White Nose Syndrome 2013 - "Got Bats?"

by Peter Youngbaer, NSS 16161, CM FE

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"Got Bats?" is the name of an innovative program by the Vermont Department of Fish and Wildlife (VFW) to engage the public in monitoring the state's bat populations in the post-WNS era. With the blessing of the National Milk Processor Board and it's "Got Milk?" campaign, VFW has helped educate the public on the importance of bats, the effects of White Nose Syndrome (WNS), and how to monitor and report the presence of bats.

Vermont is a small state, with less than 700,000 people. We're an environmentally conscious state, and as one of the earliest states to be hit by WNS, the news got around fast. Now, more than six years after it was first discovered, you'd be hard-pressed to find anyone in the state who isn't aware of WNS, and more importantly, of the status of bats on the landscape. Can your state say that?

Got Bats?

"Got Bats?" is a great question to ask in the Northeast, where WNS has hit the hardest. Cavers, researchers, land managers, and homeowners all ask the question as they check their caves, mines, buildings, and surface habitat for signs of bats. Are they all dead? Are they coming back? Are things changing?

"Got Bats?" is also a great question to ask at the leading edge of the disease. In Tennessee, Kentucky, Missouri, and in Canada, people are looking to see if the early signs of WNS last year have wreaked the same devastation seen in the early states. In January, we got the first new report of 2013, confirming WNS in a Northern Long-eared bat in Mammoth Cave National Park. Other confirmations have quickly followed from Virginia, Tennessee, and Kentucky. Canada's Prince Edward Island reported likely WNS, and North Carolina reported bats flying on the winter landscape.

These reports are not good harbingers of what's yet to come the rest of this winter and spring. Since first documented in 2006, WNS has now been confirmed in 19 states and four Canadian provinces. A fifth province is now likely, and the fungus Geomyces destructans, identified as the cause of the disease, has been confirmed on several bats in two other states.

"Got Bats?" is also a great question to ask in the western U.S., where WNS remains a distant reality but a present concern. Far too little is known of the hibernation habits of western bat species. Where do these bats go in winter? How many are there? What are the colony sizes and characteristics of their roosts of choice? Getting baseline data prior to any arrival of WNS–a luxury not afforded the Northeast–is a priority, and a place where biologists, cavers, agency personnel, and the public can collaborate to mutual benefit. Indeed, identifying significant hibernacula is an underpinning of the Federal Cave Resource Protection Act, a national law championed by the NSS. This is a time to make the law work.

What Do We Know for Sure about WNS?

After seven years of the outbreak, we've learned a lot about the disease, but still have many unanswered questions. Some things, however, we do know:

1.The disease is caused by a novel fungus, Geomyces destructans. The fungus grows on the skin of bats (epidermis), often causing blotches, scarring, and even holes. It also sometimes manifests on the muzzle of bats, giving the tell-tale "white nose." When it invades the dermis (under layer of skin), the disease is confirmed.

2.It affects only hibernating bat species. Six species are known to die from the disease, another confirmed with it, and two others documented with the presence of the fungus, but no other symptoms.

3.It affects different bat species differently. The Little Brown bat has been the hardest hit in the largest raw numbers, but also as a percentage of known roost numbers. The Tricolored and Northern Long-eared have also been hard-hit as a percentage, the Indiana bat less so. The Eastern Small-footed bat has been little-affected, and the Big Brown appears to be thriving and increasing. The Virginia Big-eared bat, which co-hibernates with affected species, has not been affected at all.

4.Temperature and humidity matter. The fungus has an optimal growth range, and low humidity impedes the disease.

5.The only method of disease transmission proven to date is by bat-to-bat physical contact. Bat-to-bat aerosolized transmission was attempted several times in the lab, but not successful. One field experiment lends credence to environment-to-bat transmission.

6.The culprit fungus, Geomyces destructans, is widespread in European bats, but no mass morbidity is known. The fungus has been shown to be genetically quite diverse in Europe, but quite uniform in North America, supporting the hypothesis that it is either newly arrived, or newly evolved.

7.The fungus can persist in the underground environment in the absence of bats. More on this in the next section.

8.The fungus has not been known to affect humans or other animals.

Research Updates

[*Ed: Research bibliography is on page 13*]

Over the past year, an increasing number of research papers on WNS have been published. Other research is ongoing, and work-in-progress is often presented at conferences, such as the annual WNS Symposium, the North American Society for Bat Research's annual Symposium (NASBR), and regional meetings of bat working groups, among others. Sometimes abstracts are available; other times PowerPoint presentations (or pdfs of them).

As a function of the NSS WNS Liaison Committee, we attempt to provide as many of these as possible on the NSS WNS website: www.caves.org/WNS. The website also includes a down-loadable NSS WNS brochure, which is updated anytime a new WNS map comes out. This brochure is intended for use by cavers at grotto meetings or to distribute at public functions to help educate the public about WNS, and to show NSS involvement in the issue.

