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(FORM UPDATED: 08/11/2010)

WISCONSIN STATE LEGISLATURE ...
PUBLIC HEARING - COMMITTEE RECORDS

2011-12
(session year)

Assembly
(Assembly, Senate or Joint)

Committee on Natural Resources...

COMMITTEE NOTICES ...

- Committee Reports ... **CR**
- Executive Sessions ... **ES**
- Public Hearings ... **PH**

INFORMATION COLLECTED BY COMMITTEE FOR AND AGAINST PROPOSAL

- Appointments ... **Appt** (w/Record of Comm. Proceedings)
- Clearinghouse Rules ... **CRule** (w/Record of Comm. Proceedings)
- Hearing Records ... bills and resolutions (w/Record of Comm. Proceedings)
  (**ab** = Assembly Bill) (**ar** = Assembly Resolution) (**ajr** = Assembly Joint Resolution)
  (**sb** = Senate Bill) (**sr** = Senate Resolution) (**sjr** = Senate Joint Resolution)
- Miscellaneous ... **Misc**

* Contents organized for archiving by: Stefanie Rose (LRB) (August 2013)

Summary of DNR Contact with Bat Stakeholders

Contact with Jeannie and Blaze Cunningham (owners of Crystal Cave)

- The Cunninghams participated in meetings with the DNR Secretary's Office on November 2, 2010 and November 30, 2010.
- DNR staff visited Crystal Cave to meet with the Cunninghams on November 3, 2010.
- Jeannie Cunningham spoke at the December 8, 2010 Natural Resources Board meeting in support of all 3 white-nose syndrome/bat rules. A summary of Ms. Cunningham's testimony from the Natural Resources Board official meeting minutes is included below:

  "Jeannie Place Cunningham, Spring Valley, representing Crystal Cave stated she was originally opposed to the proposed rules but now accepts them. She is pleased to have come to a consensus with the Department as to how they will approach the management issue. They will continue to educate every visitor on the seriousness of WNS. "
- A management plan has been developed between the Cunninghams and the DNR and has been approved by both parties during January of 2011.
- February 2011 - the DNR has purchased dedicated gear for recreational cavers at Crystal Cave (approximately $2600 of gear has been purchased to date).
- Jeannie Cunningham spoke at the October 27, 2010 Natural Resources Board meeting and was given an extension to implement the emergency rules.
- On 2/28/2011 Erin Crain spoke with Jeannie Cunningham regarding winter surveys

Contact with Tamara Thomsen

- Tamara Thomsen and Ethan Brodsky were emailed on 12/13/2010 regarding the creation of cave diver decontamination protocols.
- Rich Novy spoke with Tamara Thomsen via phone on 12/22/2010 regarding the proposed rules for decontaminating cave diver gear and later that day received her proposed decon protocols.
- Tamara Thomsen was emailed on 1/18/2011 with an update regarding her submitted decontamination rules.
- February 2, 2011 conference call with DNR staff, Jane Wiley (Natural Resources Board), Tamara Thomsen, Ethan Brodsky and John Lovaas regarding the diving gear decontamination protocols.

Contact with John Lovaas

- Administration Outreach to Stakeholder groups including Mel Vollbrect, Al Shea, Laurie Osterndorf and ER staff with Bill O'Connor and John Lavaas (11/2/2010, 11/30/2010)

- John Lovaas spoke at the December 8, 2010 Natural Resources Board meeting in support of the rules. A summary of Mr. Lovaas' testimony from the Natural Resources Board official meeting minutes is included below:

"John Lovaas, Woodstock, IL, representing Minnesota Speleological Survey spoke on Board Orders IS-47-10 and IS-07-11(E). He stated a lot has changed in the management plan over the past 60 days due to the ability to interact with Department staff. This version is livable and practical and he is much happier with what he sees today. "

- Mr. Lovaas has an outstanding open records request that has been completed and will be mailed when the invoice has been paid.

Public Hearings:
Five public hearings on two of the board order (ER-35-10 and IS-41-10) were held on October 26 in Fitchburg and November 29 in Madison, Green Bay, Eau Claire and Wausau. Four hearings were held for (IS-47-10) on November 29 in Madison, Green Bay, Eau Claire and Wausau.

Outreach to Wisconsin Speleological Society (WSS) - *(88 members including members Jeannie and Blaze Cunningham of Crystal Cave, Jan Okeson of Cave of the Mounds)* **11/2009- present:**

- presentations on bats and WNS at WSS meetings & events (11/2009 - 5/2010)
- stakeholder meeting & request for WSS input (1/2010)
- liaison outreach to WSS via phone calls & email with WSS chair, WSS meeting & event involvement, WSS newsletter, & WSS list-serve (1/2010- 6/2010)
- WSS formed a WNS committee in order to develop a WNS policy and statement to the WDNR (2/2010-?)
- Contacts with WSS members via phone urging them to contact us directly for information after misinformation about bat exclusion at Ledge View (8/2010- 10/2010)
- Discussions by phone and via email with WSS reps regarding dedicated gear planning for risk management projects at Ledge View and Maribel (9/2010- present)
- WSS included in 2 conference calls regarding risk management plans and dedicated gear at Ledge View and Maribel (11/2/2010 & 11/5/2010)
- Presented recent DNR WNS response work, answered questions, heard concerns at 11/20/2010 WSS General Meeting
- Supplied WSS with decontamination protocols, new rules, and plain-language summary of rules in person and via email (11/22/2010).
- 12/30/2010 – DNR staff emailed a plain language version of the proposed white-nose syndrome/bat rules to the WSS list serve.
- 2/6/2011 - Email from James Preston (WSS) regarding cave location information.

Outreach to the Wisconsin Speleological Society List Serve *(including Dawn Ryan, John Lovaas, Tamara Thomsen, Eric McMaster)* **11/2009- present:**

- Jennifer Schehr (DNR) sent multiple WNS updates and WSS WNS committee updates to WSS list-serve (1/2010- 6/2010); including links to USFWS WNS page, USFWS decon protocol for cavers, WI Bat Monitoring Program (WDNR), 2009 Midwest Bat Working Group Videos (WDNR presentation) (5/15/2010)

- Dawn Ryan sent links to DNR green sheet packages for listing of bats and fungus to WSS & Minnesota Speleological Society list serve (9/21/2010)
- Erin Crain (DNR) sent response to Peter Youngbaer's (National Speleological Society) email about "WDNR captive breeding colony" and encouraged recipients to contact DNR directly with "questions or concerns regarding WI bat management" to state agency reps, WSS list serve, and others including Eric McMaster (10/08/2010)
- John Lovaas sent date changes for DNR public hearings to WSS & MSS list serve (10/15/10)
- John Lovaas sent links to October NRB agenda, IS-49-10(E) green sheet package, and instructions for public comment to WSS & MSS list serve (10/19/2010)
- Erin Crain (DNR) sent decontamination protocols distributed to WSS list serve (10/26/10)

Outreach to commercial cave/mine stakeholders July 2010- present:

1. ***Ledge View Nature Center*** risk management plan development, discussions, proposal accepted, implementation of decon/dedicated gear/bat exclusion in person, by phone, via email (7/2010- present)
2. ***St. John Mine*** letter and phone contacts (8/5-11/2010; phone again 11/4/2010)
3. ***Maribel Caves County Park*** risk management plan development, discussions, proposal accepted, implementation of decon/dedicated gear/bat exclusion in person, by phone, via email (8/2010- present)
4. ***Kickapoo Indian Caverns*** letter and phone contact; visit scheduled (10/22/2010- present)
5. ***Crystal Cave*** risk management plan discussions, proposal development in person, by phone, via email (11/3/2010- present)
6. ***Cave of the Mounds*** risk management plan discussions, proposal development in person, by phone, via email (11/5/2010- present)
7. ***Eagle Cave*** risk management plan development, discussions, proposal accepted, implementation of decon/dedicated gear/bat exclusion in person, by phone, via email (10/28/2010- present)
8. ***Platteville Mining Museum*** risk management plan development, discussions, proposal accepted, implementation of decon in person, by phone, via email (10/29/2010- present)
9. ***Shullsburg Mine and Museum*** letters and phone contact, visit scheduled (8/2010- present)

Outreach to highly visited wild cave owners (6/2010- present)
(Including: Popp's Cave, Star Valley Cave, Horseshoe Bay Cave, Lost River Cave, Viroqua City Cave, Autograph Cave, Atkinson Mine, Castle Rock Cave, Cady Creek Cave, Haines)

- Initial contact letters, follow-up phone calls, site entrance assessments (6/2010- 9/2010)
- Follow-up phone calls, discussion of new rules, discussion of cave closure; result: 10 caves closed; 2 bat friendly gates needed and 2 being repaired (9/2010- present)
- "Thank you, rule updates, & request for partnership" letters sent (11/05/2010- 11/15/2010)
- Discussion with Madison Metropolitan School District Challenge Program in person and via email (result: canceling winter trips of ~300 students to Popp's Cave, implementing WNS education, may visit Eagle Cave and Ledge View instead).

