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Moving the National Park Service Cave and Karst Program Forward - Identifying and Understanding Park Resources

National Cave and Karst Research Institute

MOVING THE NATIONAL PARK SERVICE CAVE AND KARST PROGRAM FORWARD - IDENTIFYING AND UNDERSTANDING PARK RESOURCES

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Abstract
On a national level within the National Park Service (NPS), basic knowledge of cave resources has increased significantly over the last 30 years. With karst resources, while there have been some advances, knowledge of these very complex and hidden resources remain fairly limited. In recent years, NPS park managers have increasingly been working with volunteers and scientists to complete studies including the physical exploration and documentation of cave and karst areas to obtain a better understanding of the resources that they manage. Efforts at the national level within the National Cave and Karst Program are being made to know more about these resources, identify missing areas of information and to develop projects and seek funding for studies that can help the NPS better understand these resources. This understanding will lead to the long-term conservation and protection of resources through appropriate management decisions and actions and through continued education and outreach for staff and visitors.

Current Knowledge and Activities
Physical Exploration and Inventories
A number of park units with significant cave and karst resources have been very active in trying to identify and understand their resources. This includes parks with some of the longest caves in the world like Mammoth Cave, Carlsbad Caverns, Jewel Cave, and Wind Cave. A quick review of active cave discoveries at a number of parks over the last five years finds that several hundred caves have been newly discovered and over 160 kilometers (>100 miles) of cave passages and rooms have been discovered, documented, and inventoried for basic resources. The collected data has been placed into databases within the park units and used, among a host of things, to understand the geographic distribution of these passages in relationship to surface features. These newly discovered 160 kilometers (>100 miles) of resources represents about 8-9% of all the known lengths of surveyed passages in caves of the NPS. While rough figures, this tremendous amount of work has been accomplished mostly by volunteers utilized by parks to help know and understand these very complex places. While some feel that total lengths of passages in a park unit are not critical in the overall management of those resources, these numbers do give us an interesting look at the amount of work being actively accomplished as park units seek a clearer understanding of what they manage.

The picture is far less certain when it comes to knowledge of significant karst flow regimes in park units. A few parks such as Mammoth Cave have a good handle on underground flow paths and how they relate to surface features and structures. Much of the groundwater that flows through Mammoth Cave and other cave systems in and near the park comes from a huge area outside the park boundaries. Efforts over the last 30 to 40 years have provided the park and surrounding communities a much better understanding of where waters in the park

Figure 1. *Natalia Kolk-Tennant reads survey instruments during a cave survey in Ozark National Scenic Riverways. (NPS photo by Scott House)*

originate and any contaminate sources that may provide pollutants. This knowledge has allowed the park to work with many neighbors to help prevent groundwater pollution in the entire area. This has also helped the park be much more prepared for catastrophic events that have the potential to endanger people and their health and the sensitive ecosystems that are found within the waters of Mammoth Cave and the surrounding areas.

Ozark National Scenic Riverways is another park unit that has seen quite a bit of work completed to understand its groundwater flow paths. The potential for lead mining in areas near park properties have spurred major interest in preventing lead contamination into the pristine springs of the park unit, particularly Big Spring. The US Geological Survey and Tom Aley, a karst consultant with cave and karst property nearby, have been leaders in this effort. In general for many other parks with significant karst resources, far less is known about these resources and the water that flows through them.

Scientific Studies

The facilitation of research within a number of park units with cave and karst resources has provided an extensive amount of knowledge to park databases. These studies extend over a number of disciplines and cover a range of resources including biological ecosystems from microbes to vertebrates, paleontological discoveries, paleo-climate conditions, geological and mineralogical studies, cave and karst system developments, water quantity and quality, meteorological conditions, and other important aspects of cave and karst resources.

One of the unfortunate areas of current and ongoing research has been associated with a disease that has been killing millions of bats that hibernate in the eastern United States including within National Park units with caves and mines. This disease, White-Nose Syndrome, is caused by a fungus, Geomyces destructans, and has spread rapidly from its starting point in one cave in New York and is now infecting bats across multiple states and into Canada.

Microbial studies are ongoing in a number of parks as more is learned about the role microbes play in the formation of crystal growth, the types of chemicals they produce that may have potential pharmaceutical use as anti-cancer, anti-fungal and anti-biotic drugs, and how microbial communities may act as analogs to potential microbial communities that may have or still do live on other planets such as Mars. Scientific discoveries continue to document new species and genera of invertebrates, most recently in park units such as Great Basin, Sequoia-Kings Canyon, and Grand Canyon-Parashant.

