WHY WE SHOULD CARE ABOUT BATS: DEVASTATING IMPACT WHITE-NOSE SYNDROME IS HAVING ON ONE OF NATURE'S BEST PEST CONTROLLERS

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON FISHERIES, WILDLIFE, OCEANS AND INSULAR AFFAIRS

OF THE

COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES

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OVERSIGHT HEARING ON "WHY WE SHOULD CARE ABOUT BATS: DEVASTATING IMPACT WHITE-NOSE SYNDROME IS HAVING ON ONE OF NATURE'S BEST PEST CONTROLLERS."

Friday, June 24, 2011
U.S. House of Representatives
Subcommittee on Fisheries, Wildlife, Oceans and Insular Affairs
Committee on Natural Resources
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:02 a.m. in Room 1324, Longworth House Office Building, Hon. John Fleming [Chairman of the Subcommittee] presiding.

Present: Representatives Fleming, Labrador, Wittman, and Bordallo.

Dr. FLEMING. The Subcommittee will come to order. The Chairman notes the presence of a quorum. Good morning. Today, we are having a follow-up hearing on a subject this Subcommittee first examined in June of 2009. Since it was first discovered in caves west of Albany, New York, in 2006, the White-Nose Syndrome has killed more than one million bats. It has spread to 18 U.S. states, from Maine to Kentucky.

Under Committee Rule 4(f), opening statements are limited to the Chairman and Ranking Member of the Subcommittee, so that we can hear from our witnesses more quickly. However, I ask unanimous consent to include any other Members' opening statements in the hearing record if submitted to the Clerk by close of business today. Hearing no objection, so ordered.

STATEMENT OF HON. JOHN FLEMING, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF LOUISIANA

Dr. FLEMING. Despite a considerable amount of effort by six Federal agencies and various affected states, which have spent more than $16 million, we apparently are no closer to stopping this disease, which has devastated more than half of the 47 species of bats native to America.

Why is this hearing important? Bats consume vast amounts of insects, and according to the April edition of Science magazine, their value to United States agriculture is between $3.7 billion to $53 billion each year.

In the United States, they pollinate more than 360 plants and are so effective in dispersing seeds that they have been called the "Farmers of the Tropics." Also, certain bat species can capture from 500 to 1,000 mosquitoes in just one hour.

A single colony of 150 big brown bats in Indiana has been estimated to annually eat nearly 2.3 million pest insects. We also know that the one million bats that have already died from the fungus

would have consumed more than or between 660 and 1,300 metric tons of insects each year.

By losing these bats, farmers and timber harvesters now have to spend millions of additional dollars to buy pesticides to protect their crops and trees.

As a doctor, I was interested in learning that some 80 different medicines come from plants that need bats to survive. While it is reassuring to know that no human illness has been associated with exposure to infected bats or caves, it is important that we try to find out why this fungus is killing bats in the United States.

Yet, apparently the same disease has not caused mass mortality in Europe. Although this disease has spread through bat-to-bat contact, the Fish and Wildlife Service, and the United States Forest Service have closed thousands of caves and abandoned mines in an effort to try to stop the spread of this disease.

I am interested in finding out the results of these efforts, and whether prohibiting human caving activities has saved hibernating bats. I look forward to hearing from our distinguished witnesses on how we can effectively address what many experts are now calling the most precipitous wildlife decline in the past century in North America.

Now, before I recognize the gentlelady from Guam, I will mention that we are probably going to have a vote in about 10 minutes. We will try to get through our witnesses as much as possible.

But I understand that it is probably one or two votes at the most, and so we will come right back immediately after voting, and pick up where we left off. With that, I am now pleased to recognize the gentlelady from Guam, Ms. Bordallo.

[The prepared statement of Chairman Fleming follows:]

Statement of The Honorable John Fleming, Chairman, Subcommittee on Fisheries, Wildlife, Oceans and Insular Affairs

Good morning, today, we are having a follow-up hearing on a subject this Subcommittee first examined in June of 2009. Since it was first discovered in caves west of Albany, New York in 2006, the White-Nose Syndrome has killed more than 1 million bats. It has spread to 18 U.S. states from Maine to Kentucky.

Despite a considerable amount of effort by six federal agencies and various affected states, which have spent more than $16 million dollars, we are apparently no closer to stopping this disease, which has devastated more than half of the 47 species of bats native to North America.

Why is this hearing important? Bats consume vast amounts of insects and according to the April edition of *Science* magazine, their value to U. S. agriculture is between $3.7 billion to $53 billion each year. In the United States, they pollinate more than 360 plants and they are so effective in dispersing seeds that they have been called the "Farmers of the Tropics".

Also, certain bat species can capture from 500 to 1,000 mosquitoes in just one hour. A single colony of 150 big brown bats in Indiana has been estimated to annually eat nearly 1.3 million pest insects. We also know that the one million bats that have already died from this fungus would have consumed between 660 and 1,300 metric tons of insects each and every year. By losing these bats, farmers and timber harvesters now have to spend millions of additional dollars to buy pesticides to protect their crops and trees.

As a doctor, I was interested in learning that some 80 different medicines come from plants that need bats to survive. While it is reassuring to know that no human illness have been associated with exposure to infected bats or caves, it is important that we tried to find out why this fungus is killing bats in the United States, yet apparently the same disease has not caused mass mortality in Europe.

Although this disease is spread through bat-to-bat contact, the Fish and Wildlife Service and the U. S. Forest Service have closed thousands of caves and abandoned mines in an effort to try to stop the spread of this disease. I am interested in finding

out the results of these efforts and whether prohibiting human caving activities.has saved hibernating bats.

I look forward to hearing from our distinguished witnesses and how we can effectively address what many experts are now calling: "The most precipitous wildlife decline in the past century in North America".

I am now pleased to recognize the gentlelady from Guam, Madeline Bordallo, who chaired the first comprehensive Congressional hearing on the White-Nose Syndrome, for any statement she would like to make on this important subject.

STATEMENT OF HON. MADELEINE Z. BORDALLO, A DELEGATE IN CONGRESS FROM THE TERRITORY OF GUAM

Ms. BORDALLO. Thank you very much, Mr. Chairman, and I would like to say good morning and welcome to all of our witnesses. The White-Nose Syndrome is named for the striking fungal growth on the muzzles, the ears, the wings, and the tails of bats.

Much remains unknown about this disease, which was first documented west of Albany, New York, in February of 2006. Over the last five years, White-Nose Syndrome has spread to at least 16 states, and also to Canada.

The mortalities caused by the White-Nose Syndrome are astonishing, reaching up to 99 percent in some caves and mines. Over one million little brown bats have been killed, likely contributing to a 78 percent decline in the calls of these bats in the night sky over the Hudson River.

White-Nose Syndrome in bats has profound public health, environmental, and economic impacts. Bats are nature's best control of insect populations, as a single bat can eat its entire weight in insects in just one night.

When not controlled, many insects spread disease and others are agricultural pests. A study by one of today's witnesses, Dr. Justin Boyles, estimated that this benefit provided by bats to the agricultural sector is between $3 billion to $53 billion per year.

Bats with White-Nose Syndrome exhibit uncharacteristic behaviors, and emerge from hibernation during the winter, consuming fat reserves, which may result in starvation. Transmission of the disease is not fully understood, but is believed to be bat-to-bat, or transferred by humans who visit the affected caves.

Some caves have been closed on Federal lands, although Federally managed caves account for only 34 percent of the known roost areas, while 60 percent are located on privately held lands.

It is clear that there are still large gaps in our understanding of this disease. We must continue to support research about causes of and vectors for the spread of White-Nose Syndrome, and on the effectiveness of potential control measures to better manage this disease, and ensure that the night sky is once again full of insect-hunting bats.

Two years ago this Subcommittee held an oversight hearing on White-Nose Syndrome, and found a commendable amount of cooperation and coordination among Federal and State wildlife and land management agencies.

The recent release of a national plan for assisting states, Federal agencies, and Tribes, in managing White-Nose Syndrome in bats provides a framework to continue this coordination, and I do look forward to hearing more from our witnesses today on the

implementation, and on other recommendations on how to address this challenging disease. Mr. Chairman, I yield back.

[The prepared statement of Ms. Bordallo follows:]

Statement of The Honorable Madeleine Z. Bordallo, Ranking Member, Subcommittee on Fisheries, Wildlife, Oceans and Insular Affairs

White-Nose Syndrome is named for the striking fungal growth on the muzzles, ears, wings, and tails of bats. Much remains unknown about this disease, which was first documented west of Albany, New York in February of 2006. Over the last five years, White-Nose Syndrome has spread to at least sixteen States and Canada. The mortalities caused by White-Nose Syndrome are astonishing, reaching up to 99 percent in some caves and mines. Over one million little brown bats have been killed, likely contributing to a 78 percent decline in the calls of these bats in the night sky over the Hudson River.

White-Nose Syndrome in bats has profound public health, environmental, and economic impacts. Bats are nature's best control of insect populations, as a single bat can eat its entire weight in insects in one night. When not controlled, many insects spread disease and others are agricultural pests. A study by one of today's witnesses, Dr. Justin Boyles [*boils*], estimated that this benefit provided by bats to the agricultural sector is between $3 billion to $53 billion per year.

Bats with White-Nose Syndrome exhibit uncharacteristic behaviors and emerge from hibernation during the winter, consuming fat reserves, which may result in starvation. Transmission of the disease is not fully understood, but is believed to be bat-to-bat or transferred by humans who visit affected caves. Some caves have been closed on federal lands, although federally managed caves account for only 34% of the known roost areas, while 60% are located on privately held lands.

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Two years ago, this Subcommittee held an oversight hearing on White-Nose Syndrome, and found a commendable amount of cooperation and coordination among Federal and State wildlife and land management agencies. The recent release of "A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats" provides a framework to continue this coordination and I look forward to hearing more from our witnesses today on its implementation and on other recommendations on how to address this challenging disease.

Dr. FLEMING. I thank the gentlelady, the Ranking Member, and I also want to congratulate her for having chaired the first comprehensive Congressional hearing on the White-Nose Syndrome.

Votes have already been called. It is only one vote. So I am going to go ahead and release the Subcommittee to vote, and return immediately, and then we will begin hearing from our witnesses.

I do appreciate your patience on this, but we won't have any further interruptions after this. We will be good for the remainder of the hearing.

[Recess.]

Dr. FLEMING. The Subcommittee will come to order. I am addressing the witnesses now. Like all witnesses, your written testimony will appear in full in the hearing record, and so I ask that you keep your oral statements to five minutes as outlined in our invitation letter to you and under Rule 4(a)

Our microphones are not automatic so please press the button when you are ready to begin. I also want to explain how our timing lights work. When you begin to speak, our Clerk will start the timer and the green light will appear. After four minutes, a yellow light will appear, and that is a signal to you to go ahead and begin to wrap up. When the red light comes on, that means that your

time is up, your full five minutes. So we would certainly ask you to conclude with that sentence if at all possible.

You may complete your sentence, but at that time I just ask that you stop. I would like to welcome today's witnesses. First of all, Dr. Gabriela Chavarria—I hope I am coming close to the correct pronunciation on that—Science Advisor to the Director of the United States Fish and Wildlife Service, accompanied by Dr. David Blehert, who is a Microbiologist at the National Wildlife Health Center, of the United States Geological Society, who will be available to answer questions.

And Mr. Jim Peña, Associate Deputy Chief, United States Forest Service; Dr. Jon Gassett, Commissioner, Kentucky Department of Fish and Wildlife Resources; Ms. Nina Fascione, Executive Director, Bat Conservation International; Mr. Peter Youngbaer, White-Nose Syndrome Liaison, National Speleological Society; and Dr. Justin Boyles, Department of Ecology and Evolutionary Biology, University of Tennessee. Dr. Chavarria, you are now recognized for five minutes.

STATEMENT OF DR. GABRIELA CHAVARRIA, SCIENCE ADVISOR TO THE DIRECTOR, U.S. FISH AND WILDLIFE SERVICE

Dr. CHAVARRIA. Thank you, Mr. Chairman. Chairman Fleming, Ranking Member Bordallo, Mr. Wittman, I am Dr. Gabriela Chavarria, Science Advisor to the Director of the United States Fish and Wildlife Service, and I would like to also recognize with me Dr. David Blehert, with the National Park Service, and Dr. Jeremy Coleman, with the Fish and Wildlife Service.

Thank you for the opportunity to update The Subcommittee about White-Nose Syndrome in bats, and the Department of the Interior's efforts to address this wildlife disease crisis. As you mentioned, White-Nose Syndrome is an emerging wildlife disease that was first recorded in 2007.

But unlike a lot of the familiar wildlife diseases that we know of, like West Nile Syndrome, or Avian Influenza, the fungi that comes with the White-Nose Syndrome, *Geomyces destructans*, is a new species to science. So we were confronted with a totally new disease when it was first discovered.

It was found in caves where bats hibernate during the winter, and it grows at low temperatures. Unlike other fungi, they found in the environment that it grows in living tissues, and it affects a lot of the bats that are hibernating.

In infected hibernating bat populations, 80 to 100 percent of bats will die. Unlike most small mammals, bats have only one pup each year, and they only live 5 to 15 years. While it is challenging to estimate the number of bats skilled, or a percentage of bat loss to White-Nose Syndrome, losses have been significant in monitored caves with White-Nose Syndrome affected bats.

The White-Nose Syndrome is now found from Canada to Tennessee. It has been confirmed in 16 states, and in four Canadian provinces. Evidence indicates that it is spread from bat to bat, and may be spread through human activity in caves and mines where bats hibernate.

The role of bats in ecosystems as you both have mentioned is critical. It is very important. But the Department of the Interior two years ago when this disease was recognized started to lead a coordinated effort and respond together with the Bureaus within the Department of the Interior, the Fish and Wildlife Service, and Geological Survey, and National Park Service, and the Bureau of Land Management, the USDA, the Department of Agriculture, and other affected Federal agencies, affected states, the academic community, and private non-profit organizations.

We assembled a team of a hundred experts that come from different partners and organizations, and that are working together to monitor White-Nose Syndrome. They conduct and assess relevant research, develop and carry out mitigation and conservation efforts, and conduct outreach through the national plan.

The team of partners is working to identify the impact of White-Nose Syndrome on bat populations, and the ecosystem as a whole, the mechanisms by which the disease is transmitted, and the mechanisms through which it contributes to mortality in infected bats.

The team is also cooperating to monitor the spread of White-Nose Syndrome, and to develop management and containment options for Federal State wildlife managers. The team of partners has developed science based approaches to addressing this disease within the framework of the national plan.

We have established an executive committee that overseas the work of the partnership and facilitates the coordination. This executive committee is co-chaired by the United States Fish and Wildlife Service, and by the Association of Fish and Wildlife Agencies.

The United States Geological Survey is the science branch of the Department of the Interior. It conducts or partners to conduct much of the research supporting our response to White-Nose Syndrome.

The National Park Service educates parks and visitors about the White-Nose Syndrome, and it has developed management recommendations for park units in infected or potentially infected areas.

The Bureau of Land Management is an active partner. The Department works very closely with the recreational caving and cave research communities to improve the contamination protocols and cave access recommendations, and to limit the spread of the fungus through human activities.

We have closed caves to prevent the spread and we understand and share concerns about the loss of recreational opportunities and tourism supported economies, because many of our lands serve these stakeholders, and we endeavor to find new ways to minimize such impacts.

White-Nose Syndrome is the greatest challenge to bat conservation that we have ever faced. We are very happy to be here, and we are very happy that the Committee has a strong interest in this issue, and we will be happy to continue to collaborate, and I will be happy to answer any questions. Thank you.

[The prepared statement of Dr. Chavarria follows:]

Statement of Dr. Gabriela Chavarria, Science Advisor to the Director, U.S. Fish and Wildlife Service, U.S. Department of the Interior

Chairman Fleming, Ranking Member Sablan, and Members of the Subcommittee, I am Dr. Gabriela Chavarria, Science Advisor to the Director of the U.S. Fish and Wildlife Service (FWS). I am accompanied by Dr. David Blehert with the U.S. Geological Survey (USGS) National Wildlife Health Center. Thank you for the opportunity to update the Subcommittee on white-nose syndrome in bats, the National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome (WNS) in Bats, which was released in May of 2011 and the Department of the Interior's (Department) role in addressing this problem.

The sudden and widespread mortality associated with this disease has never before been observed in any of the more than 1,100 species of bats known to science. Since the Department first testified before the Subcommittee on this topic in 2009, significant progress has been made toward identifying and understanding the cause and ecology of white-nose syndrome.

Background

White-nose syndrome was first recorded in March of 2007 near Albany, New York. WNS is associated with greater than 90 percent mortality of hibernating bats in affected caves from the Northeast to the South and into the Midwest of the United States. It has also been confirmed in Canada. In some caves within its current range, close to 100% of hibernating bat populations have died. Thus far, six bat species have been confirmed with the disease, including the federally endangered Indiana bat. The fungus associated with WNS has been detected on an additional three bat species, including the federally endangered gray bat.

Affected bats may display a white powdery growth on their faces and many show tissue damage and scarring in their wings. The powdery growth and tissue damage is caused by a fungus from a group of fungi that is common in the soil environment. However, this particular species of fungus, *Geomyces destructans,* was not known to science until it was documented in association with WNS in 2008. It grows only in cold temperatures, and unlike other fungi found in bat hibernation sites, it invades living tissues of hibernating bats. When hibernating, bats lower their body temperature significantly, and may pack tightly together—two factors which seem to promote the spread of the fungus from bat to bat. Although the primary route of transmission is believed to be from bat to bat, WNS may be inadvertently spread from cave to cave by human activity in caves. Although the exact cause of mortality of affected bats is not yet fully understood, evidence to date suggests *G. destructans* is the likely cause. Dead bats are often found to be emaciated, and bats in affected caves have been observed exhibiting more activity than is normal during hibernation, including leaving caves on cold winter days. Since 2007, WNS has been confirmed in over 190 sites in 16 states [1] and 4 Canadian provinces.

The species of bats thus far affected by WNS are insectivorous, and they all rely on hibernation as a strategy for surviving harsh winter conditions when their insect food is not available. Prior to hibernation, these bats build up fat reserves to sustain them through the winter. Maintaining a low body temperature during hibernation, just a few degrees above the temperature of their cave, allows them to survive the winter on their stored fat, which can be quickly depleted in only a few hours of non-hibernation activity.

G. destructans has been observed to invade the skin and underlying tissue, particularly of the wings of affected bats, where it causes significant damage. Wing membranes represent about 85 percent of a bat's total surface area and play a critical role in balancing complex physiological processes, such as body temperature regulation, blood pressure, water balance, and gas exchange, as well as allowing bats to fly and to capture insect prey. Scientists are investigating how WNS interferes with these critical functions and how it contributes to the loss of body fat reserves in affected bats.

For some small mammal species, a mass mortality event like that caused by WNS would not significantly affect the long-term sustainability of their populations. However, bats differ from most other small mammals in that they have long lives and reproduce slowly—a combination that precludes rapid population growth and recovery. Most of the bat species currently affected by WNS live about 5–15 years and have only one offspring per year. Biologists are concerned that, even if WNS and

[1] New Hampshire, New York, Vermont, Connecticut, Pennsylvania, Virginia, West Virginia, New Jersey, Massachusetts, Maryland, North Carolina, Ohio, Tennessee, Kentucky, Maine, Indiana.

its spread could be abated, it will take many decades for populations of WNS affected bat species to recover.

The Department is concerned about the potential impact of WNS on bat populations, especially those species currently listed as federally endangered, due to the high mortality of WNS and its rapid spread. There are 25 bat species in North America that hibernate during the winter, and all are at risk for WNS. Of these, there are four species and subspecies of federally listed, hibernating bats, all of which hibernate in either caves or mines.

Most recently, WNS was confirmed in Maine, Indiana, Kentucky, Ohio, Tennessee, and North Carolina, demonstrating its continued spread from Northeastern and Mid-Atlantic states to Southeastern and Midwestern states. These regions support much larger caves and populations of hibernating bats, including millions of individuals of several species. These populations include the majority of the remaining populations of the federally endangered gray bat and remaining populations of the federally endangered Virginia big-eared bat, of which there are only about 20,000 individuals remaining. It is possible that other federally listed bat species, such as the Ozark big-eared bat, may be impacted if the disease continues to spread. Also, significant mortality of more common species may threaten the stability and health of these populations. The FWS is currently reviewing the status of two bat species—the Eastern small-footed bat and the Northern long-eared bat—in response to petitions to list them under the Endangered Species Act.

The role of bats in larger ecosystems is not well understood, but bat species comprise about one-fifth of all mammal species in the world, making their loss potentially significant to the sustainability of other animals and the plants that share their landscapes. One million bats can consume up to 8,000 lbs of flying insects in one night, including pests like mosquitoes and moths. As predators of these insects, bats play an important role in protecting agriculture crops and forests and in reducing risk of human disease transmitted by flying insects.

In addition to impacts on biological resources, WNS will have impacts on some local economies through reduced opportunities for tourists. Caves with bats are the primary attractions at many national park units, including Mammoth Cave National Park (Kentucky), Carlsbad Caverns National Park (New Mexico), and Timpanogos Cave National Monument (Utah), Lava Beds National Monument (California) and Ozark National Scenic Riverways (Missouri).*G. destructans* has been detected in four national park units: Delaware Water Gap National Recreation Area (Pennsylvania and New Jersey), Great Smoky Mountains National Park (Tennessee and North Carolina), New River Gorge National River (West Virginia), and Ozark National Scenic Riverways (Missouri).

