The slender-necked (blind) cave beetle (*Leptodirus hochenwartii*) from Slovenia is a troglobitic species first discovered in the Postojna Cave system.
The Central Connecticut Grotto (CCG) is a local chapter of the National Speleological Society (NSS) dedicated to the exploration, scientific study, and conservation of caves and all aspects of the underground environment, as well as promoting a spirit of camaraderie and fellowship among cavers. Membership is open to anyone who shares these interests. Regular membership dues are $5.00 per year. Non-voting youth or full-time student membership dues are $2.00 per year. Institutional membership is free. Please visit www.caves.org/grotto/ccg/join.htm for additional membership information. Grotto meetings, consisting of a short business meeting followed by a caving presentation, are usually held on the 3rd Tuesday of each month, starting at 7:00 p.m. However, the date, time, and location of meetings may vary, so please check the CCG website (www.caves.org/grotto/ccg/) or contact grotto chair Ashley Pospisil (860-869-0932) for any updates.

The Underground Movement is the official newsletter of the CCG. Submissions can be contributed by grotto members as well as friends of the grotto. Opinions expressed in articles are not necessarily a reflection of the official position of the CCG and NSS or shared by the newsletter editor, CCG officers, or grotto members. Unless it has been independently copyrighted (as indicated by © or as “reproduced with permission”), material published in The Underground Movement may be reprinted in any NSS-affiliated publication—pending permission of the author/photographer—provided appropriate credit is given and either a hard copy or a digital file made available.

Submissions to The Underground Movement, including original or reprinted articles, photographs, and letters to the editor are welcome. Digital files, composed in Microsoft Word with minimal formatting, should be sent to the editor at underground_newsletter@yahoo.com. Images should be sent as jpegs or tiff files. The CCG cannot publish copyrighted material without written permission of the copyright holder. Contributors are responsible for determining whether material is copyrighted as well as for securing appropriate permission.

In conjunction with ongoing efforts to help diminish the spread of white-nose syndrome among hibernating cave bats, the Central Connecticut Grotto encourages all cavers to follow recommended gear-cleaning and disinfection protocols. These can be found on the NSS White-Nose Page (www.caves.org/WNS/). Your continued cooperation and support is appreciated.
**From the Editor’s Desk**

I would like to express my thanks to those who contributed to the last several issues of *The Underground Movement* as well as to everyone who contributed to this month’s issue. It is only through continued submissions from the membership and friends of the grotto that a viable newsletter can be sustained.

The wheels of the Central Connecticut Grotto machine are continually turning. They may sometimes turn slowly, perhaps even imperceptibly so, but they continue to push grotto activities and overall growth of this organization forward.

Only a few of the grotto’s many activities are highly visible to the membership at large—most notably organized seasonal caving trips; vertical training venues; and production of the grotto’s newsletter, *The Underground Movement*. Of course, grotto activities do not occur in a vacuum. People are needed to keep the grotto’s wheels greased and turning smoothly. Efforts to keep the grotto running smoothly are considerable and generally occur behind the scenes, thanks, in large measure, to the tireless work of enthusiastic grotto Officers and a dedicated core of volunteers.

In December, the Central Connecticut Grotto held its annual elections for officers. The following new officers were elected for the 2016 calendar year: Chair - Ashley Pospisil, Secretary - Alisa Werst, and Conservation - Lee C. Del Valle. On behalf of the grotto membership, I’d like to thank outgoing officers (Chair - Lee C. Del Valle, Secretary - Ashley Pospisil, and Conservation - Jeff MacDonald) for their continued work throughout the year, and take this opportunity to welcome our new officers to their respective positions.

Grotto members interested in getting involved with any of the grotto’s various activities, or even organizing completely new activities, should contact relevant officers at info@ctcavers.org. Your contributions will certainly be appreciated.

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**The National Speleological Society (NSS)** is a non-profit organization dedicated to the scientific study of caves and karst; protecting caves and their natural contents through conservation, ownership, stewardship, and public education; and promoting responsible cave exploration and fellowship among those interested in caves.

Close to 200 regional member organizations (called grottos) make up the backbone of the NSS. Grottos are devoted to the training of both novice and advanced cavers, as well as to the continued development and refinement of equipment and technique for safe underground exploration. Grottos conduct meetings, organize training programs, and sponsor caving trips on a regular basis. Interested beginners are welcome. Information on membership in the NSS and its various programs and activities can be found at www.caves.org/.

Although membership in the NSS is not a requirement for joining the CCG, all CCG members are strongly encouraged to join the NSS. In terms of educational opportunities available, acquisition of caving skills and experience, and the potential for networking with other cavers on a local, regional, or even global scale, the benefits to cavers of NSS membership are incalculable.

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Special thanks to Merrill Ann Gonzales for generously allowing the Central Connecticut Grotto and *The Underground Movement* to use her beautiful illustrations for the cover and page headers and as the backdrop for the cover-illustration description.
Our trip to Clarksville was an exciting one! Being a beginner myself, I was quite apprehensive and didn't know what I’d be getting myself into. Thankfully, the whole crew at the Central Connecticut Grotto was extremely welcoming, and supplied me with all the gear I needed. We started off with a ten-minute hike to the entrance of the cave. Then, we each took turns slipping into a tiny hole in the ground, submerging ourselves in darkness.