Scientific investigations continue to change the way we look at cave and karst development in park units and to utilize that information in new ways. Ideas and studies over the last 20 to 30 years have shown that caves within Carlsbad Caverns and other areas have been created by sulfuric acid dissolution. As well, the significant role that hypogenic speleogenesis has played in cave development is only now being fully recognized and appreciated. Significant advances in mineral dating of stalagmites have allowed paleo-climate studies to more precisely date past climatic events such as the drought periods that cause abandonment of cultural centers in the desert southwest over the last 1,000 years. Similar to tree rings, some stalagmites have yearly growth patterns that can be dated. Of particular importance has been the controversial redefining of the timeframe when down-cutting in the Grand Canyon occurred by dating mineral deposition within caves at various levels. Along similar lines, the use of cosmogenic isotopes has been used to pinpoint the dating of passage level development in caves such as Mammoth Cave and in the caves of Sequoia/Kings Canyon.

In recent years, scientific research has expanded greatly into the study of cave and karst resources and has become more main stream as the scientific world embraces these

Figure 2. *Drip water is collected in Wind Cave for a water-quality and chemical analysis project conducted by Dr. Andrew Long. (NPS Photo)*

once hidden and out-of-the way places. While much remains to be studied, National Park units and their incredible resources have been at the forefront of much of this new push to more fully understand the physical world. Much of this is directly due to the facilitation of research by park managers in their efforts to identify and understand the resources they manage.

Management of Infrastructure & Other Projects

In more recent years, park units with commercial cave operations have recognized the inherent problems faced due to infrastructure locations placed on top of and around major cave and karst systems. Mostly developed before there was a realistic understanding between the surface and caves, particularly in karst areas, early developments tended to focus on easy visitor access. Buildings, parking lots, maintenance yards, and other infrastructure in a number of cases were placed directly on top of the resources the park unit was created for. More recent planning documents for these park units have shown a great need to mitigate, or in some cases eliminate, the impacts and potential impacts to the cave passages and rooms below these structures.

Because of aging infrastructure, Wind Cave replaced its older buried sewer lines with new, double-line pipes. With most of the infrastructure built directly on top of the cave, Carlsbad Caverns through the development of the Carlsbad Cavern Protection Plan replaced old, buried outfall sewer lines with above ground lines, removed parking from most of the old Bat Cave Draw parking area, removed one set of Mission 66 housing, and installed oil/grit separators on visitor parking areas. Timpanogos Cave is also worth mentioning. They have recently taken steps to eliminate liquid wastes from being allowed to leak into surrounding limestone bedrock at their restrooms located near the cave entrance. This is no easy feat with the restrooms being located on an extremely steep rock slope over 305 meters (1,000 feet) above the Visitor Center area.

Because of the intense efforts that Mammoth Cave and the surrounding area has put into understanding its karst resources in recent years, they continue to lead the NPS in their attempt to limit contaminants that enter their cave and karst systems. The development of a Regional Sewer System starting in the 1980's has been a great success in limiting sewer releases in the entire region. Nearby cities including Park City and Cave City and other municipalities including Mammoth Cave National Park were included in this 30-year effort to reduce effluent releases into the karst systems surrounding Mammoth Cave. The park has done a tremendous job identifying problem areas and mitigating their effects such as capturing all water that runs off of their maintenance yard and running it through a special filtering system to virtually eliminate all chemical by-products from reaching the cave system below.

While there is still much more to be done in reducing and eliminating contaminants from reaching cave and karst areas within park units, numerous parks are beginning to understand their resources and take measures to effectively eliminate problems.

Database Development & Uses

For various reasons, it has been important for Natural Resource Stewardship and Science (NRSS) teams (including the National Cave and Karst Program and other teams within the Geologic Resources Division) to provide important information to parks for new NPS endeavors such as for the Foundation planning process and for the State of the Parks initiative. The need at the national level to have relevant and current information

Figure 3. *At Carlsbad Caverns National Park, Bat Draw parking lot is modified and returned to more natural conditions while retaining historical context for the area. (NPS photo by Dale Pate)*

of cave and karst resources within parks has necessitated that a database be developed that can help provide critical information for these programs and for other significant reasons. As important is our need to understand cave and karst resources on a local, regional, and national level so that we can help identify needs and information gaps which will lead to the identification and development of critical projects and the justification for allocation of funds to complete this projects. It is also important to make sure that park managers are aware of the resources they are asked to manage and that managers within the upper echelon of NPS regional and national levels are aware and informed of issues and other relevant activities associated with cave and karst resources.