Cave closures and drastically reduced bat populations could impact the enjoyment of visitors who come to see them on national park units and other lands. The closure of caves could also reduce opportunities for recreational caving and could impact many caving organizations, clubs, and local grottos that rely on access to these resources. As caves and bat populations on federal lands are affected by WNS, gateway communities, outdoor recreation guides, and outfitters may experience loss of visitors and income.

U.S. Department of the Interior Response to WNS

The Department is leading a cooperative and coordinated response among its bureaus, including the FWS, the National Park Service (NPS), the Bureau of Land Management (BLM), and the USGS, as well as the U.S. Department of Agriculture, the U.S. Department of Defense, and other affected Federal agencies; all states; provincial and federal Canadian agencies; the academic community; private nonprofit organizations; and other stakeholders. Through the FWS, the Department has assembled a team of experts from these agencies and stakeholders to address this disease. Today, more than 100 partners are working together to identify the impact of WNS on bat populations and the ecosystem as a whole, the mechanisms by which the disease is transmitted and the mechanism through which it contributes to mortality in affected bats. The team is also cooperating to monitor the spread of WNS and to develop management and containment options for federal and state wildlife managers.

One of the team's priorities is to provide resource managers with management recommendations, based on the best available science, to control the spread and minimize the effects of WNS. To this end, the Department and its partners, including the U.S. Department of Agriculture, the U.S. Department of Defense, the Association of Fish and Wildlife Agencies, tribal agencies, and others have developed a National Plan to guide the collective response to the research and management of WNS.

The National Plan focuses on seven elements through working groups, including:

- Communications
- Data and Technical Information Management
- Diagnostics
- Disease Management
- Epidemiological and Ecological Research
- Disease Surveillance
- Conservation and Recovery

The National Plan also formally establishes two oversight committees with representation from Federal, State, and tribal resource management agencies. The National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats is based on similar disease response plans that have effectively been implemented in the past (e.g. Chronic Wasting Disease), and builds upon the coordinated efforts to address WNS, initiated in 2008.

U.S. Fish and Wildlife Service

The FWS is coordinating the Department's response to WNS, and continues to collect and distribute critical information to other Federal agencies, States, partners, and the public; to administer several of the working groups and/or sub-groups established through the National Plan; and to work with stakeholders to identify and carry out collaborative investigations, monitoring, and management actions. The FWS serves as the primary resource for up-to-date information and recommendations for all partners, such as important decontamination protocols for cave researchers and visitors and a cave access advisory that requests a voluntary moratorium on activities in caves in affected states to minimize the potential spread of WNS.

The FWS has dedicated funding toward WNS in fiscal years 2007 through 2011 for coordination, research, and state assistance. In addition to developing science-based protocols and guidance for land management agencies and other partners to minimize the spread of WNS, the FWS has funded numerous research projects to support and assess management recommendations and improve our basic understanding of the dynamics of the disease. These have included investigations into the transmission and etiology of the disease, the factors that influence the apparent differences in vulnerability of different bats to WNS, the genetic differences between samples of *G. destructans* from around North America and Europe, and the potential for species or individuals to develop resistance to the effects of the fungal infection. With funds provided by the FWS, for example, the U.S. Forest Service is developing DNA-based detection techniques to distinguish the pathogenic fungus from many closely related non-pathogenic *Geomyces* species in North American caves. As new data are collected and analyzed, the FWS has coordinated with partners to develop science-based approaches to addressing this disease within the framework of the National Plan. Information on WNS-related research projects is available at: *http://www.fws.gov/whitenosesyndrome/research.html*.

The FWS continues to work with and support states in identifying and monitoring bat hibernacula, surveying for WNS, and preparing response plans. This role is becoming increasingly complex as WNS continues to spread to new states and regions of the nation. The FWS will continue to monitor federally listed species impacted by WNS and to support states in monitoring and management of WNS in species under state jurisdiction through State Wildlife Grants and other programs.

U.S. Geological Survey

The USGS, DOI's science bureau, has unique capabilities to address emerging wildlife diseases, including specialized facilities for diagnosing and researching wildlife diseases, as well as expertise in field studies of bats. Since 2008, researchers with the USGS National Wildlife Health Center and the Fort Collins Science Center, in collaboration with partners, established criteria for diagnosing WNS; identified and first documented the fungus, ***G. destructans*; linked this newly identified fungus to the cause of the skin infection that is the hallmark of WNS; and developed rapid diagnostic tests for *G. destructans*. Additional work by USGS and research partners identified probable modes of disease transmission, proposed mechanisms by which WNS causes bats to die, confirmed the presence of viable fungus (*G. destructans*) in cave environments, and documented recovery of bats naturally infected with WNS. The USGS National Wildlife Health Center, along with many partners, continues to play a primary role in WNS research. Projects underway include studies to understand WNS transmission/pathogenesis/recovery, comparative genomic analyses to determine the origin of *G. destructans*, development of improved tools for molecular detection of *G. destructans*, and investigation into the microbial ecology of *G. destructans* in bat hibernacula.**

In order to fully implement the National Plan, USGS is assessing its capacities to most effectively manage WNS, including better methods of detecting the disease early, training personnel to conduct active field surveillance and sample collection, increasing diagnostic testing of field samples, and additional ecological field research aimed at providing the science-based guidance needed by state and federal agencies managing this devastating disease. Improved diagnostics, surveillance, and research will contribute to a better understanding of how WNS spreads and will help to identify weak links in the disease cycle that can be exploited to manage and control WNS.

National Park Service

The National Park System contains 394 national park units comprising approximately 84 million acres. Nearly one in four national park units have caves, and one in three units contain mines that can provide habitat for bats. System-wide, all 45 species of bats in North America occur in national park units, including seven species that are federally listed as threatened or endangered, and numerous others that are listed through state laws as threatened or endangered.

The NPS comprises one of the largest systems for informal learning in the world, and it educates millions of visitors about cave ecosystems, bats, and the potentially devastating impacts of WNS. Commercial cave operations in parks, such as Mammoth Cave and Carlsbad National Parks, remain open. NPS guidance recommends that access to caves requires a permit or tour ticket, which has enabled NPS to be proactive in minimizing the risk of visitors in spreading WNS. Visitors are screened prior to cave entry and gear is disinfected when necessary. The NPS develops guidance for parks through a working group comprised of veterinarians, managers, and ecologists from across the national park system. In addition, NPS continues to work with multiple partners to investigate WNS and its impacts on bat populations by providing access to sites, samples for analyses, and assisting planning for coordinated response.

Bureau of Land Management

The BLM, responsible for managing more than 245 million acres of public lands, is working to better understand and prevent the spread of WNS. The BLM was an active participant in the recently released national plan and is now focused on plan implementation. BLM Field Offices have been instructed to consider restricting access to caves and abandoned mines on BLM-administered lands and to use a targeted approach to closure that prioritizes sites with important bat resources. Prior to the completion of the 2011 national plan, the BLM in New Mexico closed 28 caves to public visitation in an effort to reduce the threat of WNS to bats. The BLM issued policy to encourage the continued engagement of external stakeholders to prevent or contain the spread of WNS including additional cave and abandoned mine closures in areas with important bat resources.

Limiting Potential for Human Transmission

The Department is working closely with the recreational caving and cave research communities to develop and improve decontamination protocols and cave access recommendations to prevent potential spread of the fungus through human activities. A decontamination protocol team has been formed, consisting of participants from across state and federal agencies, and the cave and karst research community, and the team is working to maintain consistency in methodology while incorporating the latest procedures. In March 2009, the FWS issued an advisory recommending voluntary suspension of caving activities in the states with affected bats, as well as in the adjoining states. In addition, the FWS has developed guidelines for scientists working in hibernacula to take precautions to avoid spreading the disease. The NPS has closed "wild" caves and mines in several units of the National Park System, although large, commercial caves in national park units remain open at this time. More closures may occur in response to the further spread of WNS. Several states have closed caves on lands under their management, including Indiana, Kentucky, and Wisconsin. Wisconsin has also designated *G. destructans* as an invasive species, making its transport an act which can be prosecuted under state law. The National Wildlife Refuge System (Refuge System) under FWS management includes lands with significant bat hibernacula, including those of the federally listed gray bat. All caves and abandoned mines on Refuge System lands have been closed to public entry to protect wildlife, including bats, from human disturbance.

Conclusion

White-nose syndrome remains the greatest challenge to bat conservation we have ever faced. The Department is dedicated to continuing its coordination of research and response to WNS and its impact on bat populations. Through ongoing efforts

to improve diagnostic techniques, to expand disease surveillance, and to enhance research efforts, we hope to continue to further our understanding of WNS to identify weak links in the disease cycle that can be exploited to manage and control this devastating wildlife disease. We also hope to refine and improve the processes and framework through which we address and manage similar wildlife health crises. The Department appreciates your interest in WNS and our collective efforts to address it. We look forward to working with you to slow the spread of this disease and to mitigate its impacts on bat populations.

Thank you for the opportunity to testify before you today. I would be happy to answer any questions that you or the committee members might have.

Dr. FLEMING. Thank you, Dr. Chavarria, and thank you for your testimony. Next, we have Mr. Peña. You are now recognized, sir, for five minutes.

STATEMENT OF JIM PEÑA, ASSOCIATE DEPUTY CHIEF, U.S. FOREST SERVICE

Mr. PEÑA. Good morning, Mr. Chairman, and Members, thank you for the opportunity to testify this morning. The subject of White-Nose Syndrome is important to forest managers, wildlife managers, agricultural producers, and members of the public.

The Forest Service is contributing to the larger effort to better understand White-Nose Syndrome, and is playing a role in controlling the spread of White-Nose Syndrome to hibernation sites in caves, and in abandoned or inactive mines.

The mission of the Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands, and to meet the needs of present and future generations.

This mission includes sustaining the health, diversity, and productivity of many species that uses the Nation's forests and grasslands as habitat, including bats. I am going to focus my remarks on what we are doing to try and coordinate and collaborate, as opposed to rehash a number of the science topics.

And so the coordination and cooperation among all parties involved in addressing White-Nose Syndrome is critical to arrest the spread of White-Nose Syndrome. The Forest Service is committed to full partnership and cooperation with other Federal, state, Tribal, wildlife management agencies, universities, industrial and non-industrial private forest owners, and non-government organizations such as Bat Conservation International, and the National Speleological Society.

The Forest Service has been a cooperator in the development of a White-Nose Syndrome Response Plan, and has served on White-Nose Syndrome working groups, and is actively involved in the development of several parts of the implementation plan.

There is evidence to suggest that humans can spread White-Nose Syndrome from cave to cave on their gear and equipment, and in an attempt to slow the spread of White-Nose Syndrome, we have closed nearly all caves, and abandoned or inactive mines in the Southern, Eastern, and Rocky Mountain regions.

Exceptions to the close orders are for research and monitoring, law enforcement, research, search and rescue operations, and to any cave that is specifically posted as open.

We implemented these closures because we observed the White-Nose Syndrome jump from New York to Southwest Virginia in one winter, and the next winter the fungus that causes White-Nose

Syndrome was detected in the Oklahoma Panhandle, a far greater distance than bats could travel in such a short time frame.

There is no known cure for White-Nose Syndrome, and so we must rely upon trying to limit disease spread between geographic regions and using decontamination procedures. Our cave closures may have slowed the westward spread, but it is likely too early to tell.

By acting now, we hope to substantially delay the westward spread enough for science to inform us on more effective ways to manage and contain the fungus. Given growing concerns over the viability of bat populations and the awareness of the role of bats in maintaining healthy ecosystems, the Forest Service research and development has established bat research throughout the United States.

In the past three years, we have expanded research to address challenges posed by the White-Nose Syndrome. Our current research efforts are aimed at understanding the pathogen associated with White-Nose Syndrome, including potential biological control.

Planning for conservation and recovery of affected bat populations by evaluating populations genetics and viability, assessing and quantifying the economic and ecological importance of bats to forests and agricultural systems, and finally assessing bat habitat requirements, and effects of forest management on bats.

The Forest Service understands the impacts closures are having and will continue to have on the recreating public. We will continue evaluating these decisions as new information and science becomes available, with the intent of balancing greater access to caves, while striving to maintain healthy bat populations.

In conclusion, we are responding to the serious threat populations posed by the White-Nose Syndrome. To further the conservation and management of vast and diverse habitat on our national forests and other lands, the Forest Service is committed to cooperation and partnership with Federal, state, Tribal, and non-government organizations. I would be happy to take any questions at this time.

[The prepared statement of Mr. Peña follows:]

Statement of Jim Peña, Associate Deputy Chief, National Forest System, Forest Service, U.S. Department of Agriculture

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to testify before you today on bat white-nose syndrome. The subject of white-nose syndrome is important to forest managers, wildlife managers, agricultural producers, and members of the public. This hearing is timely because white-nose syndrome is an emerging disease of cave dwelling species of bats that is both perplexing and devastating.

The Forest Service is very concerned about white-nose syndrome and the future of bats in the United States and North America. White-nose syndrome (WNS) is a disease believed to be caused by a fungus recently identified as *Geomyces destructans,* which is associated with mass mortality of several bat species at hibernation sites in the New England, Mid-Atlantic and northern Appalachian States. Since our previous testimony on June 4, 2009, WNS has continued to spread to the north, south, and west. WNS has now been confirmed in 16 states stretching from Maine to west Tennessee, and 4 Canadian provinces. DNA from *Geomyces destructans,* the fungus that is associated with WNS, has been confirmed on a bat in Western Oklahoma, although the bat lacked the pathological invasion of the skin that is characteristic of the disease.

Once introduced into a cave or abandoned and/or inactive mine, WNS has the potential to kill more than 90 percent of the hibernating bats (Blehert et al. 2009

Science Vol. 323 pg. 227). It is estimated WNS has killed more than 1 million bats during the last four years. Since 2007, when WNS was first documented in New York, populations from six bat species, including little brown, big brown, northern long-eared, eastern small-footed and tri-colored bats, as well as the endangered Indiana bat, have suffered mortality from WNS. DNA from the fungus has also been identified on three additional species, the southeastern bat, the cave bat, and the endangered gray bat, but no mortality or pathology has been documented among these species to date.

The Forest Service can contribute towards the larger effort to better understand WNS, and can play a role in controlling the spread of WNS to hibernation sites in caves and abandoned and/or inactive mines. The mission of the Forest Service is, *"to sustain the health, diversity and productivity of the Nation's forests and grasslands to meet the needs of present and future generations."* This mission includes sustaining the health, diversity, and productivity of the many species that use the Nation's forests and grasslands as habitat, including bats.

Declining bat populations diminish the integrity of our forest and grassland ecosystems. The continued loss of bats in forested ecosystems could have ecological and economic impacts. Because bats are primary predators of night-flying insects, a significant decline in bat populations could contribute to larger insect pest populations, a possible decrease of agricultural crop production, and a potential decline in forest health. Increases in insect pest populations could lead to an increase in the perception of the need for pesticides, which would have both environmental and economic consequences (Kunz et al. 2011). The value of bats to agriculture was recently estimated to be $23 billion per year (Boyles et al. 2011, Science Vol 332 pages 41–42). The strategy to prevent WNS must be a multi-pronged one and involve strategies in both affected and currently unaffected regions.

Coordination and cooperation among all parties involved in addressing WNS are critical to arrest the spread of WNS. The Forest Service is committed to full partnership and cooperation under the National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats, along with the Department of the Interior (U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, and Bureau of Land Management), State and Tribal wildlife management agencies, universities, industrial and non-industrial private forestland owners and non-governmental organizations, such as Bat Conservation International and the National Speleological Society. The Forest Service has been a cooperator in the development of the National WNS Response Plan and is actively involved in several parts of the implementation plan. We will continue to assist in the cooperative effort. Cooperative efforts include monitoring the spread of WNS,, epidemiology and isolation procedures to better understand and control the disease, and cave and mine management in order to reduce the spread of WNS to unaffected areas and regions of the United States.

THE ROLE OF THE NATIONAL FOREST SYSTEM

The Eastern and Southern Regions of the National Forest System have adopted an appropriately aggressive response to the threat posed to bats by WNS. This includes, starting with the FY2009 Budget, specific budget direction to address bat species conservation relative to WNS in the Forest Service. There are approximately 24 million acres of National Forest System lands in the Eastern and Southern Regions of the Forest Service with approximately 2,000 caves and abandoned and/or inactive mines that serve as bat hibernation sites. Several species of bats listed as endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act use these sites, including the Indiana bat, gray bat, Virginia big-eared bat, and Ozark big-eared bat. It is in these sites where WNS mortality is most evident. White-nose syndrome has not yet been documented in populations of migratory bat species that hibernate in trees or forest leaf litter.

For the Eastern Region of the Forest Service, WNS is confirmed in an abandoned and/or inactive mine in the Green Mountain National Forest (Vermont), in the Wayne National Forest (Ohio), and in caves in West Virginia's Monongahela National Forest and Indiana's Hoosier National Forest. In the Southern Region, WNS has been confirmed in Virginia on the George Washington and Jefferson National Forests, as well as in the National Forests in North Carolina. Of significant concern is the confirmation of WNS in the privately owned Hellhole Cave, in West Virginia, which is designated critical habitat for both the Indiana bat and the Virginia big-eared bat—both Endangered Species. Hellhole Cave is habitat for approximately 45 percent of the known population of Virginia big-eared bats and more than 100,000 little brown bats, the species hit hardest by WNS.

If we fail to contain WNS, there could be a rapid and precipitous population decline for many bat species. With discovery of WNS in three counties in Indiana,

there is great concern about the fate of the endangered Indiana bat. Nearly 50 percent of Indiana bats hibernate in Indiana and all are susceptible to WNS. Two recent and independent studies in New England determined a 73 percent overall decrease in summer bat activity (Brooks 2011, Biodiversity and Conservation, 5-pages, online; Frick et al. 2010, Science 679—682). Therefore, it is critical that bat hibernation locations are isolated from *Geomyces destructans.* There is no known cure for WNS, so we must rely upon the basic principles of epidemiology, which includes trying to limit disease spread between geographic regions and using decontamination procedures when visiting hibernacula.

Forest Service Cave and Mine Closures

There is evidence to suggest humans can spread WNS from cave to cave on their gear and equipment (Blehert, et al. 2011, Microbe: 267—277). This includes cavers as well as resource managers. In an attempt to slow the spread of WNS, the Forest Service has closed nearly all caves and abandoned and/or inactive mines in the Southern, Eastern, and Rocky Mountain Regions. The Forest Service acted because we observed WNS jump from New York to southwest Virginia in one winter. The next winter, DNA from the fungus that causes WNS was detected in Woodward County, in the Oklahoma panhandle, a far greater distance than bats could travel in such a short time frame. The closure orders are crafted to reduce concerns that they would deny access for Tribal rights and ceremonies by allowing requests for Tribal ceremonies to be authorized by permit on a case-by-case basis. Our Tribal partners are supportive of our efforts to slow the spread of WNS.

Exceptions to the closure orders are for research and monitoring, law enforcement, search and rescue operations, and any cave specifically posted as open. The Forest Service has been coordinating with the National Park Service on decontamination protocols for sites that are not subject to the closure orders. We are implementing the same decontamination protocols as Mammoth Cave National Park to ensure that cave visitors, including researchers and managers, do not spread WNS. The protocols include the use of specific clothing and equipment for each individual cave and abandoned and/or inactive mine.

Because there are critical bat hibernating sites in the Midwest and West, we are very concerned about the continued western spread of WNS and what we can do, working with partners, to enact proactive measures now, rather than waiting until WNS spreads to currently unaffected areas in the western United States. Opportunities exist to implement proactive habitat management monitoring and surveillance activities now in areas to which WNS has not yet spread. The hope is that acting now will substantially delay the westward spread, in enough time for the science to inform increasingly effective ways to manage and contain the fungus. In addition to the closures already mentioned, a response plan has been finalized for New Mexico which calls for targeted closure of caves determined to have significant bat roosts. In Arizona, a draft Response Plan has been prepared that would institute a similar approach. It is expected that the Arizona plan will be finalized sometime this summer. Closure decisions are also pending for the Northern and Intermountain Regions. These regions are working with other federal and state agencies to assess risk of WNS across the landscape, prioritize monitoring and surveillance activities, and adopt adaptive management approaches well ahead of WNS spread into those areas.

Management of National Forests

Bats need healthy forests and healthy forests need bats. Other than implementing the cave and abandoned and/or inactive mine closure order, the best thing we can do to conserve bats is to manage for healthy forests. While the national forests are approximately six percent of the forested lands in the Eastern and Southern U.S., they play a critical role in conservation of all species. We are using research findings to develop management strategies to benefit bats. The objective is to create suitable roosting and foraging habitat across the landscape in the quantities and patterns that mimic natural disturbance regimes, in the hopes of restoring habitat conditions for all species (Perry et al. 2008, Journal of Wildlife Management 72: 913—925; O'Keefe et al. 2009, Forest Ecology and Management 1757—1763; Hayes and Loeb 2007, pages 207—235 in Lacki et al. editors, Bats in Forests: Conservation and management, John Hopkins University Press 329 pp). The Eastern and Southern Region national forests are ideally suited to contribute to large forested landscape ecosystems. There is a significant but discontinuous corridor of national forests and parks from northern Georgia to New Hampshire. If we can retain healthy bat populations on national forests and parks, the corridor could serve as a conduit to repopulate bat populations in areas decimated by WNS. This assumes our ability to ar-

rest the spread of WNS; that the bats develop some resistance to it; or a method is found to address the fungus that presumptively causes WNS.

There may be potential to increase our management efforts to develop suitable habitat at an accelerated rate. There is potential to increase adaptive management strategies in cooperation with research to enhance suitable habitat while monitoring the effectiveness of these treatment strategies. As mentioned earlier, the Forest Service is also exploring, with several other federal and state agencies, the potential for a broad-scale collaborative effort in the West to prioritize monitoring and implement management aimed at slowing and halting the westward spread of WNS.

