Virginia Cave Board
James Madison University
Harrisonburg, Virginia
Saturday, February 26, 2022

TIME AND PLACE
The meeting of the Virginia Cave Board took place at 11:00 a.m. on Saturday, February 26, 2022, at James Madison University in Harrisonburg, Virginia.

VIRGINIA CAVE BOARD MEMBERS PRESENT
Robert K. Denton, Jr., newly elected Chair
Dr. Daniel H. Doctor, newly elected Vice Chair
David Ek
John H.H. Graves
John T. Haynes
Russell Kohrs
Meredith Hall Weberg

VIRGINIA CAVE BOARD MEMBERS NOT PRESENT
Anthony R. Bessette
Rick Lambert
Steve Lindeman
Roger W. Kirchen (ex officio member)

DCR STAFF PRESENT
Frank Stovall, Deputy Director for Operations
Anne Chazal, Chief Biologist
Michael Fletcher, Board and Constituent Services Liaison
Will Orndorff, Karst Protection Coordinator

OTHERS PRESENT
Ángel Garcia, James Madison University
Shane McGary, James Madison University
Erin Frederick
Kerri Hewett
Avery Knowlton
Kali Neydon
Jacob Whitlock

ESTABLISHMENT OF A QUORUM
With seven members of the Board present, a quorum was established.

CALL TO ORDER
Chairman Doctor called the meeting to order at 11:06 a.m. He thanked Mr. Haynes for hosting the event at James Madison University.

INTRODUCTIONS AND ANNOUNCEMENTS
Chairman Doctor asked members and guests to introduce themselves.

Mr. Denton noted that, at the last meeting, he reported that the American Society of Testing and Materials has developed a standard practice for karst survey. This was based on the standard practice promulgated by the Virginia Cave Board and will become a national template. The standard will now be issued as an international standard.

Chairman Doctor noted that the original guidance document is on the home page of the Cave Board website.

Ms. Weberg reported that as chair of the Virginia Region and co-chair of the Virginia Region Conservation Committee, volunteer work has been ongoing at Grand Caverns for almost forty years. That adds up to `55,000 hours of volunteer time (from 2012 through 2019). These are one-day events. There have been some recent problems, possibly because of new staff associated with the town.

Due to those issues, the April 23 event will not be at Grand Caverns, but the hope is to be at Dixie Caverns or to conduct an alternate conservation project. There is a sinkhole known as “the sinkhole from hell.” There is a film detailing the condition of the sinkhole. The site is in Rockbridge County.

She asked if DCR was aware of a program to pay for part of the project.

Mr. Orndorff noted that DCR has Agricultural Cost-share, but that applies if there are cattle on the property. The land owner has to sign up for that.

Ms. Weberg advised that she had just received the information the previous evening and that there is a need for more research. Ms. Weberg noted that she would announce the site and the event on social media.

RECOGNITION OF MARK HODGE
Chairman Doctor advised that the Board would like to recognize former member Mark Hodge who passed away suddenly and unexpectedly. He provided a sympathy card for member signatures.

The Board adopted the following statement. This will be posted on the Cave Board website and Facebook account:

Virginia Cave Board
Certificate of Appreciation
in Memory of
Mark D. Hodge

February 26, 2022

Mr. Mark D. Hodge was appointed as a member of the Virginia Cave Board by Governor Ralph Northam on July 1, 2018. He served until his death.

Mr. Hodge served in the United States Air Force as a Russian Cryptolinguist from 1980 until 2011 when he retired with a rank of Chief Master Sergeant, having served tours in Berlin, Frankfurt, Okinawa, and England.

Upon his retirement Mr. Hodge developed a deep interest in caving and the caving community where he performed at a level one would expect of a much younger person. He committed himself to cave conservancies, in particular the Butler Cave Conservation Society, and to the National Cave Rescue Commission.

Mr. Hodge was an outreach ambassador for caving and loved to introduce new people to the sport. He prematurely passed away on Saturday, December 4, 2021, while escorting a Boy Scout troop through Butler Cave in Williamsville, Virginia. He passed away while doing the thing he loved most, sharing his passion for caving with young people and old.

The Virginia Cave Board takes this opportunity to recognize the life and contributions of Mr. Mark D. Hodge for his many years of commitment to his country and to the caving community. The Board both honors his commitment and legacy, and acknowledges that his contributions and his spirit are missed.

