiastic and encouraged us to proceed. Proceed we did. Jer is not only an avid caver, but an avid writer, working for a newspaper in his home state of Idaho. In one evening, in a motel room, on yellow legal pads, we drafted FSM 2356. We finished at 3:00 am. A few hours of sleep and we were back with Tom in his office, editing and smoothing the draft. More draft changes completed the project. Tom escorted the new FSM 2356 section through the official channels and within six months it was a new manual supplement. Some managers have asked why cave management direction is in the Recreation portion of the FSM, pointing out that these directives could be in half-a-dozen more appropriate places. It has everything to do with Tom Lennon and his interest in caves.

Jer Thornton, Pictograph Cave, Oregon, 1969.
Image: Jim Nieland

Federal Cave Resources Protection Act of 1988

Soon after FSM 2356 became available, cavers promoted a new initiative. For years, cavers bemoaned the fact that there was no Federal legislation for the protection of caves. They had seen other laws enacted such as various antiquities acts and the Endangered Species Act.

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They thought there should be a "Federal Cave Resources Protection Act." Organized cavers wanted a law that would apply to all caves on all federal lands. The NSS and ACCA combined forces. Jer Thornton again stepped to the forefront of the conservation movement. A bill was introduced in the House of Representatives by Congressman Frederick C. Boucher of Virginia on March 2, 1987. Senator Tom Daschle of South Dakota introduced a matching bill in the Senate. The Federal Cave Resources Protection Act of 1988 was signed into law by President Ronald Regan on November 18, 1988.

As a Federal employee, I was not involved with the drafting or promotion of the legislation. The big surprise for me came later, when I saw the final draft. FSM 2356 formed the core of the Federal Cave Resources Protection Act of 1988! This was from one-night of work on yellow legal pads. A second surprise came later when the law was published in the Federal Register. The conference committee added a new concept, potentially costly and disruptive: the concept of "significant" caves. The thought had always been that all caves should come under protection of the law, not elite caves only. This qualifier required regulations to evaluate cave significance. Archeologists warned against developing a cumbersome process, based upon their experience with placing archaeological sites on the National Register. Archeologists ended up with a process that can take years of research and writing for site protection. This caution was excellent advice.

The Drafting of Federal Regulations

Once a new law is established, the affected agencies are required to develop implementation regulations. These must follow both the intent and letter of the law. Once approved, they are published in the Federal Register and incorporated into the Code of Federal Regulations for each agency.

In early meetings between representatives of the National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, U.S. Bureau of Reclamation and the U.S. Forest Service it was agreed the implementation regulations should be essentially the same between the three agencies. This would assure that the law is applied uniformly.

An important part of the agreement was development of significance criteria covering a range of cave resource components. If a cave met just one of the criteria it would be considered significant. The only caves not meeting the criteria were those not defined as caves (caves had to be naturally occurring features and not man-made) and they must be on Federal Land managed by either the departments of Interior or Agriculture. A series of meetings were held between representatives of the Departments of Interior and Agriculture to draft the final rules. Next, each agency tailored their regulations to fit within the agency's Code of Federal Regulations, or CFR's. To follow the law a process was needed to allow interested parties to nominate caves as significant. This involved asking cavers to provide cave location information, descriptions and an evaluation sheet showing how the cave meets significance criteria.

National Cave Clearing House Established

The law required an initial listing of significant caves. Subsequent listings would take place as additional caves were identified. The first challenge was deciding how to accept initial listing. It was decided there would be a national clearing house which would collect all significant cave nominations. Ronal Kerbo, of the National Park Service, volunteered the park headquarters at Sequoia-Kings Canyon National Park for the clearing house. Joel Despain, the parks' cave specialist, would collect and sort the nominations. The nominations would be divided by geographic area then sent to a regional review team. The Nation was divided into six geographic areas and review teams established for each area (map, page 10).

(History continued on page 9)

United States Department of Agriculture | Forest Service | Deschutes National Forest | 1645 Highway 20 East Bend, OR 97701

File Code: 2350 Date: January 30, 1995

Subject: Significant Cave Listing

To: The Files

The Deschutes National Forest has determined that the following caves are "significant" caves. All caves listed meet the definition of "cave" and have been found to possess at least one of the significant criteria as prescribed by the Federal Cave Resources Protection Act of 1988 (16 U.S.C. 4301-4309). These caves are in addition to those designated as "significant" in my December 14, 1994 memo.

Caves are listed by name and by individual identification number.

Ft. Rock Ranger District

Squeeze Through (613-58)
Unlikely (613-61)
Ariel II (613-12)
Mushroom II (613-53)
Scott's Cranny (613-37)
Concealed (613-38)
Tumulus Shelter (613-39)
Bifurcate (613-40)
Tom's Cave (613-60)
Skeleton Cave II (613-55)
Red Hill (613-17)
Goodest Cave (613-49)
South Matz (613-57)
Lava Pond (613-44)
Friday (613-50)
Nice (613-51)
Walk-in (613-52)
UQMC (613-63)
Katati South Hornnido (613-27)
Vent Cave (613-33)

Skylight Cave was listed as a significant cave by letter on December 14, 1994. At the time it was presumed that Skylight Cave was located on National Forest System Lands of the Deschutes National Forest. It has been determined that Skylight Cave is actually located on private lands. Skylight Cave is hereby removed from the Deschutes National Forest list of Significant Caves.

/s/Sally Collins
SALLY D. COLLINS
Forest Supervisor

An example of a determination of significance. Note that the caves are listed by number and name only, no location information is attached.

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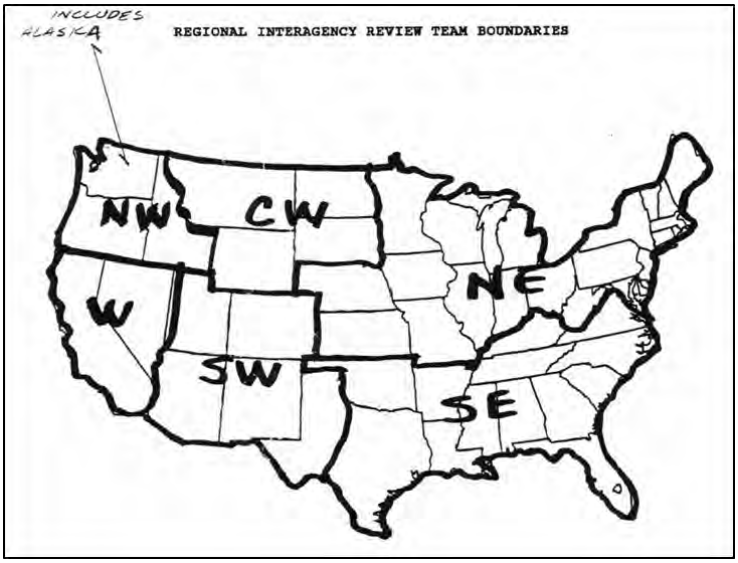
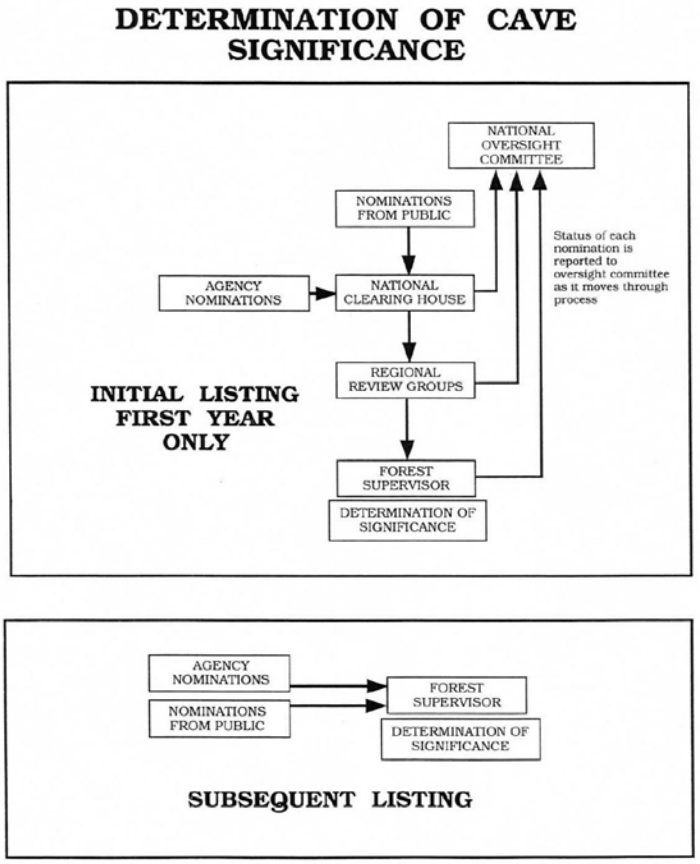