FOREST SERVICE RESEARCH & DEVELOPMENT (R&D) ROLE IN BAT HABITAT RESEARCH

Given growing concerns over the viability of bat populations and awareness of the role of bats in maintaining healthy ecosystems, the Forest Service Research and Development Deputy Area has established bat research throughout the United States. In the past three years, Forest Service has expanded this research to address the challenges posed by WNS in four areas:

- WNS-related declines, assessment, and control;
- Population genetics and population viability;
- Basic habitat requirements and effects of forest management on bats: and
- Economic and ecological importance of bats.

Forest Service scientists are internationally recognized for their expertise in identifying fungi through DNA fingerprinting. Their expertise was responsible for development of DNA detection methods for screening cave soils and debris for the pathogen. These scientists are currently developing genetic techniques that can be used in the field to detect the pathogen in the environment or in infected bat tissue more accurately. This advance will save weeks in response time by enabling scientists and managers to identify the pathogen on site in the field.

Forest Service scientists are also evaluating the potential for biological controls of the fungus. By testing naturally occurring microflora from healthy bats, they hope to find a microbial species that will reduce the ability of *G. destructans* to destroy bat skin cells.

As part of Forest Service population viability research, scientists are developing viability models for Indiana bat to estimate population-wide impacts of current and potential future mortality. To date there is no indication of innate bat immunity to the disease. Modeling the possible trajectories of declining populations should provide information needed to identify management options for conservation or recovery of this species.

Our research to understand habitat needs and inform management practices has identified optimal roosting requirements of bats during the maternity season. In general, this research has shown that bats prefer large trees or snags, often in relatively open areas. However, there is still considerable unexplained variation within and among bat species that requires further study. Additional research on the effects of forest management has shown that forest management practices, particularly thinning, prescribed fire, and creation of small canopy gaps or openings, generally do not reduce habitat attributes for bats and may be very beneficial. Forest Service scientists, in collaboration with agricultural economists, have also initiated development of models to quantify the ecological and economic importance of bats to agriculture and forest ecosystems.

Forest Service Research and Development works closely with managers, partners, and the public to ensure our research informs management strategies for the National Forest System and other public and private lands in the future. Information gained from Forest Service R&D studies on habitat requirements, bat response to forest management, and the consequences of human development on bat habitat and populations will be critical to understanding the direct, indirect and cumulative effects of WNS and other stressors on bat populations.

THE ROLE OF STATE AND PRIVATE FORESTRY AND CONSERVATION EDUCATION

Another approach for the management of healthy and resilient forests is to implement efforts with State Foresters through the State and Private Forestry arm of the Forest Service. The Forest Stewardship Program provides financial and technical assistance to State Forestry organizations for private forestland management consultation and plans. Targeting private forest management efforts to implement prescriptions that would enhance or develop attributes for bat foraging, roosting or maternity habitat in privately owned forests in and near areas affected by WNS could help bat populations recover once WNS is controlled.

Conservation Education

We know that the public is a critical partner in the effort to help save the bats. The Forest Service is actively involved in educating people regarding WNS, bat species conservation, and the ecological and economic importance of bats. Children find bats fascinating and are a key part of our education programs. We are informing people why Eastern and Southern National Forest System caves and abandoned and/or inactive mines are closed to the public until more is learned about the pathology of WNS.

CONCLUSION

The Forest Service is in the process of responding to the serious threat to bat populations posed by WNS. The Forest Service Deputy Areas for the National Forest System, Research and Development and State and Private Forestry are contributing to this vital cause. To further the conservation management of the vast and diverse habitat and fauna on National Forest System and other lands, the Forest Service is committed to cooperation and partnerships with Federal, State, Tribal and non-governmental organizations interested in the conservation and preservation of bats. Mr. Chairman, this concludes my testimony. I am pleased to answer any questions that you or the Members of the Subcommittee may have.

Dr. FLEMING. Thank you, Mr. Peña, for your testimony. We now have Dr. Gassett, and you have five minutes, sir.

STATEMENT OF DR. JON GASSETT, COMMISSIONER, KENTUCKY DEPARTMENT OF FISH AND WILDLIFE RESOURCES

Dr. GASSETT. Thank you, Chairman Fleming, and Subcommittee Members. I am Dr. John Gassett, Commissioner of the Kentucky Department of Fish and Wildlife Resources, and the Vice President of the Association of Fish and Wildlife Agencies, as well as the Chair of the Association's White-Nose Syndrome Working Group.

During the last several years with my personal involvement with White-Nose Syndrome has grown from watching its advance southward and westward, to chairing the Association Working Group to garner further state awareness, to bearing responsibility in my state upon confirming White-Nose Syndrome in Kentucky this spring.

And I am encouraged by the amount of dedication and commitment by the community of individuals, both here and abroad, that care deeply about our bat resources. But I am here today to bring you a state perspective on where the battle against White-Nose Syndrome will ultimately be won or lost.

In my home state of Kentucky, we are known for a few products for our vast limestone substrate, the best thoroughbred race horses in the world, and fine Kentucky Bourbon, are both products of our limestone beneath our feet.

But this limestone topography is also conducive to cave formation. Kentucky is home to thousands of limestone caves and caverns, some large, such as Mammoth Cave, and some so small that you couldn't fit a single person inside.

What many of these caves have in common are the bats that live there and the ecosystem that those bats support. Kentucky is home to a number of bat species, including a large percentage of the world's known population of Federally endangered Gray bats and Indiana bats.

The fact that we have tremendous numbers of caves that are homes to these bats that are now experiencing a disease that has

the potential to devastate their numbers, obviously causes us some concerns.

Since the discovery of White-Nose Syndrome a few years ago, my agency has aggressively increased surveillance and monitoring of bats, and educating landowners and grottos on the importance of minimizing cave disturbance, and closed non-commercial caves on public lands that were known to house bats.

We have initiated a voluntary cave closure on private land, and we have assisted the Service with a cave closure advisory. Have we taken some drastic measures? Yes. Will they be effective in controlling the spread of the disease? We are not sure yet.

Our approach to preventing this disease from entering Kentucky, and then arresting its spread once it got there has been controversial. For example, several years prior to the discovery of the disease in Kentucky, we began initiating cave closures on state-owned lands.

One of these closures was in a small community of Carter Caves, and on the weekend before a major caving event that had over 900 participants registered, we decided that the event could potentially jeopardize the resident bats from a caver inadvertently bringing in infected material.

We closed this event three days before it happened. Obviously, the caving community was disappointed, and we worked with a State Park to offset some of their revenue losses, but the local economic impact was significant to this small community.

We followed public cave closures by turning toward private land caves. We worked with landowners cooperatively through an educational campaign to inform them of the United States Fish and Wildlife Service cave closure advisory, and asked them to voluntarily close their caves.

Of the 80 caves or 80 cave owners that we sent letters to, only three refused to do so, and the remainder did. So once again landowners are responding to the disease threat.

Cave closures haven't been the only controversial approach to controlling disease in Kentucky. Once it was found in Ohio this spring, we visited a sampling of caves across the state to be sure that we hadn't missed it. Unfortunately, we did turn the disease up in Western Kentucky.

So we consulted with our Federal partners, because there are Federal bats involved, and began an immediate recon of the cave system within a 10 mile radius, and it turned out that this was an isolated event.

So we took what some people would say are drastic measures. We went in and evaluated the situation, and determined that we can protect the threatened and endangered bats that weren't infected, but could remove the infected non-endangered bats. We did so, and we removed approximately 60 bats, which were all that we could get to at that time.

We made a difficult call to alter the cave artificially, and where these bats were infected, and where they were hanging, we went in and attached artificial structures to keep bats in the future from roosting there.

So obviously there were folks from the caving communities and from the cave biologist side of things, and who were very upset

with the fact that we had actually physically altered the cave, but to us, it wasn't worth the risk of allowing those 3,500 Federally listed bats that were in that cave the opportunity to roost in an area that might become infected.

We have taken some drastic measures in Kentucky, and we feel that that is what states are going to have to do to ultimately win this fight against this disease. There are a litany of needs to address White-Nose Syndrome properly, particularly in the realm of research.

And we ask that research activities and funding focus on treatment and on the ground management needs. As White-Nose Syndrome moves across the landscape, a coordinated and informed effort is more important than ever before, and wildlife managers are in need of support to broaden their surveillance efforts.

We have thousands of caves in Kentucky, and it is difficult to surveil them all. States need continued support of all entities, both public and private, Federal, and non-profit, to effectively manage on a broad scale, and Congressional support via funding is critical if we are to conserve this national biological treasure.

While the professionals within this room realize that this may be the most challenging wildlife disease issue in our time, we are optimistic and hopeful that treatment controls will be found, and we will continue to press forward working in concert to ensure bat populations be afforded every opportunity to thrive.

Mr. Chairman, and Honored Subcommittee Members, thank you for the opportunity to share our perspectives, and I would be pleased to answer any questions.

[The prepared statement of Dr. Gassett follows:]

Statement of Jon Gassett, PhD, Commissioner,
Kentucky Department of Fish and Wildlife Resources

Thank you, Chairman Fleming and Subcommittee Members for the opportunity to share the perspectives of the Association of Fish and Wildlife Agencies on this important environmental issue. I am Dr. Jon Gassett, Commissioner of the Kentucky Department of Fish and Wildlife Resources and the Vice President of the Association of Fish and Wildlife Agencies as well as the chair of the Association's White-Nose Syndrome Working Group.

The Association of Fish and Wildlife Agencies (AFWA) promotes and facilitates sound fish and wildlife management and conservation, and is the collective voice of North America's fish and wildlife agencies. The Association provides its member agencies and their senior staff with coordination services that range from migratory birds, fish, habitat, and invasive species, to conservation education, leadership development, and international relations. The Association represents its state fish and wildlife agency members on Capitol Hill and before the Administration on key conservation and management policies, and works to ensure that all fish and wildlife entities work collaboratively on the most important issues. All 50 states are members of the Association.

During the last several years, my personal involvement with WNS has grown from watching its advance, moving southward and westward, to bearing responsibility in my own state upon confirming WNS in Kentucky this spring. I am encouraged at the amount of dedication and commitment by a community of individuals who care deeply about our bat resources. At the same time, I am concerned at the rate of spread, the high suspect ability of certain species and the lack of available treatment options. Again, I am encouraged by the genuine concern and interest as shown here by this Subcommittee.

White-Nose Syndrome: What Is It and Where Is It?

In the winter of 2006 the first signs of a destructive fungus (*Geomyces destructans*) appeared on hibernating bats in Howe's Cave in upstate New York. By 2009 thousands of hibernating bats from a variety of species across the northeast

(New York, Vermont, New Hampshire, Massachusetts, Connecticut, New Jersey, Pennsylvania, West Virginia, and Virginia) were dying or had died from this new disease now known as White-Nose Syndrome (WNS) for the tell-tale white fungus found on the muzzle of infected bats. As of 2011 WNS has spread north to Maine and the provinces of New Brunswick, Nova Scotia, Ontario, and Quebec. The disease has also spread south to Maryland, North Carolina, Kentucky, and Tennessee as well as to the Midwest to Indiana and Ohio. WNS has also been confirmed in Delaware, Missouri, and Oklahoma. Thus far, of the twenty-five hibernating bat species in North America, six species have been affected by WNS including the endangered Indiana bat (*Myotis sodalis*) and the endangered Gray bat (*Myotis grisescens*). The endangered Virginia big-eared bat (*Corynorhinus townsendii*) and Ozarks big-eared bat (*Corynorhiunus townsendii ingenus*) are both found within the geographical range of WNS, but no infected bats from either species have been found at this time.

G. destructans infects not only the muzzle but also the ears, and (most importantly) the wings of bats. Once *G. destructans* infects an individual the fungus colonizes the area of infection, erodes the epidermal layer, and eventually reaches the connective tissue where damage can be intensive. Infection of the wings is of the great concern as they play a key role in homeostasis. The exact cause of death is uncertain but frequent arousals due to irritation from the infection and the subsequent depletion of fat reserves may be a factor. Bats have also been reported to leave their hibernacula prematurely and succumb to the cold. Mortality can be as high as 90–100% of an infected population and estimates suggest that over 1 million bats have died from WNS to date.

Exposure to *G. destructans* occurs within caves and/or abandoned mines where certain species hibernate in huddled masses through the winter as a mechanism to survive cold temperatures and limited food supply. Temperatures within any given hibernacula range from 2–14° C which is also within the optimal range for *G. destructans* growth. North American bats have been exposed to a variety of fungal species with no detrimental effects until now. Surveys of European bat populations indicate exposure to *G. destructans,* but with none of the mortalities associated with the fungus in North America. This suggests that the fungus may have European origins, and bats there co-evolved with the fungus. This also suggests that *G. destructans* crossed over to North America through unintentional human importation (i.e. on caver's boots or other caving gear) and is now spreading throughout immunologically naïve bat populations throughout North America.

Importance of Bats and the Future Impacts of WNS

Bats play an important role in the environment as well as natural resource-based economies such as agriculture and forestry. They may act as pest control, pollinators, or seed dispersers depending on the species. Bats are a keystone species in most ecosystems and help maintain balance. So far WNS has only impacted insectivorous bats, which consume large amounts of nocturnal insects that may act as agriculture or forestry pests. Recent estimates suggest that agriculture losses from WNS could exceed $3.7 billion per year. For certain crops (ex. cotton), bats play a prominent role in pest suppression which could lead to even larger losses. Without these ecosystem services, increased pesticide application will be used. Not only will this be expensive to farmers but could adversely affect fish and wildlife in surrounding areas through direct exposure or indirect exposure through runoff. The loss of large populations of insectivorous bats could also lead to future public health and wildlife health crises with increased cases of West Nile Virus and other similar diseases.

The National Plan

We applaud the U.S. Fish and Wildlife Service and their conservation partners for the creation of the National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats. State fish and wildlife agencies sit on the National Plan Executive Committee and on the technical teams and were thus significantly involved in drafting the Plan. Recently released in May of this year the National Plan will serve as a framework for federal, state and private entities. This National Plan is only the first step as the National WNS Implementation Plan is now underway. Details for each goal and objective outlined in the National Plan will be found here. This will serve to delineate options, responsibilities and a means of checks and balances to insure that previously defined goals and objectives can and will be met. While state fish and wildlife agencies are the ultimate decision makers for strategies to reduce the impact and spread of WNS, the National Plan acts as an overarching framework where all may move towards a common goal. With the far-reaching affects of WNS, it is imperative to have a clear roadmap for

success. The National Plan and the forthcoming National Implementation Plan serve as that roadmap

State Action

For more than 100 years, state fish and wildlife agencies have been managing natural resources for the public trust by addressing threats to fish and wildlife including habitat fragmentation, degradation, disease and pathogens, and loss from changing land uses, pollution and sedimentation, deleterious or invasive species, and unsustainable use of natural resources. State, provincial and territorial fish and wildlife agencies have upheld the primary responsibility for conserving and preventing the exploitation of those resources on public and private lands and waters within their borders. State fish and wildlife agencies are proactively combating the effects of WNS through collaborative efforts with their fellow state fish and wildlife agencies, federal agencies, and NGO partners. State biologists, on average, have numerous species and duties under their purview and are limited in their ability to respond to crises at the scale of WNS. In these current economic times when state budgets are slowly shrinking, it is these partnerships that allow states to expand their efforts.

States have been resourceful in utilizing federal, state and NGO partner capacity for addressing WNS, along with various funding mechanisms. States have also been utilizing the limited funding available to further baseline knowledge and track the spread of WNS.

Examples of state efforts are as follows:

Virginia

Through federal WNS Grant funds, the Virginia Department of Game and Inland Fisheries and partners initiated three projects to assist with the understanding of WNS and its impacts. These efforts included banding bats with the objectives of monitoring demographic and biometric changes associated with WNS, determine changes in population levels, and monitor individuals over time to determine potential resistance.

Western Coordinated Multi-State Response: Arizona, California, Idaho, Montana, Nevada, Washington, and Bat Conservation International

The major focal areas of this State Wildlife Grant (SWG) are oversight, surveillance, outreach, and research. The 6 states intend to develop response plans, purchase equipment, conduct surveillance and monitoring, outreach, and research. The lead state (Arizona), Bat Conservation International, and partner states will actively engage with existing and emerging WNS networks—connecting representatives from each state partner with the broader national network of partner state and federal agencies and nonprofits (working on WNS), as well as private landowners, recreational caving interests, and corporate and foundation interests that can provide critical private dollars.

Vermont

Vermont has applied appropriated federal funding with state match dollars through the SWG program and the direct federal WNS Grants to the States. In recent years, such funds have been applied to WNS surveillance, addressing public concerns, and participating in regional or national research projects on the disease itself.

Tennessee

Current funding from the White Nose Syndrome Grant, Endangered Species Act Habitat Conservation Plan and Section 6 (Indiana and Gray Bats) funds to survey bat populations and incidence of WNS have helped identify caves with bats. The WNS Grant allowed the Tennessee Wildlife Resource Agency to purchase an array of equipment used in bat surveys.

Iowa

With USFWS WNS Grant funds Iowa Department of Natural Resources prepared Web-based and written materials regarding white-nose syndrome, identification, cause, means of transmission, actions that landowners should take to minimize spread of disease, reporting protocols, links to USFWS' and other pertinent white-nose syndrome sites and information sources, and contact information for Iowa DNR personnel to answer queries regarding white-nose syndrome and coordinate monitoring for disease.

Signs were prepared for posting on public lands which harbor hibernating cave bats and printed written materials for distribution to target audiences were also done under the USFWS WNS grant.

Kentucky

The agency has aggressively increased surveillance and monitoring, educated landowners and grottos on the cave closure advisory, provided signage and has worked with numerous researchers throughout the nation. Funding for these efforts was provided for through a USFWS WNS grant and State Wildlife Grant (SWG). Kentucky detected a WNS positive site this spring and is aggressively researching management measures that may help slow the spread.

WNS–Cave Closings

States have acknowledged and supported the USFWS's voluntary cave closure advisory issued in 2009. While this ban affects non-commercial caves on public and private property, it does not address the commercial cave industry. Many state agencies have worked diligently with private landowners, educating them on the importance of limiting disturbance to hibernating bats during the winter, as well as, the threat of WNS. Conscientious landowners have allowed signage to be erected, talked with local cavers and indicated an overall support of the voluntary closure.

While commercial cave operations are important to local economies, they too can potentially be a source of contamination. There is an effort underway by state, federal and non-governmental organizations to develop a Commercial Cave Advisory document that will assist commercial cave owners/operators. This will allow them to maintain a "clean" cave environment without crippling their business, during these difficult economic times. While recognizing the importance of caving to interest groups and commercial venues, we also recognize the associated responsibility to those organisms that inhabit these systems. Bats, invertebrates and other cave dependent species are critical to maintaining a healthy cave ecosystem.

Kentucky Department of Fish and Wildlife worked with landowners through an educational campaign and letter to inform them of the USFWS cave closure advisory. Over 80 letters were mailed to landowners asking if they would like to close their cave and receive signs for their property. The response was overwhelming, with only 3 property owners indicating that they would prefer to leave their cave open.

An excellent example of partners working together for the benefit of bats, while acknowledging economic impacts, exists at Mammoth Cave National Park (MCNP). Mammoth Cave is located in south-central Kentucky and received over 400,000 visitors per year and has an enormous economic impact in the local region. Gross ticket sales average $3 million dollars. Mammoth Cave is also home to at least 3 caves harboring the federally endangered Indiana bat and Gray bat. MCNP developed a screening process, educational materials, hired staff and developed decontamination stations to assure visitors were not a potential source of spreading WNS. Overall, visitors have been very receptive and eager to ensure protection of this valuable resource.

What is still needed?

There is a litany of needs to address WNS properly, particularly in the realm of research. We ask that research activities and funding focus on treatment and "on the ground" management needs. As WNS moves across the landscape a coordinated, informed effort is more important than ever before. Wildlife managers are in need of support to broaden their surveillance efforts, in attempts to spot and perhaps slow or limit the spread of this disease. States need continued support of all entities, federal and private, to effectively manage on a broad scale. Congressional support via funding is critical if we are to conserve this national biological treasure.

Specific needs include:

- Strategies for collaboration with public health departments to increase surveillance
- Identification of priority cave systems (in the west) and methods of protection for uninfected populations
- Training workshops for state agency staff on protocols for samples collection, preparation, and euthanasia (where appropriate)
- Education and outreach plans for the public and private land owners
- More diagnostic facilities throughout the country
- Increased surveillance and monitoring in both regions where WNS has not been detected and regions where WNS has occurred
- State and/or Regional WNS Plans
- Cost effective treatment for infected individuals in the wild
- Improved survival of infected individuals from the known causes of mortality by WNS (starvation and dehydration)

Closing Remarks

While the professionals within this room realize this may be the most challenging wildlife disease issue of our time, we are optimistic and hopeful that treatment and controls will be found. We will continue to press forward working in concert to ensure bat populations will be afforded every opportunity to thrive.

Mr. Chairman and honored subcommittee members thank you for the opportunity to share our perspectives and I would be pleased to address any questions.

NOTICE TO KENTUCKY CAVE OWNERS
"White Nose Syndrome—a new threat to cave bats"
Cave Name:_____

You are receiving this letter because you own one or more caves. If you have received this letter and do not own a cave or caves, please contact us (contact information can be found at the end of this letter) and we apologize for any inconvenience.