Our guide, Norm, led us through the cave at a nice, easy pace, making sure everyone was caught up and not getting lost. Along the way, we admired formations of stalactites, which are the icicle-shaped formations hanging down from the ceiling and which are so characteristic of caves. We even came across several fossils embedded in the ceiling, walls, and floor. At several points, we had to crawl through narrow tunnels, some no more than two feet high. However, Clarksville Cave is considerate enough to offer alternate routes that bypass these tiny tunnels. At the end of the passage, we came to a beautiful water reservoir…the Lake Room. We each took turns posing and cheezin’ for the camera, and trying to get the perfect Instagram selfie (actually, it was mostly just me trying to get the Instagram selfie). We then turned off our headlamps, and enjoyed two minutes of absolute darkness and silence.

Although Clarksville is generally known as a beginner cave, it’s got enough nooks and crannies to satisfy experienced cavers, as well. On our journey out of the cave, half of the group decided to follow the stream passage, which leads into a tunnel almost completely submerged in water. I’m 5’8” and the water was almost up to my nose. I had to tilt my head back just to keep my face out of the water. Much to my dismay, my friend Jake convinced me to follow him deeper through this tunnel. While I whined and cried, Jake told me that this is what I need to do in order to be a “real outdoors girl.” Eh, what the heck I thought. It’ll make for a good Facebook status, woo!

Finally, just a short distance beyond the end of this water-filled tunnel, we could literally “see the light” of another entrance. We quickly got our now-shivering selves out of the cave and into the shining warmth of the sun.
The Underground Movement

Central Connecticut Grotto

CCG GEAR MANAGEMENT
December 2015
Caving Gear Available for Loan to Grotto Members and Prospective Members

Personal Use - Gear Available for Loan

- Headlamps
- Helmets
- Cave Packs
- Knee Pads
- Gloves
- Vertical Gear

Limited Use - Typically for Grotto Trips or Practices

- Ropes
- Cable Ladders
- Rope Pads
- Carabiners and Other Rigging Gear
- Pulleys
“Caving Helmets” with straps for easy mounting of headlamps. Helmets are tagged and numbered to make keeping track of them easy.
Headlamps

Grotto Owns Lights Ranging in Value From < $10 to $75

- Maintenance is required and at least a couple of lights are retired each year.
- Always be sure to remove batteries and allow any moisture to dry before putting into bins. It is recommended that grotto lights work on AA or AAA batteries, which are readily available. Rechargeable batteries (e.g., 18650 lithium ion) are not good for grotto use.

Our Recent Grotto Favorite Light is the Fenix HL-25, costing ~$40 - $45

- Runs on three AAA batteries
- Provides good amount of light and battery life for a typical beginner-level trip
  280 lumens for 1 minute at a time (allows one to see up to 200 feet away)
  140 lumens for 4 hour hours
  59 lumens for 12 hours
- Battery inside of light with no external cable (cables are the first thing to fail on lights)
- IP68 waterproof and dirt protection (very important for caving)
- Rugged alloy housing that protects against impact

http://www.fenix-store.com/fenix-hl25-led-headlamp/
More Headlamps
Vertical Gear

Grotto Owns Six Complete Vertical Sets

- Basic Caving Harness
- “D” Link (aluminum preferred)
- “H” Style Chest Harness
- Chest Ascender
- Hand Ascender (mix of right and left handed)
- Adjustable Foot Loop
- Long Mini-Rack with Hyper Bar
- Cow’s Tail with Carabiner

Assorted Gear for Members to Try Out

- Full Rack, Petzl Stop, Figure 8
- Foot Ascenders
- Rope Ladder
- Extra Hand Ascenders (QAS)
- Pulley
Labeling of Gear

Sticky Kevlar Wrist Bands

Colored Electrical Tape

Engraving CCG - Manufacturers usually recommend against engraving
**Gear Sign Out Forms**

Make Two Copies - One for the manager and one for the person borrowing gear

<table>
<thead>
<tr>
<th>Central Connecticut Grotto Gear - on loan</th>
<th>Date OUT:</th>
<th>/ /2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date IN:</td>
<td>/ /2015</td>
<td></td>
</tr>
</tbody>
</table>

### Member name:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>ID No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helmet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee pads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pack/bag</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lights</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Vertical Kits

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>ID No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seat Harness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest Harness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cowstails</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Footloop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest ascender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand ascender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot ascender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carabiners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallions/screwlinks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half-moon D-ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulley</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Non-Caving Equipment for Caving Events

- 10 x 20 Canopy - Quantity 2
- Hot Plates
- Coffee Percolators
- Assorted caving DVDs and Video Tapes
- Large CCG Banner
## Central Connecticut Grotto Equipment Inventory