JMU CAVE AND KARST UROCKS PROGRAM
Dr. McGary and Dr. Garcia gave an overview of the JMU Cave and Karst UROCKS Program.

This summer, JMU will host the inaugural cohort for UROCKS. This is a ten-week research experience funded by the National Science Foundation. The program includes individual mentoring for professional and personal development.

A strong and diverse group of 53 individuals applied. The ten selected were scheduled to be notified on Monday, February 28, 2022.

Dr. Garcia noted that this the first time the National Science Foundation has funded undergraduates for such a program. The intent is to contextualize each of their disciplines through programs related to cave and karst.

Dr. McGary reported that Rick Lambert, Cave Board member, would be a mentor for the program. He advised that there were still positions open for mentors should any Board members be interested.

Chairman Doctor commented that he was excited to see this. He noted that across the country there are very few programs that have any concentration in caves and karst.

Dr. Garcia noted that the program is funded for three years.

ELECTION OF OFFICERS
Chairman Doctor noted that he had been Board Chair for four years and would be happy to step down. He nominated Mr. Denton to serve as Board Chair. There were no other nominations and Mr. Denton was elected unanimously.

Ms. Weberg nominated Dr. Doctor to serve as Vice Chair. There were no other nominations and Dr. Doctor was elected unanimously.

Mr. Ek commented that in the past the Board established the position of Secretary. He noted that staff now fulfills the role of Board meeting minutes. He expressed concern that there were sometimes action items that were not followed through with or tracked. For example, need to follow up on Virginia Cave Conservancy, letters sent.

Mr. Fletcher advised that, as he drafted the minutes, he would develop a list of action items to share with the Board. These will be shared following the meeting. Mr. Fletcher will work with members to track their completion.

TREASURER'S REPORT
Ms. Chazal reviewed the current financial statement. A copy of that financial statement is included as Attachment #1.

Ms. Weberg inquired regarding the balance from the August meeting.

Ms. Chazal agreed to verify that amount.

Chairman Doctor noted that the current funding would allow for the production of the *Virginia Cave Owners' Newsletter.*

APPROVAL OF MINUTES FROM AUGUST 28, 2021
Mr. Denton advised that he had submitted corrections via email to Mr. Fletcher. Mr. Fletcher acknowledged the receipt.

Ms. Weberg moved to accept the minutes as amended. Mr. Haynes seconded and the minutes were approved as amended.

LEGISLATIVE UPDATE
Chairman Doctor advised that he was aware of no current cave or karst legislation. Mr. Stovall concurred. The item will be kept as a standing agenda item.

DCR KARST PROGRAM UPDATE
Mr. Orndorff gave the following report:

DCR Natural Heritage Karst Program Update to VA Cave Board
Wil Orndorff, Karst Protection Coordinator

Bat counts
DNH Karst staff is near completion of the biennial bat hibernacula surveys in collaboration with Virginia Department of Wildlife Resources. The last counts of these sites were in 2019, prior to the Covid-19 pandemic. Counts scheduled for 2021 were postponed to 2022 due to concerns over potential SARS–CoV–2 transmission to bats. Approximately 25 cave hibernacula associated with either Indiana or Virginia big-eared bats have been visited in 2022. At most sites, numbers are steady to slightly lower. Here are updates on selected significant sites:

- Newberry Bane, Bland County – Indiana Bat numbers are down slightly, consistent with long-term post-white-nose syndrome (WNS) trends at the site. Little Brown Bat numbers are similar to 2019. Eastern Small-footed Bat numbers were good.

- Gap Cave, Lee County – Numbers of all species appeared similar to those in 2019, but final numbers have not been tabulated.
- Higgenbotham Cave, Tazewell County – This cave hosts Virginia's largest Virginia Big-eared Bat hibernaculum. Approximately 250 were observed, which is within the range of prior counts but on the low side. However, much of the potential habitat is not accessible, so numbers from this site should be viewed with caution. All bats observed appeared healthy.
- Rocky Hollow, Wise County – Nearly 500 Indiana bats were observed hibernating in Rocky Hollow in 2022, which is one of the larger count in the last 20 years.
- Low Moor Cave and Mine, Alleghany County – A recently (2019) identified area with Indiana and Little Brown Bats was counted for only the second time, and numbers appear stable.
- Peery Saltpetre, Botetourt County – Though this cave is included because of a small number of Indiana bats, its significance is as one of Virginia's larger remaining Little Brown Bat hibernacula. Numbers were in the mid-200s, up from 2019.