The website also includes NSS documents such as formal communications with federal agencies, reports by the Liaison to the NSS President and Board of Governors, and much more. Please check this website regularly for the most up-to-date information available.

In September of 2012, Neal Christensen, PhD, a social scientist, and Cynthia Sandeno, National Cave and Karst Coordinator for the U.S. Forest Service, published a study entitled, "Social and Economic Values of Caves on National Forest Lands: The Case of the

NPS, Steven Thomas

This Northern Long-eared bat (Myotis septentrionalis) from Long Cave, Mammoth Cave National Park, had the dubious honor of the first confirmation of White Nose Syndrome in 2013.

Monongahela National Forest." (Footnote 1) Social science is a departure from the more technical, lab-oriented sort of research we're used to seeing, but this study provides interesting insights into the varied impacts of cave closures on public lands and the users of those resources. The study concludes, in part, "There are costs associated with the cave closures on the MNF that go beyond the economic impacts related to equipment and travel-related expenditures by caving participants. Costs that were mentioned include lost opportunities to introduce people to nature, reduction of progress in science, less volunteer stewardship work, less variety of recreation opportunities, a loss of protection of caves, and a decline in interest in caving activities. Caves and bats may be more vulnerable to human caused negative impacts, such as vandalism, because the caves are closed to the mainstream caving community."

A study published in November entitled, "Pathology in euthermic bats with white nose syndrome suggests a natural manifestation of immune reconstitution inflammatory syndrome," by Carol Metayer, et al out of the US Geological Survey's National Wildlife Health Center lab in Madison, Wisconsin (Footnote 2) reported an interesting observation. Bats that initially survived a WNS infection in their hibernaculum later died from what appeared to be an immune system over-reaction once the bats were out on the spring landscape. One aspect of WNS seems to be that the fungus is able to get a foothold while bats' immune systems are suppressed during torpor. The good news is the bats initially survived; the bad news is their immune system woke up and went into high gear, ultimately killing the bats. This doesn't happen with all WNS-infected bats, but this paper presents yet another complication in fully understanding this disease.

Another important paper published in December details work conducted primarily by the U.S. Geological Survey lab on cave sediments in WNS affected caves. This work was funded in part by the NSS' WNS Rapid Response Fund, and many cavers participated back in 2009 with the collection of cave sediment samples that became the basis for this undertaking. The study, "Distribution and Environmental Persistence of the Causative Agent of White-Nose Syndrome, Geomyces destructans, in Bat Hibernacula of the Eastern United States," (Footnote 3) documents that the fungus Geomyces destructans can persist in the cave environment after bats have departed. These results could impact cave management decisions, and guidance on the use of decon protocols. A caution, however, is that we still do not know the critical mass of fungal spores necessary to cause infection.

In January 2013, the International Journal of Speleology published an excellent paper by Karen Vanderwolf of the New Brunswick Museum, et al, entitled, "A world review of fungi, yeasts, and slime molds in caves." (Footnote 4) Also funded in part by the NSS, this study focused in part on Geomyces destructans, but put it in the context of all known research on fungi, helping the reader to understand the difficulties and limits of the current status of this research. While WNS has created a huge focus on Geomyces destructans, Vanderwolf writes, "It is interesting to note that although 132 of the 225 papers on cave mycology (58.7%) were conducted in Europe, G. destructans was not documented until it was targeted by researchers after WNS appeared in North America." This paper has much information on the distribution, behaviors, and other characteristics of fungi in caves that could have bearing on our responses to WNS. I strongly recommend it.

The most recent major WNS paper (this article is being written mid-February) is one published in the spring issue of NSS Journal of Cave and Karst Studies, and funded in part by the NSS, entitled, "Evaluation Strategies for the Decontamination of Equipment for Geomyces destructans, the causative agent of WNS." (Footnote 5) This is a major research paper, showing in great detail the testing and development of the U.S. Fish and Wildlife decon protocols, including much work done in Dr. Hazel Barton's lab.

One of the conclusions of this study states, "The spread of WNS along bat migration routes (Frick et al., 2010) and the lack of numerous geographic epicenters may also suggest that human vectored transport of G. destructans may be rare." However, it does caution that "until the exact mechanism of G. destructans transport and environmental survival is known, it is critical to remove the potential impact of human transport."

It's an unfortunate truth in the scientific and academic research community that publication dates lag significantly behind the actual dates the work was carried out. In the time since these decon tests were conducted, the USFWS protocols were updated, most recently last June. At that time, concerns from another federal agency about off-label use of pesticides—the agency considers the fungus a "pest" —resulted in those changes. It wasn't a matter of them not working, as the Journal paper clearly demonstrates.