Background

In 2006, a mysterious fungus was discovered growing on the muzzles of several bats hibernating in a cave near Albany, New York, and the term "White Nose Syndrome" (WNS) was coined. Between 2006 and 2007, this syndrome spread to five caves in New York. Since then, WNS has spread to over 60 caves and mines in nine states in the northeast and eastern U.S. WNS has been associated with the deaths of approximately **1,000,000 bats** and that number continues to rise. Several bat species have been affected, including the federally endangered Indiana bat. **So far, this disease has not been found in Kentucky caves, and we want to do everything possible to keep it that way.** This letter is being sent to you to inform you of the problem and to ask for your help, as an owner of an important bat cave, to assist in keeping this problem out of Kentucky, if possible.

The U.S. Fish and Wildlife Service (USFWS) recently issued a cave advisory in states that are affected with WNS and those states adjacent to affected states. Because it was found in West Virginia and Virginia this year (2009), Kentucky is now considered an adjacent state. Kentucky Department of Fish and Wildlife Resources, USFWS Kentucky Field Office, and Kentucky Geological/Speleological Society have been working closely with cave groups and organizations through meetings to develop a state-specific response to this advisory. In Kentucky, non-commercial state and federally-owned caves have been temporarily closed to caving activities.

What we know

- Several species of bats are affected and it is estimated that over a million bats have been affected or have died from WNS
- Most affected bats have a white fungus on their face and low body weight
- Bat populations at affected sites have declined over 90% and the remaining bats are starving to death
- At some sites, cave owners reported bats flying outside during the winter
- White Nose Syndrome was found in caves in 2009 that were not affected in 2008
- As of April 2009, nine states are now infected with WNS

What we don't know

- At this time we do not know the cause of the problem
- A fungus is apparent on the bats, but no one knows if the fungus is the cause of the problem or if it is a secondary infection caused by something else
- Several labs, including the Southeastern Cooperative Wildlife Disease Study lab, Cornell University lab, and the USGS disease lab in Madison, WI, are working on this problem
- We do not know how the disease is spread from bat to bat or from cave to cave. It may be spread via the air, soil, or water in the cave and then transferred from cave to cave by cavers
- Until we know more, we need to assume this is a possible means by which the disease spreads. If it is carried from cave to cave by the bats themselves, there may be little we can do
- At this time we do not know if there are risks to humans, but the potential risks to humans are being assessed
- Biologists working at affected sites in New York have not shown any signs of problems, but we cannot assume there are no risks to humans at this time
- Also, potential impacts to other wildlife species are not known

Implications for Kentucky bats

Several Kentucky caves are important hibernation sites for bats, including three federally endangered species: the Indiana bat, Gray bat, and Virginia big-eared bat. Thousands of other caves are home to many other species of bats.

Virginia big-eared bats

Kentucky has the second largest hibernating population of Virginia big-eared bats in the country! A serious concern is that our population of Virginia big-eared bats hibernates in only a few caves during the winter, which leaves this species vulnerable to being entirely wiped out by WNS. Virginia big-eared bat populations in states that have WNS such as West Virginia and Virginia appear to be unaffected; however, these bats hibernate in caves with species affected by WNS.

Indiana bats

In the past few years, populations of Indiana bats in Kentucky caves have just started to show an increase thanks to cave protection efforts. However, Indiana bats continue to decline in many other parts of their range. Populations of Indiana bats in the northern states are currently being severely impacted by WNS. If populations in Kentucky become affected, the likelihood of recovery for this species could be greatly reduced.

Gray bats

There have been great strides made towards the recovery of the gray bat since it was first listed as endangered in 1976. Populations in Kentucky have been on the rise and in the summer, the species can be found in caves throughout the Pennyrile Region and a few in the Bluegrass. Unfortunately, this number has only grown slightly as approximately 95 percent of the entire gray bat population hibernates in only 17 caves in 5 states, Kentucky being one of them. This concentration makes them very susceptible to being wiped out quickly by WNS.

What can we do?

1. Close bat caves to human traffic until we know more about how to contain this problem. This is the best precautionary step we can take at this time. The Kentucky Department of Fish and Wildlife Resources and U.S. Fish and Wildlife Service are preparing a list of the caves we feel should be voluntarily closed. Cavers will be asked to voluntarily stay out of these caves.

2. If, as a cave-owner, you would like to officially close your cave while we learn more about this problem, we will include your cave on the list of closed caves that will be posted on a website cavers can access. We have enclosed a self-addressed stamped envelope and a form to be completed by you as the cave owner. Please check that you would like to have your cave on the "Cave Closed" list and sign and date the form. The list of closed caves will also be distributed to local caving groups. You can also contact Brooke Slack or Mike Armstrong (contact information below) for more information.

If you do not want your cave placed on the official closed cave list, we still plan to ask cavers to stay out of the cave **voluntarily** as we try to learn more about this problem. We have enclosed a self-addressed stamped envelope and form to be completed by you as the cave owner. Please check the "Cave Open" box and sign and date the form. If you allow cavers to enter your cave, we strongly recommend they clean their gear, clothing, and boots before entering the cave. A procedure for disinfection can be found at http://www.fws.gov/northeast/wnscavers.html. **If cavers going into your cave have** been caving in New York, Vermont, Massachusetts, Connecticut, New Hampshire, New Jersey, Pennsylvania, West Virginia, Virginia (states known to be affected as of June 2009) or any states adjacent to these prior to entering your cave, we highly recommend that they replace their gear and not use any gear/clothing/boots that has been used in potentially affected sites. If this is not possible, they should disinfect their gear, clothing, and boots before going in to Kentucky caves following the protocols recommended by the USFWS. If cavers find WNS in your cave, please have them report it as soon as possible to Brooke Slack or Mike Armstrong.

3. If you do not respond within 14 days, we will consider your cave(s) temporarily closed.

4. Report any unusual bat activity at the cave, such as bats flying outside the cave during winter. Some bat activity on warm winter days is not unheard of, but large number of active bats would be unusual. If you find dead bats outside your cave, contact Brooke or Mike.

Bat populations are doing well in Kentucky caves thanks to the cooperation and assistance of cave owners like you willing to help protect this resource. Great strides have been made in the last 20+ years. We could be taking a giant step backward

should WNS appear in Kentucky caves. Once it is here, there will be no going back. Your assistance at this time is greatly appreciated. We would like to have the initial list of closed caves available to the caving community as soon as possible, but the list can be updated later if you wish to change the status of your cave.

To get the latest information on White Nose Syndrome, visit: http://www.fws.gov/northeast/white_nose.html

Sincerely,

Brooke Slack
Wildlife Biologist
Kentucky Department of Fish and Wildlife Resources
502–564–7109 ext. 4573

Mike Armstrong
Endangered Species Biologist
U.S. Fish and Wildlife Service
502–695–0468 ext. 101

☐ I have read the enclosed letter informing me about WNS and the recommendations of the Kentucky Department of Fish and Wildlife Resources. I would like to close my cave or caves. Please include caves that I own on your "Cave Closed" list.

☐ I have read the enclosed letter informing me about WNS and the recommendations of the Kentucky Department of Fish and Wildlife Resources. At this time I am choosing to keep my cave or caves open to caving. I understand by doing this that I risk exposing my cave(s) to WNS.

Signature of Cave(s) Owner Date

[NOTE: Attachments have been retained in the Committee's official files.]

Dr. FLEMING. Thank you, Dr. Gassett. Next, Ms. Fascione. You are now recognized for five minutes.

STATEMENT OF NINA FASCIONE, EXECUTIVE DIRECTOR, BAT CONSERVATION INTERNATIONAL

Ms. FASCIONE. Thank you, and good morning, Chairman Fleming, Ranking Member Bordallo, and Members of the Subcommittee. Thank you for providing this opportunity to testify on this important issue today.

My name is Nina Fascione, and I am the Executive Director of Bat Conservation International. We are a non-profit conservation organization headquartered in Austin, Texas, with about 30,000 members and supporters in all 50 states and abroad.

Thank you for addressing an issue that can only be described as a massive wildlife crisis with this new emerging disease that we are talking about, White-Nose Syndrome, which is just decimating America's bat populations.

Scientists have described this disease as causing the most precipitous decline in wildlife in North America. Since its discovery in 2006, more than a million bats have died, and I would say that although the official number is more than a million, bats are hard to count, and the number is likely in the millions.

The disease strikes hibernating bats, bats that sleep through the winter in caves and mines, and of the Nation's 45 bat species, 25 hibernate. So more than half of our species in the United States are at risk.

It currently affects nine species, including two endangered species, the Indiana Bat and the Gray Bat. Losses are so severe that

researchers are predicting a regional extinction of the Little Brown Bat, which was once one of North America's most common mammals in the Northeast region, and in as little as 16 years.

Bats provide enormous benefits to humans, and their loss would have serious ecological and economic consequences. They are the primary predators of night flying insect pests, and are critical to maintaining the balance of nature.

A bat can eat to half to all of its body weight in insects each night, consuming huge numbers of insects that damage crops, such as corn, cotton, and potatoes. One million bats again is a conservative number of the amount that have died so far, and would have consumed nearly 700 tons of insects a year, which is a lot to lose.

The study published this spring in the Journal of Science, which you both mentioned, estimates the value of bats to the agricultural industry of between $3 billion and $53 billion a year, and those researchers believe that the agricultural industry will see impacts of this in as little as four to five years.

In additional to the crop losses, farmers will need to use more pesticides, which of course is an economic burden to them, as well as adding more pollutants to our environment. Bats also eat insects that damage forests, such as the Emerald Ash Borer, and that spread disease, such as mosquitos.

Another issue is that the population declines from White-Nose Syndrome could lead to listing more bat species under the Endangered Species Act or under state laws, which could cause further far-ranging economic impacts.

Already there have been several petitions for listing or status review, and many states are actively listing that species. So, regulations stemming from listing more bats could have economic impacts on many industries, including mining, defense, forestry, construction, transportation, tourism, and outdoor recreation.

The national plan for assisting states, Federal agencies, and Tribes, in managing White-Nose Syndrome in bats represents the first step in combating White-Nose Syndrome, and addressing the critical need for a national plan for this crisis.

We recognize that the details will appear in subsequent implementation plans developed by state and Federal agencies, but we must stress the implementation is urgent. We encourage the agencies to quickly identify detailed concrete actions for fighting White-Nose Syndrome and begin to address them.

But to do so requires funding, and the need for White-Nose Syndrome funding is increasing as the disease spreads. In Fiscal Year 2010, the Fish and Wildlife Service awarded $1.6 million for White-Nose Syndrome research through a granting process, for which the agency received $10.5 million in proposals.

So clearly the demand for research outstrips the supply. Also, the westward spread of the disease is sharply increasing the need for a Federal response and funding as well. Western states have a higher portion of public land than in the East, and beyond that, much less is known about Western bat populations, and the rugged terrain out West makes data gathering more difficult.

To this point, Fiscal Year 2012 is the first year for which BLM anticipates significant White-Nose Syndrome expenses, many of which will go toward surveying approximately 400 Western caves

and abandoned mines simply from baseline data on bat populations.

We recognize Congress' is facing difficult financial times, and so let me point out that monies spent on White-Nose Syndrome is a wise investment. Stopping White-Nose Syndrome now will reduce future expenses to the United States economy, resulting from pest impacts to agriculture and forestry, businesses impacted by additional bat listings, and the cost of listed species recovery. In this case, an ounce of prevention is truly worth a pound of cure.

Without the efforts of the Federal Government, White-Nose Syndrome will continue to spread across the country unchecked, killing even more bats, and consequential ecological and economical impacts will affect all of us as consumers, taxpayers, and residents of a planet further impoverished by biological diversity.

Thank you again for this opportunity to share Bat Conservation International's position on this serious matter. Thank you.

[The prepared statement of Ms. Fascione follows:]

Statement of Nina Fascione, Executive Director, Bat Conservation International

Chairman Fleming, Ranking Member Christensen, and members of the Subcommittee, thank you for the opportunity to submit testimony. Bat Conservation International (BCI) is a non-profit organization that conducts and supports science-based research, education, and conservation to ensure that bats will still be helping to maintain healthy environments and human economies far into the future. We are based in Austin, Texas, with a membership of more than 10,000 from all 50 of the United States.

WNS poses the gravest threat ever faced by U.S. bats. Since its discovery in 2006, the disease has killed well over one million bats. It is named for the previously unknown, cold-loving white fungus found on faces and wings of infected bats that is believed to cause the disease. WNS-infected bats awaken frequently during hibernation, burning the fat reserves they need to survive the winter. They often emerge early from hibernation, before the return of warm weather and insects, only to freeze or starve to death. The disease or its associated fungus has spread to 19 states and four Canadian provinces in the five years since WNS was first observed in a cave near Albany, New York. The Northeast has borne the brunt of WNS so far, but the disease or its fungus has spread as far south as North Carolina and Tennessee, and as far west as Oklahoma.

Biologists consider the WNS die-off to be North America's most precipitous wildlife decline in the past century. The disease strikes hibernating bats—those that sleep through the winter in caves and mines—and has affected every hibernating bat species in its geographic path. Of the nation's 45 bat species, 25 hibernate, and all of these hibernating species are potentially at risk of the disease. WNS or the fungus currently affects nine species, including the Federally endangered Indiana and gray bats, which could well be even closer to extinction as a result. Some WNS-infected sites experience mortality rates of almost 100%. Losses are so severe that researchers are predicting regional extinctions of the little brown bat—previously one of America's most common mammals—in northeastern states by 2026.

Bats provide many benefits to humankind. As primary predators of night-flying insects, bats are critical to maintaining the balance of nature. A bat can eat half to all of its body weight in insects per night, consuming pests that damage crops such as corn, cotton, soybeans, potatoes, and pecans. A recent article in the journal *Science* estimates the value of bats to U.S. agriculture ranges from $3.7 billion to $53 billion per year. Bats also eat insects that damage forests, such as the emerald ash borer, and that spread disease, such as mosquitoes. Some bat species pollinate crops and disperse seeds. Research of bat biology has yielded important chemical products, including a medication to prevent strokes. Bat droppings in caves support unique ecosystems, including microorganisms that could provide resources for detoxifying industrial wastes and producing pesticides and antibiotics.

The loss of bats would have serious ecological and economic consequences. The one million-plus bats killed by WNS would have eaten more than 700 tons of insects each year. With the bats gone, these insects are surviving to attack crops and forests. The authors of the *Science* article argue that, as a result of WNS, North Amer-

ican agriculture will begin noting economic losses within four to five years, with especially severe impacts to the Midwest and Great Plains regions. In addition to crop losses, farmers will need to use more pesticides, increasing the financial strain on farming families, raising the price of food for consumers, and releasing more chemicals into our environment. Bats are important predators, so their disappearance could have broad, ripple effects on the environment that we cannot yet assess.

The population declines from WNS could well lead to listing more bat species under the Federal Endangered Species Act, as well as state-level statutes, which would cause far-ranging economic costs. The Center for Biological Diversity has petitioned the FWS for listing of the northern long-eared bat and eastern small-footed bat because of WNS and other factors, while BCI and other organizations have requested the FWS to review the status of the little brown bat and to file an emergency listing of the species in the interim. At the state level, Ohio has designated four bat species as species of concern; Wisconsin listed four bat species as threatened; and other states, including New York and New Hampshire, are considering designations. According to the Government Accountability Office (GAO–06–463R), the average cost for recovery of an endangered species is $15.9 million. The highest estimate on record is $125 million to recover the whooping crane. Bat species affected by WNS have broad geographic distributions and complex ecological patterns, which would likely require very high recovery costs. Finally, regulations stemming from listing more bat species would have economic impacts on industries such as mining, defense, energy, forestry, construction, transportation, tourism, and outdoor recreation.

The Federal government recognizes how much is at stake from WNS and, in conjunction with state, local, and tribal agencies, academic institutions, and nonprofits, has mounted an admirable response to the disease. WNS and its associated fungus were unknown to science until discovered in New York, but since then, Federal dollars have enabled researchers at USGS and elsewhere to isolate, identify, and develop a test for the WNS fungus, to map its genome, and answer some basic questions about the nature, transmission, and diagnosis of the disease. The FWS, the lead agency for WNS response, coordinates government and other entities in order to maximize efficient use of resources, prevent redundancy, and facilitate an effective national response. In this role, the agency has funded scientific research and on-the-ground disease surveillance and management, developed recommendations to help prevent disease spread, and created the *National Plan for Assisting States, Federal agencies, and Tribes in Managing White Nose Syndrome in Bats* in collaboration with all involved Federal agencies, as well as State and other entities. Land-management agencies have been at the forefront in developing disease-monitoring techniques, gathering bat-survey data, managing resources to increase bat survival, and producing materials to educate the public about WNS. The NPS's Mammoth Cave National Park has developed a site-based response plan that is being used as a model for public lands throughout the country; USFS is testing ways to improve bat habitat to boost post-disease survival rates; and DoD is refining acoustical bat-monitoring methods. All of these agencies provide technical support to, and collaborate and pool resources with, State, Local, and Tribal agencies as well as academic institutions and non-profits.

The *National Plan for Assisting States, Federal Agencies, and Tribes in Managing White Nose Syndrome in Bats* represents a commendable step in combating WNS and addressing the urgent need for a national approach to our WNS response. BCI agrees with the overall framework described in this plan as a preliminary step toward guiding and coordinating WNS work nationwide. We recognize that details will appear in subsequent implementation plans developed by State and Federal agencies to meet specific needs, but we must stress that implementation is critical. We encourage the agencies to quickly identify detailed, concrete actions for fighting WNS. BCI is also pleased with the plan's acknowledgment that effective response requires adequate capacity. While we patiently await the development of permanent funding mechanisms, we emphasize that federal funding to fight WNS is desperately needed. We encourage agencies to include adequate funding requests in their FY2013 budgets to ensure that their response is not hampered by lack of capacity. Additionally, BCI: underscores the importance of involving the academic and professional conservation community (in addition to State and Federal employees) in developing the implementation plan; urges agencies to fund immediate and definitive research to determine relative risk of activities and establish levels of acceptable risk (for example, research on WNS transmission); encourages an extremely cautious approach to removing infected or uninfected bats from the environment, limiting bat access to hibernacula, and deploying treatments into natural environments; supports expanding outreach and education efforts to include all scientific and recreational communities that may pose a risk of transmitting fungal spores or

may expect to have their activities hampered by management decisions due to WNS; and applauds acknowledgement of the importance of collecting baseline data on bat communities outside the current WNS-affected area, and of assessing the ecological impacts that may result from dramatic losses of insectivorous bat populations.

Despite progress made by the Federal government as described above, the need for WNS-response funding continues and, in fact, is increasing. As the disease spreads, the number of entities involved and the scale of the response grows. While scientists have learned much about the disease, they cannot yet stop its spread. Critical research topics aimed at finding solutions include the susceptibility of different bat species to WNS, possible biological-control agents, and the disease-producing interface of the fungus, bats, and the cave environment. In FY 2010, FWS awarded $1.6 million for WNS research through a granting process for which the agency received $10.5 million in proposals. The demand for research funds clearly outstrips the supply. On-the-ground monitoring and management is required in both previously and newly infected areas. Overall coordination and communication is needed to ensure efficiency and the sharing of information and resources. The westward spread of WNS is sharply increasing the need for a Federal response. Western states have a higher proportion of public land than those in the East. Beyond that, much less is known about western bat populations than eastern ones, and the rugged western terrain makes data-gathering more difficult. To this point, FY 2012 is the first year for which BLM anticipates significant WNS expenses, many of which will go toward surveying approximately 400 western caves and abandoned mines for baseline data on bats.

Concluding from analysis of past WNS spending and disease-spread trends, we have urged Congressional appropriators to ensure that Federal agencies engaged in the WNS response receive $11.1 million to address WNS in FY 2012. The cross-agency need is broken down as follows:

FY 2012 WNS Needs

USFWS	USGS	NPS	BLM	USFS	DoD	TOTAL
$5,200,000	$2,400,000	$200,000	$1,000,000	$2,000,000	$300,000	$11,100,000

One can compare this to WNS spending from FYs 2007 to 2010 (we do not have reliable expenditure figures for FY 2011):

Estimated expenditures on White-nose Syndrome
(Note: BLM did not report WNS expenditures in past years.)

	USFWS	USGS	NPS	USFS	DoD	
FY10	3,690,000	345,500	207,000	1,815,000	206,300	**6,263,800**
FY09	1,790,000	334,000	162,500	890,000	5,000	**3,181,500**
FY07-08	3,200,000	575,000	162,500	N/A	N/A	**3,937,500**
	8,680,000	**1,254,500**	**532,000**	**2,705,000**	**211,300**	**13,382,800**

The increase for FY 2012 over FY 2010 expenses is $4,836,200, or 77%. We believe this ask is conservative and in fact will barely keep pace with the disease's spread. From 2007 to 2010, the disease moved from one state to 14, and from five sites to at least 157. From 2009 to 2010 alone, the number of affected states increased by 56%, and the number of infected sites by 78%. Overall, the number of affected states and sites increased by 50 to 100+% each year. This year, WNS has been confirmed in five new states, and confirmed or suspected in more than 30 new counties. A 77% increase in WNS spending from FY 2010 to FY 2012 is therefore clearly proportionate to the disease's expected expansion by the start of FY 2012.

Congressional support is critical for addressing WNS. Other funding sources are extremely limited. State budgets have been drastically reduced and, especially given the spread of the disease, Federal agencies' existing resources are not sufficient to meet the need.