The idea of maintaining a database is not to gather sensitive information, but rather to gather and maintain pertinent information that can help further the goals of identifying, understanding, and protecting these valuable resources while providing a variety of experiences for the visiting public.

Gathering Pertinent Information

In order to begin this important process of gathering information, the National Cave and Karst Program office has taken two critical steps to move this forward.

The first has been to contract the National Cave and Karst Research Institute (NCKRI) to develop a report on NPS park units that contain caves and karst that will help us understand which parks contain which resources and the extent of those resources as well as the amount and types of cave and karst educational programs that are available to the public. This report should also determine in a priority order, park units that are in need of more specific studies to better understand their resources. In order for NCKRI to provide the NPS with this information, it has provided a questionnaire to park units in its efforts to gain information on cave and karst resources. A final report is due in 2014.

A second effort is the development of Cave and Karst Summaries for NPS park units from information found from mostly internet searches. These searches are often augmented by NPS Natural Resource Stewardship & Science reports produced by various divisions such as the Geologic Resources Division, Water Resources Division, and others. These summaries provide the NPS Cave and Karst Program information on items such as numbers of caves, types of rock units and types of caves and also the age and distribution of limestone and other rock types that may form caves and/or karst. We are also attempting to determine if karst within a park unit is considered significant or minor. These summaries will be updated as needed and initially are being used to provide information to parks for the two national-level programs mentioned above.

Identifying Needed information

With knowledge of the extent of cave and karst resources found within NPS units, we can begin to recognize areas of missing data that are critical for the long-term protection and management of these resources. This is especially true for park units that are identified as having significant karst. Karst continues to be one of the most fascinating, and yet, least studied of American landscapes. Extremely sensitive to man-induced changes, its importance as freshwater aquifers and as habitat to numerous invertebrate and vertebrate endemic species cannot be over emphasized. Knowing groundwater flow paths as they enter, travel through, and exit park units is as important as is knowing where a surface river enters, travels through, and exits a park unit. A park manager that is unaware of the existence of a surface river flowing through his or her park would not be able to properly manage that river. The same goes for groundwater flow paths. Not knowing where groundwater comes from, travels through, or where it exits a park unit means that management of that flow is virtually non-existent. Will a catastrophic spill or chronic contamination affect drinking water for the park or a neighbor? Will a new subdivision on properties outside park boundaries affect groundwater within a park unit? Managing karst areas takes knowledge to manage properly. How many different groundwater flow paths are totally unknown at this time within NPS units with significant karst? There may be hundreds if not more. Even with park units with minor karst, are there significant elements of that karst that are critical to know for the protection and conservation of the resources of that park? By knowing what resources we do have, we have the opportunity to identify those areas where we are missing information.

Long-term Conservation and Protection

With the knowledge of what we don't know, we can work with staff from individual parks, regions, I&M networks, NRSS divisions, and outside organizations and individuals to develop specific projects that can

fill information gaps. With the NCKRI report in hand and a fresh look at parks and their amazing resources, we can provide justifications for a number of specific projects that will help us better understand the cave and karst resources the NPS manages. With the completion of more studies, we will know and understand more. With better understanding, the NPS can better conserve and protect resources that until recent years have been mostly unstudied and hidden from view. With better understanding, park, regional, and national management teams can make better decisions to conserve and protect these resources while still allowing visitor access. And with better understanding, NPS park units can provide more accurate and critical education and outreach to an ever-expanding public that will increasingly become more and more interested in cave and karst resources.

Biography

Dale L. Pate is the National Cave and Karst Program Coordinator for the National Park Service. Dale's career in the cave and karst field began as an avid caver in 1970 in Central Texas and the mountainous areas of Mexico including the Purificación area within the rugged Sierra Madre Oriental. Having received a BA in Geography from Texas State University in 1974, Dale began work in 1976 with the U.S. Geological Survey (USGS) in Austin, Texas. During the next few years, he augmented his education with a number of geology classes from the University of Texas. Dale remained with the USGS through June 1991 when he became the Cave Specialist for Carlsbad Caverns National Park. At the park, he served as a manager for 21 years with oversight of numerous cave and karst projects which included all activities within Lechuguilla Cave. Dale became the full-time National Cave and Karst Program Coordinator for the NPS in July 2012 after having served the position in a half-time capacity since May 2007.