Outreach to cave/mine landowners 6/2010- present:

- Initial letters to site owners of WNS info and request for Cave & Mine Catalogue participation (site visit permission); 1170 landowners contacted for 800 potential sites
- Follow-up phone calls to seek permission for site visits; 640 landowners contacted
- Initial site visits & face-to-face landowner contacts; 440 landowners contacted
- Follow-up "thank you & rule updates" letters sent; 220 landowners contacted (10/25/10)
- Follow-up "thank you & rule updates" letters to be sent; 105 landowners to be contacted (by 12/3/10)
- Follow-up "thank you, rule updates, & request for continued partnership" letters; 90 landowners contacted (11/05/10-11/15/10)
- Site revisit & surveillance scheduling, underground assessment visits, follow-up; 18 sites revisited (11/10/10-11/30/10), 11 sites scheduled for upcoming weeks, 3 landowners met in person (11/15/10-11/30/10), 29 landowners contacted by phone (11/12/10-/11/30/10), 20 attempted communications by phone (11/12/10-11/19/10) .
- Between December 8, 2010 and March 4, 2011 DNR staff made 116 contacts with 88 landowners requesting permission to access their cave or mine and coordinating site visits with them. (Note that this only includes conversations or emails but does not include instances when voicemails were left.) Some of these contacts are listed below.
- 12/20/2010 - Email to Jerry M. (mine owner) regarding bats & WNS.
- 12/20/2010 - Email to Barry B. (mine owner) regarding access & WNS.
- 12/20/2010 - Email to Todd C. (cave owner) regarding bats & WNS .
- 12/21/2010 Left phone message for James T. (cave owner) regarding access & WNS prevention.
- 12/22/2010- 1/11/2011 - Emails & phone calls with Tom Leathlean (Badger Mine) regarding bat rules & WNS prevention planning.
- 12/27/2010 - Spoke with son of James T. (cave owner) regarding access, bat rules, & WNS prevention.
- 12/28/2010 - Conference call with Randy G. (mine owner) regarding bat rules & WNS research project.
- 1/7/2011 - Email to Weston Hanke (Eagle Cave) regarding WNS prevention plan.
- 1/10/2011 - Phone call with Weston Hanke (Eagle Cave) regarding WNS prevention plan.
- 1/11/2011 - Visit to Eagle Cave to work on WNS prevention plan.
- 1/14/2011 - Email to Randall K. (cave owner) regarding site access.
- 1/16/2011- Met with owners of the Haeberli Cave to discuss their cave and view their site.
- 1/20/2011- Met with owners of the Baker Cave to discuss their cave and view their site.
- 1/26/2011 - Phone call with Mel L. (cave owner's realtor) regarding reduced asking price on potential SNA land.
- 1/27/2011 - Met with Randy G. (mine owner) & conducted bat count, WNS surveillance, & WNS research in mine.
- 2/7/2011 - Email to Weston Hanke (Eagle Cave) regarding WNS prevention plan.
- 2/8/2011- 3/3/2011 - Email to Mary Houck (Platteville Mining Museum) regarding WNS prevention plan.
- 2/2/2011- 2/5/2011 - Met with Michelle Maxson (Bay City & Maiden Rock mines) & conducted counts & WNS surveillance in both sites.
- 2/23/2011 - Email from Tom K. (cave owner) granting visit access.
- 2/25/2011- Met with the owner of the Spring Hill Cave to discuss their cave and view their site.

- 2/28/2011- Met with the owner of the Marklein Cave to discuss their cave and view their site.
- 3/2/2011- Followed up on a site visit to Rogers Cave giving the landowner information on what was found in her cave.
- 3/3/2011- Met with the grounds manager of Hylandale Academy so he could show us to a cave site.

Outreach to General Public (ongoing; examples from 10/2010- present):

- Public Service Announcement on radio and television regarding the ecosystem services bat provide to the general public (10/11/2010 – 10/31/2010)
- contacted and sent an article to Midwest Organic Sustainable Education Service to be put in the November issue of Organic Broadcaster (10/19/2010)
- instructional videos on the science related to WNS and proposed regulation posted on the DNR website and Wisconsin Bat Monitoring website (10/23/2010)
- instructional video on decontamination protocols posted on DNR website and Wisconsin Bat Monitoring website (10/24/2010)
- contacted Madison Area CSA Coalition, sent email outlining rules and request for comment (10/25/2010)
- sent out letters to CSA and organic farms whose addresses were listed online (10/25/2010)
- sent emails to bat roost citizen monitors and bat roost contacts (10/25/2010)
- emails sent to bat roost citizen monitors (10/26/2010)
- emails sent to acoustic citizen monitors (10/26/2010)
- Contact with 24 bat roost volunteers between 12/13/2010 – 2/28/2011.
- multiple presentations by various team members on bats, threats to bats, acoustic monitoring, DNR response to WNS, etc. to groups such as the Niagara Escarpment Resource Network, Madison Audubon Society, nature centers, state parks, summer youth programs, etc. (ongoing)
- letters sent to 29 schools with 2010 reservations at Ledge View Nature Center regarding decontamination (9/2010- 11/2010)
- Continually responded to a variety of questions from the general public regarding bats, white-nose syndrome and the associated legal implications.
- 12/8/2010 - Left phone message with Carla Hacker (school caving trip leader) regarding caving activities, bat rules & WNS prevention.
- 12/10/2010- 12/14/2010 - Emails & phone conference with Rich Waulanbach (USDA) regarding bats & WNS planning at Badger Army Ammunition Plant.
- 12/10/2010- 12/14/2010 - Phone calls with Carla Hacker (school caving trip leader) regarding caving activities & WNS prevention.
- Meeting with university outdoor organization (UW-Madison - Hoofers) (12/16/2010).
- 12/21/2010 - Email to Todd Krysiak (Baraboo News Reporter) regarding bats at Badger Army Ammunition Plant & bat rules.
- 12/21/2010 - Email to Richard Slaughter (UW-Madison Geology Dept.) regarding bat rules, decontamination & WNS prevention.
- 1/8/2011 - Presentation to Ledge View Nature Center Friends Group regarding bats, WNS, & Ledge View WNS prevention.
- Three DNR staff presented at the DNR Wildlife Statewide meeting (1/12/2011). Meeting included some members of the public as well.

- 1/24/2011 - Email to Rich Waugh (UW-Platteville Geography Dept.) regarding WNS & WNS prevention.
- 1/24/11 and 2/10/11- Spoke with Joe Senulis about coordinating visits to caves so he can conduct his bat counts.
- 1/26/2011 - Email to Phil Bramley (Bethel caving trip leader) regarding Popp's cave, bat rules & WNS prevention.
- 1/26/2011 - Presentation to Friends of Pheasant Branch Conservancy regarding bats, WNS, & WNS planning efforts.
- Heather Kaarakka mails with Tim Wilder (Fort McCoy Army Base biologist) on 2/7/2011 and 2/22/2011 regarding starting bat surveys on the Base.
- 2/16/2011 - Email from Door Co. Corporate Counsel regarding Horseshoe Bay Cave access, bats, & WNS prevention.
- 2/16/2011 - Presentation to Middleton Public High School students regarding bats, WNS, & WNS planning efforts.

Outreach to Wildlife rehabbers (11/2010):

- sent email to all 21 rehabbers in WI certified to work with bats - email announced E/T listing and two informational conference calls (11/10/2010)
- first of two informational conference calls for rehabbers (4 rehabbers called in) (11/11/2010)
- sent disinfection protocols to all 21 rehabbers and reminded all of second informational conference call (11/15/2010)
- second of two informational conference calls for rehabbers (approximately 8 rehabbers called in, some also called in to first call) (11/19/2010)
- sent an email to all 21 rehabbers re: E/T permit applications/information (11/22/2010)
- A conference call was held for all Wisconsin bat rehabilitators on January 24, 2011.
- Stacy Rowe sent emails to Scott Diehl, Cheryl Diehl and Lisa Schlenker on January 24, 2011 regarding their Endangered and Threatened Species Permits.