Congress is facing a difficult financial climate, so we underscore the fact that money spent on WNS is a wise investment. First, preventing the spread of WNS will spare businesses the regulatory and other impacts of bat die-offs. Show caves—small businesses that provide jobs and contribute to local economies—could also be hurt by WNS. States with many show caves include Missouri, Pennsylvania, Tennessee, and South Dakota. In addition, implementing WNS response generates jobs. The USFS management of forests for bat conservation includes thinning stands of trees. The agency contracts with local businesses to harvest, haul, and process the

trees for timber. Finally, conducting WNS research, management, and prevention now will reduce future expenses to the U.S. economy resulting from pest impacts to agriculture and forestry, businesses affected by additional bat listings, and the cost of listed-species recovery. In this case, an ounce of prevention truly is worth a pound of cure.

An issue of debate in the WNS community is whether caves and abandoned mines should be closed to prevent or delay spread of the disease. BCI supports strong preventative measures to reduce bats' risk of WNS. However, the mechanisms of and risk for WNS transmission among sites is still not fully understood, and without this knowledge, it is difficult to evaluate the risks and benefits of cave closures as a disease-prevention tool. Given this state of knowledge, BCI advocates targeted regional or site-specific cave closures to reduce disturbance to hibernating bats, reduce the possibility of WNS transmission, and address other conservation priorities. As part of this stance, we support efforts such as combining research and monitoring activities into efficiently coordinated visits at hibernacula so as to limit disturbance to bats; following USFWS recommended guidelines for decontaminating clothing and equipment; and managing caves and mines through collaboration among natural-resource professionals, the caving community, the public and decision-makers at all levels of government. BCI also accepts the reality that agencies must sometimes make management decisions with incomplete scientific data. In such cases, an abundance of caution can be justified when the stakes are as high as they are with WNS. We understand that cave closures can impact cavers and other users, but we hope everyone can work together to achieve our common goal of stopping this devastating disease so we will not have to face such challenging decisions in the future.

Without the efforts of the Federal government, WNS will continue to spread across the country unchecked, killing even more bats than have already died. The consequent ecological and economic impacts will affect all of us as consumers, taxpayers, and residents of a planet further impoverished of biological diversity.

Thank you again for the opportunity to share BCI's position on this serious matter.

Dr. FLEMING. Thank you, Ms. Fascione. And next is Mr. Youngbaer.

STATEMENT OF PETER YOUNGBAER, WHITE-NOSE SYNDROME LIAISON, NATIONAL SPELEOLOGICAL SOCIETY

Mr. YOUNGBAER. Thank you, Chairman Fleming, Ranking Member Bordallo, and Members of the Committee. I appreciate the opportunity to return to speak with you about White-Nose Syndrome.

My name is Peter Youngbaer, and I am testifying on behalf of over 10,000 members of the National Speleological Society. This year, we are celebrating our seventieth anniversary as the Nation's oldest and largest organization dedicated to the study, exploration, and conservation of cave and karst resources.

The NSS and affiliated cave conservancies own and manage dozens of caves throughout the country, including endangered habitat and several affected with White-Nose. Along with our written testimony, we have provided you with an April issue of our society's NSS News, which includes several articles addressing many of the questions that you have asked of us today.

One of those articles features a joint photo and bat survey expedition of the NSS's West Virginia Department of Natural Resources, and United States Fish and Wildlife Service into Hellhole, West Virginia, and tells us several important things that we know about White-Nose.

Over 50,000 little brown bats died here, nearly half the population. In contrast, less than two percent of the Federally Endangered Indiana Bats showed signs of the disease, and the population had doubled.

The Virginia big-eared bats, also Federally endangered, showed no signs of the disease. Concurrent with observations elsewhere, we know that White-Nose affects bat species differently or not at all, and cave microclimates are a factor in disease development.

Finally, this cave is well fenced and protected by an electronic monitoring system. We know that no human has entered the cave since September of 2007. We know that bats transmit the disease, but after five years there is not a single documented case of human transmission.

We do not know what epidemiologists call the multiplicity of infection, how much fungus is necessary to infect bats. Disease transmission depends on critical mass of pathogens, sufficient hosts, and appropriate environmental conditions. A perfect storm.

This same fungus is widespread in Europe, but bats aren't dying. Thus, we still can't say for certain that this is the cause of the disease. Finally, we still have no treatment for stopping or curing White-Nose. Lots of substances kill the fungus, but can also kill the bats and other forms of cave life.

Even if a treatment were developed the logistics of treating millions of bats in more than 50,000 known caves, and hundreds of thousands of mines, are staggering. This suggests that our efforts may need to shift to recovery and conservation.

Bats are a fascinating and valuable part of our ecosystem, and you will hear about the potential effect the loss of bats could have on agriculture and forestry. However, there is already a known economic impact by White-Nose management.

The canceling of major caving events, and the closing of State Parks with paid fees for caves has cost the travel and tourism industry, and state coffers. The National Caves Association, a trade group for commercial caves, reports a depressed environment, where they are receiving calls asking if they are open, or worse, why are they open.

With revenues of more than $117 million and an economic impact effect of up to one-and-a-half times that, every new headline that trumpets "government closes caves" is harmful to commerce and does little to help bats.

Regarding funding, taxpayer money has actually funded a minority of White-Nose research to date. The first appendix of our written testimony is a summary of published White-Nose research put together by Dr. Thomas Koonce, of Boston University, who testified here two years ago.

Indeed, the NSS and BCI together have funded 32 projects totaling over $200,000. Fish and Wildlife states on its website that it has spent over $11 million on White-Nose, but only $3 million on research. This balance is wrong. There is too much bureaucracy and management and not enough hard science.

The White-Nose national plan has major problems. It is little more than a broad outline. It lacks any measures for evaluating whether any of the activities are working or not. It has no budgetary component or means of prioritizing in a restricted fiscal environment.

And finally being a Fish and Wildlife document, it is narrowly focused only on biology, and omitting other cave science and conservation concerns. Our second appendix contains our formal com-

ments on the draft, which changed little despite over 12,000 public comments.

Finally, we have seen no evidence that the blanket closing of caves and mines has done anything to slow or stop White-Nose. This should not be surprising. In the Eastern United States, the vast majority of caves are privately owned and open.

As Tom Aley, scientist and owner of the Ozark Underground Laboratory points out, closing only government caves is akin to fighting a forest fire by building a control line on only five percent of the fire perimeter.

Further, it is a strategy to be targeted only on underground bat habitat, and only at a potential, yet unproven, human transmission vector. These closures and calls for private landowners to do the same unfairly targets cavers and cave owners, and stigmatizes them as environmentally insensitive.

Further, they alienate natural allies and belay a 70 year history of collaboration and conservation. We ask for Congress' help. We need targeted, not blanket management, that is evidence-based and not speculation-based. We need significant increase in research funding, and we ask that Congress insist on hard science evaluative measures, and transparency and accountability.

And we ask that you listen to the people who know caves best. Thank you again for the opportunity to testify. I will leave you with our mottos. Cave softly, cave cleanly, take nothing but pictures, leave nothing but footprints, and kill nothing but time.

[The prepared statement of Mr. Youngbaer follows:]

Statement of Peter Youngbaer, White Nose Syndrome Liaison for the National Speleological Society

Chairman Fleming and Members of the Subcommittee. Thank you for the opportunity to return to speak with you today about the status of White-Nose Syndrome, or WNS.

My name is Peter Youngbaer, and I am testifying for the National Speleological Society as its Liaison on White-Nose Syndrome, a position I have held since April of 2008.

This year, the NSS is celebrating its 70th Anniversary as the nation's oldest and largest organization dedicated to the study, exploration, and conservation of cave and karst resources, protection of access to caves, responsible management of caves and their unique environments, and promotion of safe and responsible caving.

Our Conservation Policy states that Caves have unique scientific, recreational, and scenic values; that these values are endangered by both carelessness and intentional vandalism; that these values, once gone, cannot be recovered; and that the responsibility for protecting caves must be formed by those who study and enjoy them.

As we stated a little more than two years ago, our membership, numbering more than 10,000 in all fifty states, cares deeply about bats and the cave environment which is used at times by many of America's bat species. The NSS itself, and numerous affiliated cave conservancies, both own and manage dozens of caves throughout the country, including those managed as bat habitat. Some of our own preserves have been infected with WNS, and we have had to respond as land managers and conservationists.

The NSS operates under several Memoranda of Understanding with several federal agencies, including the U.S. Fish and Wildlife Service, the U.S. Forest Service, the Bureau of Land Management, and the National Park Service. Under these auspices, the NSS has provided thousands of hours of volunteer value time, labor, and expertise in identifying, surveying, mapping, studying, and protecting cave resources throughout the country.

Regarding WNS, we operate one of the most referred to websites on WNS. We provided funding for 13 WNS research projects, developed training videos on cleaning and disinfecting protocols, and developed outreach materials for educating both cavers and the public. These include the WNS brochures produced by the U.S. For-

est Service and the National Caves Association, the trade group of commercial, or show caves in the U.S. Our individual members have assisted with field surveys of bat hibernacula, summer acoustical monitoring surveys, and in the hard science research directly related to the fungus implicated in the disease, among many other activities.

We care deeply about bats. We use them as the universal symbol of caving. We also understand from decades of first-hand experience how they interface with the overall cave ecosystem, a key to developing appropriate and comprehensive cave conservation practices in the context of this disease, which affects just one user of the cave environment.

Current State of Knowledge

When we last testified to you, we were literally at the front end of this investigation. Much was unknown. No specific public funding had been dedicated to WNS. Management was taking an approach of "an abundance of caution." We were all scrambling to try to get ahead of the disease curve. We had just come from the second Science Strategy Meeting, held in Austin, Texas, that had spent three days prioritizing research needs for WNS, and developing a budget request that was presented to you and your appropriations colleagues.

Today, we still can't say for certain that the fungus *Geomyces destructans,* is the cause of WNS, despite it being implicated in some of the physiological effects of the disease, and with bat mortalities. It has been found on a few bats in the U.S. (Missouri and Oklahoma) without concurrent histology (no WNS). The fungus is also widespread in Europe, but again without the mass mortalities seen in some U.S. colonies.

We know that the disease is transmitted bat to bat. This has been proven in the laboratory (USGS), and the spread of the disease to bat colonies in many caves and mines which are gated and closed to public access demonstrates the efficiency of bat to bat transfer in the field.

There is no proof of any human transmission of the disease—by people, clothing, or gear.

There is a single, unpublished experiment in two mines where purportedly healthy bats from another state were placed into sites where the previous year's local bats had died from WNS. Nearly a quarter of the bats died at the outset, suggesting some trauma or adjustment issues, but others did contract the disease. This suggests that at least for some period, the fungus remains viable in the environment.

We do not know what epidemiologists call the Multiplicity of Infection (MOI) for the disease. How much of that pathogen (fungus) is necessary to infect a host? Disease transmission requires not only a pathogen, but a critical mass of that pathogen. It also requires a critical mass of hosts. One hypothesis, based on the European colony sizes, and observations at smaller sites in the U.S., is that the large, tightly massed colonies of certain species of bats help with disease transmission. This may mean that small bat colonies may not be vectors, or that small numbers of bats may die without significant impact. It also may have management implications for the Western U.S. where many known bat colonies are small and widely dispersed.

A third critical element for disease transmission is the environment. We have long observed a difference in WNS disease progression in caves and mines with varied microclimates. In February, 2010, a joint expedition of the USFWS, West Virginia Department of Natural Resources, and the NSS sent three teams of cavers, biologists, and photographers into Hellhole Cave, West Virginia's largest bat hibernaculum, and a more than 28-mile-long cave system. Thankfully, most bats roost within 3000 feet of the entrance—a dramatic 150' drop into a bell chamber.

Hellhole provided key information on a number of fronts. First, the population of Little Brown bats, *Myotis lucifugus,* was hard hit, as expected. Bats had been seen out and about on the winter landscape, a sure sign of infection. After the survey, we found nearly half the population had died—some 50,000 bats. However, several other species were doing well, including the federally-endangered Indiana bat, *Myotis sodalis,* whose population had nearly doubled to 10,000 in the three years since the prior survey. Although an estimated 1.7% of the bats showed signs of WNS, the population was clearly doing better than its cousins. These two bats tend to both prefer colder cave temperatures and higher humidity, but the species differences in WNS infection rates was striking, suggesting a genetic element to disease spread.

More striking, however, was the population of federally-endangered Virginia Big-eared bats, *Corynorhinus Townsendii Virginianus.* These bats showed no signs of WNS. They also roost in near freezing temperatures and low humidity. Unlike the *Myotis* species, they also have a different arousal pattern, suggesting their immune

systems may not be in as deep a torpor and are thus able to mount a more immediate immune response. The population had also doubled since the last survey, suggesting a very healthy colony.

Finally, Hellhole provided strong evidence that the primary method of WNS transmission is bat to bat. The cave entrance is privately owned, and has been fenced and equipped with electronic monitors for years. The last human entrance was in September of 2007.

I will be bringing with me to the hearing the April, 2011 Conservation issue of the NSS News, in which I report in detail on the Hellhole trip. There is also a second, longer article where I report on the overall status of WNS.

One other area of research and investigation bears highlighting, that of potential treatment of the disease. While there are literally dozens of substances that can kill this fungus, most of them will also kill the bat. Further, bats are a key element in a cave ecosystem, providing essential nutrients to other cave-dwelling creatures. Any treatment must also respect those species, some of which are also on federal and state endangered species lists.

Even if a vaccine or treatment were found to be effective, the logistical challenges of applying treatment to individual bats or colonies are staggering to contemplate. Caves can be immense and terribly complex. Bats can go places humans can't. Some treatments would need repeated applications. With more than 50,000 known caves in the U.S., and hundreds of thousands of mines, the mind boggles. It is highly unlikely that any mass cure or treatment will be found that could be effectively administered. If such treatment were developed, its application might best be focused on leading edge colonies or on small, declining populations of endangered species as a last-ditch effort, and as part of a longer-range conservation and recovery program.

The science that would inform such a recovery program is not there. While we are beginning to observe some population stability in sites that have been infected for three or four years, we don't know why these bats are surviving. This will take genetic and other study of the fungus and the disease progression itself, not simply field observation.

Why Americans Should Care

Bats are fascinating. They have provided us with knowledge of flight, echolocation, and medicine—such as the blood anti-coagulant in the saliva of vampire bats. More to the point, they are the primary nighttime predator of insects. Some of these insects are pests, such as mosquitoes, although most of these bats prefer larger, juicier prey, such as moths and beetles. Some of these are garden, farm, and forest pests, and also the transmitters of human diseases. Bats also are the primary source of energy and nutrients for cave ecosystems. Without bats, these unique environments and other species of animals are at risk.

How the loss of bat populations will affect agriculture, forestry and other industries in this country

One of the other witnesses will speak in detail to this subject, but the short answer is, we don't know. We would expect that with the loss of such a significant number of bats, the effects would be noticeable. However, nature abhors a vacuum. To what extent other insectivores, such as birds or other insects, would move to fill the void, whether populations would increase and then crash, and at what trigger point farmers and foresters would make decisions on the increased use and cost of pesticides, would require more research. Frankly, that's not where we would urge you to put scarce research dollars.

There is another economic impact that we believe is being overlooked by current management responses. Numerous caving events have been cancelled, causing a loss of travel and tourism dollars to the local economy. For example, the Carter Caves Crawlathon in Kentucky has been cancelled for three years running. Typically, 600 people would arrive in winter—the off-season—and take up otherwise empty motel rooms and campgrounds, shop, dine, buy gas, and more—a clear boost to the region. In Iowa, the Maquoketa State Park closed its popular family destination caves, resulting in annual paid visitation dropping from 250,000 to just 60,000.

The National Caves Association reports a depressed environment where people are calling to inquire if the caves are open, or worse, asking why they are open. In an economic impact report commissioned by the NCA, show cave visitation is more than 6.5 million visitors a year, with @ $118 million in revenues, and employing over 4,000 people. The economic multiplier effect varies by size of the cave operation, but ranges from 1.1 to 1.5 times the revenues. Every new headline that trumpets "Government Closes Caves" is harmful to commerce, and does little to help the bats.

How taxpayer money is being spent on various White-nose Syndrome grant proposals

Taxpayer money has actually funded a minority of the WNS research to date. An appendix to this testimony is a list of Peer-Reviewed Published Papers on or Directly Related to White Nose Syndrome. We think that speaks volumes about how the federal agencies have handled appropriations for WNS.

The NSS believes that far too much of the money spent on WNS has gone to the bureaucracy. This includes significant increases in staff, meetings, conference calls, and various plans and documents. U.S. Fish and Wildlife, for example has hired a national coordinator, assistant coordinator, press person, and at least seven regional WNS coordinators. USFWS states that over $11 million of their funds have been spent on WNS, with about $3 million for research. That's simply the wrong balance.

Further, our scientists and others are concerned that they do not know the criteria by which proposals are sought, reviewed, or awarded. In the first two years of the WNS investigation, the Albany conference and the Austin conference came away with clearly identified scientific research gaps and priorities. The Pittsburgh conference, in May of 2010, ended with no work product. There is nothing to date from this year's May Symposium. As a research grantor, the NSS relies on clearly defined science research priorities to allocate our precious grant resources. We do not have that any more.

In 1996, the U.S. Geological Survey was separated out as the scientific research arm of the Department of the Interior. We have been very impressed with their work and supportive of specific studies undertaken and the quality of their work products. We suggest that Congress consider USGS as the lead research entity for the WNS investigation. We believe the WNS investigation, the academic scientific community, and perhaps other federal agencies would benefit from such a focus.

The committee may be aware of appropriations requests for WNS research and other activities before other committees of Congress. These requests suggest appropriating funding directly to other agencies, as well as USFWS as a more efficient and accountable way to use taxpayer funds. Half the funds we advocated for two years ago ($1.9 million appropriated specifically for WNS) were used internally by USFWS; the rest weren't awarded to grantees until this past fall. The frustration of many in the scientific and caving community is palpable.

Thoughts on the WNS National Plan

The WNS National Plan was more than two years in the making, and is little more than a broad outline. USFWS itself says it's not the plan that is important, but the Implementation Plan that follows will be the living document. This means there is little to hold anyone accountable to, and the vagueness of the document provides an umbrella under which virtually anything can happen.

The NSS submitted more than eleven pages of formal comments to the draft posted in the Federal Register. These were prepared by numerous people with varied backgrounds in the cave sciences and planning and management. Our comments are the second appendix.

The final document changed little, and USFWS tells us that they will not post replies or discussion in the Federal Register, but will produce some other document. This is a disservice to the public, some 12,000 of whom replied. A discussion of the rationale for choosing what to change and what not should be provided for open, honest, and scientific debate.

There are three major problems with the National Plan. First, it is largely absent any measures for evaluation. How do we know if any particular strategy or task is working without assessment? How will we know when to stop doing something because it's not working, or do more of it because it is?

Second, the National Plan has no budgetary component. Sure there are lots of ideas about a website, database, research, management, etc., but no price tag. There is no prioritization or prioritization process. We believe this is unrealistic in the current fiscal environment, and frankly, renders the plan virtually meaningless.

Finally, as cave conservationists, the NSS is concerned that a plan that is essentially a U.S. Fish and Wildlife document is narrowly focused only on biology, due to the mission of USFWS. Yes, WNS is a biological phenomenon, but it takes place within a context. Caves are laboratories for studies in a variety of sciences—geology, paleontology, archaeology, and hydrology –just to name a few. A national plan that focuses management entirely on bats, without acknowledging the legitimate variety of needs and uses of caves is short-sighted in its vision, and in its probability of success.

How closing hundreds of caves and abandoned mines has helped to stop the expansion of this devastating disease

Simply put, it hasn't. The NSS strongly opposes the blanket closure orders that have been issued across the country. We don't believe there is any evidence that they have done anything to slow WNS. In March of 2009, when USFWS issued its caving advisory (still unrevised today), many in the organized caving community were willing to call time-out, stop caving, or reduce caving to non-bat caves or dedicated project caves.

The message was, we don't know what's going on, and we need to give science time to catch up to the disease to get some answers. That was two years ago. People have grown impatient as they have not seen science catch up, despite all our efforts and in the face of significantly short funding. Instead, we continue to see closure orders across the country, all in the name of an abundance of caution, and in the absence of good science.

As we stated earlier, after all these years there is no documented evidence of human transmission, yet all the management is targeted there. The agencies themselves state they can't stop the bats from transmitting the disease yet, but they can control people. But not all people. Show caves and government-owned commercial caves continue to operate. And privately-owned caves—the vast majority in the Eastern U.S.—remain open.

The NSS acknowledges the possibility that humans might be a transmission vector, but after five years, if this were done easily the disease would have spread far beyond its current boundaries. Indeed, looking back to the bat hibernacula map that BCI's Merlin Tuttle presented to the committee two years ago, the progress of the disease has clearly mirrored the natural movements of bats.

We also unfortunately believe there is an element of "defensive" management taking place, as state and federal agencies are under legal pressure from advocacy organizations to close all caves and mines and radically alter the Endangered Species Act and Federal Cave Resources Protection Act. That is not good management, good science, nor good public policy. We suggest that Congress look at how the legal system is operating and demanding of the time and resources of particularly the USFWS to respond to and sometimes settle with taxpayer dollars that would better be directed to WNS research.

Further, there is a strong feeling among our members that cave resources on public lands are there for the enjoyment of the people who own them and generations to come. The USFS talks about "multiple uses," and the National Park Service protects resources for the "enjoyment" of the public. As a sheer matter of fact, many caves are not used by bats, which can be quite particular about their roosts.

Our members have attended many meetings around the country working on state WNS response plans and with federal agencies. Often, the agencies say they feel they must "do something." But blanket closures are the typical response. Thankfully, in some areas, collaborative efforts have led to targeting of key bat roosts. Sheer numbers of caves and mines make this a far more practical, supportable, and affordable approach.