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>When/How Acquired</th>
<th>Approximate Cost to Grotto</th>
<th>Condition</th>
<th>Location (Subject to Change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canopy (10 x 20 - 8 legs). Powell &amp; Powell Original Kind Canopy</td>
<td>1</td>
<td>Purchased Spring 2001</td>
<td>$180</td>
<td>Good</td>
<td>NB</td>
</tr>
<tr>
<td>~109 pounds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopy (10 x 20 - 6 legs). Powell &amp; Powell Kind Canopy ~103 pounds</td>
<td>1</td>
<td>Purchased April 2002</td>
<td>$127</td>
<td>Good</td>
<td>NB</td>
</tr>
<tr>
<td>Canopy accessories (rope, stakes, etc.)</td>
<td>NA</td>
<td>Various purchases</td>
<td>$30</td>
<td></td>
<td>NB</td>
</tr>
<tr>
<td>Hot Plates</td>
<td>2</td>
<td>December 2001</td>
<td>-</td>
<td></td>
<td>HRP</td>
</tr>
<tr>
<td>Coffee Pot - Westbend 12 - 42 cup Percolator*</td>
<td>2</td>
<td>Donated by Ben Milspaugh</td>
<td>-</td>
<td>Good</td>
<td>NB</td>
</tr>
<tr>
<td>(®)</td>
<td></td>
<td>Spring 2001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffee Pot - Westbend 12 - 30 cup Percolator</td>
<td>1</td>
<td>Purchased used January</td>
<td>$15</td>
<td>Good</td>
<td>NB</td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water’s Journey - DVD</td>
<td>1</td>
<td>Purchased from Speleobooks</td>
<td>$35</td>
<td>Good</td>
<td>NB</td>
</tr>
<tr>
<td>Leave No Trace - Video Tape</td>
<td>1</td>
<td>Given to grotto at NSS</td>
<td>-</td>
<td>Good</td>
<td>NBF</td>
</tr>
<tr>
<td>2000 Convention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB Olympus Caving Helmets</td>
<td>3</td>
<td>Purchased from EMS</td>
<td>$100</td>
<td>Good</td>
<td>NB</td>
</tr>
<tr>
<td>October 2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petzl Zoom Zora headlamps and attachment clips (mounted on helmet)</td>
<td>3</td>
<td>Purchased from EMS</td>
<td>$85</td>
<td>Good</td>
<td>MDL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>October 2002</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*One “coffeepot cup” is 2/3 of a real cup.

Location Key: SM = Steve Millett, NB = Norm Berg, MDL = Mark and Diane Lucas
## Central Connecticut Grotto Equipment Inventory, Cont’d

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>When/How Acquired</th>
<th>Approximate Cost to Grotto</th>
<th>Condition</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunton Inclinometer</td>
<td>1</td>
<td>Donated by Bob Simmons</td>
<td>-</td>
<td>Good</td>
<td>SM</td>
</tr>
<tr>
<td>Write-in-Rain Survey Book</td>
<td>1</td>
<td>Donated by Ken Nichols, who found it at Knox Cave circa 2006</td>
<td>-</td>
<td>Fair</td>
<td>MDL</td>
</tr>
<tr>
<td>Petzl Myo 3 Headlamp</td>
<td>1</td>
<td>Donated by Connecticut Junior Republic Fall 2006</td>
<td>-</td>
<td>Good to Fair</td>
<td>MDL</td>
</tr>
<tr>
<td>Knee Pads</td>
<td>2 Pair</td>
<td>Donated by Steve Millett</td>
<td>-</td>
<td>Fair</td>
<td>SMP</td>
</tr>
<tr>
<td>Gloves</td>
<td>2 Pair</td>
<td>Donated by Steve Millett</td>
<td>-</td>
<td>Fair</td>
<td>SM</td>
</tr>
<tr>
<td>CCG Banner</td>
<td>1</td>
<td>Made and donated by Jansen Cardy</td>
<td>-</td>
<td>Good</td>
<td>NB</td>
</tr>
</tbody>
</table>
Dear Member:

Another year has passed with the Northeastern Cave Conservancy (NCC) accomplishing important tasks. Our growth and accomplishments are only possible because of the support of the membership.

Accomplishments of the NCC in 2015

- The biggest news is our acquisition of Spider Cave, Schoharie County, NY, as Preserve #9. The owners, Midge and Joe Carl, have been most cordial to cavers over the years in permitting access to the cave, and in 2014 decided to donate the cave to the NCC for its perpetual care. The Acquisitions Committee has attended a series of Planning Board meetings throughout 2015, and met all of their requirements. The land survey is finished and plotted, and the legal description sent to our lawyer for her to draw up the closing documents, which should be signed in early January, 2016.

- We now manage approximately 87 acres and 16 known caves.

- As part of the NCC Board’s due diligence, the last two Preserves which haven’t been surveyed are being finished, and filed in the court houses. Knox was done in the summer of 2015 – nine acres, one more acre than we previously believed to have. Onesquethaw is being done in January, 2016. With all of our property surveyed and filed, more precise boundary marking can be done, making for better neighbors, as the saying goes.

- Positive relationships continue to grow with NYS Thacher State Park. Our Thacher Park Project of inventorying and mapping caves in the park continues, and the permit with the State was renewed. The State required that only NCC members could participate in the Project, thus representing another benefit of being an NCC member.

The biggest news at Thacher is the building of a new visitor center and the NCC involvement. We have been asked to design two displays: a geology display upstairs and a kid’s cave under the stairs leading down. The building shell, now being closed in for the winter, is financed by the State budget. But the cost of the design and construction of the interior displays has to be funded by contributions from the public. Two large groups have come forth with contributions, and the NCC is hoping to raise $10,000. Life and Board Member Thom Engel has offered a matching grant up to $5,000, so this is where you, the members, come into play. We need your financial support for this unique opportunity to have the NCC thrust into the public’s eye. Literally tens of thousands visitors annually will see our exhibits, and learn about cave conservation through the NCC. We will be permitted to distribute our new brochure, targeted at the general public, thus changing the mix of our membership and donations.