Kevin Keel, et al, after this paper was completed, demonstrated that gear and clothing submerged in hot water (greater than 50 degrees C, or 120 F) for more than 20 minutes also kills the fungus. Since then, the gear manufacturer Petzl, has published its own guide to taking care of one's gear, and clearly and firmly states its gear should not be subjected to temperatures greater than 30 degrees C. For cavers, personal safety is job one, so paying close attention to both the decon protocols (and their options) and the recommendations of gear manufacturers is paramount.

While new reports of bat deaths come in, there is good news. In September, Kate Langwig, et al published a study in Ecology Letters entitled, "Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome." (Footnote 6) The study shows that large declines in bat populations come in species that roost colonially, that is, in tight clusters. The Little Brown bat was one of them, but it appears to be changing its social behavior and taking up solitary roosting, ostensibly to mitigate against disease spread. One of the researchers even said "the Little Brown bats are probably not going to go extinct because they are changing their social behavior in a way that will result in their persisting at smaller populations." The study discusses the other affected species, some of which have also stabilized after several years of decline, but they note the Indiana bat, another tight-roosting species, has not yet adapted as has the Little Brown.

One of the most fascinating pieces of research this past year was presented both at the North American Society for Bat Research (NASBR) conference in Puerto Rico in October, and again at the January meeting of the Northeast Bat Working Group (NEBWG) in Albany, New York. In a presentation entitled, "Changes to bat and aquatic communities due to white-nose syndrome," (Footnote 7) researcher Kate Miller showed a fascinating study of a significant Connecticut stream habitat. She had pre-WNS data on bats, insects, and fish. Little Browns and Tricolored bats foraged heavily pre-WNS. Post WNS, those bats are now absent. Big Brown bats moved in as insect predators, but so did fish. We often say that nature abhors a vacuum, but here was evidence.

The New York Department of Environmental Conservation has been conducting detailed bat hibernacula surveys for many years. This has been a great boon to the tracking of WNS impact in that state, as good pre-WNS data existed for many caves and mines. In the 2012 Winter Bat Survey Results (Footnote 8), more good news is reported. In three of the five original WNS sites, bat populations have grown. One Little Brown colony grew from 1,496 in 2011 to 2,402 in 2012. These numbers are consistent with other reports in recent years that the populations are stabilizing.

Finally, in her "Vermont's Got Bats? Campaign" presentation at the NEBWG meeting (Footnote 9), Alyssa Bennett,

Vermont Fish and Wildlife, had two items of particular note. First, Little Brown bats that had been banded prior to 2006 and the WNS arrival, were re-captured at a covered bridge maternity roost, demonstrating that some individuals have survived the entire ordeal to date. Most interesting however, was data comparing Little Brown to Big Brown roosting sites pre- and post-WNS. In side-by-side maps of the state, these species have virtually swapped their numbers on the landscape, again demonstrating that nature abhors a vacuum.

Management and Conservation Activities

Over the past year or so, there has been a slow but steady shift in management and conservation approaches to WNS. Perhaps it's due to the growing understanding that it's bats that are transmitting the disease, or that cave closures have proven ineffective in preventing the disease from spreading. Perhaps it's also due to no cure or major intervention measure having been found to stop the disease.

A key presentation was given in December to US Forest Service officials by USFS biologists involved in the WNS investigation for a long time. Their broad recommendation was to shift future resources and priorities away from prevention and intervention and more toward conservation and recovery.

In the Northeast, where WNS has apparently done its worst, the focus has shifted to conservation measures intended to help the survivors. One clear strategy has been to emphasize to the public to avoid disturbing hibernating bats, something the caving community has known since long before WNS reared its ugly head. Similarly, identifying and protecting habitat, and engaging the public to erect bat houses and monitor and be more aware of bats in general, have become priority activities.

In other regions of the country, the caving community has become more assertive in engaging state and federal agencies, non-governmental entities, and land managers. Whether it's through the NSS, the Cave Research Foundation, cave conservancies, or on their own, cavers are involved.

A case in point is in the US Forest Service Region 2, an area that includes Colorado and parts of neighboring states. In 2010, Region 2 issued a blanket cave and mine closure order for the entire region—perhaps in reaction (over-reaction, some say)—to the news of a single bat in Oklahoma testing positive for the presence of the fungus. It did not test positive for WNS, and no bat in Oklahoma or anywhere nearby, nor any soil or sediment sample has tested positive since.

The NSS sent a formal letter of protest, engaged in conference calls, and ultimately got a formal response from the US Secretary of Agriculture (USFS is under that department). This led to negotiations that opened caves during the 2011 NSS Colorado Convention. Region 2 extended its closure order, but continued discussions locally with cavers, grottos, and the Colorado Cave Survey, as well as nationally with the NSS.