The areas were determined by interagency needs and predominant agency management, not by Forest Service regions.

The Clearinghouse began receiving nominations in 1994. Great effort was made to contact cavers and to encourage the submission of cave nominations. Since the National Speleological Society worked hard to encourage the law their members worked to nominate as many caves as possible for Initial Listing. Significant cave nominations poured into the clearinghouse. Since local cavers knew more about caves and their locations than most agencies, the initial listing process had great impact. For the first time the magnitude of cave numbers became apparent. When nominations were received they were to be entered into a log starting at the national clearing house, and each time they were moved their movements were tracked and reported to a national overview team in Washington, D.C. The national overview team assures conformity to the regulations, and makes sure nominations moved smoothly through the designation process.

At the end of the initial listing period, regional review teams sorted the nominations. The first sort was by agency, then by management unit. The teams consisted of cave specialists from each agency. The caves needed to meet only two criteria. They had to be on federal



Top Left: For review of initial nominations, the Untied States is divided into six regional areas. Note that these are not Forest Service regions.

Right: The process for initial, and then subsequent listings.

land and be natural features, not man-made. The teams batched the qualifying nominations forwarded them, along with a cover letter, to the authorized officers for final declaration of significance.

Maintaining confidentiality of cave location information is a requirement of the law and regulations. The teams maintained a listing of the caves, control numbers, agency and management unit but no specific location data. The master listing, along with team findings, is forwarded to the national oversight committee. The cave nominations were forwarded to the appropriate national forest or management unit. Location information appears only on the nominations, and not copied in any way.▪

Jim Nieland, USFS retired, has a life-long interest in caves. During the period of the FCRPA he was Region 6 cave specialist and acting USFS National Cave Lead. He remains active in cave-related fields and is known for developing closures for abandoned mines that protect wildlife habitat.

Dan Austin, Jewel Cave cartographer, navigates a canyon in the Splinter Section of Jewel Cave. Image: Adam Weaver

The Biggest Cave in the Forest

Adam Weaver
Black Hills National Forest

There are many forests that are well-known for their karst resources. Some have intricate cave management programs, with specialists devoted to karst, and trip leader programs for local enthusiasts. Because the Black Hills National Forest is known for its timber and recreations programs, and has no "cave program" to speak of, it makes sense that most people have never thought about the quantity or quality of the caves that are here. For those unfamiliar with the geology of the Black Hills, a tertiary mountain building event referred to as the "Black Hills Uplift," and subsequent erosion have created the current landscape. The Black Hills are ringed by karst zones created by sequential layers of limestone being tilted upward, and after erosion, becoming the surface. The largest of these exposed formations is the Madison limestone. At its thickest point in the region this formation is 1000 feet thick. The unique geology of the area has also led to the formation of approximately 400 caves, the majority of which are in the Black Hills National Forest. The two largest caves, Jewel Cave (195 miles in length), and Wind Cave (148 miles) are both National Park Service (NPS) units.

The management of the caves of the Black Hills is really a story of interagency cooperation and understanding. The Black Hills is home to a small but storied subchapter of the National Speleological Society (NSS) called the Paha Sapa Grotto.

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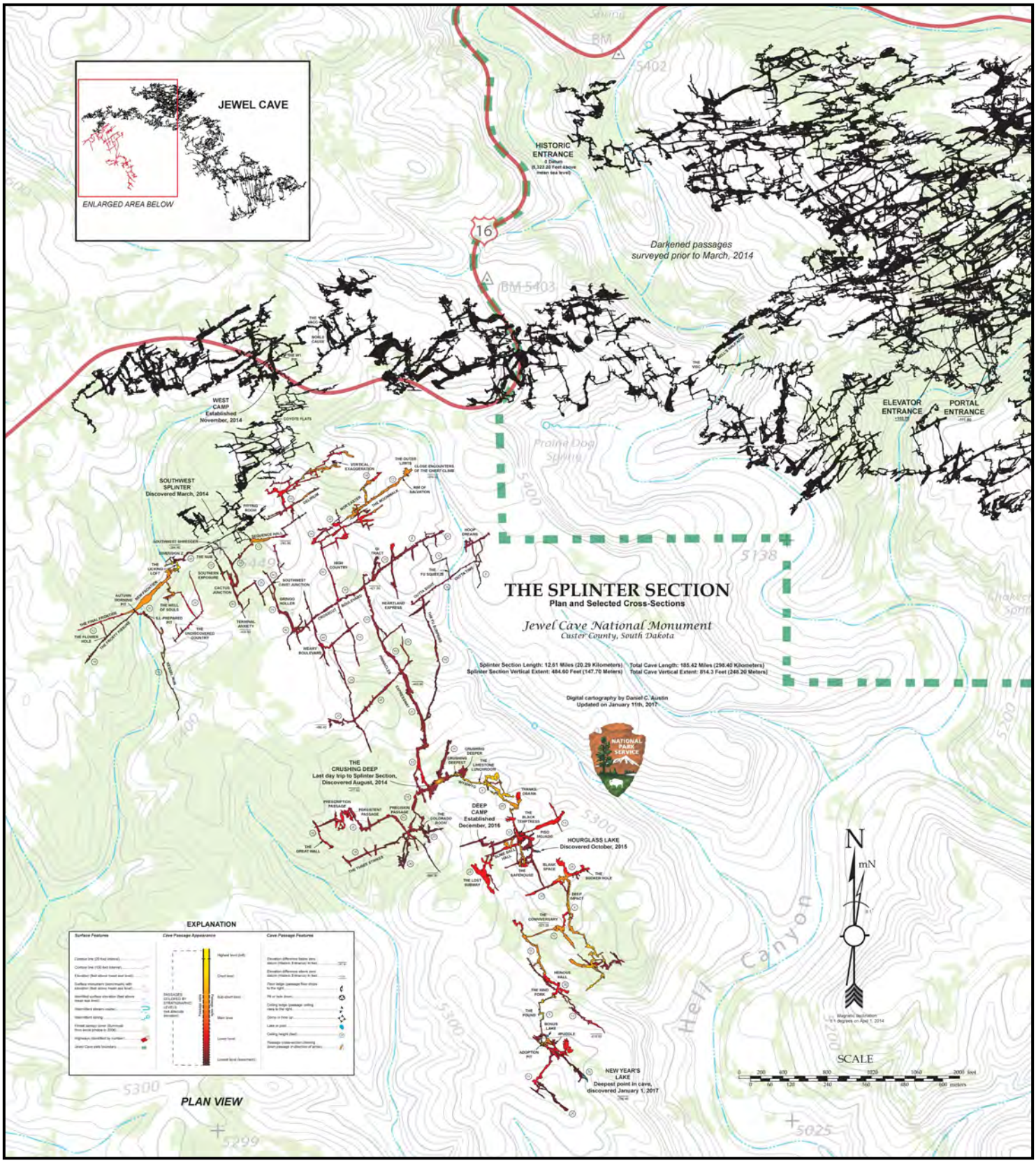