Help us reach our goal of $5,000 raised and $5,000 matched for the Thacher displays. Please remember the NCC in this season of giving.

Thank you and Best Wishes for enjoyable holidays,
Bob Addis, President

Northeastern Cave Conservancy, Inc.
P.O. Box 254, Schoharie, NY 12157
ncc@necaveconservancy.org
THACHER STATE PARK VISITOR CENTER
— Thom Engel —

In 2013, New York finalized a master plan for John Boyd Thacher State Park (Thacher Park). The plan calls for the construction of a Visitor Center near the west end of the Indian Ladder Trail. The new Visitor Center is now under construction, and I have been asked by the state to serve on a committee to develop content for interactive exhibits and permanent displays. The Park is particularly interested in a “kids cave” and an adult-themed karst interpretive display. Currently, there is a fund-raising effort for the exhibits, spearheaded by the Open Space Institute.

Education is an important mission of the Northeastern Cave Conservancy (NCC). Indeed, it is the reason we are a non-profit. Helping to fund the cave and karst exhibits at the visitor center would further our mission and will, in my opinion, reach more people than we do at our preserves. To that end, between now and April 2016, I will match each dollar up to $5,000.00 raised by the NCC for the Visitor Center displays. Please send your tax-deductible contribution earmarked for the Visitor Center to the NCC Office (Northeastern Cave Conservancy Inc. · P.O. Box 254 · Schoharie, New York 12157).
Underground Archaeology News

Entoptic Imagery and Shamanism

In his book *The Mind in the Cave: Consciousness and the Origins of Art* (2004), David Lewis-Williams argued forcefully for an intriguing shamanistic interpretation of prehistoric cave art. Shamanism is a religious concept based on a belief in an alternate reality (i.e., a spirit world outside of the realm of everyday life). Accordingly, an altered state of consciousness—commonly related to the use of psychoactive plants, but also caused by various other stimuli—may have afforded ancient shamans a rare glimpse into that otherworldly realm, and the walls of caves offered a tapestry upon which to document what they saw there.

A variety of visual phenomena can be associated with altered states of consciousness and trancelike states. These include eidetic hallucinations and entoptic hallucinations (phosphenes). Such images are open to a wide range of interpretation, dependent largely on cultural context and value systems. Thus, while hallucinations associated with trance-like states, hallucinogenic drugs, sensory deprivation, REM-state dreaming, migraines, etc. may be deemed largely unimportant in modern society (or perhaps even reflect the ravings of a madman), similar visions may be central to the religious life of those in other cultures.

Eidetic or photographic hallucinations are culturally determined sensations that arise within the cerebral cortex. They can be experienced by various senses (e.g., hearing, vision, touch, and smell).

Entoptic hallucinations and phosphenes are subjective visual experiences derived from within the eye or its connections to the brain. They have no relationship to the outside world. They commonly manifest as a varied assortment of geometric signs, such as dotted lines, parallel lines, wavy lines, zigzags, spots, circles, crosses, triangles, squares, etc. Such non-figurative symbols are frequently found in decorated caves, often in close association with the many iconic animal figures more familiar to many.

Entoptic images are considered to be hardwired features of the human brain, inasmuch as similar visual phenomena are experienced by people living in geographically separated cultures having no contact. Selective neurological mechanisms have been explored to account for the effects of altered states on the production of such imagery by the human mind. Such imagery may be culturally interpreted as being of divine origin.

More recently, Sayin (2014) suggested that these visual phenomena are part of an ancient and forgotten human language made up of visual signs and symbols. Inherited as a genetic capacity of the human brain, these geometric patterns emerge during altered states of consciousness, especially those induced by use of psychoactive plants. Perhaps there is a universal library of such symbols embedded in the human nervous system. As such, they may have been accessed by shamans during altered states of consciousness and their inclusion in ancient cave art may have been part of an early form of communication.

It is believed that psychoactive plants have been widely used by shamans throughout human for religious rituals. Lewis-Williams considered the intense visions generated within the mind during altered states of consciousness to have been of paramount importance in the creation of Upper Paleolithic cave art (and also the rock art of more modern hunter-gatherer tribes). This belief served as the foundation for his archaeological investigations of Ice-Age art and shamanism.

Thus, Lewis-Williams maintains that early shamans did not consciously invent two-dimensional imagery, nor did they first envisage such imagery in the shapes of natural rock around them (although natural features of the cave wall may have served as proxy for a portion of an animal image). Rather, such images were born within these people’s own minds, serendipitously generated as a neurochemical byproduct of an altered state of reality. Eventually, they realized that these images were culturally significant and needed to be preserved. Early two-dimensional images, therefore, were not meant to be representations of the physical world per se, but of the shaman’s own mystical journeys—snapshots, if you will, of a spirit realm miraculously projected onto and floating across the walls about them. Once this initial step was taken, Lewis-Williams hypothesizes, symbolic art began to flourish.


News From the World of Bats

Natural History

Quantifying Ecosystem Services Provided by Bats. The value of an animal species or taxon is often defined by ecosystem services provided. Ecosystem services encompass the various benefits to human society, both direct and indirect, that these species offer. In realistic terms, attributes that warrant favorable consideration are often rooted in economic significance.