Outreach to Wildlife Control Operators (11/2010):

- took testimony at a rules public hearing in Fitchburg from five excluders (11/26/2010)
- sent email to 32 excluders reminding them of the incidental take public comment period (11/2/2010)
- Gerald Hanson (excluder from Eau Claire) called (11/11/2010)
- sent email to 32 excluders asking again for comments (have not yet received many), included a transcript of testimony at the Fitchburg public hearing (11/15/2010)
- Sent update email to 25 animal control operators regarding revisions to the broad incidental take permit (12/15/2010)
- Sent email to APS-American Pest Solutions to clarify several questions they had regarding the broad incidental take permit (12/15/2010)
- Spoke with Andy Hanks (animal control operator) (12/17/2010)
- Spoke with Rob Busch (animal control operator) (1/10/2011)
- Emailed follow up information to Rob Busch (animal control operator) (1/10/2011)

Administration Outreach to Stakeholder groups including Mel Vollbrect, Al Shea, Laurie Osterndorf and ER staff (9/2010 to present):

- individual contacts to utility representatives (9/2010)
- meetings with Cave Coalition: Bill O'Connor, John Lavaas, Jeannie Cunningham, Joe Klimzik (11/2/2010, 11/30/2010)
- Conference call with Bat Conservation International (11/15/2010)
- Conference call with North American Society of Bat Research (11/10/2010)
- Conference call with TNC (11/23/2010)
- Conference call with Executive Committee of the Conservation Congress (11/30/2010)

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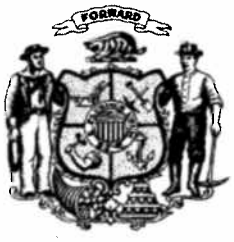

Human Transmission of *Geomyces destructans*, the fungal pathogen associated with White-nose syndrome (WNS) in hibernating bat species

Research conducted at the United States Geological Survey (USGS) Wildlife Health Center has shown that *G. destructans* is transferred from bat to bat, and a multi-agency project demonstrated bats can develop WNS through infection directly from an affected cave environment, in the absence of infected bats.

There is also evidence of human transfer of *G. destructans* from site to site and/or bat via contaminated equipment, gear or clothing. The New York Department of Environmental Conservation, Wildlife Pathology Unit has isolated *G. destructans* fungal spores on equipment and clothing after exiting an affected cave. There have been long-distance jumps in the spread of WNS, beyond the distance bats move. These "jump" sites have been frequently-visited caves, often with small bat populations (Turner and Reeder 2009). The U.S. Geological Survey, National Wildlife Health Center has detected *G. destructans* fungal spores in cave sediment in the absence of bats, demonstrating persistence of the fungus (Lindner et al. *2010*).

Even in the face of incomplete information, general epidemiological principles should be used to inform the WNS investigation and response. All available evidence indicates that WNS is caused by an infectious agent and can therefore potentially be spread by all known modes of disease transmission, including direct contact, inhalation, ingestion, inanimate objects, and human or animal vectors. Wildlife diseases such as WNS spread rapidly when there is high prevalence of pathogen(s), efficient chains of transmission, abundant susceptible hosts, and/or environments that allow pathogen persistence without a host. Regardless of the infectious agent (fungus, bacterium, or virus), universal precautions should be implemented. Universal precautions are procedures and guidelines designed to reduce incidence of disease by both preventing infections and breaking chains of transmission. (Dr. Blehert, USGS, National Wildlife Health Center, and National WNS Plan). On Friday December 8th, during Dr. Blehert's presentation to the Natural Resources Board (NRB), he indicated human transmission was possible based on the fungus biology, and therefore a likely route of transmission for infection at larger distances than bat-to-bat transmission alone. As well, he indicated an abundance of caution was a good practice to implement because of the strong possibility.

Jeremy T. H. Coleman, Ph.D., the National WNS Coordinator, U.S. fish and Wildlife Service (USFWS) wrote in a letter of support to the Natural Resources Board.

> There is wide agreement that *G.destructans*, is primarily transmitted by bats. Although there is scientific uncertainty and disagreement regarding the risk of transmission of *G. destructans* by people, there is general consent in the scientific community that humans are a potential vector for transport based on historical precedence of disease transmission, detection of *G.destructans* spores on exposed caving gear, and known human movements relative to outbreak locations in 2008-09. Human transmission poses a particularly serious threat because people can travel distances that greatly exceed those known for bats within a season, making it possible for WNS to arrive in a new site well before it would likely arrive through bat-to-bat transmission. Such a location would then serve as a new index site for the disease, allowing it to spread through bat movements throughout a region. Even if the probability of human transmission is relatively small, as it may be, the known impacts of WNS once it is established are enough to justify taking the precautions to prevent its arrival.

The USFWS has recognized and responded to the possibility of human WNS transmission by creating decontamination protocols for field researchers and recreational cave users - the two most frequent groups to visit caves and therefore likely to contaminate sites. Based on the devastating effects of WNS on bats populations in other states – and the fact that *Geomyces destructans* cannot be safely removed from a cave at this time – the USFWS National Response Plan and Strategic Decision Making Initiative (Szymanski 2009) recommend that WNS-free states implement strict biosecurity measures to minimize the risk of anthropogenic transmission of the fungus into caves.

A plausible hypothesis for the origin of this disease in North America is introduction via human trade or travel from Europe, based on recent evidence that G. destructans has been observed on at least one hibernating bat species in Europe (Frick et al, Science 2010). Anthropogenic spread of invasive pathogens in wildlife and domestic animal populations, so-called pathogen pollution, poses substantial threats to biodiversity and ecosystem integrity and is of major concern in conservation efforts (Frick et al, Science 2010).

Dr. Hazel Barton Testimony, October 26 DNR Bat Hearing, Fitchburg Wisconsin.

> "As far as human transmission we do suspect a site that was mentioned in Pendleton County, West Virginia as possibly human transmission. It appears that it was a new epicenter of infection. This was long before we knew about White-Nose Syndrome being a pathogen and a transmissible agent, people did not wash their gear and they did not clean their gear. There are anecdotal stories of people carrying in equipment or three kilos of mud into a cave environment. If WNS is spread by person-to-person it does not happen easily, it happens rarely. If this was not the case then WNS would have come here decades ago and on the West Coast. The movement of the infection, the epidemiology right now does match the movement of bats, apart from as I said in Pendleton County, West Virginia."

Disease Control. '**No action**' provides zero control on the anthropogenic transmission or spread of the disease. WNS may arrive in the state of Wisconsin much sooner than environmental routes (bat-to-bat transmission) alone would bring it here, and the spread of the disease would be faster throughout the state after it has arrived.

Human-facilitated introduction and spread of *Geomyces destructans* is a significant risk that warrants an abundance-of-caution approach. Unlike bat transmission, human transmission is something we can manage, and in fact, control of human transmission is one of the most effective preventive actions we can take. Tools to manage human transmission of WNS include: 1) Cave access restrictions for humans or bats, 2) Permit and schedule coordinated research entry to caves, and 3) Require decontamination of equipment, clothing, and gear, or use of dedicated gear for a site. (Environmental Assessment, Wisconsin Department of Natural Resources, November 2010 http://dnr.wi.gov/org/land/er/bats/).

Citations

Dr. Hazel Barton Testimony, October 26 DNR Bat Hearing, Fitchburg Wisconsin.

Environmental Assessment on Rules to Protect Wisconsin Cave Bats and Manage Geomyces destructans, the Fungus Associated with White-nose Syndrome. Wisconsin Department of Natural Resources, November 2010. http://dnr.wi.gov/org/land/er/bats/

Frick WF, Pollock JF, Hicks AC, Langwig KE, Reynolds DS, Turner GG, Butchkoski CM, and Kunz TH. 2010. An Emerging Disease Causes Regional Population Collapse of a Common North American Bat Species. Science 329:679-682.

Lindner DL, Gargas A, Lorch JM, Banik MT, Glaeser J, Kunz TH, Blehert DS. 2010. DNA-Based detection of the fungal pathogen *Geomyces destructans* in soils from bat hibernacula. Mycologia.

Szymanski JA, Runge MC, Parkin MJ, Armstrong M. 2009. White-nose syndrome management: report on structured decision making initiative. Department of the Interior, U.S. Fish and Wildlife Service, Fort Snelling, MN, USA.

Turner GG, Reeder DM. 2009. Update of White Nose Syndrome in Bats, September 2009. Bat Research News 50(3):47-53.


Frick et al. 2010 Science.pdf ...