In August 2012, the order was again extended, but with exemption granted to NSS and CRF members for activities consistent with national Memoranda of Understanding between the organizations and the Forest Service. This isn't a blanket opening of caves, but it is a recognition of the Volunteer Value provided by the caving community in cave and bat conservation as well as monitoring and assistance in managing these natural resources.

In December, Region 2 sought public input for an Environmental Assessment aimed at looking beyond the current closure order. Again, cavers participated and filed formal comments, including the NSS (Footnote 10).

Other examples abound. The Virginia Region (VAR) also filed formal comments calling for re-opening caves in two National Forest units. Indiana cavers have been meeting with state officials, trying to hammer out an agreement for cave access. The Southeastern Cave Conservancy (SCCi) is working with officials in Tennessee to re-open certain caves. In New Mexico two years ago, cavers met with various state and federal agencies and came up with a very limited cave closure order targeting just 21 of literally hundreds of caves. That group has just met again this winter to plan next steps.

Many cavers have volunteered with state and federal agencies across the country to monitor cave entrances, conduct winter bat surveys, carry out summer acoustical monitoring, or manage the caves themselves. Importantly, quite a few of the agency personnel who work daily in our national parks and forests and other federal and state lands are cavers and NSS members themselves.

More formally, the US Fish and Wildlife Service remains the coordinator for the federal response to WNS. They have updated their website: www.whitenosesyndrome.org and continue to move forward with activities related to the WNS National Plan. The website contains all the details, and the various WNS working groups have posted their action plans.

Potentially more importantly, National WNS Coordinator Jeremy Coleman reports that the Executive Committee set up under the national organizational structure will be meeting in March to adopt a formal implementation and prioritization plan, including funding tied to each piece. Coleman also reported to the NEBWG meeting that USFWS was looking at a continuation of funding from Congress at the $4 million level, same as 2012. However, we all know how up in the air the federal budget situation is. How that will affect the prioritization, and thus the level of management activities and research is anyone's guess.

One other piece of importance to cavers is the long-outdated USFWS caving advisory. At this past May's national WNS Symposium, I gave a presentation as part of a panel examining options to the current advisory and cave closures. My talk was entitled, "One Size Does Not Fit All."

Another presenter, Mollie Matteson of the Center for Biological Diversity, suggested that rather than targeted cave closures, we should have targeted cave openings, where each state would pick one cave for public access. Seriously? The mind boggles. Which Tennessee cave, out of more than 9000 would you choose? California would need one centrally located, no doubt, given the distances north to south.

Other panelists included state officials representing saturated, leading edge, and as-yet-unaffected states. As you might expect, appropriately, they had different perspectives.

USFWS last year created a WNS Stakeholder group, with representatives from dozens of non-governmental organizations. This is an advisory group to the WNS Steering Committee. A few of the people selected by their organizations met at last May's WNS Symposium. Jennifer Foote, NSS member from New Mexico, an active caver and bat researcher, and former NSS Board of Governors member, and member of the NSS WNS Ad Hoc Liaison Committee, was appointed by WNS President Wm Shrewsbury to represent the NSS.

The Stakeholder group was given a charter written by the Steering Committee, but the group has had only one conference call meeting last fall to date. I think the jury is still out as to how effective this committee can or will be. That said, USFWS plans to involve this group in the caving advisory revisions. In the meantime, it remains unchanged since March of 2009.

Conclusion

There are certainly other WNS-related activities and much research going on that I could not possibly cover in an article like this. I urge those interested to go to the NSS WNS website as a starting point. We have links to the USFWS site, the U.S. Geological Survey, the National Parks, and many more. Let me again emphasize that the website also provides materials for you to use.

Over the past few years, I've had the opportunity to give many talks on the subject of WNS. These also give me a way to talk about caves, caving, and the NSS. Last year, at the request of the WNS Liaison Committee, the NSS produced a new traveling tabletop display. It uses the theme, We Explore, We Study, We Conserve, and has professionally produced panels presenting the various aspects of the NSS and our membership. One panel is devoted to our involvement with WNS.

This display is available for your use. Contact me at wnsliaison@caves.org for details and to arrange scheduling. This is another tool available for you to use when talking about what we all love—caving, and all that it entails. NSS members need to stay engaged, not just with agencies, but with the public. People are fascinated with bats, and also with caves. They want to know, and we are the people who can fill in the details for them.

Start a conversation. If they say they were out fishing at the lake, ask if they saw any bats. If they start talking about their house, ask if they have any bats in the attic. If another caver tells you about their last trip, ask if the cave had any bats. I think the conversation will take care of itself, but it all starts with, "Got Bats?"

The White Nose Syndrome Story Map

Bernie Szukalski

Many of us are fascinated by maps; they've been used to communicate and present information since mankind has been able to scratch in the dirt with a twig, or scrawl on the surface of a rock. Maps can deliver what might be complex information in ways that are easy to understand, and can capture the tradecraft and knowledge of others in an easily shareable way.