Vital ecosystem services afforded by bats include their roles in pollination, seed dispersal, and insect predation. Conservationists often point to these facets of chiropteran natural history when considering the need for increased vigilance in bat-conservation activities. Better management of many bat populations has become increasingly important in the aftermath of WNS emergence, the increased construction of wind turbine facilities, and the continued fragmentation of valuable habitat.

In spite of oft-cited ecosystem services provided by bats, these have been largely based on untested assumptions and questionable estimates. In the case of insectivorous species, for example, such estimates are related to the size of bat populations, the amount and species of insects actually consumed, the extent of crop damage caused by pest species, and the actual efficacy of insect suppression. In fact, there have been very few studies actually quantifying the economic benefits of ecosystem services attributed to bats (Boyles et al., 2013). This has been largely due to difficulties in the implementation and limitations in the design and interpretation of such studies.

Accurately quantifying ecosystem services provided by bats is important in garnering public support of bat conservation. However, Boyles and co-workers stress that, “Our goal as researchers should be never to mislead the public about the value of bats but instead to set realistic estimates of their economic worth to humans.” This is an attitude that should be adopted by all bat conservationists.

Insectivorous bats, of course, are voracious predators of insects, many of which are economically significant pests of crops. It is generally believed that bats provide important agricultural ecosystem services. Considering the importance of crops to human survival (including the greatly increased needs to meet future demands of human populations exploding out of control), the potential economic benefits of suppressing populations of crop pests (e.g., increased crop yield, increased crop quality, decreased costs, and minimized use of insecticides—which are not only expensive but potentially harmful to consumers) are significant.

Some of the difficulties involved in establishing an economic benefit of bats to agricultural ecosystems are as follows. Bats primarily consume adult insects, however, crop damage by many insect pests is typically a function of the insect’s larval stage. When, in the course, of a particular insect’s reproductive cycle do bats primarily consume insect pests (i.e., before or after eggs are laid)? The latter may vary by location, depending on whether a given insect pest has one or more than one generation per year. Do bats consume enough adult insects to impact the number of eggs laid? Moreover, since most insects lay far more eggs than will actually hatch and produce young that will survive to adulthood, will any impact of bats on the number of eggs laid actually be significant?

Recently, Maine and Boyles (2015) studied the potential ecosystem services provided by bats in the suppression of corn earworms (Helicoverpa zea). The larvae of these moths feed on both the leaves and kernels of corn, causing considerable economic damage.

The corn earworm is considered by many to be the most important economic pest species in North America, consuming not only corn, but a wide variety of other important crop species, as well. Corn earworm caterpillars reportedly causes as much as 100 million dollars of crop damage annually, and cost farmers as much as 250 million dollars in insecticide application each year (despite the fact that caterpillars continue to develop resistance against insecticides).

Apart from direct damage caused, these caterpillars may also have an indirect impact on the quality of corn and other crops by increasing their vulnerability to colonization by fungi, especially Aspergillus flavus and Fusarium graminearum. Both fungal species produce mycotoxins (aflatoxin and fumonisins, respectively) that cause severe liver damage (including liver cancer) in both livestock and humans that consume moldy corn. Clearly, a significant role of bats in suppressing corn earworms would be...
of considerable economic benefit.

In their investigation of the efficacy of bats in suppressing corn earworms, these workers created six large, outdoor exclosures (20 meters x 20 meters x 7 meters) and six paired control plots. Each replicate was located in a separate field. Exclosures were covered in netting, attached by clips to steel cables. The netting prevented entry of bats during the evening. However, the clips enabled workers to slide the netting aside each morning, allowing farmers to work in that section of field, as needed, and also allowing entry of birds during the day.

A variety of insectivorous bats were noted to hunt in the study area, including eastern red bats (Lasiurus borealis), evening bats (Nycticeius humeralis), tricolored bats (Perimyotis subflavus), and northern long-eared bats (Myotis septentrionalis). According to the authors, eastern red bats in the area feed on several species of moths, most notably noctuids (which includes the corn earworm). As such, they may be the most significant chiropteran predator of common moth pests in the Midwest. Evening bats in the study area prey heavily on the spotted cucumber beetle (Diabrotica undecimtata howardi). Both adult and larval forms are important agricultural pest, attacking various crops (including corn). Tricolored bats in the area principally eat caddisflies. The northern long-eared bat may glean prey from vegetation, but occasionally eats a high volume of moths.

Results of this study showed that corn in the exclosures had 59% more corn earworm larvae than the control plots. This indicates that bat predation on adult moths is sufficient enough to have an effect on larval numbers. Concurrently, there were 56% more damaged corn kernels in the exclosures compared to the control plots. When caterpillars were present prior to the growth of corn kernels, significantly less leaf damage was observed in the control plots compared to the exclosures. Although the crop yield by weight (bushels/hectare) from the control plots was 20% higher than that from the exclosures, this was not a statistically significant difference. The authors suggested that 11 enclosure/control pairs, instead of six, would be required to detect a significant difference in yield.