The most recent approved map publication from Jewel Cave National Monument, showing the "Splinter Section" where current exploration takes place on U.S. Forest Service land. Cartography: Dan Austin

(Biggest cave continued on page 13)

(Biggest cave continued from page 12)

Cavers on a camp trip bundled up in sleeping bags at West Camp in Jewel Cave. Image: Ben Smith

One of the oldest chapters of the NSS, this group has been involved in the locating, cartography, and conservation of caves in the region since the early 1960s. The grotto is also the only organization that has the location of all of the known caves. The Black Hills National Forest has a Memorandum of Understanding (MOU) in place with the Grotto, and both groups have worked well together in the past few years to accomplish some small conservation and exploration projects. Also in place is a service first agreement between Wind Cave National Park, Jewel Cave National Monument, and the Black Hills National Forest for mutual aid and specialist knowledge for cave and karst related issues. Finally, to circle back to the title of this article, the forest and Jewel Cave National Monument have an additional MOU for the management of Jewel Cave.

At its current mapped extent, more than 110 miles of this cave are on National Forest System (NFS) land. The NPS maintains the only entrance, oversees the exploration program, issues all permits to enter the cave, and through the expertise of Dan Austin, continues the cartography for Jewel Cave. The U.S. Forest Service handles all of the surface mitigation to prevent damage to the underground resources that are identified by the exploration program (see article page 14). The Paha Sapa Grotto has trained generations of cave explorers in cave survey and safety, and is very closely involved in the exploration of this system. The current exploration generally takes place in the western branch, on NFS land, through what is called "The Southwest Splinter." This very small, grabby, passageway was the breakthrough point for the discoveries of the last few years. As I write this article, there are currently just over 21 miles of cave and 9 lakes (contact point with the Madison Aquifer) past the Splinter. The exploration is greatly aided by the two established camps, "West Camp" and "Deep Camp." These camps are located 4-5 hours and 8-10 hours respectively from the entrance, and each allow survey teams to stay in the cave for four days per expedition. These camp trips are accomplished by volunteers, and are arguably the hardest cave trips in the nation. Most trips consist of a few local devoted explorers accompanied by some of the best explorers from around the nation, who come to test their mettle in Jewel. We cover miles of cave just to get to the edge of the system, and then begin mapping. It's a constant balance of speed, safety, survey, science, and seldom photos. Every moment is regimented for efficiency, every item brought in the cave is scrutinized for its weight and size. The methodology, or perhaps more aptly described "mentality" of the survey in Jewel is not for everyone. Many people come only once. But it has led to a long history of very productive survey trips accompanied by a record of safety that is unimpeachable.

The camps and lakes can be viewed on the map (page 12). This is the most recent map approved by the park for publication, and it is only a year old. Since this map was produced we have surveyed 10 more miles of cave passage in this area! Although I had hoped to get a newer version of the map for this article, I think this paints a picture of the rate that our knowledge of the cave system is expanding. By the time you read this, it is almost certain that we will have another mile of cave mapped. This is what makes the Jewel Cave project special. We know there is more. It isn't a question of if the passage continues, it is a question of when someone will want to push hard enough. Jewel Cave, the largest cave in the forest, has no end in sight. ▪

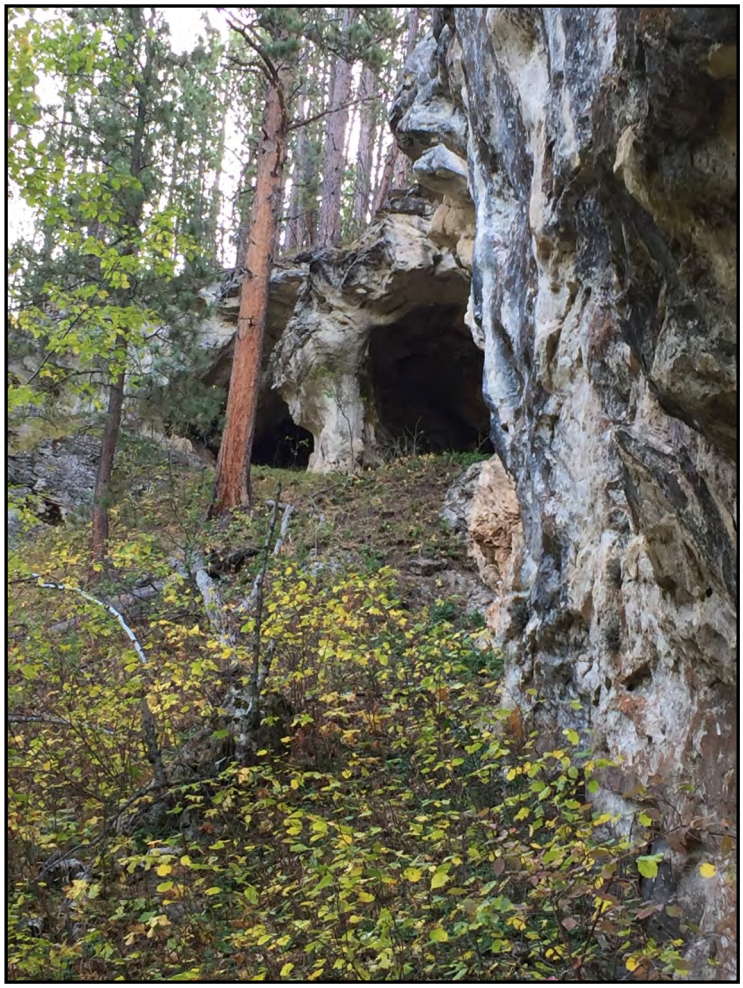
Karst Vulnerability of the Black Hills National Forest

Deanna Stever
Salmon-Challis National Forest

Near the end of my five-year sabbatical from the U.S. Forest Service, I was approached by the Black Hills National Forest to join the Black Hills Resilient Landscape Project Interdisciplinary Team. My duties were to represent Minerals and Geology and complete an analysis in an Environmental Impact Statement (EIS) with an emphasis on cave and karst resources. Using examples of the karst vulnerability assessment from the Tongass National Forest, this is how the analysis happened.