Blanket closures don't work. Knowledgeable caving organizations are aware of them, but many orders aren't followed up with signage, and little, if any expensive gating is done. Thus, we see unaffiliated people—locals, scouts, church groups, college outing clubs, etc. continuing to visit caves. While perhaps administratively attractive to issue a paper order, unless followed up with resources for enforcement, they are practically unworkable. We have seen vandalism and landowner reactions that fly in the face of good cave conservation. While there are quite a few great and long-standing partnerships between the NSS, cave conservancies, local grottos (chapters) and other affiliated caving organizations in some parts of the country, in others, agencies issuing closure orders have alienated their most natural allies, our members. Not only do the closures not work, they are counterproductive.

Similarly, closing caves and mines only addressed underground roosts. Bats also roost in buildings, in culverts, under bridges, and in trees. Attempting to contain a disease on only public lands, with little practical enforcement, only underground, and with a myriad of exceptions, and where the known predominant means of transmission is bat to bat, we believe is folly.

Arguments have been made that blanket closures can buy time, but continuing them where WNS has already marched through seems pointless. Implementing them where WNS is nowhere near seems equally futile. In those cases, if there is a human vector, the single best strategy is to inform any cave visitor—caver, tourist, or scientist—to leave any gear used in a WNS site at home.

The one area where an argument may still have some validity is on the leading edge of the disease. Enforcing cleaning and disinfecting protocols and temporarily

barring visitation, may temporarily delay the disease, but if the bats are going to get it, they will spread it, closure order or not.

Rather than continuing in this manner, and absent a major scientific breakthrough in treating the disease, we believe the most productive course of action may be to focus on the science and management of conservation and recovery. We may ultimately be able to do little to stop the disease from running its course, but we can focus on the survivors and doing all we can to help them recover and populations grow again. Funding research that targets understanding how and why those bats do survive should be a priority. Funding management actions that target significant habitat, both above and below ground, and mechanisms to enhance survivability would be critical. Let's not waste our efforts doing "something" that is of questionable value with negative collateral consequences.

Conclusion

These are tough times for some of our bats, and the NSS remains deeply concerned and committed to doing what is possible to help mitigate the impact of the disease. However, we do insist that the decisions on funding for research and management be based on hard evidence, and prioritized use of human and financial resources. The impacts of WNS have begun to be felt in the economy, both from the disease itself, and from our response to it. We may not be able to control the former; we can control the latter. We clearly need a better focus to our management decisions, and a way to objectively evaluate and prioritize those decisions. We also need a significant increase in funding for research. We ask that Congress insist on hard science, evaluative measures, and transparency in accountability.

Finally, we ask that you listen to the people who know caves best and have a 70-year history of working to study and protect our country's cave resources, including its bats. Working with the organized caving community has proven mutually beneficial, and continues even in this era of WNS. Examples include the NSS' Mammoth Cave Restoration Project—more than 20 years of critical work, the Fort Stanton Cave Study Project with the Bureau of Land Management, the Windeler Cave Project with the Western Cave Conservancy, which manages that cave for the U.S. Forest Service, and the Mark Twain National Forest work with the Cave Research Foundation, which has provided an immense amount of baseline research on many of the 600 some caves in that unit, including a recently-added WNS monitoring component.

Some of these efforts require cavers with certain levels of expertise in areas such as cartography, sciences, technical caving skills, and management, but others make use of interested people of all skill levels. That is key, for future cave scientists, world-class explorers, and even career wildlife managers come from the humble beginnings of a first step into a dark void. Maintaining access to that experience for future generations helps build an appreciation for the resource, and fosters the development of the conservation ethic that is needed to wisely protect both caves and bats.

Thank you again for the opportunity to testify. We'll leave you with our mottos, which reflect our long-standing conservation ethic and respect for our caves and the things that dwell within.

Cave softly. Cave cleanly.

Take nothing but pictures. Leave nothing but footprints. Kill nothing but time.

[A letter submitted for the record by Mr. Youngbaer follows:]

December 26, 2010

Dr. Jeremy Coleman
WNS National Coordinator
New York Field Office
3817 Luker Road
Cortland, New York 13045

Subject: Comments on Draft WNS National Response Plan—"A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats"

Dear Dr. Coleman:

On behalf of the National Speleological Society, Inc. (NSS), we are pleased to submit these comments on the Draft WNS National Response Plan—"A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats."

Overview

The NSS, founded in 1941, is a non-profit membership organization dedicated to the scientific study of caves and karts; 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. We are the nation's oldest and largest organization devoted to cave science, cave conservation, and cave exploration, with approximately 11,000 current members.

The NSS has a long track record of collaboration with federal and state agencies in the areas of cave protection and management and bat conservation. We were instrumental in the enactment of the Federal Cave Resources Protection Act of 1988. The NSS and its internal organizations, including cave conservancies, own numerous cave nature preserves, several with endangered bats and other endangered species, and manage them appropriately. Some of our own caves in NY and West Virginia include bats affected by White Nose Syndrome.

We have been intimately involved in the investigation of White Nose Syndrome (WNS) since its discovery. Our members have funded WNS research, through a special NSS grants program, and have actively participated in field work, laboratory research, management planning, and public education.

Consistent with our involvement to date, the NSS Cave Conservation and Management Section is submitting under separate cover a list of NSS members who are willing to serve on the various Working Groups identified in the Draft WNS National Response Plan. These individuals hail from across the country and provide expertise and experience in the Working Group subjects. This is a direct result of your meeting with us at our Convention in Vermont on August 3, 2010, and expressing the need for experts to participate on the Working Groups. We hope you will contact them as soon as possible to discuss the required work.

The NSS reviewed the U.S. Fish and Wildlife Service (USFWS) draft document "A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats" (WNS National Response Plan), dated October 21, 2010. We understand the USFWS prepared the draft WNS National Response Plan to provide guidance for investigation and management of White Nose Syndrome (WNS). The draft plan broadly identifies goals and action items, and outlines the roles of various agencies, to curtail the spread of WNS and to conserve species of bats.

The NSS reviewed the draft WNS National Response Plan for accuracy, completeness, and conformance with the following statutes:

- National Environmental Policy Act of 1969 (42 USC § 4321 *et seq.*)
- Endangered Species Act of 1973 (7 USC § 136, 16 USC § 1531 *et seq.*)
- Federal Cave Resources Protection Act of 1988 (16 USC § 4301 *et seq.*)

Although these statutes, referenced in the draft WNS National Response Plan, provide protections for wildlife and natural resources, the NSS finds no regulations, guidance documents, policy directives, or conventional standards issued to address the preparation or implementation of a national response plan covering bat mortality and other effects across multiple genera within the order *Chiroptera.* The scale of devastation from WNS appears unprecedented in the United States; therefore, the draft WNS National Response Plan is setting a ground-breaking standard for controlling and mitigating the destructive consequences of WNS.

The NSS has also reviewed the mission statements of all federal agencies which were represented in the plan preparation. These varied and potential competing mission statements are critical to enunciate in any final document in order for the American public to appreciate the competing interests of wildlife protection, scientific investigation in many fields, public understanding of natural resources, forest vitality, commercial activities, and recreational and other public use of our public natural resources.

While the draft WNS National Response Plan lists the various federal and state agencies that assisted in the preparation of the document, the document is of and by the U.S. Fish and Wildlife Service and is clearly a wildlife-centric document. USFWS's mission and statutory authority is not sufficiently broad to appropriately reflect all the legitimate interests that must be balanced in addressing White Nose Syndrome. We recognize that is not the fault of USFWS, but a limitation of its authority and mission. Were the draft plan jointly issued by the various federal agencies, we suspect a somewhat different draft plan would be before us.

Thus it falls to us, the NSS to raise these points. Bat conservation must be considered in the broader context of cave conservation, and even conservation in general. This includes protecting cave as well as bat resources, including groundwater, precious and beautiful formations, archeological and paleontological relics, and the diversity of cave biology beyond bats. It includes allowing other cave science and exploration to continue while WNS is being addressed. It includes educating the public

about bat and cave conservation, and it includes inspiring the next generation of Americans about the beauty, wonder, and value of caves and bats through appropriate exposure to them in the natural environment.

Any WNS National Response Plan needs to reflect this balance and be informed by it. Some real life examples underscore this necessity: Should a seismologist conducting vital underground geological research in a Missouri cave—a critical seismic area—be prevented from doing so because the cave may contain bats? Should fantastic cave formations that have stood for centuries of enjoyment be destroyed by vandals because conservation-minded cavers who normally monitor the site were kept away by management strategies? Should a commercial cave business be threatened with financial ruin, affecting not only the owners, but the community around them, as well as the lost opportunity to engage and educate thousands of members of the public?

All of these issues deserve to be reflected and balanced in the WNS National Plan. They must inform how action items are determined, and how scarce financial resources are prioritized. Addressing WNS does not and cannot take place in a vacuum. The draft WNS National Response Plan sections need to enunciate how these competing concerns are considered, weighed, and addressed.

The NSS offers the following general and specific comments to clarify the proposed plan.

General Comments

1. The WNS National Response Plan provides a broad program-level overview of the WNS problem, data needs, investigation methods, and response actions. At the program level, the plan divides the WNS issue into manageable components to be addressed through seven Working Groups. The plan provides Goals and Action Items for each Working Group without specifying the methods or implementation expectations to achieve the individual goals within the Working Groups.

Evaluating the progress on each Goal and Action Item may provide an assessment of the Working Groups and the status of each component in its relationship to the overall WNS issue. However, at the program level, the plan does not list any goals or objectives, and the only action specified in the document is the creation of the Working Groups. The overall goal (or mission statement) of the WNS National Response Plan is unclear and not stated. Without a clear definition of goals and expectations, how will performance of the national response be monitored and evaluated? What are the performance measures, and how will success of the national response be gauged? What is the exit strategy? Is there a time-table, or is this an open-ended initiative?

The WNS National Response Plan should be modified to clearly state the overall purpose and mission of the plan and to list goals and objectives for the program implementation of the plan. Explain how the goals and objectives will be implemented and how the overall purpose and mission will be achieved. Document and describe what efforts are needed at the national level, and outline the anticipated needs and actions at the regional, state, and local levels. Explain how these efforts will be coordinated; identify coordinating tasks; outline expected results; and, explain how the results will be monitored and measured. Define how the success of the National Response will be measured and assessed.

The WNS National Response Plan should include provisions to re-assess the planned responses on a periodic basis through evaluation and assessment of initial goals and other identified measures of success. How will we evaluate whether or not a specific research path is being productive? How do we measure whether a management strategy is working, or not, and whether to abandon, alter, or continue it?

2. The WNS National Response Plan focuses on relationships of Federal agencies with each other and with State agencies. The plan does not recognize the efforts or roles that private corporations, organizations, educational institutions, and even individuals are providing to the national response. For instance, individual NSS cavers first noted and reported the WNS issue to wildlife biologists. These same individuals and organizations already study, monitor, and provide forums for public presentation and discussion. The WNS National Response Plan should be modified to include a goal to establish partnerships with individuals and organizations that support bat conservation including, but not limited to, government agencies, conservancies, caving organizations, groups and individuals who are involved with bat conservation. Upon establishing these partnerships, the plan should call for coordinated efforts, possibly through the Steering Committee and the Working Groups, with the various groups and individuals involved with the national response. The Communication Working Group may be used to develop an organization chart and formalize lines of communication between Working Groups and between agencies and the various individuals and groups involved.

3. The plan states that a Steering Committee was formed to ensure coordination between Federal and State agencies. It is unclear who formed the Steering Committee, and the make-up of the committee is not identified. Clarification regarding formation of the Steering Committee is requested within the "Specific Comments" section of this letter. However, if the Steering Committee serves to oversee and coordinate the Working Groups as part of implementation of the national response, the NSS believes that stakeholder involvement with agency representatives at the Steering Committee level is desirable and necessary for success. Stakeholder groups, such as the NSS, carry enormous resource potential and knowledge base concerning all aspects of the WNS issue. We recommend including credible stakeholder groups on the Steering Committee to assist with coordination and implementation of the national response. The NSS stands ready to serve in such capacity with an established WNS liaison and working committee operating in all regions of the U.S.

4. The document does not provide a Reference Section. The facts presented within the document should be referenced to a source of the information. Please provide references within the document and list those references in a Reference Section.

Specific Comments

1. I. Introduction, Page 1, Paragraph 1. The introduction identifies WNS as a disease responsible for unprecedented mortality in hibernating bats. However, it is unclear who prepared the plan, under what authority, and to what standard. The introduction should be expanded to identify responsible agencies and parties and to explain the basis and organization of the document.
2. I. Introduction, Background, Page 1, Paragraphs 2ff. The plan provides a basic descriptive orientation to the WNS issue. However, the description is sparse with regard to information and specific details of the fungus *Geomyces destructans* and the disease White Nose Syndrome. The Background information section should be expanded to identify effects of the fungus and of the disease and to clarify the relationship of cause and effects. Include the historical development and current status of the disease.
3. I. Introduction, Background, Page 2, Paragraph 1. In describing *Geomyces destructans,* the plan characterizes the preferred environment for the fungus as "conditions characteristic of bat hibernacula." The conditions identified are common for the northeastern U.S.; however, bat habitats and hibernacula in southern and western areas of the U.S. may be warmer and drier than the preferred environment described. This fact may become a critical factor in controlling and mitigating the WNS issue. The text should be modified to clarify that conditions favorable for *Geomyces destructans* are most common in northern humid regions (such as the northeast).
4. I. Introduction, Ecological Significance, Page 2, Paragraph 3. This section summarizes the ecological significance of bats and the impacts of WNS to public health and the environment. However, the information does not explain the role of bats in the ecosystem. The discussion does not document the potential impacts of the disease to bats and only briefly states some of the resulting impacts to public health and the environment. Bats are an integral part of cave and karst ecosystems. Although the bats are directly affected by WNS, the resulting impacts put entire cave and karst ecosystems at risk or even into crisis. The discussion should be expanded to better identify the role of bats in the ecosystem and to provide additional information regarding potential impacts resulting from the demise of bats.
5. I. Introduction, The Planning Process, Page 2, Paragraph 4. This section justifies the need for a national response plan. The text lists the following factors as critical factors requiring a national response: (1) The mobility of bats, (2) The rapid spread of WNS, (3) The potential for human-assisted transmission, and (4) The severity of its (WNS) consequences. It is unclear whether the human-assisted vector of the disease is as much of a critical factor as bat-to-bat transmission or other environmental factors and vectors. If justification for a national response plan requires identification of disease vectors, the most important vectors should be identified with a clear plan to address those vectors. The text should be modified to justify the need for a national plan based on the severity and consequences of WNS. Any critical factors or vectors that require management under a national plan should be explicitly identified with an outline of required actions and mitigation.
6. I. Introduction, The Planning Process, Page 3, Paragraph 1. The plan describes authorities under the statutes referenced in this letter. It is unclear whether any guidance or regulations exist addressing national response

plans. If such documents exist, the plan should provide references and describe applicable sections and requirements.

7. I. Introduction, The Planning Process, Page 3, Paragraph 2. A. The plan outlines the historical development of collaboration between agencies responding to WNS. The text refers to early collaborations and formal requests. In order to understand development of the response to the WNS issue, these early work efforts and requests for assistance should be documented in the text with reference citation.
   B. The text indicates that the USFWS and U.S. Geological Survey (USGS) response to the requests for assistance includes advice to organizations and the scientific community "with appropriate expertise and authorities." It is unclear exactly what activities and expertise the USFW and USGS are providing under this plan. The discussion should elaborate what expertise, authorities, or other actions the agencies are providing as part of the national response.
   C. The text should be amended to read that it is "incumbent upon wildlife management agencies to **advise and consult** (emphasis added) non-government organizations and those in the scientific community with appropriate expertise and authorities to assist in mitigating this threat." The plan should recognize this is a two-way street, taking expertise where it is found.
8. I. Introduction, Origin of the Plan, Page 3, Paragraph 3. This section describes the formation of the Steering Committee. However, the text does not provide details regarding the make-up, functions, or activities of the committee. The section should be expanded to identify the Steering Committee and describe in more detail the committee's function and activities, including its authorities.
9. I. Introduction, Implementing the Plan, Page 3, Paragraph 4. A. The plan calls for State agencies to implement surveillance, monitoring, and management programs. It is not clear how implementation of these programs will be funded. The text states that federal agencies will provide tools and financial assistance when available. For States to successfully implement the plan, the expectations, methods, and funding must be provided to the states. Please explain these items within the plan and provide references for additional information.
   B. The Plan focuses on the States to implement the surveillance, monitoring, and management programs. However, it is not clear whether all States are technically and fiscally capable of establishing these programs. Will this approach result in 50 different programs? The Plan should consider development of the State plans and how the WNS National Response functions in relation to the States.
10. I. Introduction, Implementing the Plan, Page 3, Paragraph 5. This section of the Plan calls for general principals of epidemiology, ecology, and conservation biology to inform national response actions. The text mentions gains in knowledge about WNS and its etiology with large gaps still apparent. The plan should provide details regarding the understanding of WNS and the associated knowledge base. Who conducted the principal research, how did this occur, what do the results determine? Identify what gaps exist in our knowledge base and explain how these gaps are being addressed.
11. I. Introduction, Implementing the Plan, Page 4, Paragraph 1. A. The text refers to basic components of a standard outline for response plan, including objectives, management tools, management of contaminated environments, results monitoring, restoration plans, and budget. However, it is unclear where these components are in the WNS National Response Plan, including results and performance measures. The Plan should be modified to clearly address these components.
   B. The text suggests that funding is tied to the State Response Plans; however, it is not clear what funding is available. The text should specify the expectations for the State Response Plans and identify the funding available.
12. II. WNS Response Strategy, Page 4, ff. A. The plan outlines Human Health Implications, General Practices, and Elements of the National Plan. The Plan does not identify directives or mandates that the Plan is required to address. Furthermore, the goals and performance measures of the National Response Plan are unclear. The Response Strategy should explain how the directions from the Steering Committee are implemented. The WNS Response Strategy should be an extension of the overall goals and objectives derived from the steering committee. This section should describe in detail

the gaps in information, the necessity of collecting this data, what is hoped to be achieved, and how progress will be measured.

13. II. WNS Response Strategy, Human Health Implications, Page 4, Paragraph 3. A. This section discusses WNS human health risks. The text calls for "safe work practices and personal protective equipment" for bat researchers. The Plan does not outline or provide reference to applicable guidance on these matters. The discussion should identify safe work practices and reference appropriate personal protective equipment. Further, this section is silent on the dangers to humans from exposure to chemicals cleaning and disinfecting clothing, gear, and equipment. Perhaps the protocols themselves should be revised to include such information
    B. The Plan states that additional research is necessary to investigate potential WNS human health risks. The Plan should identify what areas of research are needed and how that aspect is addressed in the National Response Plan.
14. II. WNS Response Strategy, General Practices, Page 5, Paragraph 1. A. The Plan focuses on the human vector for disease transmission. However, it is unclear whether the human vector is as critical of a vector as bat-to-bat or other environmental vectors. The Plan should address other, and possibly more critical, vectors in an effort to curtail the spread of the disease.
    B. The Plan provides recommendations for field activities to prevent the spread of WNS. It is unclear whether either the USFW or the USGS is able to offer assistance for meeting and maintaining the recommended actions. The Plan should identify any assistance that the federal agencies can offer to States and Stakeholders affected by the WNS issue.
15. II. WNS Response Strategy, Elements of the National Plan, F. Disease Surveillance Working Group, Page 7, Paragraph 1. The stated purpose of this group is to develop standards for WNS surveillance. It is not clear who is responsible for coordinating data collection across the nation. The Plan should be modified to identify who will coordinate national data collection and by what means this data will be obtained, reviewed, and disseminated.
16. III. Action Plans, Page 7, Paragraph 3. The plan establishes Working Groups to address elements of the national response. However, certain specifics regarding the groups are missing from the description. What is the make-up of the Working Groups; how are they established; how will the efforts be coordinated; what are the expected activities and anticipated results? The National Plan should provide more detail concerning the Working Groups and whether Regional Subcommittees may be formed to address region-specific needs, goals, and issues.
17. III. Action Plans, A. Communication and Outreach, A.1. Overview, Page 7, Bullet 1. The National Response Plan acknowledges the investigative focus of Federal and State agencies researching the WNS issue. However, it appears that many private individuals, corporations, and organizations are also investigating the WNS issue. The WNS National Response Plan should recognize that non-government organizations are part of the investigative community. In order to make a broader appeal and a larger chance of success, the national plan should be modified to recognize the role of non-government organizations as part of a coordinated effort and capable of making substantial contributions.
18. III. Action Plans, A. Communications and Outreach, A.2. Goals, Page 8. A. The plan lists 4 goals for the Communications and Outreach Working Group. It appears that this group could provide a conduit of information between the Working Groups and outside audiences. The group may disseminate information gathered through the Working Group efforts into the WNS research database. In order to assist in this effort, it is suggested that the group create a single website where partner agencies and organization can post and access peer-reviewed publications and data. Information from all the Working Groups should be provided on this website.
    B. In addition to dissemination of information, an important part of communication is feedback into the national response. Currently, the WNS National Response Plan does not provide for external comments or observations back to the national response. It is suggested that the Communications and Outreach Working Group may provide for this 2-way communication through a website-based email contact and through other formalized lines of communication.
19. III. Action Plans, B. Data and Technical Information Management, Goal 2, Page 10. This goal appears to call on the Data and Technical Information Management Working Group to establish and maintain an information

website. While data collection and management is clearly the focus of this group, the NSS suggests that information dissemination, including website construction and maintenance may be better coordinated through the Communications and Outreach Working Group. Any databases maintained by the Data and Technical Information Management Working Group should be linked into the website.