Maps are what eventually led me to Esri, where among other things I'm part of the Esri Story Maps team, headed by Allen Carroll, formerly chief cartographer at the National Geographic Society. During my tenure at Esri, I've seen maps and the technology behind them evolve in amazing ways. Maps are now interactive, can be data-driven and dynamic, and can be enriched with multimedia content—a far cry from the paper maps that I grew up with.

Like pictures, all maps tell a story, and the Esri story maps team has been focused on evolving web map capabilities and developing new tools and application templates to unlock spatial data to tell these stories. A good story map is based on authoritative content, and that's where leveraging GIS and other veracious data to tell interesting stories comes into play.

Like many cavers, I was familiar with the static GIS maps produced by Cal Butchkoski of the Pennsylvania Game Commission, which are compiled from a variety of sources to show the spread of WNS over time (*Ed: see page 12 for one of these*). I was also familiar with the detailed species information and habitat ranges for bats published on the Bat Conservation International (BCI) website. I'd connected with BCI over a potential project a couple of years ago that never lifted, but after a recent Esri story map was published about IUCN's "red list" of endangered species and their habitats, I thought it was time to consider a WNS story map.

I proposed a story map similar to the IUCN application that would provide details and photographs of impacted species and their habitats, shown against WNS-affected counties as depicted in Cal's maps. It seemed the habitat ranges, combined with a GIS animation of the spread of WNS, would make for an interesting story map app.

I contacted BCI, who provided the habitat ranges for the nine affected species of bats in the form of shapefiles, a ubiquitous GIS data format. They also provided permission to use information from their website, and provided a license for the use of Merlin Tuttle's photographs of the nine impacted bat species for the application, a key ingredient to the story map.

BCI also facilitated contact with Cal Butchkoski at the Pennsylvania Game Commission, who graciously provided the shapefiles he used in making his static maps. The data included the date of the suspected or confirmed WNS occurrence. All the data pieces were now in hand to produce the story map application.

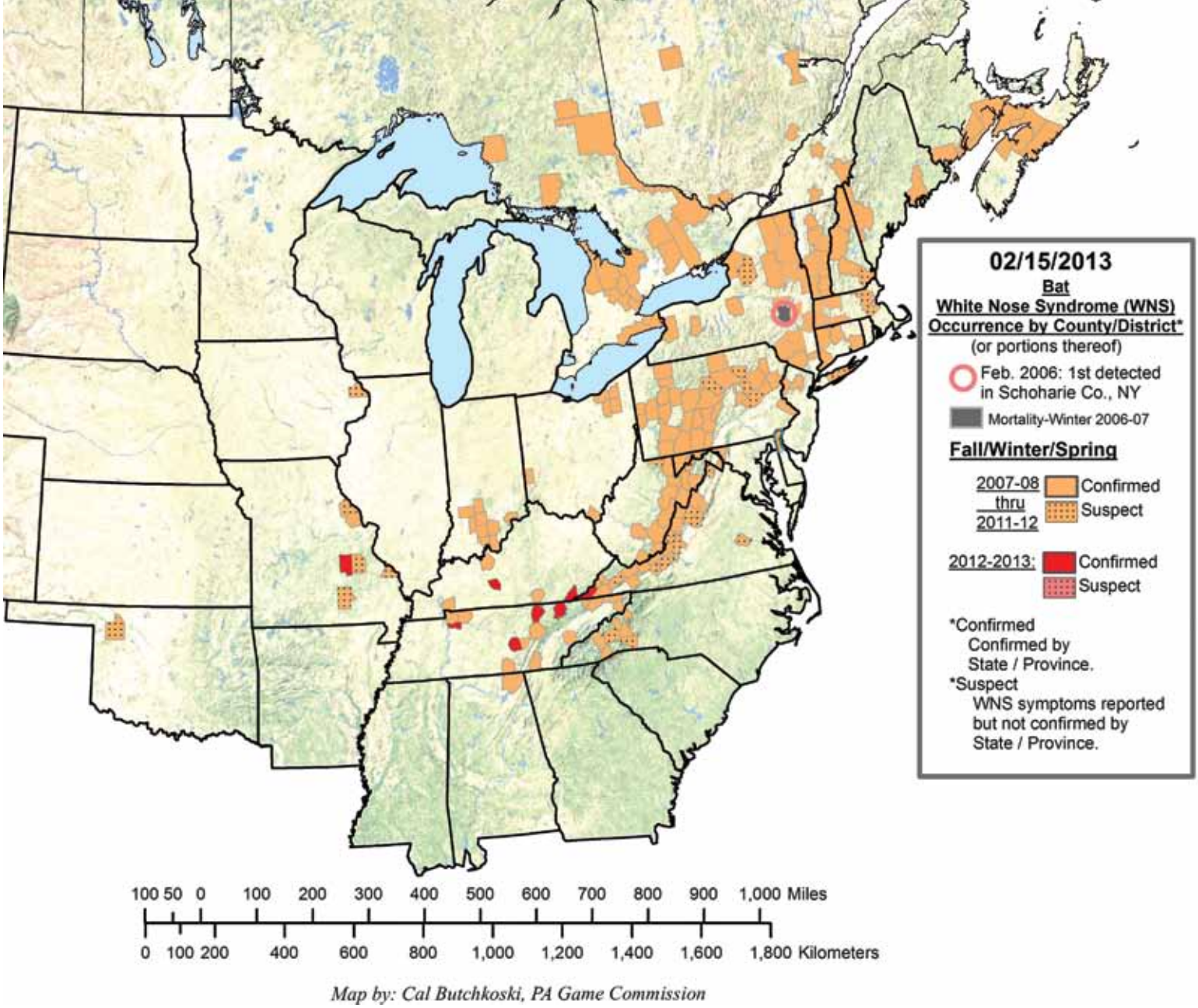
After experimenting with animating the data using ArcGIS for Desktop, we decided that Cal exposed more detail than needed for the story map application. Simpler is often better when communicating, especially for the more public audience intended for the application, so I decided to simplify Cal's data, reducing it to a two-color thematic map of suspected and confirmed cases, along with the date information used to drive the animation. A video of an early version of the story and how the animation was created using ArcGIS for Desktop can be found here: http://youtu.be/ztNI-5MGNso