Why: A Brief Project Description

Black Hills Resilient Landscape Project (BHRL) is designed to move landscape-level vegetation conditions in the Black Hills toward objectives outlined in the amended Black Hills National Forest Land and Resource Management Plan. This will increase ecosystem resilience to disturbances such as severe wildfire and mountain pine beetle infestation, provide diverse wildlife habitats, contribute to public safety and the local economy, and reduce risk of wildfire to landscapes and communities. Proposed activities, which will occur on much of the forest, include timber harvest, non-commercial thinning, hazardous fuels reduction, prescribed burning, hazard tree removal, enhancement of hardwoods and grasslands, pine planting, site preparation, maintenance of aspen, bur oak, and grasslands, and enhancement of stand diversity. The BHRL has a similar adaptive approach to the recent successful implementation of the landscape-scale Mountain Pine Beetle Response Project.



A cave in the Minnelusa Formation. Image: Deanna Stever

Geology and Karst of the Black Hills

The Black Hills uplift is an asymmetric, domal structure approximately 120 miles long and 60 miles wide and trends north-northwest between the Belle Fourche and Cheyenne Rivers (Driscoll, 2002). It is cored by Precambrian, metamorphic and granitic rocks surrounded by folded Paleozoic sedimentary rocks. These layers of rocks were domed into their present configurations during the Laramide Orogeny which began during late Cretaceous (60-65ma) and continued into the Eocene Period (Driscoll, 2002). Later the northern Black Hills were intruded by a west-northwest -trending belt of stocks, laccoliths, dikes, and sills during early Tertiary time (50-60ma). Much of the area of the Black Hills was then covered by a thin sequence of Oligocene terrestrial sediments and erosion has uncovered the older rocks and has created the present form of the Black Hills.

(Vulnerability continued on page 15)

(Vulnerability continued from page 8)

Karst Aquifers

The Mississippian-age Madison aquifer occurs in the upper karstic portion of the Madison Limestone where solution openings and fractures have produced a well-developed secondary porosity and permeability. The aquifer is contained within the limestones, siltstones, sandstones and dolomites of the entire Madison Limestone and overlying Englewood Limestone. The Pennsylvanian-age Minnelusa aquifer is confined within the sandstones, dolomite and anhydrite in the lower portion and upper portion of the Minnelusa Formation. The aquifer's primary porosity is in the sandstone units and secondary porosity derived from collapse breccias created by fracturing and dissolution of interbedded evaporates (gypsum and anhydrite).

Significant recharge to the Madison and Minnelusa Aquifers is through precipitation on their outcrop and streamflow losses of surface water. The low-permeability of the lower part of the Minnelusa Formation acts as a confining unit except where karst features in the upper Madison Formation reduce the effectiveness and water leaks into the Minnelusa Aquifer. Flow is generally from recharge areas to the northeast, and within the Black Hills both the Madison and Minnelusa aquifers are often hydraulically connected and are likely sources for most large artesian springs.

Carbonate Karst

The cavernous Madison Formation is exposed encircling the Black Hills uplift and these rocks have undergone several stages of cave and karst development. The Mississippian limestone was first affected, while buried, by the dissolution of interbedded sulfates rocks (gypsum and anhydrite) that formed solution voids and breccias, broken fragments of rock cemented by a fine matrix. Later the Madison was exposed and meteoric water infiltrated and replaced the sulfates with calcite and dissolved karst features and minor caves. The Madison was then buried by Pennsylvanian-Cretaceous sedimentary rocks filling the numerous voids with sediments. Speleogenesis and groundwater flow continued once the Laramide Orogeny (Paleocene-Eocene) uplifted and exposed the Madison once again. Post-Laramide speleogenesis preferentially dissolved and enlarged paleokarst voids (Palmer, 2015) creating abundant caves, and surface karst features such as: sinking streams, sinkholes and exposed Mississippian paleokarst.

A cave in the Madison Formation. Image: Deanna Stever

Evaporite Karst

Calcium sulfate rocks such as gypsum and anhydrite occur as evaporate deposits in many sedimentary rock units of the Black Hills. Subsidence and collapse has resulted from the dissolution of gypsum and anhydrite in the Minnelusa and Spearfish Formations. This has developed disrupted bedding, breccia pipes and pinnacles in the Minnelusa, and sinkholes and breccia pipes extending into the Spearfish and overlying formations. Some of the sinkholes located in the Spearfish are resurgent springs where the aquifer's potentiometric surface lies above the land surface and dry sinkholes where it lies below the bottom of the sinkholes. The dissolution in the subsurface of the thick anhydrite in the Minnelusa and consequential collapse creates the largest sinkholes.

(Vulnerability continued on page 16)

(Vulnerability continued from page 15)

A caver explores a cave entrance on the Black Hills National Forest. Image: Deanna Stever

Creating Spatial Data and Karst Vulnerability

Using a combination of geology and groundwater/aquifer data, I was able to create karst vulnerability areas within the Black Hills National Forest. The U.S. Geological Survey's (USGS) publication Karst in the United States: A Digital Map Compilation and Database is available in free digital data in Google Earth and ArcGIS format and can be used to create Karst Vulnerability for your area if other digital geologic data is unavailable.

The process with these data:

1. Create a feature class of carbonate karst from the downloaded USGS Karst in the United States: A Digital Map Compilation and Database (https://pubs.usgs.gov/of/2014/1156/) and clip to BHRL Project boundary.

2. Create a Feature class of evaporite karst from the USGS Karst in the United States: A Digital Map Compilation and Database (https://pubs.usgs.gov/of/2014/1156/) and clip to BHRL Project boundary

Or if you have local, digital geologic data:

1. Create a feature class of high vulnerability karst merged Madison and Englewood Formations (from digitized geologic maps) and clip to BHRL Project boundary.

2. Create a feature class of moderate vulnerability karst merged Minnelusa, Whitewood, and Minnehkata Formations, Spearfish and Gypsum Springs Formations downloaded from digitized geologic maps and clipped to BHRL Project boundary.

3. Create feature class of low vulnerability karst merged all other carbonate and evaporite formations lacking karst features downloaded from digitized geologic maps and clipped to project boundary.

Black Hills NF Karst Vulnerability Described *(from Black Hills Resilient landscape Project EIS, Geology Report)*

Karst is a term that describes the complex geologic environment in which surface waters and groundwater are tremendously intertwined and create unique physiographic and hydrologic features and landforms. In the Black Hills area these features develop by the dissolution of soluble rock, primarily limestone and dolomite (carbonates) and gypsum and anhydrite (evaporites).

Low Vulnerability Karstlands:

Low vulnerability karst lands are those areas where resource damage threats associated with land management activities in the areas are not likely to be appreciably greater than those posed by similar activities on non-carbonate substrate. A generalized characterization of these lands would be that they are underlain by the other carbonate formations, Spearfish or Gypsum Springs formations in areas where karst features are absent.