Differences in fungal burden was also found between exclosures and control plots. Approximately 20% of the ears of corn in the exclosures showed evidence of fungal growth, compared to only 12% in the control plots. In concert with the increase in fungal contamination, a significantly higher level of fumonisin (4.82 ± 0.17 parts per million) was also found in the exclosures compared to the control plots (4.15 ± 0.17 ppm), suggesting a previously unknown ecosystem service provided by bats. No significant differences were observed in aflatoxin concentrations in exclosure versus control plots; however, the authors reported that Aspergillus flavus was rare at the study site.

The results of this study demonstrate a positive effect of bats on the suppression of corn earworms in an exclosure study site. Moreover, the reduction of mycotoxins also increases crop quality.

Corn earworms are tympanate moths, meaning they are able to hear the ultrasonic hunting calls of bats. Moths in the exclosures were not only protected against bat predation, but may also have been shielded against hearing the ultrasonic cries of hunting bats. This may have provided an impetus for increased egg laying. In considering the underlying mechanisms by which bat suppression of corn earworms occurs, the authors suggested that changes in moth egg-laying behavior in response to ultrasound detection may also play an important role.

Because artificial lighting may diminish the response of some tympanate moths to the ultrasonic hunting calls of bats, the placement of suitable lighting systems near fields may increase predation efficacy. However, the spectrum of light, species-specific hunting behavior, and even potential adverse effects of light on crops must all be considered. Additional information on effects of artificial lighting and bats can be found in the March and September 2014 issues of The Underground Movement (see http://www.caves.org/grotto/ccg/um/2014_03_um.pdf and http://www.caves.org/grotto/ccg/um/2014_09_um.pdf).

On the negative side, increased predation of crop pests by bats may expose bats to a greater insecticide burden, which may have untoward consequences.


White-Nose News

Invasion of *Pseudogymnoascus destructans* into Previously Unaffected Areas. Since its discovery in New York State, *Pseudogymnoascus destructans*, the fungal agent causing white-nose syndrome (WNS) continues to spread. This devastating malady has caused the death of untold numbers of bats in the Northeast, and continues to threaten populations of several species of cave-hibernating bats.

Extensive research over the last few years have added greatly to our understanding of the pathophysiology of this disease in bats. However, many complexities of disease transmission and dispersal remain to be unraveled. One such aspect that has received relatively little attention, for example, involves the dynamics of the disease cycle during fungal invasion of previously uninfected sites.

This issue was recently investigated by Langwig and her co-workers, who studied changes in the prevalence of fungal infection among bats during the initial invasion of *P. destructans* into a new location in the Midwest (Langwig et al., 2015).

Accordingly, they sampled five species of bats¹ from two hibernacula in central Illinois. Bat counts were taken for each species except the big brown bat. Because they were found to be roosting around crumbling rocks, accurate counts were too difficult and dangerous to obtain. Sampling was conducted for two consecutive winters, and included skin swabs from 15 - 20 specimens of each species; and from the rock beneath, near (10 - 20 centimeters), or at a distance (greater than two meters) from bats. Sampling was conducted twice during each winter season. Samples were tested for the presence of *P. destructans*.

During the early part of the 2012 - 2013 season, only one specimen (a northern long-eared bat) was found to be positive for *P. destructans*. No evidence of fungus was found in any of the rock wall samples. Four months later, however, the prevalence of infection was considerably higher: >85% for little brown and northern long-eared bats, 40 - 75% for big brown and Indiana bats, and 15 - 60% for tri-colored bats. The prevalence of fungus on the rocks beneath the bats ranged from 0 - 60% although no fungus could be detected on rocks at a distance.

By early winter of 2013 - 2014, it was obvious that *P. destructans* was considerably more widespread within the hibernacula, being identified from 70% of samples from beneath bats, 22% of samples near bats, and 14% of samples greater than two meters from bats. Moreover, prevalence of infection was found to be ≥70% for four species sampled and 85 - 100% for tri-colored bats. By the end of the 2013 - 2014 winter season, 98% of bats were infected with fungus; and 91% of samples from rock beneath bats, 66% of rock samples from near bats, and 44% of rock samples far from bats were positive. The long-term presence of fungal isolates in the environment is a likely source of infection (or re-infection) for hibernating bats, thereby contributing to persistence of WNS-infected bats.

Adverse effects of WNS syndrome on bat populations within the hibernacula were positively correlated with the fungal sampling results. Moderate to severe population reductions were found by the 2013 - 2014 season: 47 - 73% reduction in the number of tri-colored bats, 16 - 96% reduction in the number of Indiana bats, 95 - 99% reduction in the number of northern long-eared bats, and 81 - 88% reduction in the number of little brown bats. The authors report that as many as 20,000 little brown bats were lost.

The authors emphasize the important need for developing effective interventions that can be implemented rapidly or even proactively in order to help stem the consequences of *Pseudogymnoascus destructans* invasion.


¹These included little brown bats (*Myotis lucifugus*), big brown bats (*Eptesicus fuscus*), northern long-eared bats (*Myotis septentrionalis*), tri-colored bats (*Perimyotis subflavus*), and Indiana bats (*Myotis sodalis*).
**Rabid Bytes**

**Cost-Benefit Analysis of Vampire-Bat Management Strategies.** With the rise of cattle ranches in Latin America, livestock have become the preferred food source for vampire bats (*Desmodus rotundus*) in cattle-raising areas. Cattle depredation continues to have an enormous economic impact on the livestock industry in Latin America. Adverse effects of vampire bats include rabies-related cattle deaths due and also debilitation secondary to blood loss following vampire bites. The latter may cause weight loss, hide damage, and decreased milk production.