The next step was to web-enable the local data by publishing it as web services for use in the final web application. The affected counties were published using an instance of ArcGIS for Server in the Amazon cloud, and the bat habitat ranges were published using cloud-based ArcGIS Online hosted services. From here it was a matter of choosing the basemap, and going through iterations of color schemes and transparency.

Another task was to come up with the application design and layout. An early and easy decision was to portray two themes in the app: the animation showing the spread of WNS over time and the habitat ranges for each species on top of the affected counties. A number of templates were used to prototype ideas, with the final application being a custom app so that the "two halves" of the app would dovetail nicely, with the time slider in the first half being replaced by the species photos in the second. The final app leveraged ArcGIS Online basemaps and the hosted services from the Amazon and ArcGIS Online clouds, and is published here: http://storymaps.esri.com/stories/2012/whitenose/

As it turned out, the day the story map was released, Cal sent word of two additional counties to be added to confirmed status. A quick update on the backend services kept the app up-to-date with the results for the Winter 2011/2012 period. We intend to update the story map with the results from Winter 2012/2013 later this year.

The application was well-received, and remains one of the more popular ones in the Esri Story Maps collection at http://storymaps.esri.com/home/. But it has also generated some controversy, and has proven to be a catalyst for debate. But that's what a good story map is meant to do—present authoritative information in a compelling way to showcase an important topic to facilitate awareness and discussion.



Map by: Cal Butchkoski, PA Game Commission

Above: Screen captures from the ESRI website showing various maps that can be generated from the data used to make the upper map (which has more up to date locality data on instances of White Nose. On the left, an overall map of WNS, basically showing an older view of the top data set. On the right, users can select any of 9 bat species and see its range in relation to WNS outbreaks.

An Interview with Bat Conservation International

conducted by Bern Szukalski

1. In how many species of bats of North America has WNS been discovered?

Seven bat species have been affected by WNS so far: little brown myotis (Myotis lucifugus), big brown bats (Eptesicus fuscus), tricolored bats (Perimyotis subflavus), northern myotis (Myotis septentrionalis), eastern small-footed myotis (Myotis leibii), the endangered Indiana myotis (Myotis sodalis) and the endangered gray myotis (Myotis grisescens). Two additional species have been detected with WNS-associated fungus: southeastern myotis (Myotis austroriparius) and cave myotis (Myotis velifer).These species have not yet been diagnosed with the disease. If current WNS infection and mortality patterns continue, the populations of 25 species of hibernating bats in the United States could decline, and some previously common species could be threatened with extinction.

2. Why should we worry about WNS killing bats?

The number of insects consumed annually by one million bats is staggering: just under 700 tons. The USFWS recently estimated that WNS has killed over 5.5 million bats since 2006. These bats have extraordinary value in maintaining the health of nearly all terrestrial and aquatic ecosystems. And since many of the insects eaten by bats are crop pests, losing large numbers of bats may have expensive impacts on agriculture.

3. How is WNS detected?

Although there are several non-diagnostic field signs of WNS that are easily observed, WNS is reliably diagnosed in a lab where scientists look for a characteristic microscopic pattern of skin erosion caused by the fungus Geomyces destructans. Field signs can include visible white fungal growth on the bat's muzzle and/or wing tissue, emaciation, and abnormal bat behaviors in their hibernation sites (hibernacula), such as movement toward the mouths of caves and daytime flights during winter.