(Vulnerability continued on page 17)

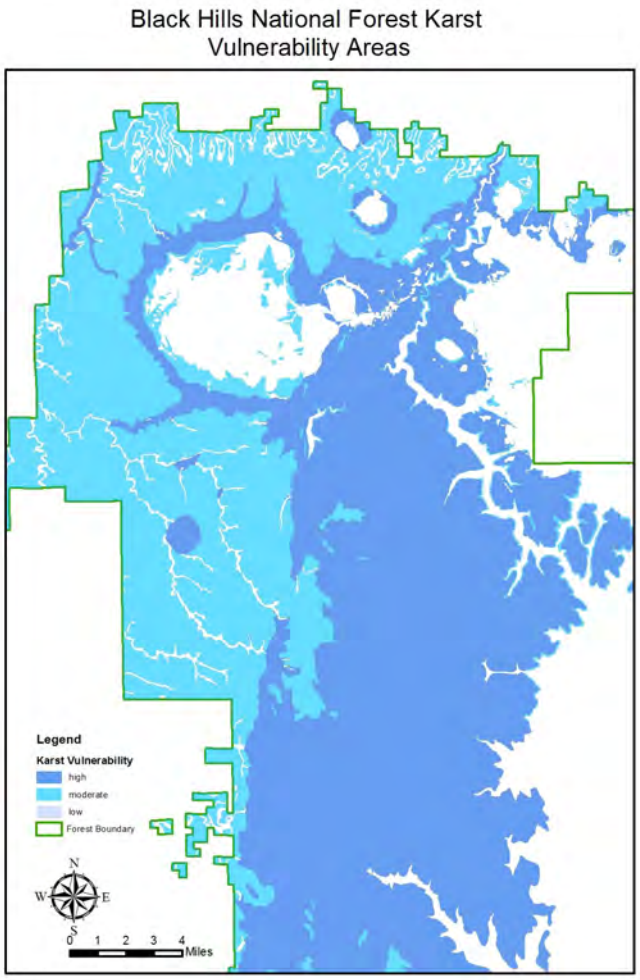


Figure 1. Enlarged view of Karst Vulnerability of the Black Hills NF . Cartography: Deanna Stever

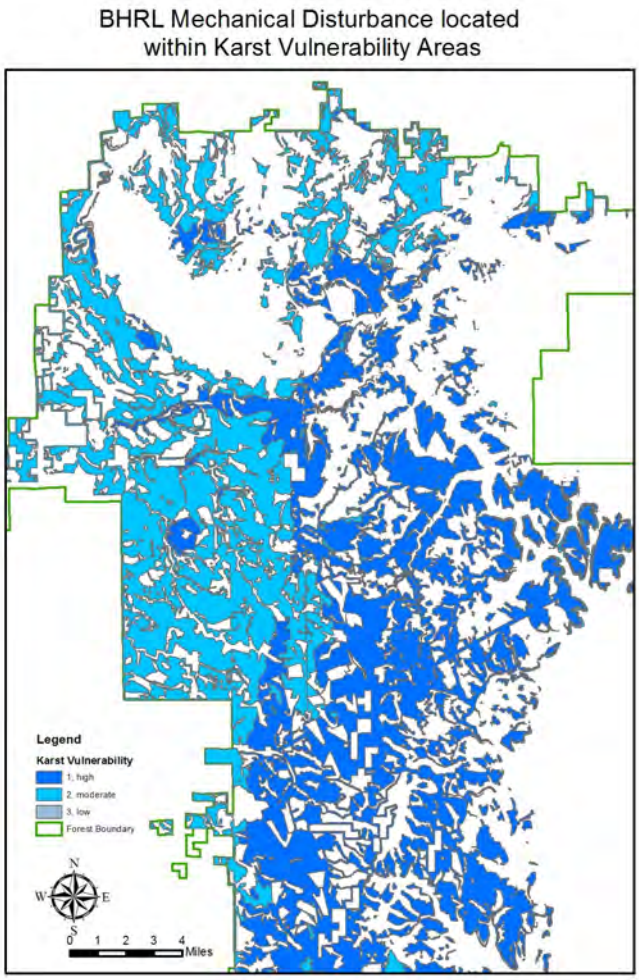


Figure 2. An enlarged view of BHRL Mechanical Disturbance areas intersected with Karst Vulnerability areas.

(Vulnerability continued from page 16)

Generally, these lands pose little or no threat to organic, sediment, debris, or pollutant introduction into the karst hydrologic systems beneath through diffuse recharge.

Moderate Vulnerability Karstlands:

The moderate vulnerability karst lands are those areas where resource damage threats associated with land management activities in the areas are appreciably greater than those posed by similar activities on low vulnerability karst lands. A generalized characterization of these areas would be areas underlain by Minnelusa, Whitewood, and Minnehkata Formations and Spearfish and Gypsum Springs evaporite formations that include collapse features such as sinkholes, resurgent springs and pinnacles.

High Vulnerability Karstlands:

The high vulnerability karst lands are those areas where resource damage threats associated with land management activities are appreciably greater than those posed by similar activities on low or moderate vulnerability karst lands. These are the areas contributing to or overlying significant caves and areas. These are areas underlain by the Madison and Englewood Formations, composed of carbonate bedrock that is well drained internally. Surface streams are rare and are often captured when entering this area. Karst systems and epikarst are extremely well-developed and collapse karst features may be numerous.

(Vulnerability continued on page 18)

Activity	Maximum Acres/miles	Maximum acres/miles on High Vulnerability Karst	Maximum Acres/miles on Moderate Vulnerability Karst	Maximum Acres on Low Vulnerability Karst
Forest density reduction	565,400	159,400	180,900	9,400
Mechanical Harvest, site prep, and tree planting	578, 400	305,500	352,100	16,000
Prescribed Fire	100,000	17,900	38,800	220
Roads	618	65	92	0.3

Table 1 BHRL Activities on Karst (Example from BHRL Geology report)

(Vulnerability continued from page 17)

These include all collapse karst features, caves, sinking or losing streams, insurgences, and open resurgences. The highest vulnerability features are those that could produce and transport the greatest amount of sediment, debris, and/or organics if disturbed. These include sinkholes and cave entrances accepting a sinking stream, whether intermittent or not. The subsurface drainage network is highly vulnerable to sediment, organic matter, logging debris, and other pollutants generated as the result of surface activities.

Within polygons labeled as high or moderate vulnerability there are features that require buffering under current Black Hills Management Plan standards. These buffers were drawn as the minimum 100 foot radius buffer. However, these buffers will need to be designed and laid out by a karst specialist during unit layout taking into account factors such as aspect, slope, wind throw potential, soils, etc., at which point certain buffers may need to be enlarged or modified in response to these concerns.

Analysis

Grouping the proposed BHRL project activities by anticipated effects to cave and karst resources streamlined the analysis:

1. Create a feature class of merged project activities, provided by project leaders.
2. Create a feature class of intersected project activity feature classes with each karst vulnerability feature class.
3. Calculate acres of feature classes for each project activity group.

