

COPING WITH WHITE NOSE SYNDROME

By David J. Thomas, Ph.D.

By now, most cavers have heard of White Nose Syndrome (WNS). WNS is a fatal disease of hibernating bats characterized by white fungal growth around the nose, wings and other parts of the body. WNS was first identified in an upper New York cave in 2006. Since then, around 500,000 bats have died. A newly described¹, cold-loving fungus of the genus *Geomyces* causes the “white nose” on affected bats (see photo page 9). Many species of *Geomyces* are found in cave soils and elsewhere, but the new strain associated with WNS is genetically and morphologically different from the more common types.

About 90% of WNS-affected bats show external infection by the fungus, but it is still unclear whether the fungus is causing the bat deaths, or it is a symptom of an underlying disease. All of the dead bats are severely emaciated – their fat reserves are completely depleted. Something about WNS causes bats to emerge early from hibernation, but without insect prey, the bats starve.

The pattern of infected bat hibernacula strongly suggests that bats directly transmit WNS to each other along migration routes. Infected bats may leave infectious agents within hibernacula where other bats can become infected without direct contact with infected bats. Finally, there is the possibility that cavers could be carrying WNS from cave to cave. In my opinion, this seems the least likely contributor to the spread of the disease, but nobody wants to be the cause of the spread of this disease.

Since state and federal agencies are required to do whatever is reasonably possible to uphold the Endan-

gered Species Act and other environmental protection laws, they are taking precautions to limit any possible transmission of WNS by cavers. In most cases, this has meant cave closures on federal and state lands. See the inset on page 5 for a list of current Arkansas cave closures. Other public or private caves in the state are still open, but subject to the USFWS-recommended restrictions. Both the NSS and the Little Rock Grotto have officially endorsed these restrictions.

Please observe all cave closures and advisories in all states. Some states have instituted closures and issued advisories beyond normal permanent and seasonal closures. Before caving anywhere, check <http://caves.org/WNS/index.htm> for updates to decontamination procedures and a list of closures. If this web page does not include closure information from a state in which you plan to go caving, contact that state’s wildlife agency to obtain the latest information on cave access. Before caving in another country, check with that country’s wildlife agency for information on cave access.

The USFWS defines “affected states” as those with known instances of WNS and “adjacent states” as any state sharing a physical border with an affected state.

Affected states as of 2009-06-09: Connecticut, Massachusetts, New York, Pennsylvania, Vermont, New Hampshire, New Jersey, West Virginia, and Virginia.

Adjacent states as of 2009-06-09: Rhode Island, Maryland, Delaware, Ohio, Kentucky, Tennessee, and North Carolina.

Upon exiting a cave (whether inhabited by bats or not), cavers should follow the recommended containment and decontamination procedures. Decontaminate all clothing, footwear, and gear prior to departing for a caving outing if these items were not decontaminated after last exiting a cave. Gear that cannot be decontaminated or disposed of (e.g., if harnesses, ropes or webbing cannot be decontaminated), should not be taken into caves or parts of caves that require their use.

Because clothing, footwear and gear used in accessing a WNS-affected cave within the past 3 years could pose a risk of spreading WNS, the Service advises that these items not be used when accessing caves anywhere and that these items not be transported until the cause of WNS is identified and the effectiveness of decontami-

1 *The fungus has been named Geomyces destructans; the original paper is available at http://botit.botany.wisc.edu/toms_fungi/147gargas9-73.pdf*



Closure status of Arkansas caves
(current as of 2009-06-22):

- As of July 1, all Buffalo National River caves will be closed to all caver traffic, including Fitton Cave.
- All US Forest Service caves are closed for a minimum of one year, with the exception of commercial tours at Blanchard Springs. This includes the Sylamore regions we have been surveying and cataloging with our AACS work weekends.
- Devil's Den State Park has closed Farmer's Cave and Big Ear Cave.
- The most recent response from Arkansas Game & Fish regarding the Madison County WMA (Whippoorwill, etc) suggests that this area may close in the near future, but presently remains open.
- The Nature Conservancy elected not to provide a permit for the Memorial Day weekend at Sherfield's Cave; this cave is closed until further notice.

LRG and the NSS request that cavers honor closures.

nation procedures can be evaluated. Cavers should decontaminate these items immediately (see decontamination procedures below) and store them away. Any surfaces with which these items may have come into contact (e.g., car trunk) should be thoroughly washed and decontaminated.