20. III. Action Plans, C. Diagnostics, C.1. Overview, Page 10. The WNS National Response Plan focuses virtually exclusively on the relationship of *Geomyces destructans (G. destructans)* as the causative agent and White Nose Syndrome as the effect, as evidenced in the first statement of this section. There is strong circumstantial evidence for this cause and effect relationship. For instance, studies show that fungal growth on body parts is *G. destructans; G. destructans* is found in affected cave sediments but not in unaffected cave sediments. Also, bats placed in an affected mine acquired WNS. However, standard disease research practices require the Koch's Postulates be satisfied before establishing the cause-effect relationship. There remains a possibility that a bacterial or viral or some other agent may be the primary pathogen and that the *G. destructans* infection is secondary. The NSS is unaware of any research which infected bats from a pure culture of *G. destructans.* In fact, recent analyses show bats infected with *G. destructans* fungus but not the disease White Nose Syndrome. Unless Koch's Postulates are satisfied, research should continue into other potential primary pathogens and not a total focus of the national response to *G. destructans,* lest our total efforts are thrown toward the wrong causative agent. Until *G. destructans* can be shown to be etiologic in WNS, searches should continue for other agents. The goals under the Diagnostics Working Group should be revised to conduct or support research to satisfy Koch's Postulates to show the cause and effect relationship between *G. destructans* and WNS.
21. III. Action Plans, C. Diagnostics, C.2. Goals and Action Items, Goal 4, Page 11. The Action Item for this goal as stated is to work with the "Scientific and Technical Information Group." However, the Plan does not list a Scientific and Technical Information Group. If the intended reference is the Data and Technical Information Management Working Group, the text should be so modified.
22. III. Action Plans, D. Disease Management, D.1. Overview, Page 11. Some of the possible response actions include chemical or biological treatments. However, it is not clear whether there is a clear mechanism to evaluate these methods. Even after appropriate laboratory and field-scale pilot tests, the approach may not work or show unintended consequences. Is there a mechanism within the plan to determine this approach or treatment methods should be abandoned? The Plan should include an evaluation process for any selected treatment remedy.
23. III. Action Plans, D. Disease Management, D.2. Goals and Action Items, Goal 2, Page 12. A. This goal is to reduce the risk of WNS transmission to bats by humans. Implicitly, this goal supports research into WNS transmission by human-to-environment-to-bats. However, this aspect of data acquisition is not explicitly stated in the plan. As indicated by other goals for this working group, other vectors for disease transmission will likely be found to be more critical for control than the human vector. The plan should establish a mechanism or system to evaluate the various vectors with regard to their importance, feasibility for control, and cost or implications of control.
    B. The Action Items under this Goal focus on human interaction with the bat and cave environment. However, commercial trafficking in bat guano for fertilizer could spread the disease if guano con be a source of WNS etiologic agents (such as *G. destructans*). If bat guano proves to be a vector for disease transmission, then regulation is called for imports, exports, and interstate trafficking of bat guano. The Action Items under this goal should be modified to study or support research of the potential for bat guano to contain WNS infective agents and its role as a disease vector.
24. III. Action Plans, E. Etiology and Epidemiological Research, E.2. Goals and Action Items, Goal 1, Page 13. The stated goal is to review current knowledge to identify data gaps, and the listed Action Items cover expert review and research questions. A very critical aspect that should be a priority for the national response is to determine whether otherwise healthy individuals show evidence of exposure to *G. destructans,* and if so, do these individuals

produce antibodies and are these antibodies protective? This determination will require development of an enzyme-linked immunosorbent assay (ELISA) technique to detect the presence of the antibody in a blood sample. Recent studies show that apparently there are bats exposed to and carrying *G. destructans* that do not develop WNS. Developing an ELISA test for antibodies in bat serum against *G. destructans* will help answer several important questions, including whether bats can mount an immune response to antigens from *G. destructans.* Also, this test is important to determine if there are asymptomatic carriers who could be a reservoir for infection. All this information is critical in any attempt to manage the WNS disease. The goals under the Etiology and Epidemiological Research Working Group should be revised to conduct or support research to develop an ELISA test for *G. destructans* antibodies.

25. III. Action Plans, F. Disease Surveillance, F.2.Goals and Action Items, Page 15, Goal. A. The goal is to create a nation-wide disease surveillance program. As previously mentioned herein, the National Response Plan should identify funding this effort and explain how that funding is provided to the States. If there are elements or action items that necessary for implementation and funding of the surveillance program, these components should be list in this section.
    B. Action Item 3 is confusing as written. Perhaps this Action Item should be reworded "Integrate surveillance efforts and research with other subcommittees."
26. III, Action Plans, G. Conservation and Recovery, G.2. Goals and Action Items, Page 16, Goal 4, Action Item 1. The Action Item call for the group to work closely with the "Research Working Group." However, the Plan does not list a Research Working Group. The text should be modified to reference the intended Working Group.

The NSS appreciates this opportunity to comment on the draft WNS National Response Plan. The NSS welcomes any further discussion for planning or implementation of the national response. Please contact me for further discussion or to clarify any of these comments. My telephone number is (802) 272–3802, and my email address is wnsliaison@caves.org.

Sincerely,

Peter Youngbaer
NSS WNS Liaison

Copied to:
Gordon L. Birkheimer, NSS President
NSS Board of Governors

Dr. FLEMING. OK. Thank you for those words of wisdom, Mr. Youngbaer. Finally, Dr. Boyles, you have five minutes, sir.

STATEMENT OF DR. JUSTIN G. BOYLES, DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY, UNIVERSITY OF TENNESSEE

Dr. BOYLES. Thank you. Chairman Fleming, Ranking Member Bordallo, and Members of the Subcommittee, thank you for allowing me to testify today. I have conducted research on bats for nearly 10 years, and I have been involved with research on White-Nose Syndrome since shortly after it was discovered.

There are 45 species of bats in the United States, 42 of which are insectivorous. The bat species affected by the White-Nose Syndrome are the primary predators of night-flying insects, and the top predators and their respective food webs.

Insectivorous bats in the United States are well known predators of pest insects, including cotton bollworms, corn rootworms, spotted cucumber beetles, spruce budworns, cutworms, leafhoppers, and many others.

These pests attack a multitude of agricultural, horticultural, and forestry products, including from a long list: cotton, corn, potatoes, tomatoes, cucumbers, squash, melons, pumpkins, apples, strawberries, beets, roses, spruce, and fir trees.

Two studies illustrate must how many insects are consumed by bats. A study from Indiana, which was mentioned, reports that an average-sized colony of 140 big brown bats may consume on the order of 1.3 million pest insects each summer.

To put this in some perspective, there are roughly 20,000 big brown bats that roost in the buildings in Fort Collins, Colorado alone. A second study, this from the Northeastern United States, suggests that a single little brown bat may consume four to eight grams of insects each night during the summer.

Extrapolating these values to the one million bats that have died to date from White-Nose Syndrome means that between 1.5 and 3 million pounds of insects are going uneaten each summer in the area affected by White-Nose Syndrome.

Economic estimates of the value of bats are rare, but two studies from cotton dominated landscapes in Central Texas suggest that bats are worth between $12 and $174 per acre per year, and depending on a number of factors, including the density of crop pests in a given year.

While these values will obviously vary across the United States because of differences in the monetary value of crops, the amount of pesticides used, and the bat and insect communities in each area, a simple extrapolation of these values to the whole of agriculture in the United States suggests that bats may be worth between $3- and $53 billion per year to the national economy.

Importantly, bats have also been shown to limit herbivore in insects or by insects in both tropical and temperate forests. However, the estimates that I have just given you do not consider the value of bats to the forestry industry, nor do they consider the costs associated with the secondary effects of pesticide use on ecosystems and public health.

Thus, all available evidence suggests that bats are extremely valuable to the economy, and I would venture that bats are the most economically important non-domesticated mammals in the United States.

Regarding the closing of caves and mines, which has been an obvious controversial step in the management of White-Nose Syndrome, several people have argued that there is little or no evidence that exists that cave closures have slowed or will slow the spread of White-Nose Syndrome.

While this statement is factually correct, or may be factually correct, it is misleading because in my opinion, it is a proposition that is exceedingly difficult to test scientifically, and therefore it will be difficult to either refute or to support.

The evidence cited by other witnesses on the panel, among other quickly mounting evidence, suggests that human facilitated movements of *Geomyces destructans,* the fungus that we are talking about, are possible.

Human facilitated dispersal events may be disproportionately more devastating than bat facilitated dispersal events because of the distances that humans can move the fungus.

For example, even a single introduction of *Geomyces destructans* by humans into the Western United States could lead to the collapse of an entirely new bat community, a fate which is unlikely in the next 5 to 10 years given the current rate of expansion of White-Nose Syndrome.

Thus, in my professional opinion the risk of cave visitations to both ecosystems and the economy far outweigh the possible benefits, and I believe the cave closure policies currently implemented by Federal and state agencies are both warranted and prudent.

Finally, in the roughly five years since White-Nose Syndrome has emerged, researchers have amassed an impressive body of knowledge about the disease. Given the scale of the problem very little funding has been available, and we have done a lot with very little.

Still, large gaps remain in our understanding of White-Nose Syndrome, and many of these gaps are vital to the control of *Geomyces destructans,* and in conserving and restoring the populations of insectivorous bats. The only way to fill these gaps is through well targeted and well coordinated scientific research, a process that is unfortunately neither cheap nor quick.

To be frank, limited funding and a lack of coordination hindered our progress to date. The recently released national plan by the United States Fish and Wildlife Service addresses some of these shortcomings, especially those related to the communication between the various parties.

However, as is often the case, funding has been and will remain the most limiting factor in our research on White-Nose Syndrome. I believe the ecological and economic ramifications of a collapsing bat community are so severe as to warrant a larger investment of personnel and funding to develop a better understanding of this devastating wildlife disease.

Only with an increased understanding will we be able to develop solutions to the problem in time to make a difference. Thank you, and I welcome the opportunity to answer any questions.

[The prepared statement of Dr. Boyles follows:]

Statement of Justin G. Boyles, Ph.D., Post-Doctoral Research Fellow, University of Tennessee, Knoxville

Thank you for allowing me to testify today. I have conducted research on bats for nearly 10 years and have been involved with research on white-nose syndrome (WNS) since shortly after it was discovered.

There are 45 species of bats in the United States, 42 of which are insectivorous. The bat species affected by WNS are the primary predators of night-flying insects and are the top predators in their respective food webs. Insectivorous bats in the United States are well-known predators of pest insects including cotton bollworms, corn rootworms, spotted cucumber beetles, leafhoppers, cutworms, and spruce budworms, among many others. These pests attack a multitude of agricultural, horticultural, and forest products, including cotton, corn, potatoes, tomatoes, cucumbers, squash, melons, pumpkins, apples, strawberries, beans, celery, eggplant, beets, roses, and spruce and fir trees. Two studies illustrate how many insects are consumed by bats. A study in Indiana reports that an average-sized colony of 150 big brown bats (*Eptesicus fuscus*) may consume 1.3 million pest insects over a summer. Big brown bats are ubiquitous in the natural and man-made landscape—for instance, researchers estimated that approximately 20,000 big brown bats summer in Fort Collins, Colorado—meaning the species confers these benefits throughout our environment. A study from the northeastern United States suggests that a single little brown bat (*Myotis lucifugus*), the species most commonly affected by WNS, can consume 4–8 grams of insects each night during summer. Extrapolating these values to the 1 million bats that have died from WNS to date means that between 1.5 and 3 million pounds of insects are uneaten each summer in the area affected by

WNS. Economic estimates of the value of bats are rare, but two studies from cotton-dominated landscapes in central Texas suggest bats are worth between $12 and $174 per acre, depending on a number of factors including the density of crop pests in a given year. While these values will obviously vary across the United States because of differences in the monetary value of crops, the amount of pesticides used, the bat and insect communities in the area, and several other factors, a simple extrapolation of these values to the whole of agriculture in the United States suggests bats may be worth between $3 and $53 billion/year to the national economy. Bats have been shown to exert strong top-down control on insect populations in both tropical and temperate forests and importantly, these estimates do not consider the value of bats to forestry or secondary effects of pesticide use on the ecosystem and public health. Thus, all available evidence suggests that bats are extremely valuable to the economy and I would venture that bats are the most economically important non-domesticated mammals in the United States. While there are significant ecological and economic reasons to be deeply concerned about the impact of WNS on bat populations, in my opinion, we also should be concerned with bat conservation based on moral and ethical responsibilities to conserve our natural resources.

The closing of caves and mines has been a controversial step in management of WNS. While I agree that bats are likely the most common distributor of the fungus, I believe cave closures are both necessary and justified because evidence implicates human-facilitated movements. During my research, I have spent considerable time in caves and mines in the eastern United States. Therefore, I understand the draw of caving and sympathize with the standpoint of the National Speleological Society. However, as a scientist, I must respectfully disagree with their views on cave closures. They have argued that little evidence exists that cave closures have slowed or will slow the spread of WNS. While this statement may be factually correct, it is misleading because, in my opinion, it is a proposition that is impossible to test and thereby either support or refute. If *Geomyces destructans,* the fungus associated with WNS, is verified to have originated in Europe as the circumstantial evidence and emerging data on the genetics of the fungus suggest, human-facilitated movements are very likely the explanation for the appearance of *G. destructans* in the United States in the first place. Thus, long-distance movements of *G. destructans* by humans are likely possible. Further, research has shown that *G. destructans* can survive in and on clothing and caving gear, providing a possible path for long-distance, human-facilitated expansion of the disease. Human-facilitated dispersal events may be disproportionately more devastating than bat-facilitated dispersal events because of the distances humans can move the fungus. Even a single introduction of *G. destructans* by humans in the western United States could lead to the devastation of an entirely new bat community. Such a collapse is unlikely in the next 5 years given the current rate of bat-driven expansion of WNS. More than a dozen species of hibernating bats occur in the western United States and are currently unaffected by WNS. There may be natural geographic barriers to the movement of hibernating bats, such as the Great Plains, that limit bat-facilitated, but not human-facilitated dispersal of *G. destructans.* Further, cave disturbances are implicated as one of the driving factors behind historical declines in bat populations because they upset the delicate energy balance that bats must maintain to survive winter. Given that WNS also appears to upset this delicate balance, the added stress caused by cave visitation could compound the effects of the disease. Thus, in my professional opinion, the risks of cave visitations to both ecosystems and the economy far outweigh the possible benefits gained by relatively few people and I believe the cave closure policies currently implemented by Federal and State agencies are both warranted and prudent.

In the roughly five years since WNS emerged, a tiny number of researchers has amassed an impressive body of knowledge about the disease. Given the scale of the problem, very little research funding has been available to researchers and we have done a lot with very little. Still, large gaps remain in our understanding of the putative pathogen, the physiology of bat hibernation, and how the two interact to result in the patterns of mortality seen in WNS-affected populations. Many of these information gaps are vital to attempts to control *G. destructans* and conserve and restore populations of insectivorous bats. The only way to fill these knowledge gaps is through well-targeted and well-coordinated scientific research, a process that is unfortunately neither quick nor cheap. To be frank, limited funding and a lack of coordination have hindered our progress to date. The recently released National Plan by the U.S. Fish and Wildlife Service addresses many of these shortcomings, especially those related to communication between the various parties involved. However, as is often the case, funding has been and will remain the most limiting factor in our research on WNS. I believe the economic and ecological ramifications of collapsing bat communities are so severe as to warrant a larger investment of per-

sonnel and funding to develop a better understanding of this devastating wildlife disease. Only with an increased understanding will we be able to develop solutions to the problem in time to make a difference.

Dr. FLEMING. Thank you, Dr. Boyles, and again, excellent information. Again, I want to thank all of our witnesses for their valuable contributions to this hearing during National Pollinators Week.

This is an extremely deadly fungus, and I hope Federal, state, and local, and non-governmental organizations will continue to work together to find a way to stop the spread of this disease.

At this point, we will begin Member questions of the witnesses, and to allow all Members to participate and ensure that we hear from all of our witnesses today, Members are limited to five minutes for their questions.

However, if Members have additional questions, we can have more than one round of questioning, and often do. I now recognize myself for five minutes. Just some quick questions just so I can get a better understanding.

The organisms name is *Geomyces destructans*; is that correct, panel? And I am not sure who is best trained to answer this question, but I will take it from anyone, and Dr. Boyles certain seems to know a lot about the pathology of this, how does it actually kill the bat?

Dr. BOYLES. This is something that we don't know, and actually if I could defer. Dr. Blehert is probably the correct person to answer this question.

Dr. FLEMING. OK.

Dr. BLEHERT. Thank you. So that does represent an active area of research. When we initially discovered it, we described the fungus as a dermatophyte, which is as you probably know defines a fungus that infects the dead skin layer, the dead skin layer at the surface of the skin.

This fungus turns out to be quite different. It is actively invasive, and it invades and destroys living skin tissues. A recent publication put out by our group of researchers surmises that this fungus causes—well, we know that the focus causes devastating damage to bat wings.

Bat wings skin represents over 85 percent of the surface area of a bat. So the skin of their wings performs much more than just a simple barrier function. It is also critical for many physiological functions, ranging from water balance, passive exchange of air, and other gases, temperature regulation, blood pressure regulation.

And so we believe that it is at the heart of this disruption of these numerous physiological processes that are dependent on bat wings that are the mechanism of mortality.

Dr. FLEMING. OK. And I understand that this organism, the fungus, has been endemic to Europe, and that many, if not all, species have been resistant to it in the past, but yet we have, I understand, around 8 or 9 species here that are not resistant to it, and that die at a rate of almost 100 percent.

Do we have an understanding of why certain species and certain locations, geographical locations, that species and organisms are resistant to the organism?

Dr. BLEHERT. I think that it may come down to much more than just differences within the species themselves, but since all diseases involve an interaction between a pathogen, and in this case, *Geomyces destructans*, a bat host, and the environment that bats inhabit, I think what research will ultimately support is that bats inhabit different ecological niches within caves.

So, for example, a bat that inhabits a colder and dryer area may be less susceptible, compared to a bat like a little brown bat that inhabits a slightly warmer and very humid portion of the cave.

Additionally, as the number of bats decline, disease transmission dynamics change dramatically. There are fewer hosts available for the fungus. Hosts allow that pathogen to amplify, and so as the number of hosts is reduced, we are finding that our American bat populations, which were once quite numerous, are actually becoming more like the European bat populations, in which bats are less numerous, and further and fewer in between.

So it may be that not all of our populations will go to zero, and that we will see a much different topography with regard to hot bats persist with this fungus, much as they are seeing today in Europe.

Dr. FLEMING. Is that to say that the main host are the affected species?

Dr. BLEHERT. Yes. So, for example, we look at the little brown bat, which was once very numerous in these caves, is perhaps an amplifying species. The fungus grows to a certain degree in soil, but it grows dramatically on bats.

So in the presence of a lot of bats, you can go from very few fungal infectious agents to literally trillions, and then that agent remains infectious in the cave, and associated with soil, carcasses, et cetera.

And as carcasses are removed, or as they further deteriorate, those spores will ultimately—spore burdens should decrease over time.

Dr. FLEMING. I see. Have there been any attempts, from a research standpoint, to actually spray or treat with antifungal treatments in caves just to see if reducing the spores can actually make a difference in survival?

Dr. BLEHERT. There has been some work along those lines in the laboratory, but it is very difficult to transition some of these treatments from the laboratory to the caves. One of the very real concerns is that fungal diseases are on the rise among humans, and there are very few pharmacological compounds suitable for treating fungal diseases in humans.

So it perhaps could be very dangerous to widely broadcast these compounds in the environment, and then risk breeding resistance to these compounds among wild animals, or among fungi in the environment, and perhaps creating more super bugs that would pose a risk to humans. So there are a lot of unintended consequences that we have to consider.

Dr. FLEMING. And finally is there any natural predator for the fungus itself?

Dr. BLEHERT. I would imagine that there likely is if you make an analogy to chestnut flight. There are some what are call microviruses, and so viruses that can weaken the fungus, and it is sort

of a constant battle between the fungus, which can sexually recombine, and change, and the viruses have to keep up. But as was mentioned by Mr. Peña, biocontrol is another active area of research.

Dr. FLEMING. OK. Most interesting. Let's see. Next, I will recognize the Ranking Member for five minutes. And the gentlelady asked if we will have one round or more than one round, and we have three Members here. Mr. Wittman, what is your interest? Would you like to have a second round?

Mr. WITTMAN. I am open for multiple rounds.

Dr. FLEMING. As am I, and so if we don't get them covered the first time, we will come back around.

Ms. BORDALLO. All right. Thank you, Mr. Chairman. My first question is for Dr. Chavarria. What is the scientific basis for using bat cave closures to manage the White-Nose Syndrome? And is it possible that current closures have limited the spread of the White-Nose Syndrome?

And I know that a lot of these caves are on private properties. How successful have you been in closing those caves, and what percentage of those caves are still open? If you could answer that.

Dr. CHAVARRIA. Yes, Ms. Bordallo, and I am going to ask Dr. Blehert to elaborate on the cave closure. But you heard the Chair, and that the White-Nose Syndrome in Kentucky, and they have strong support from Kentucky private landowners to close caves.

The Park Service has allowed their managers at the regional level to close or not close their caves as necessary. The Service did close all of our caves.

Ms. BORDALLO. All of the public caves?

Dr. CHAVARRIA. Well, most of our caves are not open to the public. They are just open for research, and they are dedicated for protecting endangered bats.

Ms. BORDALLO. Doctor, if you can expand on that?

Dr. BLEHERT. With regard to the scientific basis, all infectious diseases—whether it is common cold viruses among children in day care centers, or *Geomyces destructans* among bats in a cave—involve a triad of interactions between an environment, and a susceptible host, and a disease agent.