Implementation

When the time arrives to implement BHRL, the data created during this analysis will guide field surveys and identify project design criteria. The implementation team identifies a sub-project area within the BHRL project area and proposed activities. The geologist team member consults the BHRL geology geodatabase and identifies karst vulnerability areas and determines the need for field surveys and provides appropriate design criteria for the project.▪

An Expedition Into Silvertip Cave, Montana

Gabriella Eaton
Bigfork High School Cave Club

Fifteen miles into the backcountry of the Bob Marshall Wilderness lies Silvertip Mountain. In August, its snowpack still clings to the mountainside amongst the vibrant wildflowers. Limestone peaks surround our campsite which sits on a cliff side overlooking the valley beneath. Below the high alpine slope is the Silvertip Cave System. In here, the water and air temperature stays around thirty seven degrees Fahrenheit. During our 2017 expedition, 18 people spent 10 days surveying leads, taking photos, and rigging ropes in this system that is over 9 miles long.

In 1974, Mike McEachern discovered the Silvertip System when he found the entrance to Bell Cave. In previous years, others had discovered a few small caves that are located higher up the mountain but these caves don't connect to the Silvertip System. After the discovery, cavers from all over traveled to the Bob Marshall Wilderness, chasing the national depth record. To their disappointment, a cave in Wyoming [also on National Forest System (NFS) lands] called Columbine Crawl took the title at 1550 feet deep. The Silvertip System was 1089 feet deep and 30,702 feet long as of 1981. In 2015, Hans Bodenhamer decided to start remapping the system and as of now, there are 6.64 miles mapped.

On our expedition in 2017, we started hiking up to camp in the late afternoon. The eighty degree heat was killer, especially on my way up "heartbreak hill." We were also slowed down by an excessive amount of vegetation downfall that choked the trail in numerous places. One group stayed behind to help clear the trail. We arrived at the halfway point ,"packers camp", at around 8 PM, woke up at 5 AM and finished our hike

A caver descends into the Silvertip Cave System. Image: Jean Krecja

to the North Cirque Camp. The last part of the hike is mostly uphill, but thankfully there are tons of huckleberries along the way. Because a lot of gear is needed for this trip, to help lighten our packs, packers bring some of it in on mules. On this trip the packers arrived a day late. Some of us who were already at the North Cirque ran out of food. Others stayed at "Packers Camp" to wait for the mules and help clear trail.

(Silvertip continued on page 20)

Main Image: Cavers meet with Hans Bodenhamer (right) after exiting the Silvertip Cave system in Montana. Image: Carrie Voss
Inset Image (left): The "demonic" chiz. Image: Ian Chechet

(Silvertip continued from page 19)

Luckily, for those of us starving at North Cirque Camp, Hans packed in thirty bagels!

On the first day of caving, Hans, Lee Brooks, and I went to Bell Cave to survey in the very bottom. In order to get there we had to rappel alongside an eighty foot waterfall, which had three rebelays. I had practiced rebelays many times on the surface but it was my first time experiencing a rebelay in a cave. There was freezing water shooting into my face and hands which made everything more difficult. After the rappel we had to pass through several traverse lines to get to the start of our survey. Our trips never lasted more than eight hours but this felt like eternity in a place that was so taxing.

After a few days at camp, ground squirrels start to make their appearance. Historically, cavers at Silvertip call them "chiz." At first they are kind of cute. Then, after I heard stories of the chiz gnawing on the lines that hold up your food bag and devouring the precious contents, they seemed more demonic. The chiz didn't get into our food bags during this trip, but they definitely tried and were constantly harassing us during breakfast, lunch, and dinner. Other than the chiz, we didn't see much wildlife except for a single mule deer that we named Frank. He was a trophy buck who wandered into camp frequently. It was common conversation to talk about who received a visit from Frank in the night.

There is one particular part of the Silvertip System that most cavers avoid. It features a 1000 foot armpit-deep wade in icy water in order to get to unsurveyed leads.

(Silvertip ontinued on page 21)

The "infamous" deep wade in armpit-deep cold water in the Silvertip Cave System in Montana. Image: Jean Krecja

(Silvertip continued from page 20)

For some reason, I always ended up going here. For the record, I think it is one of the most beautiful places in the cave. There is crystal clear water in an arched hallway and the reflections of our headlamps off the water cast dancing lights onto the walls. In some spots, we had to crawl on the sides of the walls to prevent us from going underwater. Heather Bodenhamer topped over her waders a couple of times and by the end of the day she had these massively large-looking ankle (balloon like appendages that extend from the knee to some point well beyond the bottom of the foot). When we arrived at the beginning of our survey it was a nice walking passage, but as we continued it became ankle deep water with extremely narrow walls. We only surveyed three leads that day but it might as well have been twenty. Because it is so strenuous, we end up eating a lot of candy while we are caving. During the wading portion our Swedish fish got a little wet. When mixed with muddy hands it gave them a nice crunch.

While we were eating wet Swedish fish, other survey teams made some valuable accomplishments. The groups' biggest accomplishment this past year was to connect Blood Cave into the main system. The entrance to Blood is only a five minute walk from the Bell entrance on the surface but traveling between those same points inside the cave requires three long hours of travel. The elusive connection was found in a tight squeeze that bypasses some flowstone blocking the passage. In addition to the blood connection, our group surveyed the Bird, Stairwell, and Tipfish entrances to the system. On this year's expedition, we mapped 1.55 miles of passage. We have now well surpassed the length of the original survey. We hope that once we complete the survey of Blood Cave and push some more leads we will have a system over ten miles long. These accomplishments could not be possible without the members of this years expedition; Carl Froslie, Will Urbanski, Carrie Voss, Ian Chechet,

(Silvertip continued on page 22)

2017 National Cave Rescue Training on the Deschutes National Forest

Eddy Cartaya
Deschutes National Forest

The National Cave Rescue Commission (NCRC) is a commission of the National Speleological Society (NSS), which has a formal Memorandum of Understanding (MOU) with the U.S. Forest Service as an official partner in assisting with agency efforts to protect, preserve, monitor, and interpret cave resources on National Forest System (NFS) lands. Many forest personnel have duties that take them underground, and some forests have caves that are not just open to the public, but have managed access. For example, Lava River Cave and Ape Cave are two Pacific Northwest (PNW) Region show caves where U.S. Forest Service staff manages and patrols visitation.

For these reasons, cave rescue training is an important part of employee safety as well as the safety of rescue responders who may be tasked to respond to medical or trauma incidents in our caves. The U.S. Forest Service Handbook FSH 2809.15 requires that the agency provide training to cave-going employees, and states that the agency should consider cosponsoring such training events. The Deschutes National Forest in Central Oregon led the way in this endeavor in June 2017 and was the host site for the 2017 National Cave Rescue Commission annual 100 hour seminar. Over two years of planning went into preparing and planning this seminar.

(NCRC continued on page 23)

(Silvertip continued from page 21)

Silvertip Mountain beckons for future caving trips in Montana. Image: Heather Bodenhammer

Hans Bodenhamer, Graham Schindel, Neil Marchington, Ann Brooks, Lee Brooks, Galen Jamison, Ben Tobin, Rob Spangler, Amanda Simpson, Tiffany Nardico, Marty Abercrombie, Heather Bodenhamer, and Jason Ballensky. Since we were so busy, the expedition went by pretty fast and soon the time arose to make the long haul back to our cars. As we trekked through the forest, daydreams of soft beds, hot showers, and anything besides freeze dried food crossed everyone's minds. However, we would all miss the serenity of the Bob when we returned to our jobs and everyday life. As I reached the apex of heartbreak hill I looked South. The familiar peak and our peaceful camp stood in the distance awaiting our return.▪

Check Out Other Minerals and Geology Management Newsletters!

