Watching the Dark

New surveillance cameras are changing bat research

by Paul Cryan and Marcos Gorresen

COURTESY OF PAUL CRYAN

This wind turbine was imaged by a thermal-imaging surveillance camera that records temperatures instead of reflected light. It includes a bat (the dark speck in the top-right corner) that's flying at night about 325 feet (100 meters) above the ground.

It is, according to an old proverb, "better to light a candle than to curse the darkness." And those of us trying to discover new insights into the mysterious lives of bats often do a lot of cursing in the darkness. Bats do most things under cover of night, and often in places where humans and most other animals can't go. This dark inaccessibility is great for bats, but not so great for those of us trying to study them. Successful conservation hinges on understanding bat behaviors and needs, as well as identifying and addressing the things that threaten them in the darkness. But how do we light a candle without scaring the bats away or altering their behavior?

Scientists, engineers and conservationists have been developing new tools for watching bats in the darkness for decades. *BATS* magazine has chronicled many alternatives over the years: night-vision scopes or goggles, thermal-imaging cameras, camcorders with infrared lights (which bats and humans cannot see), beam-break detectors and bat-house cameras, to name just a few.

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Duct tape unites two generations of cave cameras. The near-infrared camera on top was custom made with a weatherproof case. The white camera is an off-the-shelf thermal-imaging unit that came ready to deploy for entire winters.

These technologies have brought us a long way, but the new threats of wind-energy turbines and White-nose Syndrome have pushed us into uncharted territory. Now we must watch bats more efficiently, cheaply and for longer periods in more places and under more difficult conditions than ever before. But we are, finally, finding these more affordable candles that burn longer and help us see farther.

Consider the challenge of observing an eastern red bat flying on a moonless night near the highest parts of a wind turbine. With turbine blades now reaching 300 to 500 feet (120 to 150 meters) or higher, that's like trying to see the hand of someone waving to you at night from the 35th to 45th floor of an unlit skyscraper.

Or consider that bats can spend eight months or more deep in caves, mines and other dark, cold and wet holes in the ground during winter hibernation, when WNS hits hardest. And during

that time, they cannot tolerate disturbance by humans and our sometimes-noisy equipment. Also, most researchers cringe at the thought of leaving expensive observation equipment out in cornfields beneath wind turbines or in remote, damp caves for months on end.

In the process of customizing video equipment to survive in caves and fields, our team stumbled across a whole range of tools that were hiding right under our noses – commercial surveillance cameras. You know the type: those cameras hanging in the corners of store ceilings and on traffic poles at intersections. Bat biologists have used closed-circuit video cameras in the past, but as the market for surveillance cameras has boomed, more powerful and cost-effective cameras are becoming available.

Now, for example, you can buy a thermal video camera that images the heat emitted by objects (rather than light reflected off them) for less than $5,000, complete with a fully weatherproof enclosure and the ability to automatically record several nights of video on a removable memory card. Science-grade thermal cameras were previously used to gather some incredible imagery of bats interacting with wind turbines (*see* BATS, *Fall 2005*), but such cameras cost tens to hundreds of thousands of dollars, were not weatherproof and tended to crank out more data than many bat watchers really wanted to sift through.

Another benefit of new-generation surveillance cameras is that they are Internet-compatible. The camera can become its own live 'Batcam' website by simply plugging in a cable and clicking a few buttons. These new cameras are dramatically changing the way we watch bats in the dark.

And the technology keeps getting better. While taking full advantage of now-standard thermal and near-infrared surveillance cameras, we are also experimenting with new near-infrared cameras that collect video at light levels that are orders of magnitude dimmer than cameras of just a few years ago. This lets us look ever deeper into that inky blackness.

After several years of working with these new off-the-shelf outdoor surveillance cameras, leaving them exposed to the elements as our robotic eyes on the ground (and up into the sky), we are happy to report that the sea change is here. With these cameras, we are seeing things we have never seen before with bats, as demonstrated by our work at wind turbines and in WNS-infected caves.