Staffing changes
Tom Malabad, Lead Cave and Karst Scientist, was moved from non-general grant and contract funds ("soft money") to general funds. After a national search, former wage staff employee Katarina Kosič Ficco was hired as the full-time Cave and Karst Field Scientist, a position supported by non-general grant and contract funds.

Extraction of Petra Fossil from Burja Cave, October 2021
DCR karst staff collaborated with the US Forest Service, the Cave Conservancy of the Virginias (CCV), the Virginia Museum of Natural History, and the Virginia Speleological Survey (VSS) in the extraction and removal of a large, fossilized cat skeleton from Burja Cave, located on the Jefferson National Forest in Lee County, VA. The fossil was initially discovered in 2016 during exploration of the cave, newly discovered by Katarina Kosič Ficco and Mike Ficco (CCV, VSS). The cave is a multi-drop vertical cave located on a steep mountain side, and presented unique challenges to extract the skeleton, including training by the Ficcos of the lead paleontologist (Dr. Alex Hastings) in vertical caving techniques necessary to safely access the excavation site. The specimen was a complete, intact articulated skeleton. Preliminary examination suggests the remains may be of an American Cheetah, which went extinct at the end of the Pleistocene (Ice Age), ~ 12,000 year ago. The cat, named "Petra," will ultimately be displayed at the Virginia Museum of Natural History in Martinsville.

Karst Workshop, New River Valley in May 2022 – May 3 and May 4
The DCR karst team is hosting a workshop for local planners, consultants, and officials from the New River Karst Region, in Dublin, Virginia, on May 3 and 4. The workshop is cosponsored by the Cave Conservancy of the Virginias and the New River Regional Commission. Virginia Cave Board member Bob Denton is involved in developing and presenting content at the workshop.

Groundwater Isopods of Virginia Monograph
The DCR Natural Heritage Program is supporting and working in collaboration with Dr. Julian Lewis in preparation of the *Groundwater Isopods of Virginia*, a major revision to the taxonomy of freshwater groundwater asellid isopods that will include numerous descriptions of species new to science. Led by Lewis, the monograph will combine traditional morphologically based taxonomy with modern molecular

genetics to better understand the biology and natural history of this diverse and fascinating group, members of which are found in caves, karst springs, and coastal plain seeps. Lewis was a student of founding Virginia Cave Board member John Holsinger.

LAND CONSERVATION UPDATE
The Nature Conservancy (TNC)
Mr. Lindeman was unable to attend the meeting and there was no TNC update.

DCR
Ms. Chazal presented a land conservation update provided by Rob Evans at DCR. The update is included as Attachment #2.

NEW BUSINESS
2023 National Speleological Society Convention, Elkins, WV

Ms. Weberg noted that the National Speleological Society Convention would be held in Elkins, West Virginia in 2023. The 2022 Convention will be in Rapid City, South Dakota.

Ms. Weberg was appointed as co-chair in March 2020. Mr. Haynes and Mr. Lambert will tentatively conduct a geology field trip.

Ms. Weberg advised that the high school where the convention is planned will not commit to the event due to COVID protocols. The committee is researching options at Davis and Elkins College.

NSS volunteers will prepare the sessions.

Dates will be confirmed when a location is secured.

Natural Bridge State Park Cabin Update
Chairman Doctor noted that the development of Natural Bridge State Park had been of interest to the Board with regard to the proximity of new cabins to the Caverns at Natural Bridge. He noted that he would like to have a DCR representative review the plan with the Board at the next meeting. He suggested that the meeting be held at Natural Bridge if possible.

Mr. Fletcher noted that that the approved Master Plan for Natural Bridge State Park was available at the following link: https://www.dcr.virginia.gov/recreational-planning/document/mp4nbexecsum.pdf

Bringing CaveSim to Virginia

Ms. Weberg reported that CaveSim is a cave simulator built in the back of a trailer. This is taken across the country to caving events and to schools. There is a plan to bring CaveSim to Baltimore in September. The hope is to be able to work with that trip to bring CaveSim to Virginia.

After discussion the Board agreed to attempt to schedule the CaveSim visit in conjunction with Virginia Cave Week that could be moved to September.

Mr. Orndorff showed a promotional/educational video regarding CaveSim.

Ms. Weberg advised that she would like to bring CaveSim both to Washington, DC, as well as to Richmond so that legislators may have the experience.