Historically, management strategies designed to reduce the adverse impact of vampire-bat bites on livestock have been twofold: pre-exposure vaccination of cattle against rabies and destruction of vampire bats in the wild. Pre-exposure vaccination of livestock has proven to be an effective means of protecting cattle against the ravages of vampire-bat rabies. Selective destruction of vampire bats typically involves treating captured bats with an anticoagulant paste, which is then spread among many individual members of a colony during the course of social grooming activity (anticoagulant may also be applied directly to cattle, which is then taken up by bats as they feed).

In Mexico, the principal economic losses associated with vampire bats are those related to cattle death. As such, a cost-benefit analysis of vampire control strategies is an important yardstick for management options. Anderson et al. (2014) conducted a cost-benefit analysis and economic evaluation of vampire-bat rabies management programs (i.e., pre-exposure vaccination of cattle versus vampire-bat destruction) in Mexico.

Based on the results of this analysis, the authors concluded that pre-exposure cattle vaccination is a far better option for the protection of cattle against vampire rabies. In fact, the expected benefit-to-cost ratio is greater than six, which means that more than six pesos were realized for every one peso spent on cattle vaccination. The principal source of this benefit lies in the reduction of cattle mortality and the reduced need for rabies testing in cattle. Indeed, a six-fold benefit-to-cost ratio represents a considerable potential economic boon to cattle ranchers.

The cost-benefit ratio of vampire-bat control programs, on the other hand, was noted to be very small. Based on the assumptions of the study, control programs relying on population-control methods are likely to be inefficient (implying that the cost of resources used outweighs the benefits obtained). According to Anderson et al. (2014), the greatest efficacy is to be found when vaccination programs are utilized alone, without recourse to destruction of bat colonies.

In spite of clear benefits of cattle vaccination, its use is not widespread. Reasons for this may include a lack of understanding of this approach, and a lack of access to the vaccine or appropriate veterinary care. The authors emphasize the need to educate local ranchers about the potential benefits of vaccination.

These results should be considered in light of previous work on the efficacy of vampire-control programs to eliminate this source of rabies virus. Streicker et al. (2012), for example, have recently reported that that culling bats to prevent rabies outbreaks may actually be counterproductive, since they may result in a large number of immunologically naïve individuals that are incapable of resisting viral infection.

Others have suggested continuing to explore ways to vaccinate vampire bats against rabies. Instead of employing anticoagulant poisons applied to the backs of captured bats—which is then consumed by roost mates during periods of social grooming—orally active rabies vaccines might be employed (Stoner-Duncan et al., 2014). Others have suggested developing a vaccine that could be inoculated into cattle and transferred to vampire bats during the course of feeding. To date, only preliminary efforts have been directed towards the development of orally effective rabies vaccines suitable for use in vampire bats.


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1This refers to selected killing of vampire bats only, not indiscriminate destruction of bat populations, which often includes both insectivorous and frugivorous species. Such wanton destruction has often been used by indigenous peoples, who often do not distinguish between vampire bats and other species.
In its cave, scientists are shown collecting samples and gathering information, as they try to figure out what is making the bats ill.

In *A Little Brown Bat Story*, Melissa Kim introduces young readers (pre-school through second grade) to some of the ecosystem services provided by bats (e.g., consumption of insects) and to the ravages of white-nose syndrome (WNS), the fungal disease which has had such a devastating effect on populations of little brown bats, most notably in the northeastern United States. This is a delightful tale—beautifully illustrated by Jada Fitch’s full-page, full-color illustrations, which are sure to appeal to young readers.

A brief list of “Fast Facts” and a short “About Little Brown Bats” section provide some interesting information on the natural history of little brown bats and the potential dangers faced by hibernating bats due to WNS. The author emphasizes the fact that WNS is currently the most significant threat to bats in North America. Accordingly, she writes, “While bats are often unfairly associated with rabies and vampires, the public image of bats is not their biggest obstacle.”

In this regard, it should be noted that bats provide important ecosystem services and are critical components of various ecosystems. However, it is also important to recognize that bats are significant reservoirs of rabies virus in this country. And while the prevalence of this disease is extremely low in healthy-appearing bats captured in the wild, it is considerably higher among bats that have interacted in some fashion with people or pets and which have been submitted to public-health facilities for testing. Educating people, especially children, about the dangers of handling bats is a critical component in changing the public image of these animals.

*A Little Brown Bat Story* is the second title in Islandport Press’ Wildlife on the Move series. The series is meant to provide young children with information about wildlife migration, conservation, and animal-human interactions. The first title in this four-part series was *A Snowy Owl Story*; a third title about the endangered Blanding’s turtle is scheduled for release in the spring of 2016.

This book will be a nice addition to the home library for young readers, especially that of budding, young naturalists. It is sure to open a world of new ideas for parents and children to explore together.
I understand that Bill Rock, well-known caver, was awarded a $10 million contract to develop a robotic cave explorer for use on Mars. If Mars has any water, it is deep underground in caves, so Rock’s robot can function in underwater caves. Last I heard, he was testing the contraption in a Florida sinkhole near the Woodville Karst.