Turner&Reeder_2009_UpdateOfWNSinBa


Szymanski_etal2009_WNS_SDM_Report_


Lindner_etal2010_DNAbasedetectionofGl


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FWS statement of support_WI Nat Res

Treatment Options Would be Considered for Abandoned Mines Rather than a Sensitive Cave System

Roughly a third of a million bats hibernate in Wisconsin each winter. Wisconsin has very few natural caves because of glaciation, and therefore the vast majority of our hibernating bats use mines. Wisconsin's largest mines - Neda Mine in Dodge County and Bay City/Maiden Rock Mines in Pierce County – collectively house approximately 290,000 bats, and dozens of smaller mines house smaller bat aggregations. Mines are novel, manmade sites where research and adaptive management pose few or no environmental risks. For this reason, recent and ongoing research to find a cure for White-nose

Syndrome uses mines as study sites (for example, Wisconsin DNR participated in the study demonstrating that bats can acquire WNS from a previously infected site – Greely and Bridgewater Mines in Vermont). Consistent with this national research convention, WDNR's Environmental Assessment discusses possible experimental efforts to combat WNS in the context of a focus on mines – rather than caves.

Another critical fact of the Wisconsin landscape is that the state's few naturally occurring caves differ greatly from the pristine sites in the cave-rich karst regions of the country, where light never intrudes, nutrients are scarce (and guano is a critical resource), and the only creatures who come and go are a few specialist animals. Caves such as Crystal Cave in Pierce County, Cave of the Mounds and Eagle Cave in Iowa County, and Ledge View and Maribel Caves in Calumet County may receive hundreds of visitors per day, are illuminated by extensive arrays of light that encourage unnatural moss and algae growth, and accumulate a great deal of waste (chewing gum, dust, fibers, trash). In addition, these caves have in many cases been extensively dug out over a period of many decades (to "improve" their tourism appeal or simply as a recreational pursuit) – and Crystal Cave and Ledge View are still impacted by these activities. In some caves, extensive concrete floors or walkways have also been installed, and hydrological manipulation (creation of waterfalls or removal of water from the cave system via pumps) occurs. Finally, in Eagle Cave groups of Boy Scouts from across the Midwest come and sleep overnight in the cave.

In conclusion, Wisconsin's lack of vast, pristine cave networks – the kinds of systems found in the karst regions of the country (e.g., Missouri has over 6000 caves) – means that our wintertime bat population occurs almost entirely in mines. This fortunate circumstance means that Wisconsin has a tremendous opportunity to conduct adaptive management and test emerging White-nose Syndrome treatments with little or no associated environmental impacts.


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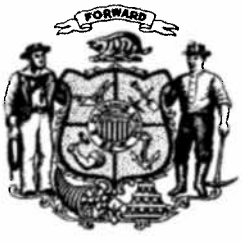
FORWARD

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 LUKER ROAD
CORTLAND, NY 13045

3 December, 2010
U.S. Fish and Wildlife Service
3817 Luker Road
Cortland, NY 13045
jeremy_coleman@fws.gov

To: Wisconsin Natural Resources Board
c/o: Laurie Ross
Natural Resources Board Liaison
101 S. Webster Street
P.O. Box 7921
Madison, WI 53707
Laurie.Ross@wisconsin.gov

Re: Board Order ER-35-10, support
Board Order IS-41-10, support
Board Order IS-47-10, support

Dear Ms. Ross and Members of the Wisconsin Natural Resources Board,

Thank you for the opportunity to comment on the actions under consideration before the Board. I would first like to commend the Wisconsin Department of Natural Resources (DNR) for taking a strong and proactive stance to protect native bat populations from the looming, and very grave threat of white-nose syndrome (WNS). The U.S. Fish and Wildlife Service (FWS) considers WNS to be one of the most pressing wildlife issues confronting Federal and State conservation agencies in North America, and we support actions such as those under current consideration (ER-35-10, IS-41-10, and IS-47-10), that prioritize the protection and conservation of bats. As I understand that these three actions are intended to work in concert, and support all three, I will hereafter refer to them collectively as the proposed orders.

White-nose syndrome is devastating bat populations in eastern North America, and particularly in the northeastern U.S., where the disease has been established the longest; the earliest evidence of the disease dates to February 2006. In New York, the once ubiquitous little brown bat (*Myotis lucifugus*) has declined 90% from pre-WNS population estimates, and the population of the Federally-listed Indiana bat (*Myotis sodalis*) has likewise declined by approximately 60% state-wide. Impacts to other hibernating species in New York range from 55-98% declines, indicative of long-term, if not permanent, damage to local bat populations. While we do not know if WNS

will have similar impacts on bat populations in all parts of North America, evidence from other affected states and provinces in the East demonstrate the same general patterns of decline, with no substantive indication yet of leveling off. It is because of the gravity of these observed impacts, and the responsibilities of managing imperiled bat populations, that the FWS has exercised an abundance of caution in recommending and managing activities that impact caves and bats in North America. The orders proposed by DNR to protect bats in the state of Wisconsin are novel and proactive, and they appear to follow the same precautionary principle that has guided the actions and response of FWS to WNS for the past three years.

In responding to the threat of WNS, the agencies responsible for the management of bats and cave ecosystems across North America face many challenges. One significant challenge is the scientific uncertainty about the origin of WNS and way(s) in which it actually kills bats. While we are making steady progress in our understanding of the presumptive causative agent of WNS, the fungus *Geomyces destructans*, including methods of transmission and the behavioral and physiological impacts of the resulting infections, there is still much we do not know. Even if we lack total knowledge of an issue, wildlife conservation agencies must make management decisions and take decisive actions to conserve natural resources. One way that agencies act on management challenges in the face of uncertainty is through an iterative process known as adaptive resource management. What Wisconsin DNR is proposing through the orders under consideration is an adaptive program that addresses managing high risk situations associated with the arrival and spread of WNS within the state. While many would advocate that conservation agencies take no action in the face of the uncertainties of WNS, the threat posed to bat populations by this disease are grave enough to make that option untenable.

There is wide agreement that *G.destructans*, is primarily transmitted by bats. Although there is scientific uncertainty and disagreement regarding the risk of transmission of *G. destructans* by people, there is general consent in the scientific community that humans are a potential vector for transport based on historical precedence of disease transmission, detection of *G.destructans* spores on exposed caving gear, and known human movements relative to outbreak locations in 2008-09. Human transmission poses a particularly serious threat because people can travel distances that greatly exceed those known for bats within a season, making it possible for WNS to arrive in a new site well before it would likely arrive through bat-to-bat transmission. Such a location would then serve as a new index site for the disease, allowing it to spread through bat movements throughout a region. Even if the probability of human transmission is relatively small, as it may be, the known impacts of WNS once it is established are enough to justify taking the precautions to prevent its arrival.

United States Department of the Interior

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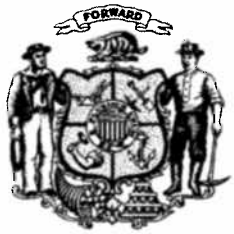
The orders proposed in Wisconsin may be novel, but few states have been in the same position relative to their resources and preparedness. Biologists with Wisconsin DNR have been engaged with WNS since the beginning of our collective response to the disease in early 2008. Wisconsin DNR staff has participated in national research conferences, WNS workshops, and in the development of the national response plan. The orders under consideration in Wisconsin have, therefore, been developed in light of the most current information available to the WNS community. As this is a somewhat innovative suite of actions, the effectiveness of the overall approach is untested and remains to be demonstrated. I can say with certainty, however, that we know what has happened in Northeastern states that were not able to take such proactive measures to protect their bat populations. This is not to suggest that all states face the same risks and challenges regarding WNS, and it is likely that programs that work in Wisconsin may not be effective elsewhere. However, the precautionary principles guiding these proposed measures are in agreement with those endorsed by the FWS, and therefore we support the adaptive approaches under consideration.

Thank you again for your time and the opportunity to comment on this issue.

Sincerely,

Jeremy T. H. Coleman, Ph.D.
National WNS Coordinator
U.S. Fish and Wildlife Service


WISCONSIN STATE LEGISLATURE


FORWARD

Environmental Assessment on Rules to Protect Wisconsin Cave Bats and Manage *Geomyces destructans*, the Fungus Associated with White-Nose Syndrome

Wisconsin Department of Natural Resources

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Introduction

White-nose syndrome (WNS) is a disease causing unprecedented mortality in cave bats. The fungus *Geomyces destructans*, the putative pathogen, is associated with WNS (Gargas et al. 2009, Frick et al. 2010). Since initial detection in 2006 in Howe cave, New York , WNS has been documented in fourteen states and two Canadian provinces, spreading rapidly in all directions from the first affected site. The Wisconsin Department of Natural Resources (WDNR) is responding to the threat of WNS to Wisconsin bats by creating management guidelines in a 'Surveillance and Response Implementation Strategy'. The Natural Resources Board adopted emergency rules in September 2010 listing the four cave bat species of Wisconsin as state threatened and listing the fungus *Geomyces destructans* as a prohibited invasive species. Additional authorities and tools were provided to help prevent the spread through anthropogenic means with an emergency rule adopted in October 2010. The underlying strategies embodied in this emergency rule are to allow for early detection of WNS in Wisconsin and outline preventative measures to slow the anthropogenic spread of the disease to and within Wisconsin. These three emergency rules are also proposed as permanent rules. This voluntary Environmental Assessment (EA) assesses these rules.