Ms. Weberg and Mr. Orndorff will follow up regarding CaveSim.

Following the CaveSim discussion, the Board recessed for lunch.

The Board reconvened at 1:05 p.m.

OLD BUSINESS

Virginia Cave Owners' Newsletter

Ms. Weberg reported that the *Virginia Cave Owners' Newsletter* is in production. She expressed appreciation to Emi Endo and Betty Saxman for their editing and layout work.

Articles are included from Dr. McGary, Mr. Orndorff, Katarina Kosič Ficco, and Chairman Doctor.

Mr. Bulluck is overseeing the production process.

Ms. Weberg proposed that later in the year, when the CaveSim visit is finalized a postcard announcement be sent to the list.

Mr. Haynes asked if the newsletter was distributed to owners of karst features without caves. Mr. Orndorff advised that it only went to cave owners. However the newsletter is uploaded to the DCR website and the link may be shared.

Chairman Doctor noted that the Board had previously discussed updating the mailing list.

Ms. Weberg noted that reviewing the list will be a multi-month project. Mr. Orndorff will work with Ms. Weberg in that regard.

The newsletter will be mailed in April.

Virginia Cave Week

As noted, Virginia Cave Week will be rescheduled to coincide with the September CaveSim visit if possible.

Treatment of Karst in Virginia's Regulatory Environment

Mr. Ek advised that in 2015 he brought to the Cave Board the desire to reach out to other state agencies. In 2018 he wrote a paper that was distributed to the Board prior to this meeting regarding the opportunity to expand communications.

Mr. Ek contacted most of the departments who have karst resources. However, the timing never seemed right for further discussions. Many were not aware of the Virginia Cave Board.

Mr. Ek's document is included as Attachment #3.

Chairman Doctor noted that he would like to see the document prepared to send to the legislature. He will work with Mr. Ek in that regard.

Mr. Denton will reach out to the new director at DEQ. Mr. Haynes will assist with edits to the document.

Mr. Denton noted that the Department of Health should also be contacted.

Mountain Valley Pipeline
Mr. Orndorff advised that he would forego a report in the interest of time. He noted that the issue is currently tied up in the court system. The final restoration cannot occur until the stream permits are issued.

PUBLIC COMMENT
Mr. Orndorff introduced Doug White for the purposes of updating the Board regarding a property in Blacksburg related to the Windsor Hills sewage pump station.

Mr. White advised that he had moved to the area in question in 2003. This has been an ongoing issue.

Residents have lost their agricultural wells because the leader pipe from the pump house was broken and sewage was flowing into the sinkhole.

Mr. White showed several visuals of the area in question.

The issue is between the Town of Blacksburg and Montgomery County. The watershed is ultimately flowing into the Roanoke River.

Chairman Doctor and Mr. Orndorff previously wrote to the Town of Blacksburg noting that this was a health concern, but received no response.

Chairman Doctor thanked Mr. White for attending the meeting and outlining the problem. He noted that the Virginia Cave Board has no regulatory authority. However, he advised that the Cave Board could continue to advise and will reach out to both DEQ and the Town of Blacksburg.

NEXT MEETING
The next meeting of the Virginia Cave Board will be June 4. Mr. Fletcher will work to arrange meeting space at Natural Bridge State Park.

There was no further business and the meeting adjourned at 2:53 p.m.

ATTACHMENT #1

DCR - Natural Heritage (Cave Board)		
Summary of Financial Activities		
Fiscal Year 2022		
Beginning Cash Balance (unreconciled)		**(260)**
Revenues (by Fiscal Year)	**Description**	**Amount**
FY15 Revenues		1,600
FY16 Revenues		-
FY17 Revenues		250
FY18 Revenues		3,457
	Richmond Area Speleological Society donation	*1,000*
	The Robertson Association donation	*1,700*
	Blue Ridge Grotto donation	*50*
	Prior Year Expense Disbursement	*707*
FY19 Revenues		1,425
	Donation from John H. Graves	*100*
	Donation from Richard A. Lambert	*25*
	Virginia Highland Grotto of the National Speleological Society Donation	*300*
	The Robertson Association grant rec'd 5/7/19	*900*
	Donation from Meredith Weberg	*100*
FY20 Revenues		566
	Donation from The Robertson Association	*566*
FY21 Revenues		50
FY22 Revenues		1,000
	Donation from National Speleological Society	*1,000*