Working with BCI biologists Cris Hein and Michael Schirmacher and the wind industry, we used surveillance cameras to better understand how bats interact, often fatally, with wind turbines. Beginning in Pennsylvania, then moving to Indiana and most recently to Hawaii, we recorded thousands of hours of video at wind turbines and watched hundreds of bat interactions with them.

Much of what we're seeing is new: bats swooping and diving near turbines, investigating different parts of the turbines, approaching them in consistent ways that vary with weather and operating conditions, and chasing each other near the turbines. These observations are helping us understand why and how bats are susceptible to collisions with wind turbines and will hopefully help us find solutions.

Since about 2009, we have partnered with Dave Dalton of Wildlife Engineering, the National Park Service, New York Department of Environmental Conservation, University of Tennessee and Indiana Department of Natural Resources to put surveillance cameras deep into caves and abandoned mines affected by WNS to observe bats as they hibernate.

With this surveillance work, we hope to not only understand how infection by the fungus *Pseudogymnoascus destructans*, the cause of WNS, disrupts hibernation, but also to discover more about how bats behave as they hibernate. Surprisingly little is known about bat hibernation, and this is one of the first times bats have been watched closely over the course of entire winters.

As with the videos from wind-energy sites, it is exciting to watch these videos display activities of bats that few people have ever seen. Over the past five winters of watching hibernacula videos, we have witnessed bats drinking from stalactites, wrestling with cluster mates, grooming, mating, being crawled over by millipedes, and much more. Although these events are exciting and enlightening, they are relatively rare. And that brings us to the biggest challenge of using video to study bats — dealing with the thousands of hours of imagery that is now easy to record.

These hibernating little brown myotis (*Myotis lucifugus*) were photographed with a video surveillance camera that uses near-infrared light that is invisible to bats and humans. Bats do not seem to be disturbed by the cameras or their infrared lights.

Take it from us experts: about the only thing more mind-numbing than watching a cluster of bats hibernate in real time is watching an hours-long video of a spinning wind turbine. Watching paint dry is almost thrilling by comparison. Although things get interesting when there's a bit of action in a cave or at a turbine blade, those are interspersed with much longer stretches where nothing happens at all.

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A researcher sets up an infrared surveillance camera to monitor hibernating bats deep in a cave. The clean suit was worn to minimize chances of moving the fungus that causes White-nose Syndrome out of the cave.

During one of our turbine-monitoring projects, for example, we saw an average of about six bats appear for a few minutes during each nine-hour night of recording. In the video imagery recorded at hibernacula, brief bits of action fill only a tiny fraction of the months of recordings. Most new surveillance cameras include motion detectors and can be set to record only when movement occurs, but that won't work in certain situations, such as when turbine blades are turning. We needed a more streamlined way to find the few gold nuggets buried in the video streams, and we wanted a method that we could share with fellow bat researchers.

We started with the question: Why watch hours of videos if a computer can do it for you? But after surveying existing options, we decided to develop our own software that could be freely shared and improved by anyone interested in using surveillance cameras for studying rare events. With the help of David Hayman, a Smith Fellow funded by the Cedar Tree Foundation and the Society for Conservation Biology, we started working on software code to automatically sift through entire nights of video imagery in mere minutes or a few hours and find those rare periods of activity.

It will, of course, take a while to work out the inevitable bugs and deal with the tens of thousands of hours of video that we've gathered over the past few years. But the process is moving forward, and we hope to publish our research results during the coming year. We'll also release the computer code we used to mine the video imagery. It won't be perfect, but we hope it helps open the floodgates of all that modern surveillance cameras offer for bat researchers.

Yes, it is better to light a candle than curse the darkness. It's better to leave a weatherproof surveillance camera out there in the darkness than to sit waiting in the wind or cold for those rare, enlightening glimpses. It's definitely better to let a computer crunch through months of video imagery from multiple cameras than to let your eyes and mind glaze over watching it roll endlessly across a screen. And it is much better to invest time and expertise in studying and conserving bats instead of babysitting finicky machines.

Anyone can now buy today's weatherproof surveillance cameras, set them up in a few hours and have them out watching bats in the darkness. No experience required. That is a very exciting prospect, and we expect to do a lot less cursing in the dark during the coming years.

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