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Background

Bats affected with white-nose syndrome (WNS) were first observed in 2006 at a single cave near Albany, New York. WNS has since been found in 14 states and 2 Canadian provinces, spreading up to 800 miles in 2009 (Turner and Reeder 2009). Mortality rates of affected colonies reach 100%. WNS has been linked to the death of over one-million bats since 2007 and threatens to cause the extinction of several bat species in the near future. According to a Consensus Statement issued at the WNS Emergency Science Strategy Meeting in May 2009, white-nose syndrome "... has caused the most precipitous decline of North American wildlife in recorded history." Last spring, the disease was detected within 225 miles of Wisconsin's southern border and 300 miles from the northern border. That means a WNS-infected cave is now located within the 280-mile dispersal range of Wisconsin little brown bats (Humphrey and Cope, 1976). Based on the disease's current location and known rate of spread, we anticipate the detection of WNS in Wisconsin as early as January 2011 as surveillance commences.

Hibernating bats are susceptible to WNS. Those infected tend to show a white fungal growth on their face, arms, legs, wings, and/or tail caused by the newly isolated and named fungus, *Geomyces destructans*. Infected bats exhibit atypical behavior such as daytime activity during winter hibernation, which rapidly depletes stored energy reserves. Wing damage and emaciation are also common.

To date, nine species of cave bats are affected by WNS, including the federally endangered Indiana bat, which historically was found in Wisconsin. All Wisconsin cave bats, which include the little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), eastern pipistrelle (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*), are among the species fatally affected by WNS. Consequently, Wisconsin's cave bat population as a whole is threatened by this devastating disease. The little brown bat is Wisconsin's most common bat species and because this species has seen the greatest mortality rate due to WNS, Wisconsin anticipates significant impacts to its cave bat populations when WNS begins to affect Wisconsin bats. Research published in the journal *Science* (Frick et al. 2010) states "...we expect a 99% chance of regional extinction of little brown myotis within the next 16 years."

Wisconsin has one of the highest concentrations of cave bat populations in the Midwest and large numbers of cave bats from neighboring states hibernate in Wisconsin. Consequently, Wisconsin's cave bat population, and those of surrounding states, is threatened by this devastating disease. Three hibernacula alone house over 300,000 bats, including all four cave bat species. The largest known hibernaculum in the state, Neda Mine, may also be the largest in the Midwest with a recorded population of 143,000. The little brown bat is the most common species in Wisconsin and given that this species has seen the greatest mortality rate due to WNS, Wisconsin is anticipating significant impacts to its cave bat populations when WNS begins to affect Wisconsin bats.

Bats are a vital part of many ecosystems and white-nose syndrome has significant environmental, economic, and public health impacts. All bats affected by WNS are insectivorous and a single little brown bat can eat up to 1,000 insects per night, often consuming large numbers of agricultural pests, which cost farmers and foresters billions of dollars per year. As predators of many insects, bats also may play an important role in reducing risk of human disease transmitted by flying insects. Bats play an important role in the unique and fragile cave ecosystems, and their disappearance would have significant impacts. The nutrients bats bring into caves, and upon which other cave species depend, often have no other means of entry. In many cases, only bats regularly move in and out of the cave environment, while other cave species must rely solely on

what is found or brought inside. Thus, the disappearance of bats from caves could affect the status of other species as well.

Research conducted at the United States Geological Survey (USGS) Wildlife Health Center has shown that *G. destructans* is transferred from bat to bat, and a multi-agency project demonstrated bats can develop WNS through infection directly from an affected cave environment, in the absence of infected bats.

There is also evidence of human transfer of *G. destructans* from site to site and/or bat via contaminated equipment, gear or clothing. The New York Department of Environmental Conservation, Wildlife Pathology Unit has isolated *G. destructans* fungal spores on equipment and clothing after exiting an affected cave. There have been long-distance jumps in the spread of WNS, beyond the distance bats move. These "jump" sites have been frequently-visited caves, often with small bat populations (Turner and Reeder 2009). The U.S. Geological Survey, National Wildlife Health Center has detected *G. destructans* fungal spores in cave sediment in the absence of bats, demonstrating persistence of the fungus (Lindner et al. *In Press*).

Even in the face of incomplete information, general epidemiological principles should be used to inform the WNS investigation and response. All available evidence indicates that WNS is caused by an infectious agent and can therefore potentially be spread by all known modes of disease transmission, including direct contact, inhalation, ingestion, inanimate objects, and human or animal vectors. Wildlife diseases such as WNS spread rapidly when there is high prevalence of pathogen(s), efficient chains of transmission, abundant susceptible hosts, and/or environments that allow pathogen persistence without a host. Regardless of the infectious agent (fungus, bacterium, or virus), universal precautions should be implemented. Universal precautions are procedures and guidelines designed to reduce incidence of disease by both preventing infections and breaking chains of transmission.

Bat Ecology as it Relates to WNS

Movements As WNS can be transferred from bat-to-bat, the potential distance an infected bat can travel becomes relevant to WNS management decision making. From coarse empirical data of within-season spread of WNS in Virginia from 2008 to 2009, potential seasonal bat movement could be inferred as a distance of 75 miles (Rick Reynolds, VA Dept. of Game and Inland Fisheries, pers. comm.). All four Wisconsin cave bat species are present in Virginia. Other studies of bat movement include both published and unpublished information on band recapture data of dispersed and migratory bats. There is a range of distances travelled among individual bats, bat species, and within different time frames (e.g., male dispersal distance in late summer and migration distance to/from winter grounds). Band recoveries or band resights found migration distance for little brown bat up to 280 miles (Humphrey and Cope, 1976) and dispersal distance up to 105 miles (Gerda Nordquist, MN DNR, pers. comm.). Kurta and Murray (2002) recaptured migrant Indiana bats (*Myotis sodalis*) an average of 286 miles from their summer location in Michigan. Distance travelled by Wisconsin bats is now greater than the distance WNS is detected from the state.

Mortality Hibernacula surveyed before and after WNS appeared have documented bat declines of more than 75%, and 90% to 100% in some cases (Blehert et al. 2009). Possible underlying conditions that cause bat susceptibility to fungal infection are unknown and for now the exact process by which infection leads to death remains undetermined. It is known that chronic disturbance of hibernating bats can lead to high winter mortality rates due to depleted fat reserves when food is scarce (Speakman et al 1991). WNS infected bats display aberrant behaviors, such

as daytime flights and roosting near cave and mine entrances with rapidly fluctuating temperatures or in colder areas, which in turn may lead to higher mortality of the infected bats. Scientific evidence also suggests that skin infection by *G. destructans* may be a primary cause of the mortality associated with WNS.

Predators Bats are major consumers of agricultural and forest pests, as well as mosquitoes which transfer West Nile Virus. These bats eat millions of insects every year and if their numbers are significantly reduced by WNS, the economic impact of increased crop damage could prove severe. One study estimated that bat control of a single agricultural pest in Texas alone was worth as much as $1.7 million dollars per year (Cleveland et al. 2009). Already, the U.S. Forest Service estimates that 2.4 million pounds of insects will go uneaten due to WNS. Bats reduce the necessity of insecticide applications, saving farmers up to hundreds of thousands of dollars annually. Bats are also a critical component of fragile cave ecosystems and their absence could lead to a cascade of impacts to rare invertebrate cave species.

Wildlife Disease Control

General goals for managing wildlife diseases include: 1) preventing introduction of disease; 2) controlling spread of existing disease; or 3) eradication of disease (Wobeser 2006). Disease control is in the prevention stage while management options continue to be developed and assessed. Prevention, slowing and controlling spread of WNS is a priority in Wisconsin at this stage in the progression of the disease. Although the natural movement of bats cannot be easily managed, it is possible to manage human-assisted transfer of *Geomyces destructans* and WNS. Measures to help prevent introduction of *Geomyces destructans* to hibernacula include measures of decontamination and/ or physical exclusion of bats or humans from hibernacula, and early detection of any infected sites to control further spread of the disease. In choosing disease management actions for prevention, or in response to a specific WNS detection event, specifics of each unique situation must be considered. This includes but is not limited to: the species and number of bats at risk or judged infected or exposed, the seasonal timing of WNS or *Geomyces destructans* detection, the characteristics of the cave/mine (including but not limited to ownership, access, physical features, other cave biota), the potential for implementing various control treatments at the site, as well as the geographic area and proximity to other hibernacula.