Total Revenues		**8,348**
Expenses (by Fiscal Year)	**Description**	**Amount**
FY15 Expenses		1,350
FY16 Expenses		990
FY17 Expenses		957
	Newsletter	*957*
FY18 Expenses		957
	Newsletter	*957*
FY19 Expenses		150
	Cave Board meeting space	*150*
FY20 Expenses		1,585
	Newsletter	*1,585*
FY21 Expenses		-
FY22 Expenses		931
	Newsletter	*931*
Total Expenses		**6,920**
Total Cash Balance (as of January 31, 2022)		**1,168**

ATTACHMENT #2

LAND PROTECTION REPORT
Prepared for VA Cave Board
For more information on any of these or other projects, contact Rob Evans

CLOSED PROJECTS

Cedars Natural Area Preserve (NAP) (Lee Co): 4 projects were completed here in mid-late 2021. Perhaps most notable for Cave Board are the so-called **Powell River Springs tracts.** We acquired an 11-lot subdivision directly along the Powell River and 2 natural springs, one of which is "inhabited by the most unique assemblage of asellid isopod crustaceans in the United States."

Bush Mill Stream NAP (Northumberland Co): near Heathsville. DCR purchased an ~ 41-acre addition to this NAP in August 2021. Tract protects one of the best sites in Virginia for Bog Fern, as well as a portion of the floodplain of Bush Mill Stream and tidally influenced wetlands of the Wicomico River a tributary of the Chesapeake Bay.

Piney Grove Flatwoods (Sussex Co): DCR established the 66th statewide NAP, with a 446-acre purchase in partnership with TNC in September 2021.

Pinnacle NAP (Russell Co): DCR accepted donation of >258 acres from TNC on Feb 11, along the Clinch River.

IMMINENT CLOSINGS

Cedars NAP (Lee Co): DCR will close 3 projects by May 2022, totaling approximately 236 acres. All are notable for the Cave Board. One includes another significant karst spring as well as frontage on the Powell River (Woodward). One mitigates an ongoing contamination source to Flanary Bridge Spring (Wilder-Free), and the last protects one cave entrance (Smith heirs).

NEW PROJECTS

Folly Mills Creek Fen (Augusta Co): Located a few miles south of Staunton located in the floodplain of Folly Mills Creek on the **Beekmantown Formation (dolomite**) along the Pulaski-Staunton Fault. This site features a globally rare calcareous wetland, presumably fed by artesian flow as well as overbank flooding, with numerous rare plant species and one or more sinkhole features. **DCR is contemplating purchase of ~ 58 acres that include portions of the floodplain and adjacent wooded slopes.**

Brocks Gap (Rockingham Co): Site adjoins the south side of the North Fork Shenandoah River on slopes and outcrops of **Conococheague limestone.** Features a Northern White Cedar Slope Forest, a globally rare type known from a handful of sites in Virginia (and possibly West Virginia), and includes the northern terminus of one of the region's largest and most significant blocks of unfragmented forest. **DCR is contemplating a project to protect approximately 150 acres at the heart of the globally rare forest as well as some surrounding mature forests**.

ONGOING PROJECTS

DCR has 17 acquisition projects in various stages of completion across the Commonwealth, (in addition to those listed above) ranging from the Eastern Shore to Lee County.

A short listing of those with possible interest to Cave Board:

Cedars NAP (Lee Co): Two active projects. One of these includes a parcel recently purchased by a private conservation buyer on our behalf. **The tract includes the entrance to Frazier Cave.**

Cowbane Prairie NAP (Augusta Co): Stuarts Draft, near Hershey Corporation. DCR is actively working to add portions of 5 parcels that adjoin the existing NAP and the South River to permanent protection.

Lyndhurst Ponds NAP (Augusta Co): near Lyndhurst. DCR is actively working to purchase approximately 53 acres (3 parcels) adjoining the existing NAP that include significant wetlands and buffers.

Deep Run Ponds (Rockingham Co): near Grottoes. DCR is actively pursuing all or parts of at least 8 different parcels that adjoin the existing NAP and lie with the Port Republic Civil War Battlefield Study Area.