Rock knows a lot about rebreathers and underwater exploration, but I know plenty about underground caves and mouth breathers—cavers who are allergic to mold. The hazards to be expected in caves include falls (where the robot topples over a cliff or into a vertical shaft) or where rocks fall on the robot (burying it under a heavy pile). Robots notoriously run out of batteries, so power loss is an inherent risk that needs to be taken into account when designing a caving robot. Since robots have evil enemies that are often equipped with weapons such as claws, trip-hammer smashers, saws, and flame throwers, a properly designed caving robot will need offensive and defensive weapons to survive the competitive realm of Mars cave exploration.

I built a prototype test caving robot that I think shows a lot of promise. It is roughly conical in shape, much like an ice cream cone. But to the average evil person or robot, it resembles a big stalagmite. If rocks fall on it, they will slide right off, since its walls are made of fiberglass-reinforced Teflon. Should it fall into a pit, it will land heavy side down. In order to prevent it from burning, I’ve constructed the inside of damp campfire wood. It uses eight tiny feet for locomotion, so four of them are in contact with the ground at all times. A flypaper dispenser is its main weapon. Fuel is carbide, the most dependable source for cave lights, and it carries five gallons of water to drip on the carbide. Therefore, there are no batteries to deplete. Photos are out of the question because it is dark in Mars caves, so no camera will bring back pictures. I know this will disappoint the evening newscasters, so I have attached a GoPro camera to a railroad train pointed at the ballast next to the rail. The resulting moving video will be broadcast continuously from the robot during its exploration and will convey the appearance of real progress.

For its maiden test run, I took my caving robot to Mammoth Cave (Kentucky). I started it at the top of the Historic Entrance. It looked cute climbing down one concrete step at a time, with its little cone head tipping precariously as it moved off one step and onto the next. At the bottom, it trundled off into the cave. Alas, it was stopped by a locked metal door—you can’t think of everything, you know. Several hours later, the first tour guide opened the door, and the robot marched in along Houchins Narrows. The National Park Superintendent who was watching the monitor commented that the robot was picking up images of rocks. This was hard to explain, since the path in the cave was paving blocks. I pointed out that the feed from the robot showed a macro lens photo blowup of minute dust and lint particles that just looked like rocks.

The robot was programmed to make the complete Historic Tour of Mammoth Cave. But when the tour group exited, my robot was nowhere to be seen. I decided to wait for it a while before calling out a recovery mission. Eighteen hours later, it tapped on the closed metal door. I had to wait until the next morning’s tour group arrived before the guide unlocked the door and I could retrieve it. I was sorry to see that the carbide was nearly spent, and most of the five gallons of water had been used. I picked up my caving robot and examined it closely. Some vandals had scratched the letters J. L. on one side; the other side had B. A. carved into the Teflon. That was a hazard I had not anticipated in a caving robot. I picked up my conical robot and cradled it under my right arm as I climbed the steps past the waterfall. At the top of the platform, I was met by a seasonal ranger.

“Whatchoo got there?” he demanded, pointing his Taser at my robot.

“It’s my cave-exploring-robot prototype, just back from a successful trial,” I explained.

“I’ll just bet it is,” he said, with a hint of sarcasm in his voice. “Looks like a stalagmite to me, and there’s a $10,000 fine for taking speleothems out of the cave!” I explained to him that it just looked like a stalagmite. He unfolded his investigational magnifier and peered at the J. L. and B. A. inscriptions. “I think you put those initials on there,” said the ranger. He was speaking into his
lapel mike. “We need a bus to transport a vandal to Bowling Green...yeah, the U.S. Magistrate’s office.” He took my robot and placed it into the back of an electric vehicle. Then he turned and put handcuffs on me. “Graffiti artist fines are doubled in this Park, buster. And I think you just ran your bill up.” I protested that the robot was a science experiment and that the Superintendent could vouch for my project. “Better get the Superintendent up top. This vandal says he has the Super’s OK to steal a stalagmite and carve his initials on it.”

We met the Superintendent back at the Visitor Center, just as the paddy wagon pulled up for my trip to Bowling Green. She told the ranger to release me at once. “This is Ergor Rubreck, world-famous caver, who has been testing a caving robot explorer. It’s OK.”

The cuffs had nearly rubbed my wrists raw, but I thanked the Superintendent for rescuing me. She told me that the ranger would undergo re-education by Resource Management to tell the difference between a stalagmite and a robot. She apologized for the inconvenience, but was genuinely pleased when I told her that I’d send her the robotic sensor download.

In retrospect, I believe I’ll equip my modified robotic cave explorer with a lock-picking device, and run further tests...but not in a National Park.
The Underground Movement

Central Connecticut Grotto

Calendar of Events

January 19 - Monthly Grotto Meeting. Please see the grotto website (www.caves.org/grotto/ccg/) for additional details.

December 12 - February (?) - Conversation II Art Exhibition. Includes a display of cave-related artwork by Mark Williams. No Pop Gallery, 130 Park Street (second floor), New Haven, CT.

Neighboring grottos in the Northeast may also sponsor various activities or host annual events of interest to CCG members. Links to homepages of other grottos can be found on the NSS website (www.nssio.org/Find_Grotto.cfm).

Photograph of the Month

Steve and Felicia Millett join the grotto holiday party from China. Photo by Norm Berg.