Current WNS Management Plans

National

Before a WNS management plan was completed, the United States Fish and Wildlife Service (USFWS) published a cave advisory in March 2009, which recommends suspending activities in caves to protect bats from white-nose syndrome (Appendix A). The Structured Decision Making (SDM) Initiative for WNS management, a collaborative of USFWS and several state natural resources agencies including the Wisconsin Department of Natural Resources (WDNR), was published in October 2009 (Szymanski et al.). The SDM reports on an analysis evaluating 23 management alternatives against six objectives in an attempt to determine how best to control the spread and minimize the effects of WNS on hibernating bats at the individual and population level. The highest scoring alternative action for areas greater than 75 miles away from WNS restricts cave and mine access, with appropriate decontamination and gear dedication procedures implemented, to commercial and research uses only.

In October 2010 the USFWS released a draft 'National Plan for Assisting States, Federal Agencies, and Tribes in Managing WNS in Bats' (Appendix B). The Plan's general recommendations for preventing infections and breaking chains of transmission include: avoid contact with bats, wear barriers (gloves, coveralls, etc.) if contact with bats is necessary and disinfect potentially contaminated items. Furthermore it recommends adhering to basic hygiene practices promoting personal surveillance as well as oversight of research, wildlife management and caving activities. Web-based links to the science based, and routinely updated, decontamination protocols for field researchers and cavers are provided (Appendix C, D and E).

Federal public land cave closures include: United States Forest Service (USFS) caves and mines in the 20 states of Region 9 (CT, DE, IL, IN, IA, ME, MD, MA, MI, MN, MO, NH, NJ, NY, OH, PA, RI, VT, WV, WI); the 13 states of Region 8 (KY, VA, TN, NC, SC, GA, FL, MS, AL, AR, LA, OK, TX); the five states of Region 2 (CO, KS, NE, SD, WY); Wayne National Forest, OH; Ottowa National Forest, MI; and Monongahela National Forest, WV. The National Park Service (NPS) has closed and mines in: Buffalo National River, AK and Great Smokey National Park TN/NC. The USFWS has a caving moratorium in 17 states (NH, MA, CT, VT, NY, PA, WV, VA, ME, RI, DE, MD, OH, NC, TN, KY) and closed caves in Wheeler National Wildlife Refuge, AL.

Regional

The USFWS is drafting a Region 3 (Midwestern states) WNS Contingency Plan similar to the national plan but it is not yet available. The WDNR continues to participate in the now USFWS Midwest region bi-monthly Midwest Bat Working Group conference call for state agencies and cooperators of Midwestern states. The purpose of the Working Group is to communicate and collaborate on WNS research, surveillance and management actions within the Region.

States and Provinces

ALABAMA: The first objective of the Alabama WNS Management Plan (Appendix F) is to "reduce the possibility of the spread of WNS in Alabama's bat populations and take other actions to conserve the values of the cave/karst ecosystem and similar areas". The Plan recommends the following strategies to accomplish this goal: 1) closures that protect significant bat caves yet permit appropriate recreational use of other caves, 2) request governments to require and private landowners to voluntarily implement, and cavers to use decontamination protocols, 3) partner with others who are affected by or work with bats or their habitat for conservation and early detection surveillance, 4) develop procedures to reduce the possibility of WNS spread from

infected caves, and 5) implement safe treatments of infected bats, caves, mines, and similar ecosystems.

GEORGIA: All people visiting caves and/or working with bats, including wildlife rehabilitators, are asked to follow USFWS disinfection protocols, reduce caving activities and respect public and private cave closure advisories. Disinfection protocols must be instituted in order to retain a GA DNR scientific research permit. No WNS positive bat may be released from rehabilitation. (Appendix G).

KENTUCKY: The Kentucky Department of Fish and Wildlife Services has released the "Bat Handling/Disinfection Protocol for Summer Bat Field Studies in Kentucky" for consultants and researchers to follow while working in bat sites during the summer months. (Appendix H)

MICHIGAN: Plan will be available soon.

MISSOURI: The Department of Conservation's (MDC) White-Nose Syndrome Action Plan requires that staff and permitees follow disinfection protocols when entering MDC caves and encourages the use at other caves. Wildlife Collector Permit holders are not allowed to bring any equipment into Missouri that has contacted bats in WNS-affected states and to disinfect any gear that has come into contact with bats in non-affected states before use in Missouri. Since WNS has been detected in Missouri hibernacula, MDC has closed entry to all MDC bat caves. (Appendix I).

NEW MEXICO: Cooperating agencies of NM released a WNS Response Plan with the primary objective of preventing potential human transmission and containing any novel occurrence of *Geomyces destructans* in the state. Access to public caves or mines with significant bat roosts has been restricted and access to other caves or mines requires decontamination protocol adherence. (Appendix J).

TENNESSEE: A Cooperative Monitoring and Response Plan (Arnold Air Force Base et al. 2009) aims to minimize potential for monitoring and research to contribute to the spread of WNS by implementing disinfection protocols, establishing a monitoring framework for early detection of WNS, and devising a response strategy for a WNS outbreak. The plan restricts public access to caves and mines on state owned lands including state parks, natural areas, forests, and wildlife management areas for the winter of 2009/2010. Exceptions to the cave closures were allowed with methods to limit the spread of WNS including designated gear or gear and clothing decontamination.

State owned public land cave closures or restrictions have been instituted in the nearby states of IL, IN, and MO as well as in the states of WV, VA, AR, TN, PA, NM, TX.

Federal Environmental Assessments N/A

Tribal Involvement The Great Lakes Indian Fish and Wildlife Commission was approach by the Department during the creation of this E.A. and will be sent a final version.

Non-Regulatory Actions Taken by Wisconsin DNR

Bat Population Monitoring. The Wisconsin Bat Conservation & Management Plan currently implements long term monitoring at several important hibernacula with surveys recording bat use and data loggers recording environmental conditions. In an effort to fill existing gaps of possible

sites used as bat hibernacula, WDNR started cataloguing cave and mine locations in Wisconsin in the spring of 2010. Further efforts are ongoing to determine if the caves and mines are suitable for bat use and will ultimately include collecting data on bat use. The resulting dataset will include: location of hibernacula, species of bats that use them and how many, distance from other hibernacula, bat movement among sites, site accessibility, and available survey resources. These data will allow managers to make the most informed decisions when setting priorities in WNS surveillance.

An effort to monitor the summer bat population of Wisconsin involves the Wisconsin Citizen-based Monitoring Network, which was started in 2007. Volunteers collect data at summer roost sites, including in some cases an index of breeding females at the maternity roost, as well as conduct mobile acoustic surveys on designated routes. This work provides valuable, multi-year data on Wisconsin's bat populations to determine species distribution, seasonal movements and species status and trends.

WNS Surveillance All techniques for monitoring Wisconsin bat populations allow for WNS surveillance opportunities hence the two goals are integrated into a single effort.
WDNR also continues to track or investigate all public reporting of bats displaying unusual behaviors and sick, dead or dying bats through an online submission form. As was found in eastern states during the initial spread of WNS, unexplained increases in submissions of bat reports may provide anecdotal evidence about the onset of WNS. Such data or reports may also assist in locating previously unidentified hibernacula by mapping bat reports or result in a survey of nearby hibernacula or other bat roosts.

WNS Research WDNR has been and will continue to be involved in multi-agency collaborative white-nose syndrome research.

Communications Outreach to stakeholders and public is ongoing. The Department has been contacting stakeholders potentially impacted by the rule and working to get information to the public. Stakeholders include commercial caves and mines, active underground mines, private cave and mine owners, recreational cavers, agriculture and forest industries, animal control operators, wildlife rehabilitators, and conservation organizations. General WNS information and links to other WNS pages can be found on the WDNR Bureau of Endangered Resources web site.

Disease Control Disease control is in the prevention stage while management options continue to be developed and assessed. Department activities have centered on determining the size of our cave bat population, identifying potential hibernacula, decontamination, and developing voluntary agreements with cave and mine owners.

Regulatory Actions Taken by Wisconsin DNR to Control WNS

Wisconsin bats, notably the little brown bat, migrate up to 280 miles between their summer and winter habitat. When WNS was found within 280 miles of the Wisconsin border (~225 miles from the southern border) in April 2010, Wisconsin increased its WNS disease management efforts. Knowing the potential for WNS to be found in Wisconsin as early as winter 2011, the department put into place tools needed, via emergency rules and permanent rule proposals, to both slow the arrival of the disease to the state, and slow the spread of the disease once in the state.