ATTACHMENT #3

Virginia Agencies That Have Some Cave/Karst Responsibility or Connection

Assessment and Commentary by David A. Ek, Virginia Cave Board

Draft (8 pages), February 25, 2022

Note: While this DRAFT is written by a current Virginia Cave Board (VCB) member, it has not been sanctioned by the VCB or the Virginia Department of Conservation and Recreation (DCR); therefore, it does NOT reflect the opinion or recommendation of the VCB or DCR. It is only provided for thought, comment, and consideration.

Caves and karst present wide-ranging challenges not inherent in other landscapes. These unique differences often require customized knowledge and expertise, not only to address issues in a cost-effective and efficient manner, but also not to compound the problem and make it worse. In such a karst-heavy state such as Virginia, there are multiple cave and karst coordination, facilitation, and managerial needs and functions. The following are a few broad categories that represent the variety of state-level karst-specific functions:

- **Recreation and Tourism**
  Some of the state's largest tourist destinations are in and on cave and karst landscapes. For example, both Natural Bridge and Luray Caverns rank as some of the most visited sites in the state. Cave and karst recreation and tourism provide a significant economic engine for the state, especially within certain economically vulnerable regions.

- **Karst Biology and Ecology**
  A high percentage of rare, endangered, and vulnerable species and habitats occur in karst landscapes.

- **Water Supplies**
  Karst waters are especially vulnerable to contamination, affecting not only the environment, but also posing real public health and safety concerns as well. Due to the inherent ability of karst aquifers to rapidly transport contaminants, the vulnerability of karst aquifers and springs (and communities dependent on them) cannot be overemphasized.

- **Agriculture and Forestry**
  Due to the same inherent ability to rapidly transport pollutants, karst landscapes also rapidly transport agriculture soil, nutrients, and waste products. This is an area in landscape management that is ripe for the adoption of additional karst-specific Best Management Practices (BMPs) that would not only benefit watershed and aquifer users, but also farmers and ranchers, since they are not served by having their valuable soil nutrients, and other assets, being flushed away through karst conduits.

- **Watershed and Wellhead Protection**
  Due to the rapid water and contaminant transport mentioned earlier, watershed, water supply, and wellhead protection within karst landscapes usually require a different approach. No one and no industry benefits from an unusable or contaminated water supply.

- **Infrastructure Siting and Management**
  There are countless *lessons learned* throughout the nation's karst landscapes, such as when a Kentucky auto museum (and its cars) fell into a collapsing sinkhole. Siting buildings on karst

bedrock requires special consideration or otherwise risk destabilizing the building's structural integrity—oftentimes rapidly. This specific Kentucky collapse example was partly due to using a typical stormwater management approach—one that has serious consequences when used in karst environments.

- **Stormwater**
  Stormwater management in karst terrain presents unique challenges. As an example, the entire regulatory framework of erosion and sediment control uses mostly a perimeter control approach. The thought being if the project's boundaries are protected, no sediment will escape. However, through sinkholes and other karst internal drainage, sediment can often escape project boundaries and impact downstream regions regardless of how substantive perimeter controls are maintained. Another example is ponded stormwater BMPs—they often fail when used in karst landscapes.

- **Historic Resources**
  Cave often preserve an extensive record of Virginia's historic legacy, both prehistoric and historic.

- **Economic Development and Sustainability**

  It is well-documented that globally, karst regions are often some of the most economically impoverished lands around, and this economic condition is tied directly to the inherent nature of karst landscapes (soil and nutrient loss through sinkholes, reduced surface water quantity, poor water quality and public health considerations, etc.). These inherent conditions often lead to a perpetual cycle of poverty and neglect, other than as a location to place national or regional infrastructure that influential communities don't want in their backyards, while providing minimal or no value to local disenfranchised communities. This further leads to a cycle of a boom-and-bust dependence on single industry economies. While these conditions are not often lumped into cave and karst issues, for any comprehensive economic development strategy within these depressed communities, data clearly establish that the unique conditions inherent in karst landscapes is a contributing factor. Given that, any recovery or assistance program in these regions that ignores the realities of living on karst is likely not to be as effective, efficient, or sustainable.

These preceding examples and categories highlight the need and benefits of having a state-level cave and karst management program. Out of necessity, the DCR has attempted to serve that role, but as you can see, these duties range far from DCR's responsibilities and capabilities.