And in the case of White-Nose Syndrome, the infectious agent is *Geomyces destructans*, and the environment is caves. We have shown in my laboratory that the fungus does remain viable in soil in the bottoms of caves, and so based on basic epidemiological principles, restricting people to move in and out of those caves provides a means to prevent the persistent and environmentally resistant spores that the fungus produces for the purpose of reproducing itself, both out of infected caves and into new sites, or into caves.

So it is a two-way street. It is not only preventing humans from accidentally introducing it to a site, but mounting molecular forensic evidence being developed by my laboratory collaboratively with other groups, indicates that the likely source of this fungus in North America is Europe.

And the most likely means by which that happened was through a human transmission event.

Ms. BORDALLO. So have you seen a decline?

Dr. BLEHERT. I think it would be——

Ms. BORDALLO. Since the closures?

Dr. BLEHERT. Right. I might defer to the Fish and Wildlife Service to answer that.

Ms. BORDALLO. Is there anyone who can answer that? Has there been a decline?

Mr. COLEMAN. That is a difficult thing to answer. What we have not seen since the management of cave closures was instituted was a major jump, and that is really what we are trying to target with this actions, is the creation of a new epicenter, far removed from the current locations of the disease.

So, for example, Oregon. If White-Nose Syndrome should suddenly show up there as a result of a human transmission, and so that is how we are measuring success. We have not seen that, and we know that the bats themselves are going to be capable of transmitting the disease and moving it increasingly westward than south, but we have not yet seen a major jump, which has been potentially signs of the effectiveness of the policy.

Ms. BORDALLO. All right. So your answer then is you really don't know if there has been a decline. Is that what I am getting at here?

Mr. COLEMAN. A decline in the transmission of the disease?

Ms. BORDALLO. Yes, recognizing that there are more bats infected with the disease since the closure.

Mr. COLEMAN. Well, we do know that it has been spreading, and that there has been an increase in the numbers of bats that are infected.

Ms. BORDALLO. So even with the closure of the caves then, it has been increasing?

Mr. COLEMAN. Yes, the bats themselves are able to move the disease.

Ms. BORDALLO. All right. Then how successful have you been with closing the private land, the caves that are on the private lands? Do you meet a lot of resistance from the private landowners in closing the caves?

There is a group of people that are out there for recreational activity looking at caves, and so I just wonder could you give me some idea? Are you coming up with resistance to closing the caves on private lands?

Mr. COLEMAN. Yes, I would say there is some resistance to that. There are people who are concerned about the loss of revenue as we have heard, and about the loss of recreational opportunities due to the closures of caves.

The Fish and Wildlife Service's position has been that this is the scientifically justifiable route to take, and the best thing to do to protect our bat species, and that is why we have recommended it.

Ms. BORDALLO. All right.

Mr. COLEMAN. I would refer to Dr. Gassett to specifically talk about the State of Kentucky.

Dr. GASSETT. Yes, Madam. In Kentucky on private lands, we have identified 80 private landowners that have what we consider significant bat habitat, and we sent letters to all of them to ask them to voluntarily close their caves, and only three refused, and so 77 of those 80 complied with the voluntary closure request.

Ms. BORDALLO. All right. So that is in Kentucky, right?

Dr. GASSETT. In Kentucky, correct.

Ms. BORDALLO. What about the other states?

Dr. GASSETT. I don't have any data on the other states.

Ms. BORDALLO. All right. I just want to get an idea of closing the caves and what resistance we are getting.

Mr. COLEMAN. Well, each state has come up with their own response plan, and many states I should say, and not everyone has one. In those response plans, they treat this issue differently based on whatever their priorities are in that state.

So some states, like Kentucky, have seen a lot of success in outreach with the public, and private landowners, and some states have not seen fit to close caves as a response to White-Nose Syndrome, and others have chosen a medium ground where they posed partial closures, but not close to all the sites, and it really depends on the state, because that is how they directed it to private landowners.

Ms. BORDALLO. Are all the states cooperating with advising these recreational activists that visit the caves about the situation, and the risks that they are taking?

Mr. COLEMAN. Well, again, each state has chosen a different approach to this, and so some states have been in favor of cave closures to control human transmission.

Ms. BORDALLO. But even if they are not closed, are there signs that you are entering this at your own risk?

Mr. COLEMAN. Well, again, the states have—it is up to their jurisdiction to put up signage and that sort of thing. So everybody handles it a little bit differently, and again there are several states who have interacted and several who have not.

Ms. BORDALLO. All right.

Mr. YOUNGBAER. If I might pick up on that question. This varies very widely. State agencies and Federal agencies have varying authorities over lands that they own or control, but very little over private land ownership.

You take a state like Tennessee, which has over 14,000 known caves, or Missouri, which has over 6,000 known caves, the vast majority are on private lands. Therefore, unless there is an Endangered Species present, and not subject to any government authority, all that can be done is to suggest.

There are many people who visit these caves, and landowners, private landowners, have private property rights, and tend to be a little weary of governments, and there are iterations of that all across the country.

People who visit caves are not just members of the National Speleological Society, but you have rock hounds, geocachers, scout groups, church groups, college outing clubs, and just locals, who know that the hole in the ground has been there for a couple of hundred years, and every Tom, Dick, and Harry in town has their signature up in the signature room in the back, and that is where you go to cool off in the summer heat.

These are not closed in a physical sense. These are closed by administrative orders in most cases on even the government lands. So, therefore, the bats are free to come and go, and transmit this disease.

And I think that is why Tom Aley, who I quoted in my testimony, basically says that this is like putting a fire line up for only five percent. It simply does not work in containing this disease.

Ms. BORDALLO. Thank you very much. You made it very clear.

Dr. FLEMING. Thank you. Mr. Wittman, from Virginia.

Mr. WITTMAN. Thank you, Mr. Chairman, and I wanted to thank the panel members for joining us today. It is a very interesting discussion, and a very timely topic. We have heard in the past that the population of bats—and I am assuming overall—has been affected by a reduction in population of an estimate of about a million.

I was wondering if you could give us what today's estimate is with the reduction in bat populations by this fungus? If you could give us some indication about which species might be most affected by this, and you had alluded to some of the species that are not affected by it.

But I would like to learn a little bit more about which species are, and is there a likelihood that any species would become extinct by this? We have talked about population dynamics, and some homeostasis being reached by bat populations in relation to response to this particular fungus, but is there one particular species, like the little brown bat, that could go extinct?

And I will leave it up to which panel members are most qualified to answer that question.

Mr. COLEMAN. Which species is most affected?

Mr. WITTMAN. Yes. Well, let's start with the question about what are the current numbers, as far as the total bat populations that are deceased based on an exposure to this disease, and current numbers, and your best estimate?

Mr. COLEMAN. The estimate that we generated before of over a million bats was based on approximation of an unknown number of bats, and the data that we had to show known declines in select known sites where data existed before and after White-Nose Syndrome arrived.

So it is actually very difficult to come up with a total number of bats when we didn't know what the total population looked like prior to White-Nose Syndrome. We are currently working on a way to come up with a new estimate for that, but what we can report on are known declines.

Again, in sites where we have pre-and-post White-Nose Syndrome data, and as many have quoted here, we are looking at numbers that range from about 60 percent to about 100 percent decline in bat populations at specific sites, and on a statewide basis, the numbers are consistent in affected states that have been infected for multiple years exceeding 80 percent in total populations by species.

So the number as I believe Nina mentioned earlier is likely much higher than one million bats, but we don't know the answer to that right now. We are working on it. The extinction, we have a modeling project that the Service funded a few years ago.

It was published in the Journal of Science that showed the likelihood of the extirpation of little brown bats in the Northeast within the next 16 years based on the declines that we were seeing, and

actually the declines have been exceeding the values that they used for that 16 year estimate.

So we could be looking at something much sooner than that for little brown bats, for example, which were up until now the most common bat in the Northeast. So there is a real potential, at least within the current range of White-Nose Syndrome, that that bat could disappear.

There are other species that are likewise affected. The Tri-Colored Bat, and the Northern Long Ear Bat, have also shown very grave declines as a result of White-Nose Syndrome.

Mr. WITTMAN. All right. Let me ask this. I know that The Smithsonian Conservation and Research Center has allocated some dollars to essentially establish a captive population of Virginia Long Ear Bats.

Can you tell us what the—or does anybody know what the current state of that particular effort is, and what may be the long term impact of that in relation to addressing this particular disease across all bat populations?

Mr. COLEMAN. We did initiate a program with The Smithsonian Institute a few years ago to look at captive propagation needs for the Virginia big-eared bat. They brought in 40 animals in 2010 to explore what it would take to house them.

And this gets to some of the things that came up earlier about ways that we can look at this from a conservation standpoint, and how to care for bats after White-Nose Syndrome goes through.

So insectivorous bats are notoriously difficult to maintain in captivity. There are only a few instances of certain species that have been successfully kept in captivity with the idea of propagation completely aside, and with very little success in propagating, or even keeping them in captivity.

So we initiated that program to look at what it might take to house Virginia big-eared bats in captivity, and at the time White-Nose Syndrome was basically on the doorstep of West Virginia.

We didn't know how that species was going to respond to the presence of the fungus. We anticipated the worst and thought that since there are very few sites that house major portions of that population, if White-Nose Syndrome arrived, we anticipated that it potentially could have wiped them out.

There are only some 20,000 individuals alive as far as we know at this point. In that program, most of those bats did die over time, but it was a successful program, and we did learn a considerable amount through that exercise.

There are still two bats remaining in captivity. They were successfully kept over the winter of this past year, and they came out of hibernation, and they are eating very well I am told, and are actually doing quite well in captivity. The question we are having now is what do we do with those last two, and we are working on that issue.

Mr. WITTMAN. Very good. Thank you, Mr. Chairman.

Dr. FLEMING. I thank the gentleman. I have a couple of more questions. Are there other questions? OK. Well, I will go ahead and ask a couple of questions, and then open it up for the Ranking Member.

You know, whenever you have an epidemic such as this among human or animal populations, you tend to find that there is a subpopulation, and that for whatever reason is resistant to that disease, or they at least survive.

And so my question is are you seeing that among some, if not all, of the species of bats? Certainly that would give us some encouragement in terms of the possibility of extinction, and certainly over time they could reproduce as a resistant population.

And ultimately evolve themselves into healthy, and hearty, and resistant to White-Nose, which is kind of what I was touching on when I mentioned about Europe and some of the other species. So I would love to hear what you have to say about that.

Dr. BLEHERT. So, yes, and I don't have access to all of the detailed site specific data with regard to population persistence, and while there are reports of some populations disappearing, there are reports of others that decline, and then maintain a smaller number of animals.

And so I believe that there are a number of means by which that could happen, either by the development of an immunological resistance, or also by selection for behavioral traits that provide certain bats with the ability to weather this disease, even in the absence of their immune system, which is known to become naturally suppressed during hibernation, and may be part of the problem that led to the emergence of this disease, and is one of the major problems in managing it.

So as I said previously, we may see rather than populations disappearing, that our bat population demographics become more akin to those that we see today in Europe; small populations persisting more in isolation, as opposed to massive caves full of millions of bats.

Dr. FLEMING. Well, is that to say that maybe this fungus, or some other, may be the reason why we see a little different behavior between the populations in Europe, versus here, that may be—that what is happening there is really the fact that whatever is going on happened there first, and really instead of seeing extinction, we will just see smaller and more isolated groups? I think that is kind of what you are suggesting?

Mr. COLEMAN. Yes, it is very possible, and one of our projects is doing a molecular forensic analysis of rates of genetic change in fungal isolates from bats from North America and Europe.

This work is being done by the laboratory with Paul Keim, who works for the FBI, for example, to do molecular forensic work back at the beginning of 2000 with regard to anthrax letters, for example.

But given enough isolates, we may actually be able to construct a history with regard to how long the fungus has been in Europe, and how it has dispersed over Europe, even to the point of pinpointing a source for how it came to the United States. So that will provide us some more information about that natural history.

Dr. FLEMING. All right. Now, when you talk about humans being the potential vector of this, I don't think you are really meaning that somehow that they have become temporary hosts, but perhaps on their shoes, or on some of their gear, and that sort of thing?

Mr. COLEMAN. Yes, it would be inadvertent mechanical transmission.

Dr. FLEMING. And so is there a treatment perhaps for that equipment that we could educate our backpackers, and our cave explorers, that when you finish your work in one cave that you put your gear through a certain treatment process that may be very helpful in this?

Mr. COLEMAN. Yes, I absolutely think that is the case. There are certainly elements to the White-Nose Syndrome response that is beyond our control, and others that are within our means, and those within our means include regulatory measures, like site closures, decontamination procedures, which the Fish and Wildlife Service has instituted and recommended, as well as dedicated gear recommendations.

And these are the same procedures that are used to control the spread of agricultural or human diseases, and serve as the very basis for why when you come back from another country the customs agent asks you if you visited a farm.

Dr. FLEMING. Mr. Youngbaer, is this a methodology that we could pursue that would allow us to begin opening up our caves perhaps?

Mr. YOUNGBAER. Well, very much so, and in fact, we have been very much involved working with Fish and Wildlife in the development of those protocols, and one of our scientists, a leading microbiologist at Northern Kentucky University, has been very much involved with testing materials, and treatments, and refining those protocols, which have existed for two-and-a-half or three years.

We promote those through training videos. There is an element of safety for people because you are involving chemicals in the treatment of your gear and equipment, and this goes for biologists who were working directly in the handling of bats, and some of the surveillance and monitoring, as well as people who visit caves.

But I can tell you that that is probably limited to the organized caving community who is within this loop of knowledge and network. It is very difficult to get it out to a lot of the other publics.

I serve as the vice president of the Northeastern Cave Conservancy, and we have a cave with a kiosk which has White-Nose Syndrome protocols that we educate literally thousands of youth group visitors, camps, that come and visit these caves.

They learn safe caving techniques, and they learn about White-Nose Syndrome, and they learn about the potential of human transport. I think that we all admit that there is a potential for human transport, but there is little evidence that that has actually occurred.

Dr. FLEMING. What is the nature of the treatment?

Mr. YOUNGBAER. Well, for example, you need to remove and wash, typically with Woolite, which is a very excellent surfactant to remove all organic material, because the bleach or Lysol IC compound that you then use interacts with the organics, and so you need to make sure that they are clean before they are then treated.

There are a range of different treatments. Some are available in the laboratories, and some you can do in the field, and some of them are boiling water for 15 minutes will kill the fungus, and then you rinse.

Depending on whether it is soft material or hard material, there are different ways that you can treat that. We have major regional caving events. We set up large decon stations, and we do that at our national conventions. We do that at regional events.

That is something that we have been doing for years, and have developed in concert with U.S. Fish and Wildlife.

Dr. FLEMING. Would this open the way perhaps to a permitting process, and therefore allowing only those people who have a permit that perhaps paid for such permit, and have demonstrated knowledge, and perhaps have been through a course, so that we would only have people who are properly trained in these decontamination processes that would have access to caves?

Mr. YOUNGBAER. In fact, in a number of the government-owned and -managed sites, that is the current practice. If you are doing a permit on a BLM cave, or National Park cave, or Forest Service cave, that is required, as it is today.

Dr. FLEMING. OK. Very good.

Dr. CHAVARRIA. Mr. Chairman, may I add something?

Dr. FLEMING. Sure.

Dr. CHAVARRIA. Within the Department of the Interior and the National Park Service, they have a lot of recreational caves that are visited by millions of people every year. So, through education, which is a big component of the national plan, we are already educating a lot of the people that are visiting these caves.

And we have control of who comes in and out of the caves, because they pay for a ticket, and so education, not only with the cave experts, but also with the general public, has become a critical piece of the plan.

Dr. FLEMING. Right. Thank you, and I yield to the Ranking Member.

Ms. BORDALLO. Thank you, Mr. Chairman. I just have a couple of questions. First, for Dr. Boyles. If some bat species are not affected by the White-Nose Syndrome, or even are thriving in its presence, then why should we worry about other bat species dying?

Dr. BOYLES. I guess the simplest answer to that is that not all species are equivalent. If we just talk about the agricultural impacts, each species has a different diet. Some of them are moth specialists, and some are beetle specialists.

So conserving the moth specialist does little to affect the beetle populations, for instance, and each species is different. And specifically regarding White-Nose, I think the important part is the species that is being affected, and that is the little brown bat as we have heard.

So we are seeing huge collapses in a very common species. The species that were mentioned a bit are doing well, and are all endangered or have small populations anyway. So we are not even seeing a one-to-one replacement of individuals from the common species, a common species crashing, and the not so common species doing well as of right now.

Ms. BORDALLO. A followup. Can you comment on the role that insect eating bats play in the ecosystem, and if other animals would be able to fill this role?

Dr. BOYLES. Sure. So, bats are the primary and in many cases the only predator of nighttime flying insects, many of which are

pests. Even the ones that aren't pests to humans, are still important in ecosystems.

Unfortunately, there really isn't any other natural alternative to bats. The are a few birds that are nocturnal insectivorous, Whippoorwills and things of that sort. But they tend to be rather uncommon.

They are much more limited in their foraging and will not—most likely will not be able to replace the bats, no.

Ms. BORDALLO. Thank you. And, Ms. Fascione, are there examples of caves where bats are the main attraction, and what might be the economic impact if these bats died from the syndrome?

Ms. FASCIONE. Yes, there are many examples of caves where bats are the main attraction. Carlsbad Caverns National Park is perhaps the best known example, where millions of people have been educated and have come to appreciate bats over the years.

But in these White-Nose Syndrome-infected areas, there are many cases where—and as in my home state of Pennsylvania, they have many, many caves that even advertise their visits. The commercial caves, state-owned caves, and the Federal caves will advertise for bats.

And so really they are small business owners, and families, that run some of these commercial caves that rely on the bats to bring in tourists.

Ms. BORDALLO. What is the percentage of caves that are problematic generally, the syndrome is there, and versus those that are free of any of this fungus or disease?

Ms. FASCIONE. Well, researchers are monitoring this, and——

Ms. BORDALLO. I mean throughout the United States.

Ms. FASCIONE. Right. It is being monitored county by county, and it is spreading. So even though, for example, Pennsylvania went through the White-Nose Syndrome a few years ago, each year, and in fact in Maryland, this year there were additional counties that were impacted.

So I don't know, and I don't know if anybody has a percentage of the caves.

Ms. BORDALLO. A percentage of all the caves throughout the United States and Canada that are affected.

Mr. COLEMAN. I can't answer that question, but what I can tell you is that we have 190 sites that are known to be affected at this time, and there are thousands and thousands of sites.

Ms. BORDALLO. So it is a small percentage, but still spreading?

Mr. COLEMAN. Yes, that's true, but one of the other things that is important to know is that many of these sites have never been visited. We don't know where all the hibernacula are, and we don't know if—well, we see and diagnose White-Nose Syndrome in a cave based on the bat populations that are there, but as Dr. Blehert said earlier, the fungus could be in these sites. And it could serve as an environmental reservoir for the infection, and even though bats aren't there in the wintertime, and if they only use it transiently, or if people come in and pick it up from those sites and transport it.

Ms. BORDALLO. Well, Mr. Chairman, I don't have any further questions, but I do think that we have to proceed with finding a solution to this problem.

Dr. FLEMING. I quite agree, and that concludes our questions today. We have had a great panel, and very informative, and we certainly thank you for that. Members of the Subcommittee may have additional questions for the witnesses that they may want to submit in writing.

The hearing record will be open for 10 days to receive these responses. Finally, I want to thank the Members and Staff for their contributions to this hearing. If there is no further business, and without objection, this Subcommittee stands adjourned. Thank you.

[Whereupon, at 11:38 a.m., the Subcommittee was adjourned.]

[Additional material submitted for the record follows:]

Peer-Reviewed Published Papers on or Directly Related to White Nose Syndrome

Compiled by

Thomas H. Kunz, Ph.D.
Director, Center for Ecology and Conservation Biology
Department of Biology
Boston University
Boston, MA 02215

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Published (and In Press) Research on or Related to White-Nose Syndrome Supported by the Department of Interior (National Park Service, Office of Surface Mining, U.S. Forest Service, and U.S. Fish and Wildlife Service, U.S. Geological Survey)

1. Blehert, D. S., A. C. Hicks, M. Behr, C. U. Meteyer, B. M. Berlowski-Zier, E. L. Buckles, J. T. H. Coleman, S. R. Darling, A. Gargas, R. Niver, J. C. Okoniewski, R. J. Rudd, and W. B. Stone. 2009. Bat white-nose syndrome: an emerging fungal pathogen? Science, 323:227.
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1. **Kunz, T.H**., J.T. Foster, W.F. Frick, A.M. Kilpatrick, G.F. McCracken, M.S. Moore, J.D. Reichard, D.M. Reeder, and A.H. Robbins. 2011. White-nose syndrome: an overview of ongoing and future research needs. Pp. 195–209. In: Proceedings of Protection of Threatened Bats at Coal Mines: A Technical Interactive Forum (K.C. Vories and A.H. Caswell, eds.). USDOI Office of Surface Mining and Coal Research Center, Southern Illinois University, Carbondale, Illinois.

2. Lindner, D.L., A. Gargas, J.M. Lorch, M.T. Banik, J. Glaeser, **T.H. Kunz**, and D.S. Blehert. 2011. DNA-based detection of the fungal pathogen Geomyces destructans in soils from bat hibernacula. Mycologia, 103: 241–246.
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Published (and In Press) Research on White-Nose Syndrome Funded by United States, European, and Canadian Academic Institutions, Non-Government Organizations (Bat Conservation International, The Eppley Foundation, National Speleological Society, Morris Animal Foundation, and The Woodtiger Fund).

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