In September 2010 the Natural Resources Board approved two emergency rules and gave permission to go to public hearings for identical proposed permanent rules. The first emergency

rule lists the four native cave bat species of Wisconsin as threatened species under NR 19. Listing cave bats as threatened prohibits disturbance of the bats during hibernation, prohibits the possession or transfer of the animals, and decreases the overall number of bats taken through minimization efforts from alternative sources of mortality. The effects of WNS on the cave bat community in the Northeastern states are devastating and it's already predicted that the little brown bat has a 99% chance of being regionally extirpated within the next sixteen years. Cave bats of Wisconsin met three criteria for assessed changes in population condition indicating the need for the rule change. First is the need for immediate protection (from a new threat, in this case WNS). The second and third criteria points are unrelated to this emerging disease: there has been a significant change in the Natural Heritage Inventory State Rank for these species since 1997, and the little brown bat has been recommended for listing since 1997.

While emergency listing the cave bat species in WI as threatened provides protection to the animals, it does not affect the spread of the fungus. The second emergency rule adds the fungus *Geomyces destructans* to the list of prohibited invasive species in NR 40. This listing gives the Department regulatory authority to limit human transport of the fungus.

Geomyces destructans meets the definition of invasive species as it is nonnative to the state, never having been found in soil samples here. Recent peer-reviewed journal articles have found and described the same fungus in six European countries (Wibbelt et al. 2010, Martinkova et al. 2010) adding support to the hypothesis that it is of European origin. There are no bat species that travel between continents and it is not known how it may have arrived in North America.

Furthermore *Geomyces destructans* meets the definition of a prohibited invasive species in the following ways:

1) Based on evidence from the states where WNS has been found, the fungus has the potential of greatly reducing or extirpating four of WI's eight bat species. Bats are primary predators of night flying insects, many of which are agricultural, forest, and human health pests. Indirect and direct economic impacts are tied to likely increases in chemical pesticides needed to combat the agriculture and forest insect pests when the ecosystem services of the insectivorous bat species populations decline.

2) The species has not been found in soil samples and winter surveillance in WI for the fungus during the 2009/2010 hibernacula counts, indicated no current signs of the fungus present. Neighboring states surveillance for the disease shows the fungus as close as 225 miles south of our border in Missouri and 300 miles north of our border in Ontario Canada.

3) A study last year using WI bats transported to two hibernation sites in VT showed that the fungus remains present in the environment after all of the bats within a cave are eradicated. Given the spread and continued establishment in all of the states it has entered, it shows that spread continues throughout each location. There is evidence to support the ability of *Geomyces destructans* to establish itself in Wisconsin caves and mines.

4) There are several options for controlling the species' spread within the state. Current decontamination protocols are relatively inexpensive and effective at preventing transfer from site to site through human spread. On-site cave and mine management includes closure to unauthorized human access through signage and bat-compatible cave gates. There are a limited number of hibernacula in the state making it feasible to implement control efforts having long-term protection benefits. Environmental control methods and treatment of bats once the fungus is present at a site is currently being researched. There

are actions presently available to help slow the spread while additional treatment options become available at a future time.

5) There is no recognized or likely beneficial use or commercial value to the fungus *Geomyces destructans*. The negative socio-economic impacts are related to reduced recreational opportunities for cavers, increased agricultural and forestry expenses for combating additional insect pests, and reduced production at organic farms. Wildlife viewing areas to watch fall swarming behavior at hibernacula would no longer be an option for citizens interested in experiencing the night-time flight emergence of one of Wisconsin's natural resources.

In October 2010 the Natural Resources Board approved a third emergency rule and gave permission to go to public hearings for additions to NR 40 dealing with the management of white-nose syndrome. These rule changes gave the Department regulatory authority to access caves and mines for monitoring and surveillance and to enact management actions at sites where WNS may become introduced thereby providing reasonable and feasible means of slowing or stopping the spread. The rule changes define how and under what circumstances the department will implement management actions needed to be in place for this winter's hibernation season.

The three rule changes on their own are justifiable, but potential results of doing nothing appear grave to many resources in Wisconsin. All bat species in Wisconsin are insectivorous and provide an ecosystem service that cannot be easily replaced once they have declined or have been lost from system. To do nothing is an option that would have long-lasting impacts to the agricultural and forestry industry economics. Organic farmers do not have the option of increasing use of pesticides because they rely on alternative forms of pest reduction using integrated pest management. Losing bats as their natural ally of the primary predator of night flying insects, organic and small family farmers are likely to undergo an economic impact reducing production of their marketable goods.

Bats of Wisconsin travel large distances, sometimes hundreds of miles, from their summer roosting areas to their overwintering grounds to hibernate. Wisconsin has some of the Midwestern United States largest populations of cave bat species, it is also known that Wisconsin share bats with its neighboring states. Doing nothing impacts not just the residents and ecosystems of WI, but also impacts our surrounding states natural resources. There is the potential of losing not a single species of bat, but an entire taxonomic group from the region if this invasive species of fungus is allowed spread unchecked.

Actions Taken by Other Wisconsin State Agencies to Control WNS N/A

Rule Review

1. Threatened Species Listing

Rule Description
Due to the immediate threat of white-nose syndrome in Wisconsin, the Department proposes to add the following cave bat species to Wisconsin's threatened species list, NR 27.03 (3), Wis. Admin. Code: little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), eastern pipistrelle (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*). In anticipation of listing, DNR will issue broad incidental take guidelines.

Rule Summary
The proposed rule change seeks to provide protection to Wisconsin's cave bat species, whose populations have declined at a national level due to white-nose syndrome and are imminently threatened by the disease in the state. Listing will prohibit the transport, possession and disturbance and decrease mortality of four WI cave bats species: little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), eastern pipistrelle (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*). Listing these species before WNS has been detected in Wisconsin will allow the Department time to work collaboratively with stakeholders to ensure that appropriate conservation measures, such as the protection of refuge hibernacula, are developed and in place in the event that WNS arrives in Wisconsin. The disappearance of cave bats from the ecosystem will have significant economic, environmental and public health impacts.

A broad incidental take permit/authorization would be created, as provided for under s. 29.604, Wis. Stats. The broad incidental take permit/authorization would allow for the incidental taking of state listed cave bats that may occur as a result of specific public health concerns, bat removals, building demolitions, forestry activities, bridge demolitions, miscellaneous building repairs and wind energy development projects. Some take of bats may still occur as a result of these activities, however take will be minimized by following specific minimization measures. The department has concluded that the projects covered under this permit are not likely to jeopardize the continued existence and recovery of the state population of these bats or the whole plant-animal community of which they are a part; and has benefit to the public health, safety or welfare that justifies the action. This incidental take permit/authorization is only needed when a bat is present or suspected to be present (e.g., Natural Heritage Inventory report of bats in the area, evidence of bat presence).

Rule Authority
DNR authority for these rules is granted in state statutes 29.604, 227.11, and 227.24 Wis. Stats.

Estimated Cost and Funding Source
The department will be issuing a broad incidental take permit/authorization associated with the listing that will cover take caused by many private companies and organizations such as pest control operators, construction companies, and wind energy development. It is assumed the impact to farmers of this rule change will be positive; especially in light of the fact that if bat populations in the state were to be devastated, the costs to agriculture from pest destruction of crops and pesticide use would increase.

Proposed Action
Listing the little brown bat, big brown bat, northern long-eared bat and eastern pipistrelle as threatened species in Wisconsin.

Effects
Listing the cave bats as threatened species will allow the department to effectively regulate the take, transport, possession or disturbance of these four species.

Affected constituencies include commercial caves and mines, private cave and mine owners, recreational cavers, wildlife rehabilitators, animal control operators, the agricultural industry, the conservation community, wind utilities, WI Department of Transportation (WDOT) and homeowners. Concerns will likely include how listing the bats will affect current activities. Many of these potential concerns will be addressed through a broad incidental take permit/authorization and voluntary agreements so that the listing does not have a significant economic impact on a substantial number of small businesses.

A broad incidental take permit/authorization would be created, as provided for under s. 29.604, Wis. Stats. The broad incidental take permit/authorization would allow for the incidental taking of state listed cave bats that may occur as a result of specific public health concerns, bat removals, building demolitions, forestry activities, bridge demolitions, miscellaneous building repairs and wind energy development projects (see the "Broad Incidental Take Permit/Authorization for Cave Bats" attachment for more information). Some take of bats may still occur as a result of these activities, however take will be minimized by following specific minimization measures and the department has concluded that the projects covered under this permit are not likely to jeopardize the continued existence and recovery of the state population of these bats or the whole plant-animal community of which they are a part; and has benefit to the public health, safety or welfare that justifies the action. This incidental take permit/authorization is only needed when a bat is present or suspected to be present (e.g., Natural Heritage Inventory report of bats in the area, evidence of bat presence).