USFWS asks that all cavers carefully clean their gear and wash their clothing after each cave visit. At first, bleach was recommended for cleaning everything, but it was soon apparent that the active ingredient in bleach (sodium hypochlorite) could damage most cave gear. Currently, USFWS recommends the procedures outlined at <http://www.fws.gov/northeast/whitenose/FINALContainmentandDecontaminationProceduresforCaversJune2009.pdf>. See page 7 for a reprinting of the suggested procedures from the USFWS "quick reference guide for cavers."

Be careful when choosing disinfectants. Many manufacturers tout "antibacterial" products. However, we don't know whether the causative agent of WNS is bac-

terial, viral, fungal, protozoan or even chemical. Ideally, the disinfectant should work against many different microorganisms. Personally, I use a hospital disinfectant called "Professional Amphyl® Bulk Hospital Disinfectant Cleaner." It's not the easiest product to find (Office Depot sells it for around \$30 per gallon), but a little goes a long way. The concentrate is normally diluted to one or two percent. The diluted solution can be added to a spray bottle and used for surface disinfection and cleaning. A small amount of concentrate also can be added to laundry for disinfection of packs and pads (and even clothing). Amphyl® contains phenolic compounds mixed with potassium hydroxide, and it is certified effective against viruses, bacteria and fungi. I've used it for years in teaching and research laboratories.

Household Lysol® disinfectant products are good alternatives to Amphyl® (they are made by the same manufacturer). Depending upon the specific products, Lysol® disinfectants contain quaternary ammonium compounds and/or phenolics in an alcohol base. They

work for surface disinfection, but they can't be added to the laundry. For webbing and boots, I use pre-diluted 70% isopropanol (rubbing alcohol) in a trigger spray bottle. Use enough to saturate the webbing or fabric. Remember that most disinfectants need to remain for 20 minutes or longer. When disinfecting with Lysol® or rubbing alcohol, take care to keep away from flames. The aerosolized alcohol can be explosive.

Ropes and harnesses may be especially difficult to disinfect safely. Before trying any of these recommendations, check with the rope manufacturer. At present, the only rope that I've washed and disinfected is a length of PMI Pit Rope that I use routinely as a hand line. I place the rope in a mesh bag and wash it with ¼ cup of Amphyl® in a front-loading commercial washer. After washing, I loosely coil the rope and let it air dry. So far, I haven't noticed any visually-detectable defects.

Cavers who find bats potentially infected with WNS should contact state and federal wildlife agencies as soon as possible. Please also contact the Little Rock Grotto WNS liaison (me). Do not pick up or otherwise try to move the bats. Photographs may be useful if they can be obtained without risk to bats or cavers. Also, do not directly contact any news media. Not all white fungal growth is WNS. Some bats die during hibernation of causes other than WNS, and subsequently become hosts for other common cave fungi (see photo page 9).

Although WNS has been reported widely in the news media, very little actual data have been published in the scientific literature. One article described the new species of *Geomyces* associated with WNS. A second article described a potential mitigation strategy of artificially warming key hibernacula. Several laboratories are working on WNS, but nothing else has been published so far. The most up-to-date WNS news is available on the NSS web site, <http://www.caves.org/WNS/index.htm>. Also visit:

- http://www.fws.gov/northeast/graphics/WNS_Mapping_06-05-09_DS.jpg.
- <http://www.fws.gov/northeast/whitenose/FINALContainmentandDecontaminationProceduresforCaversJune2009.pdf>

ABOUT DISINFECTANTS

Disinfectants work by interfering with, or destroying, one or more parts of a cell. Many different disinfectant preparations are available, but most use one or more of the following active ingredients (adapted from Prescott, Harley and Kline's Microbiology, 7th Ed., by J. M. Willey, L. M. Sherwood and C. J. Woolverton; McGraw Hill Higher Education, NY, 2008).