4. Who gathers the data about WNS?

Currently WNS data are collected and summarized nationwide by a team of federal, state, tribal and non-governmental partners working under the guidance of the WNS National Plan which is available at www.whitenosesyndrome.org

5. Do all of those species exhibit high degrees of mortality?

We have seen extremely high bat mortality at hibernacula due to WNS; however there appear to be differences in mortality rates by site and by species within sites. A report published in 2011 in Bat Research News provides evidence that mortality rates vary among species from their sample of bat counts from five northeastern states. Overall bat count declines range from 12% (eastern small-footed bats) to 98% (northern myotis). Little brown bats, the most common species impacted, exhibited declines of 91%. However, conditions continue to evolve and in some cases it is unclear if differences in colony size from year to year reflect total mortality or if they are also influenced by migration to and from other colonies.

6. Does WNS always cause mortality?

We don't have banding data to confirm prior infection, but we do think some bats have survived exposure to WNS. Bats have been detected emerging from hibernacula with observed field signs of WNS and appear to survive, heal, and in some cases are reported to also reproduce successfully. Although there are survivors, the high rate of mortality we are observing indicates that bat populations will not likely recover for many years due to their slow reproduction rates.

7. If one bat is observed with WNS, does this mean that it will spread to others?

Researchers are still working to understand transmission rates, but within the same species in the same hibernation site, it appears that transmission rates are very high.

8. Have any colonies demonstrated recovery after initial mortality?

Although there are reports of a few caves in New York where biologists have documented very small increases in bat numbers over the last couple years, the bat counts at these sites are still at a tiny fraction of their pre-WNS levels. These sites are definitely the exception; the vast majority of hibernacula continue to show significant declines. The most promising observations from sites that have been impacted by WNS for >4 years is that rates of population decline may be slowing.

9. If bats with WNS are observed in a single cave in a county, does WNS typically spread to other caves?

Yes, the pattern of infection we've observed is consistent with other invasive species. Once a site is infected in an area, the surrounding sites have a much higher probability of infection if they are in close proximity (for example, in the same county).

10. In what types of caves has WNS been observed? Is it just limestone caves, or other types of caves?

WNS does not appear to be confined to a specific geologic feature. WNS infected bats have been found from many different types of caves in the affected region. Infected bats have also been found in several different types of mines, as well as abandoned military bunkers, and aqueducts

11. Is it only in hibernating colonies that WNS is found?

WNS has only been found in hibernating bat species, but the fungus that causes it can be detected on bats after they emerge from their hibernation sites and apparent survivors have lower reproduction rates. Although we tend to report on bat declines in hibernating colonies, it is important to remember that the impact of reduced bat populations from WNS is broader than just caves and mines. During the summer these bats feed on insects across the landscape miles away from where they hibernate. Summer bat activity in WNS affected regions has also declined precipitously.

12. Is it true that dirty caving gear can spread WNS? Is this significant, or is it mostly bat-to-bat transmission?

Transmission of WNS is expected to be primarily from bat-to-bat or substrate-to-bat, but we know that fungal spores are resilient and can "hitchhike" on gear. G. destructans spores have been isolated from gear used in WNS positive sites and has been isolated from cave substrate well after bats have vacated the site. We are concerned that fungal spores could be deposited on the cave floor or walls by contaminated gear and bats would come into contact with those spores when they arrive to hibernate. We don't yet know the likelihood of infecting a clean cave with fungal spores transmitted on gear, but the severity of this situation requires an abundance of caution.

13. Is there any hope for a cure or stop to the spread of WNS?

We must remain hopeful that we can

find a way to save bats from WNS. Although a cure or vaccine is unlikely in the near future, we do believe there are possibilities to both reduce mortality rates and protect bat colonies and their habitats in order to provide bats with all the resources they need for populations to recover. We also hope that management strategies to slow the spread will continue to buy time to identify and implement potential treatments.

14. What research is being done?

There is a tremendous amount of current research targeted at solving this bat crisis. The entire list too long to provide here, but some examples of general research topics include developing new diagnostic tools, investigating mechanisms and rates of transmission, exploring risk factors and potential source of innate immunity of bats to WNS, testing several methods of WNS treatment and controls, evaluating effectiveness of decontamination, and understanding G. destructans etiology and epidemiology.

15. Is WNS inevitable?

We don't believe that anything is "inevitable", but we are highly concerned about the spread of WNS. If the current patterns continue, over half of US and Canadian bat species are at risk. This is an unprecedented disease with absolutely horrific consequences for bat populations and cave communities. Nothing in the future of WNS is certain, but we are certainly concerned for the bats' survival.