(Only accessible to Forest Service Employees)

National Groundwater Program Newsletter: Baseflows

National Minerals and Geology Program Newsletter: Diggin' Deep

Paleontological Resources Report

NCRC Weeklong Training participants and instructors practice securing a patient into a litter used in cave rescue. Image: Rick Speaect

(NCRC continued from page 22)

The NCRC is not a responding rescue team, but rather a commission with three main functions. The first is to provide quality education in the topics of cave rescue to all cavers, employees, and rescue personnel who may be in a position to help or respond to an underground incident. The NCRC has an education committee which is tasked to constantly update and refine multiple levels of cave rescue training.

The second function is based largely on the 10 regions of NCRC, which roughly line up with the 9 regions of the Forest Service. Each NCRC region has a regional coordinator whose primary role is to coordinate with federal, state, and local agencies with cave interests or SAR response duties, and assist with rescue pre-planning efforts. Sometimes these preplans take the form of ICS training for cave operations, or may consist of planning sessions with agency personnel to plan logistics, establish rescue caches, pre-rigging, and develop cave evacuation maps, similar to the fire evacuation route on the walls in your office. NCRC national seminars, as we hosted here in 2017, serve this function by default, as the in-cave exercises occur in NFS caves, and involve numerous mock rescues. This allows local agency personnel and regional coordinators to photograph and document how these rescue problems were solved for future reference. It is a good way to also test any proposed pre-plans developed jointly by USFS / NSS personnel.

Thirdly, regional coordinators maintain local rescue caches that can be deployed upon request to any agency, forest, or rescue team requesting cave rescue assistance. The PNW region has its primary cache located in Redmond, Oregon, with smaller caches in Roseburg, Oregon, and up in Washington. With White Nose Syndrome remaining a major concern, these caches stay local so as to avoid any cross contamination.

(NCRC continued on page 24)

(NCRC continued from page 23)

If any part of a cache is deployed outside of its zone, it must be fully deconned in accordance with current WNS decon policy. Much of the 2017 national seminar done in-cave was done using the PNW cache for this reason, with out of area caches used for cliff and gym site training.

The 2017 seminar had over 100 attendants from around the world. Several agency personnel from the USFS and NPS attended, as did dozens from mountain rescue teams, and teams from all over the country. The Deschutes is a strong steward for its cave resources, and made the permitting process very easy. Special caveats were written in to establish quiet zones in certain sinkhole entrances known to have other caves nearby closed for special bat concerns. In one such cave, the final exercise involved about 35 people working to haul a patient in a litter out. The entire last segment of the rescue had to be done in total silence, which was new for most responders. Although this was done to protect bat interests, it ironically provided a unique training opportunity for the team to communicate via hand signs. This is something that may have to happen in caves with roaring waterfalls nearby, or at entrances with gale force winds.

The NCRC national seminar teaches four levels concurrently. Each of the four levels train separately for days one through five. On days six and seven, all levels come together and work as large team to solve complex in-cave rescue problems. Levels one, two, and three comprise the core curriculum material. All levels address caver safety, cave resource preservation during rescue operations, patient assessment, splinting, hypothermia treatment, and packaging, belays, and vertical passage rigging. Single Rope Technique (SRT) is required in all three levels. Students must demonstrate a prescribed level of SRT competency prior to admission into the course. Some levels teach specialty techniques, such as crack as crack and crevice, passage modification, and water problems. Level one is designed to train personnel new to cave rescue to

A patient in a litter is suspended by rope during a practice cave rescue. Image: Rick Speaect

function as a team MEMBER. This is ideal for USFS employees working at caves, as they may be requested to assist as part of a task force due to their knowledge of the cave. Level two trains students to lead task forces of personnel from many disciplines and agencies to fulfill a specific function in a large rescue. Level three trains advanced rigging problems, and prepares students to manage the higher ICS responsibilities involved with rescue operations. All three core levels have a written exam and practical test to pass. There is also a field-work only level, called Team Operations Field Exercises (TOFE). This level has no testing, and is designed for students who have completed level 2 to spend a full week in the field solving rigging and extrication problems.

Due to the WNS concerns, an extensive part of the seminar logistics revolved around decontamination. These seminars require a huge amount of team gear, not to mention the personal gear for 100 people.

(NCRC continued on page 25)

(NCRC continued from page 23)

To facilitate this, I worked with BLM sources and other organizations to have a set of industrial boilers brought up from California so we could use the hot water treatment for decon. While this initially worked, as the week progressed, it became clear these were not enough, and it was taking far too long to perform decons. As such, we had to supplement with six children's swimming pools to set up the bleach method of decontamination, with lines of pools, buckets of bleach, and rows of drying racks. The methods worked well. USFS resource personnel came out to inspect the decon procedures and were pleased. NCRC students are long accustomed to decontamination procedures, and for most, it is just a part of doing business in caves now. No one complained, except for one instructor whose brand new cave suit had its color run and become a tie-dye suit….rather unique looking.

The PNW region of the NCRC hosts many smaller courses as well. Two day-long Orientation to Cave Rescue (OCR) courses can be offered pretty much any time anywhere upon request by an agency. We do this annually for the Oregon Caves National Monument. Increasingly popular are the three to five day Small Party Assisted Rescue (SPAR) courses, which train small groups (three or four people) of cavers, employees, or responders deploying as a hasty team, to assess, stabilize, and assist an injured caver out of a cave without the help of an outside rescue team. This is critical for instances in remote areas, where rescue is improbable, or would be a long time coming. It is also useful for personnel who may be able to start a patient moving towards an entrance instead of waiting statically for a rescue team. These are great minimal gear, minimal impact courses, especially considering that a full team call out rescue puts a lot of people inside a cave, and creates a greater impact on the resource. There is a five day SPAR course scheduled for Redmond, Oregon September 19 thru 23 2018.

Top Image: Cave rescue course participants move a litter with a patient secured through a tight spot involving technical litter passing and delicate litter handling during a mock rescue.

Bottom Image: Cave rescue course participants handle the ropes on complicated rigging during the mock rescue portion of the week long training course.
Images: Rick Speaect

The 2017 NCRC National Seminar was great success, not just for the students who learned great skills, but for the partnership of the NSS and the US Forest Service, who clearly share the mutual passion to protect and preserve our NFS caves, and ensure we have the pre-planning and skills needed to help anyone, be they employee or visitor, who may find them injured inside one of our caves.▪

Berryessa-Snow Mountain National Monument Cave Inventory and Management Plan

Ryan Mikulovsky
Mendocino National Forest

On July 10, 2015 President Obama proclaimed the Berryessa-Snow Mountain National Monument (Monument). The Monument's boundary includes 213,900 acres of the Mendocino National Forest (National Forest System land) and 192,700 acres of Bureau of Land Management (BLM) and other public lands (acreages inclusive of inholdings). Cave resources are known to occur within the Mendocino National Forest portion of the Monument. Thus objects of historic or scientific interest within the Monument, including caves, were to be protected for the benefit of all Americans: :

"The area has two important tension-crack caves, likely also created by landslides. These are classified as significant under the Federal Cave Resources Protection Act of 1988 and provide habitat for the Townsend's big-eared bat."