- Alcohols – isopropanol and ethanol – work by inactivating proteins and, to a lesser extent, dissolving cell membranes. Maximum disinfection occurs with a 70% solution (70 parts alcohol plus 30 parts water); most rubbing alcohol formulations are pre-mixed at this concentration.
- Alkalis (sodium hydroxide, potassium hydroxide) are the active ingredients in drain openers and oven cleaners. They work by reacting with fats and oils, including those in cell membranes, to form soap. In cells, this causes the membranes to dissolve.
- Detergents include soaps and other cleaning agents that have the ability to mix with both water and "oily" compounds. Cell membranes contain "oily" phospholipids that detergents disrupt.
- Phenolics are chemicals derived from phenol (also called carbolic acid), the first widely used disinfectant. Phenolics work by inactivating proteins and disrupting cell membranes. Examples include hexachlorophene (PhisoHex®) and orthophenylphenol (Amphyl® and some Lysol® products).
- Quaternary ammonium compounds (also called quaternary amines) are types of detergents with greater antimicrobial activity than other detergents. Examples include benzalkonium chloride (Bactine®, Zephiran®) and cetylpyridinium chloride (Ceepryn®)
- Sodium hypochlorite is the active ingredient in bleach. A 10% solution of bleach in water makes an effective disinfectant. Bleach works by oxidizing biomolecules. However, it is very corrosive to metals, and repeated use may break down synthetic textiles (nylon, polyesters, etc.) as well.

DECONTAMINATING YOUR CAVE GEAR

There have been many, many opinions shared about the proper way to decontaminate cave gear, and the US Fish & Wildlife Service has changed or updated their resources documents in regard to this matter several times.

These instructions are excerpted directly from the US-FWS document at <http://www.fws.gov/northeast/whitenoise/FINALQuickReferenceforDeconProtocolsforCaveActivityJune2009.pdf>. After every caving trip, please abide by the following steps.

Step #1: Upon exiting a cave...

- Thoroughly scrape or brush off any dirt and mud from your clothes, boots, and gear and then place them in a sealed plastic bag or plastic container with lid to be cleaned and disinfected off site.
- Outer clothing should be removed prior to entering a vehicle after/between a site visit. A clean change of clothing is recommended. Surface cleaning of exposed skin (arms, face, neck, hands, etc.) with antibacterial hand sanitizer (i.e. Purell®) should occur prior to entering the vehicle's cab.

Step #2:

- For clothing – Wash all clothing and any appropriate equipment in washing machine using the hottest cycle possible for material and conventional detergents. Laboratory testing has found Woolite® fabric wash to be the best surfactant for clothing. Rinse thoroughly, and then follow by soaking with

sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 9 parts water in a tub or plastic container. Soak for 10 minutes, then rinse and air dry. *Editor's note: as mentioned previously in the adjoining article, bleach can damage many textiles; a quaternary ammonium compound or phenolic should be suitable in place of bleach for this step, as below.*

- For submersible gear (i.e. soft-sided gear.) – Disinfect any equipment that can be submersed in a solution with an appropriate and compatible disinfectant such as sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 9 parts water in a tub or plastic container or 0.3% concentration of quaternary ammonium compounds (i.e. Lysol® All-purpose Professional Cleaner or the antibacterial form of Formula 409®). Keep submersed for 10 minutes, then rinse and air dry.

- For non-submersible gear (i.e. hard-sided gear) – Disinfect any equipment that cannot be submersed by applying an appropriate and compatible disinfectant to the outside surface by using 0.3% concentration of quaternary ammonium compounds such as Lysol® All-purpose Professional Cleaner, Lysol® disinfecting wipes or the antibacterial form of Formula 409®; or use sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 9 parts water. Keep on surface for 10 minutes, then rinse and air dry.

- For boots – Boots need to be fully scrubbed and rinsed so that all soil and organic material is removed. The entire rubber and leather boots, including soles and leather uppers, can then be disinfected with an appropriate disinfectant such as 0.3% concentration of quaternary ammonium compounds (i.e. Lysol® All-purpose Professional Cleaner or the antibacterial form of Formula 409®) or sodium hypochlorite bleach (i.e. household bleach) solution diluted to 1 part bleach to 9 parts water. Keep on surface for 10 minutes, then rinse and air dry.