16. What I can I do to help?

There are several things you can do to help and ALREADY HAVE been doing to help. The NSS and its members have been friends of bats and BCI for decades. You were one of the first organizations to volunteer time and resources to protect bats and many of you altered your own lifestyles for this cause. We appreciate you! Please continue to avoid disturbing bats (especially in hibernacula and maternity colonies) because disturbance has been linked to reduced bat survival and site abandonment. Please continue to honor cave closures and gated caves. Temporary closures and cave gates have historically been effective strategies for protecting sensitive bat populations. Decontaminate your gear when caving and don't take gear and clothing from WNS infected regions to other areas of the country (and world) where WNS does not exist. Please report unusual bat behavior to your local wildlife agency. And finally, be an advocate for bats! Teach others about bat conservation and encourage decision-makers to prioritize WNS so we can work together to find common ground and ensure the survival of our bats in years to come.

Recent WNS Research
compiled by Peter Youngbaer

[Ed. note: Since most are not going to want to type in these long URLs, I have placed a copy of this as a Word document with clickable links on the NSS News Extensions page at www.caves.org]

1. Social and Economic Values of Caves on National Forest Lands: The Case of the Monongahela National Forest; Neal Christensen, PhD, Christensen Research, and Cynthia Sandeno, USDA Forest Service National Cave and Karst Coordinator; U.S. Forest Service, Sept. 2012 www.caves.org/WNS/Caves_and_WNS_social_economic_final.pdf

2. Pathology in euthermic bats with white nose syndrome suggests a natural manifestation of immune reconstitution inflammatory syndrome; Metayer, et al; *Virulence*, Nov. 15, 2012 www.landesbioscience.com/journals/virulence/2011VIRULENCE0119R.pdf

3. Distribution and Environmental Persistence of the Causative Agent of White-Nose Syndrome, Geomyces destructans, in Bat Hibernacula of the Eastern United States; Lorch, et al; *Applied Environmental Biology*, Dec. 2012. www.caves.org/WNS/Lorch12GdestructansPersistance-1.pdf

4. A world review of fungi, yeasts, and slime molds in caves, Vanderwolf, et al; I*nternational Journal of Speleology*, January 2013. www.caves.org/WNS/Vanderwolf13CaveFungiReview.pdf

5. Evaluation of strategies for the decontamination of equipment for Geomyces destructans, the causative agent of WNS, Shelley, at al; *Journal of Cave and Karst Studies*, v. 75, no. 1. www.caves.org/pub/journal/PDF/v75/cave-75-01-01.pdf

6. Sociality, density-dependence and microclimates determine the persistence of populations suffering from a novel fungal disease, white-nose syndrome; Langwig, et al; *Ecology Letters*, Vol. 15, No. 9, pp 1050-1057, September, 2012; abstract and link to full article: http://onlinelibrary.wiley.com/doi/10.1111/j.1461-0248.2012.01829.x/abstract National Science Foundation press release: www.nsf.gov/news/news_summ.jsp?cntn_id=124679&org=ERE&from=news

7. Changes to bat and aquatic communities due to white-nose syndrome; Kate Miller presentation to Northeast Bat Working Group, January 2013 www.nebwg.org/AnnualMeetings/2013/2013presentations/NEBWG2013Miller.pdf

8. NYDEC Reports: 2012 Winter Bat Survey Results www.dec.ny.gov/press/81767.html

9. Vermont's Got Bats? Campaign; Alyssa Bennett, VT F&W Dept, January, 2013 www.nebwg.org/AnnualMeetings/2013/2013presentations/GotBats2013NEBWG.pdf

10. NSS Response to USFS Region 2 Environmental Assessment, December, 2012 www.caves.org/WNS/USFS%20Region%202%20EA%20Response%2012.12.21.pdf

Attend a BCI Workshop!

Bat Conservation International still has spaces available in Arizona field study workshops this year. As cavers, I know you realize the value of this training and how important, relevant, and entertaining BCI's curriculum can be.

We are offering two different six-day classes at our flagship Arizona venue this year.

"General" course (Bat Conservation & Management) which has a heavy emphasis on bat identification and study techniques.

Acoustic Monitoring course will focus on acoustics, bat detector use and signal analysis.

Both courses provide ample opportunity for participants to learn and practice netting, trapping, handling, identification and acoustic monitoring skills using a variety of capture techniques, bat detectors, and signal analysis protocols. As you recall, registration fees for BCI courses include all meals, lodging, and field transportation at our study sites. This makes these classes extremely efficient to attend. They are conducted in remote locations and a few of our field sites are more than 5-10 miles from our lecture/lodging/eating facility, allowing us to spend more time in the field working and learning.

The deadline for registration is April 1, but with only two workshops this summer, they are expected to fill quickly. See BCI's training courses on our website: www.batcon.org/workshops

Feel free to contact me if you have any questions or need more information about these or other training activities: Dianne Odegard, phone 512-327-9721 ext 26, email dodegard@batcon.org

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