Tension crack caves are also known as crevice caves. The geology of the National Forest System (NFS) lands within the Monument is key to crevice and talus cave formations. NFS lands within the Monument are primarily Franciscan Assemblage geology. Two subdivisions of the Franciscan Assemblage include the Eastern and Central belts.

Fragile rock collapse over the crevice Flat Top crevice cave. A California Fuchsia overhangs the crevice.
Image: Ryan Mikulovsky

The Eastern belt is comprised primarily of greywacke and metamorphosed marine sedimentary rock such as South Fork Mountain Schist. Other common rocks of the eastern belt include light metamorphosed sandstone called greywacke and a metamorphosed seafloor basalt commonly called greenstone. Both greywacke and greenstone may crop out as big jointed or fractured rock blocks up to an acre in size (usually much smaller, say half of an acre). The larger the outcrop, the more likely it will have cave resources. Greenstone and greywacke are fairly resistant to weathering, while surrounding rock is not, which creates prominent and scenic outcrops with important habitat and cultural value. The Franciscan central belt hosts a wide variety of rocks, but primarily metamorphosed shale.

(Monument continued on page 27)

Flat Top outcrop amidst a dry glade and earthflow. Note the stunning pinnacle to the right. Image: Ryan Mikulovsky

(Monument continued from page 26)

The central belt is most known for its mélange: a bedrock composed mostly of sheared argillite and blocks of exotic rock such as metamorphosed oceanic crust within. These mélange are very prone to a type of landslide called earthflows and these can extend from ridge to stream channel. These mélange areas have large exotic rock blocks of greenstone, diabase, greywacke, rare limestone scattered throughout, and sometimes they occur within earthflows.

Both the Eastern Belt and Central Belt can have prominently exposed rock blocks and depending on their geometry, geomorphic history and hillslope position, they can have caves. When these large blocks are pulled apart along their joints or fractures by earthflows or other mass wasting processes, caves may form. These caves are known as talus and crevice caves and can be important habitat for wildlife. They may also have cultural value and some of these caves are extremely deep chasms that may have fossil resources.

Prior to the 2017 Berryessa-Snow Mountain National Monument inventory, two caves were designated as significant within the Monument. These caves were well known to the forest biologist as Townsend's big-eared bats inhabit them. These caves are also clearly interacting with geomorphic features as one cave sits in a large earthflow and another is at the sharp edge of a ridge along a headwall, forming a very steep bluff.

(Monument continued on page 28)

(Monument continued from page 27)

One of the smaller "closet-sized" caves discovered in the Monument. This one is about 3 feet wide and goes back about 20 feet. Not only is this a pull-apart crevice cave, there's also talus accumulating above it. Image: Ryan Mikulovsky

With designation of the Monument, it became obvious that an inventory of outcrops for caves would be necessary. So special project funding was competed for and received from the Forest Service's Minerals and Geology Management group.

Eighty-nine outcrops in the Monument were mapped remotely using LiDAR and high resolution satellite imagery. Thirty-six outcrops were visited over a span of two and half weeks and out of those seven new caves were discovered. ESRI Survey123 was used to collect information needed to determine significance and to collect basic cave metrics. These caves were loaded into the NRM Cave Database.

Most visited caves were very small, closet-sized talus caves. During this summer inventory, none of these small caves had bats. Many mapped outcrops were not visited because of their remoteness at the bottom of drainages, far downslope from access roads or were between private in-holders without Forest Service access.

The most notable newly discovered crevice cave is narrow and steeply dipping. Flat Tap cave is within an unusually large two-acre greenstone outcrop. The cave itself is up to 60 yards long and is a minimum 30 feet deep and up to 8 feet wide. The cave is sitting next to a deeply incised stream and is on a large earthflow; these geomorphic features may be responsible for its linear formation. Although no bats were observed during the summer investigation, this cave has high potential for bat habitation and other resource values. However, since it is in a specially designated area (Monument), it is automatically eligible for designation as a significant cave.

This inventory provides the basis to manage caves in the Monument. Prior to this, only two caves were known but now it is clear that the Monument is rich with these unique formations with their attendant ecosystems. Any cave in the Monument can be nominated and designated as significant. However, first caves with clear resource value are being nominated for significance. Additional biological and cultural inventory should occur at all caves to understand how best to protect them from risks associated with human contact and climate change.

There are likely more caves to discover, with potential manageable resource values, in the Monument and in the rest of the Mendocino National Forest.▪

SMALL PARTY ASSISTED RESCUE

a technical seminar presented by the

NATIONAL CAVE RESCUE COMMISSION

Bend-Redmond, Oregon

September 19 thru September 23 2018

hosted by

Oregon High Desert Grotto & Glacier Cave Explorers,

About the Seminar

This is a comprehensive, 5-day course covering techniques that will allow small groups of experienced cavers to extricate and evacuate injured companions, and /or survive while waiting for rescue. The course will draw from all levels of the NCRC curriculum, and is rigging intensive. The class involves ample time for small party rigging practice, and incorporates techniques from a broad range of SRT industries plus local refinements. This is an intensive five-day introduction to cave rescue techniques that can be performed by a party of 5 or less persons, using minimal gear normally carried on caving trips. This course teaches students how to handle most problems that arise while caving, including basic medical skills, moving patients through horizontal and tight obstacles, helping persons who are stuck on rope, building and operating improvised haul and lower systems, sheltering in place, and how to prepare for and prevent problems with limited equipment and personnel.

This course is NOT about litter based rescues or large operations. The target audience is project / expedition cavers, small teams working in caves, or rescue team members with caves in remote or inaccessible locations where minimal gear techniques can be used by a small hasty team, traveling light and fast. Course is also valuable to those leading grotto trips, or recreational trips into technical caves. Students will be expected to study some material in advance so that the workshop sessions reinforce and elaborate on existing information. Skills will then be practiced on the PNW alpine caving tower, and then reinforced with 3 days of stations and scenarios in caves. The course will be demanding with long days, but will provide participants with valuable skills that can be used to help themselves and others if a cave accident or entrapment should occur.

Registration

Cost: **$200.00**, includes lodging (camping), and meals during the 5 day course, (The full NCRC Manual is available for purchase at $40.00 each.) Class size is limited to 18 students. To register, go to https://www.regonline.com/ncrc2018pnwspar

Refunds are available up to September 7, minus a $15.00 registration fee. No refunds available after September 7 2018.

Details on accommodations and logistics available at the registration link. There are no NCRC course prerequisites, however competent SRT skills are required. This is not a beginners' class. For safety and class efficiency, all students will be required to demonstrate basic vertical skills before taking this course. Required skills, including knots, basic haul systems, and single rope techniques are described here: http://caves.org/commission/ncrc/national/NCRC_Student_Area/L3_EntryPrepPkg_HO_v140308.pdf

Questions?

For **questions** regarding gear, prerequisites, or seminar material, contact Eddy Cartaya, pacificnorthwest@ncrc.info 541-213-6257

For **questions** regarding registration, or to pay by check, **Contact ncrc@cavetopia.com or 303-880-3168**