There are multiple state agencies that have, or should have, some karst-specific responsibilities and duties; however, there are widespread deficiencies that impact the state's abilities to effectively manage certain karst-related regulations and functions. The most significant deficiency is within the Department of Environmental Quality (DEQ). Since DEQ absorbed other departments' water programs (i.e., stormwater and Class V injection wells) to become the premier and sole agency responsible for water matters, it has yet filled critical karst-specific water functions and responsibilities. This was also evident back in later 2014 and early 2015 during my and the Virginia Cave Board's preparations for the feature "Building on Karst" Workshop for the 2015 Environment Virginia Conference.

During the planning and preparations of this high-profile workshop, it was deemed critical to include a presentation on water-related cave and karst laws and their regulatory framework. Given this topic is strongly aligned with DEQ's mission, the Cave Board reached out to DEQ and requested them to speak at the Workshop. DEQ managers declined the invitation, because, "Currently, there is no one in DEQ with any karst water knowledge or experience." The manager went on to explain that DEQ had recently gone through a substantive reorganization. This included absorbing several water-related functions traditional managed by DCR. Consequently, during this workshop preparation discussion, the DEQ

manager recognized there were still gaps in DEQ's water expertise, and that karst is one of these unresolved experience gaps. At the time, the Cave Board offered DEQ position management planning assistance relative to karst matters—if they should ever choose to resolve this recognized experience gap. Given this background, at this time, if the new DEQ team is receptive to developing its karst water expertise and capabilities, then I recommend the Cave Board re-extend our offer of assistance.

By all indications, all state boards are administratively placed under one specific agency. For the Virginia Cave Board, this agency is DCR. However, in the Act creating the Board, it specifies that its role is to provide cave and karst guidance and expertise to all state agencies involving caves, not just DCR. Due to various factors, the wide-ranging integration across and among other state agencies other than DCR has never materialized (yet). However, the original reason for placement under DCR is perfectly understandable, given the nature of society's understanding of caves and karst at the time. In the history of cave matters, nearly all organizations involved in caves considered caves as isolated recreational entities, not as an integral component of a karst hydrologic system complete with its dependent ecological systems.

The Virginia Cave Resources Protection Act is a good example of this, since it infers the biggest threat to caves is vandalism. There is no specific reference to what we *now* know to be much bigger threats—impacts to the integrity and connectivity of integrated karst systems. This same evolution of thought and understanding also played out with the National Park Service and its management of world-class cave and karst systems. However, as time went on, we now know that reasonable cave and karst management needs extend well beyond caves as only a recreational amenity. Many cave and karst-heavy states have adapted to these changes to better prepare themselves to handle the varied modern challenges in cave and karst programs. Virginia still has room to catch up and adapt to these new karst realities.

The Cave Board has varied cave and karst expertise, but the Act limits it to agencies that specifically ask for assistance. The Cave Board can do a better job of letting state agencies know of the Board's capabilities, rather than just passively waiting for an agency to ask (when in most situations, agencies other than DCR often do not even know the Board exists). However, it is perhaps not the role of the DCR director to suggest that other state agencies request Cave Board assistance; therefore, this further highlights the need for a new state employee specifically designated to serve as cross-coordination and facilitation functions for cave and karst matters, regardless of the department.

As an example, the following are the various state agencies that have some cave and karst responsibility and need:

Department of Emergency Management

Develops and maintains state emergency plans and assists communities in developing localized emergency operations plans.

Sinkhole collapse, sinkhole mitigation, sinkhole mapping, technical expertise. This department used to employ a person,that among other tasks, mapped and coordinated known sinkholes and threat ratings. The department lost this position during the Great Economic Downturn (in 2008), and to date it has never been refilled.

Department of Energy

Enhances the development and conservation of energy and mineral resources in a safe and environmentally sound manner to support a more productive economy.

Ground disturbance, sinkhole collapse, BMP development, etc.

Department of Environmental Quality

Administers state and federal laws and regulations for air quality, water quality, water supply and land protection.

Very wide-ranging: stormwater, water quality, groundwater vs. surface water, septic, wells, Class V injection wells, environmental justice, etc.

Department of Forestry

Protects and develops healthy, sustainable forest resources for Virginians.

BMPs.

Department of General Services

Manages the Commonwealth's real estate portfolio; oversees the management, maintenance and operation of buildings and ground in and around Capitol Square; and runs the state employee parking and building access systems.

Siting and maintaining buildings and hard infrastructure on karst landscapes requires special precautions and practices. Since the Department of General Services manages the state's real estate portfolio, the active flow of the most up-to-date sustainable BMPs for such karst lands may turn out to be an economically wise investment.