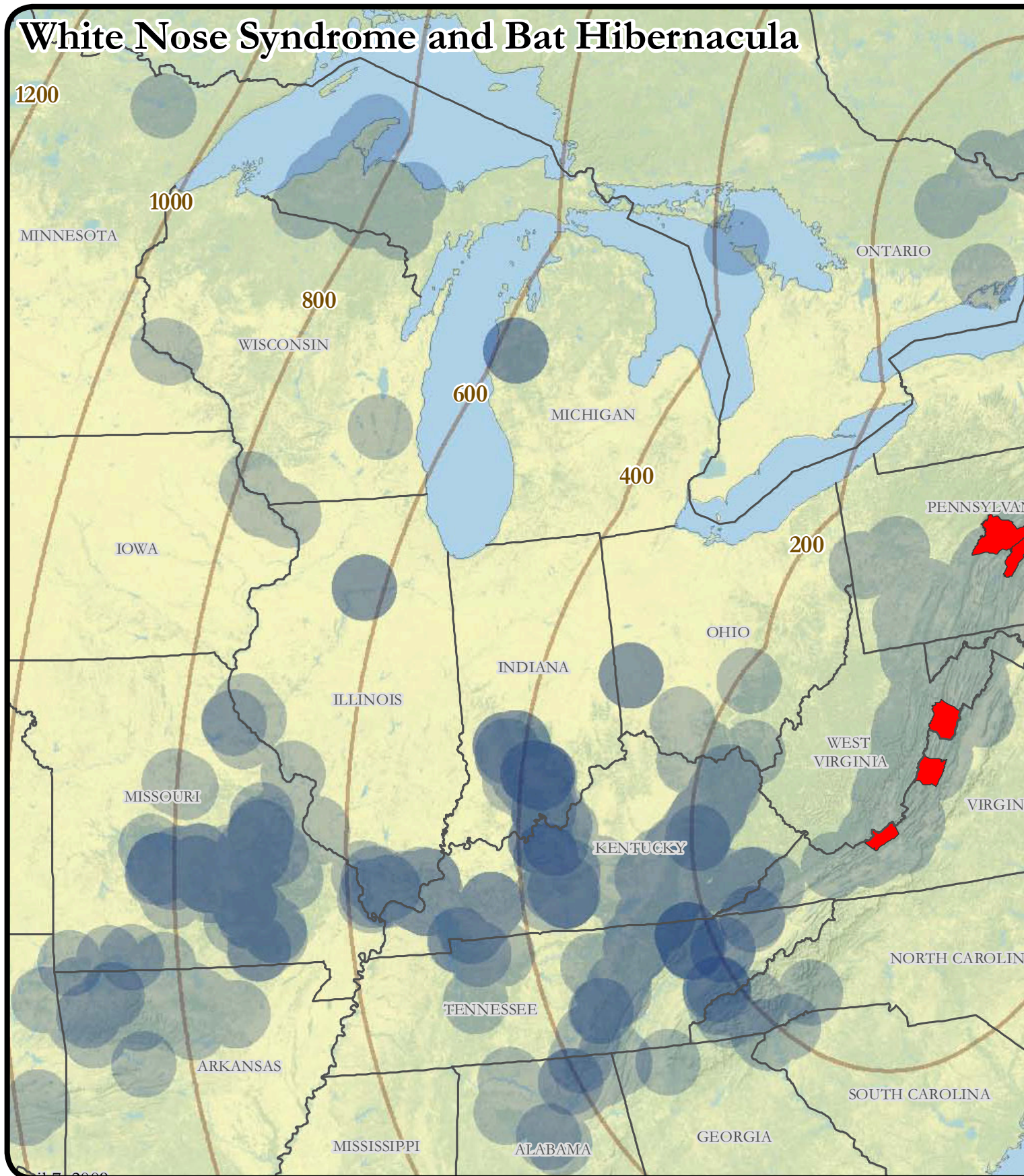
- For ropes and harnesses – This equipment should be dedicated to one cave or not used at all. Decontamination of vertical equipment is recommended. However, the performance integrity may be compromised by using these disinfecting agents mentioned above repeatedly. Laboratory testing is ongoing.

At left - Ain't no party like a cave gear decontamination party 'cuz a cave gear decontamination party don't stop. Mike Patton and Jared Sickles demonstrate with Jeff Bartlett's helmet. After a trip to Mammoth Cave, we all got together for "step 2" as described above, using a quaternary ammonium product.



Pages 8-9, Below - The most recent map of WNS-affected states and counties, published by BCI. AR caves are presently about 800 miles from the nearest known instance.

Page 9, top - This little brown bat exhibits the fungal growth around the nose typical of White Nose Syndrome. Small amounts of fungus also grow on the ears and wing edges.



Middle - This group of hibernating bats contains several individuals with signs of White Nose Syndrome. Hibernacula with high bat densities may allow direct transmission of WNS

from bat to bat, and possibly from bat to the cave itself. Other bats that subsequently visit the cave could become infected. Bottom - Not all fungi indicate WNS. This Eastern pipistrelle probably died of other causes during hibernation. A white fungus of the type often found growing on feces then colonized the dead bat.