Department of Historic Resources

The Department of Historic Resources is the Commonwealth's official historic preservation agency, and its director is designated as the State Historic Preservation Officer (SHPO).

Legacy resources.

Department of Housing & Community Development

Partners with Virginia's communities to develop their economic potential and invests more than $100 million each year into housing and community development projects throughout the state, the majority of which are designed to help low- to moderate-income citizens.

Since karst regions are often some of the most economically impoverished regions of the state, the special needs of these communities should be incorporated into not only economic investment opportunities, but also housing and community development programs.

Department of Planning and Budget

Advises the governor on how to wisely use public resources for the benefit of all Virginians by analyzing, developing, and implementing various fiscal, programmatic, and regulatory policies.

How can the governor receive informed planning and budgeting advice concerning caves and karst if there is not someone at a broad-level connecting the karst-related dots into a cohesive and sensible strategy that could be implemented seamlessly across the state?

Department of Professional and Occupational Regulation (DPOR)

DPOR issues state credentials—licenses, certificates, or registrations—to those qualified to practice in regulated professions.

We may want to incorporate the state's karst survey standards into an actual recognized professional certification through DPOR.

Department of Transportation (VDOT)

VDOT is responsible for building, maintaining, and operating the commonwealth's roads, bridges, and tunnels.

Stormwater management, transportation planning and review, BMP development, etc.

Department of Wildlife Resources (DWR)

Responsible for a wide range of wildlife conservation functions, ranging hunting and fishing, wildlife watching, public lands, boating, and outdoor recreation.

DWR has a wide-ranging indirect connection to cave and karst resources and access.

Science Museum of Virginia

The Museum is a catalyst for inspiration, a place that sparks curiosity and generates ideas in science, technology, engineering, and mathematics (STEM). The Museum features permanent exhibitions about space, health, electricity, and Earth—to name a few.

Since karst occupies such a high percentage of the state, it would seem vital that the Science Museum maintain close access to relevant and timely cave and karst information.

Virginia Department of Agricultural and Consumer Services

Promotes the economic growth and development of Virginia agriculture, provides consumer protection, and encourages environmental stewardship.

There is a wide array of BMPs that could potentially be developed to facilitate not only the state's goals, but also better serve agriculture's interests in a non-regulatory manner.

Virginia Department of Conservation and Recreation

Works to conserve, protect, enhance, and advocate wise use of the commonwealth's unique natural, historical, recreational, scenic, and cultural resources.

Natural Heritage, conservation areas, state parks, recreation. DCR's Natural Heritage Program does a good job of managing this subset of the state's cave and karst needs, but this is only a subset of the state's cave and karst program needs.

Virginia Department of Health

To promote and protect the health of all Virginians.

Water quality, sewage drain-fields, remediation, wellhead protection strategies, industry- specific BMPs, etc.

Virginia Economic Development Partnership

To encourage, stimulate, and support development and expansion of the Commonwealth's economy.

Since karst regions are often some of the most economically impoverished regions of the state, the special needs of these communities should be incorporated into all the economic investment opportunities and initiatives within these vital areas of the state.

Virginia Museum of Natural History

Interpret Virginia's natural heritage within a global context in ways that are relevant to all citizens of the Commonwealth.

Since karst occupies such a high percentage of the state, it would seem vital that the Science Museum maintain close access to relevant and timely cave and karst information.

Virginia Resources Authority

Supports community investments in the following areas: water, wastewater, local government buildings, public safety, transportation, energy, parks and recreation, solid waste, airports, brownfield remediation and redevelopment, federal facility development, flood prevention and dam safety, land conservation and preservation, broadband, site acquisition and development for economic and community development.

Since karst regions are often some of the most economically impoverished regions of the state, the special needs of these communities should be incorporated into all the economic investment opportunities and initiative within these vital areas of the state. Karst regions also tend to suffer most from environmental justice concerns.

Virginia Tourism Corporation (VTC)

VTC strives to serve the broader interests of the economy of Virginia by supporting, maintaining, and expanding the Commonwealth's domestic and international inbound tourism and motion picture production industries in order to increase visitor expenditures, tax revenues, and employment.

Cave and karst tourism. Some of the state's largest tourism draws are cave and karst resources. For instance, both Natural Bridge and Luray Caverns rank as some of the most visited sites in the state. A concerted and coordinated effort by the VTC could facilitate and promote this incredible asset even more.