Analysis of Alternatives

No Action Under the 'no action' alternative the four cave bat species would not be listed as threatened and there would therefore be no additional regulation of take, transport, possession or disturbance related to these species.

2. Prohibited Invasive Species Listing

Rule Description
The proposed changes to ch. NR 40, Wis. Adm. Code, will add the fungus, *Geomyces destructans*, to the list of prohibited invasive species, allowing the department to effectively manage its spread and limit human transport.

Existing rules ban the transportation (including importation), possession, transfer (including sale) and introduction of invasive species that are listed or identified as "prohibited", with certain exceptions. Transportation, possession, transfer and introduction without a permit are exempt if the department determines that the transportation, possession, transfer or introduction was incidental or unknowing, and was not due to the person's failure to take reasonable precautions. Existing rules authorize the department to enter property with the permission of the owner or person in control of the property and, if permission cannot be obtained, to seek an inspection warrant from the Circuit Court. Entry is only for the purpose of inspection, sampling or control of prohibited invasive species.

The current rules also allow the department to enter into consent orders with persons who own, control or manage property where prohibited invasive species are present to implement approved control measures, and to issue unilateral orders for control purposes unless the person was not responsible for the presence of the prohibited invasive species. If a control order is not complied with and the department undertakes control measures, the current rules allow for cost-recovery by the department for the expenses it incurred.

Rule Summary

Due to the immediate threat of white-nose syndrome in Wisconsin, the department proposes to add *Geomyces destructans*, the fungus that causes white-nose syndrome, as a prohibited invasive species under NR 40.04, Wis. Admin. Code, via emergency rule. Chapter NR 40, Wis. Admin. Code establishes a classification system for invasive species and regulates those in the prohibited and restricted categories. It also establishes preventive measures that when followed, will help minimize the spread of invasive species into or around the state. To ensure long-term regulatory authority for this species the department will propose adding it to Ch. NR 40, Wis. Admin. Code through a permanent rule change in the near future.

While the need to act immediately on white-nose syndrome is clear, 2009 Wis. Act 55, Invasive Species Bill, authorizes the department to promulgate emergency rules to identify, classify or control an invasive species, without a finding of emergency. Such emergency rules can remain in effect for as long as two years or when it is replaced by a permanent rule if earlier.

Existing rules ban the transportation (including importation), possession, transfer (including sale) and introduction of invasive species that are listed or identified as "prohibited", with certain exceptions. Transportation, possession, transfer and introduction without a permit are exempt if the department determines that the transportation, possession, transfer or introduction was incidental or unknowing, and was not due to the person's failure to take reasonable precautions. Existing rules authorize the department to enter property with the permission of the owner or person in control of the property and, if permission cannot be obtained, to seek an inspection warrant from the Circuit Court. Entry is only for the purpose of inspection, sampling or control of prohibited invasive species. The listing of the fungus that causes WNS may result in the need for cavers to decontaminate caving equipment or avoid environmentally sensitive areas.

The current rules also allow the department to enter into consent orders with persons who own, control or manage property where prohibited invasive species are present to implement approved control measures, and to issue unilateral orders for control purposes unless the person was not responsible for the presence of the prohibited invasive species. If a control order is not complied with and the department undertakes control measures, the current rules allow for cost-recovery by the department for the expenses it incurred.

Rule Authority

DNR authority for these rules is granted in Sections 23.09 (2) (intro.), 23.091, 23.11 (1), 23.22 (2) (a) and (b) and (2t) (a), 23.28 (3), 27.01 (2) (j), 29.039 (1), 227.11(2)(a), and 227.24 (1) (a), Stats.

Estimated Cost and Funding Source

Many potential stakeholder concerns may be addressed through cost-sharing, technical support, and education provided by the department. Examples include: reviewing proposed research proposals and issuance of scientific research licenses, cost-sharing for installation of bat gates and other conservation actions, providing cave/mine closure signage and decontamination protocols, and providing locations of caves that may be used for recreational caving activities (where bats are known to have been excluded).

Proposed Action
Adding the fungus that causes white-nose syndrome, *Geomyces destructans*, to the list of prohibited invasive species in Wisconsin.

Effect
Listing *Geomyces destructans* as a prohibited invasive species will allow the department to effectively manage its spread and limit human transport by regulating its possession, transportation, transfer and introduction.

Affected constituencies include commercial caves and mines, private cave and mine owners, recreational cavers, property owners, the agricultural industry, and the conservation community. Concerns will likely include how listing the fungus will affect current activities. Many of these potential concerns may be addressed through cost-sharing, technical support, and education provided by the department. Examples include: reviewing proposed research proposals and issuance of scientific research licenses, cost-sharing for installation of bat gates and other conservation actions, providing cave closure signage and decontamination protocols, and providing locations of caves that may be used for recreational caving activities (where bats are known to have been excluded).

Under NR 40, the department may ask any person who owns, controls, or manages property where a prohibited species is present to control the prohibited species in accordance with a plan approved by the department. While a person who owns, controls or manages property where a prohibited species is present is responsible for controlling the prohibited species that exists on the property, the department will seek funds to assist in the control of prohibited species. Therefore, conducting control measures will not necessarily result in a cost to commercial cave operators. Additionally, commercial caves will have the option to exclude bats from their cave(s) with the help of the department, allowing them to remain open for tourism, and resulting in no loss of tourism dollars.

Analysis of Alternatives

No Action
Under the "no action" alternative the fungus *Geomyces destructans* would not be listed as a prohibited species and there would therefore be no regulation of possession, transportation, transfer or introduction of this species.

3. White-nose Syndrome Management

Rule Description
The proposed rule lists *Geomyces destructans* as a prohibited invasive fungus species under Chapter NR 40, Wis. Adm. Code which establishes a classification system for invasive species and regulates those in the prohibited and restricted categories. The added provisions to s. NR 40.04 and 40.07 relate to early detection and prevention of the spread of WNS due to anthropogenic activities.

The Rule also sets out authority for the department to grant written exemptions from the new decontamination requirements if it would not allow WNS to be transported to other locations and adds the following key definitions:

"Cave" means any naturally occurring void, cavity, recess or system of interconnected passageways beneath the surface of the earth or in a bluff, cliff or ledge, including pits and sinkholes, but does not include a rock shelter.

"Mine" means any artificial excavation, shaft, underground passageway, slope, tunnel or working from which ore or mineral is or was extracted, but does not include an open pit mine. However, caves or mines may be located adjacent to open pit mines.

"Near" means, for purposes of s. NR 40.07 (8), within 100 feet of.

"Rock shelter" means an overhang or cave-like opening in a bluff, cliff or ledge that is shallow and does not provide an area of substantial daytime darkness.

Rule Summary

The proposed rule provides the tools for early detection of WNS in Wisconsin, requires decontamination procedures of persons and gear entering caves and mines, and allows physical exclusion as a means to prevent spread of *Geomyces destructans*. *Geomyces destructans* has been identified as the fungus associated with white nose syndrome in cave bats. Because the department has little if any control over the natural movements of bats, the main focus in WNS management is on removing humans as a vector for spreading the disease. It establishes these preventive measures, that when followed will help minimize the spread of this invasive species into or within Wisconsin.

Under the proposed rules, the public will be asked to take preventive measures that are meant to slow the introduction and spread of Geomyces destructans in the state. The department is seeking funding to assist with the installation of barriers, and therefore cost to those parties who install such barriers should be negligible. Additionally, commercial caves will have the option to exclude bats from their cave(s) with the help of the department, allowing them to remain open for tourism, and resulting in no loss of tourism dollars. Finally, the department will work with active underground mines to develop control plans that will not hinder mining operations.

Under current ch. NR 40, the department may ask any person who owns, controls, or manages property where a prohibited species is present to control the prohibited species in accordance with a plan approved by the department. While a person who owns, controls, or manages property where a prohibited species is present is responsible for controlling the prohibited species that exists on the property, the department will seek funds to assist in the control of prohibited species.

The department will normally follow an informal, stepped enforcement process in order to obtain compliance with invasive species rules. This process involves informal discussions between department staff and the individual, landowner or company, notifying the person of potential violations and providing guidance on how to comply with the rules. Notices of non-compliance may follow if necessary. If formal enforcement is necessary, ch. NR 40 will be enforced by department conservation wardens, county district attorneys, and circuit courts through the use of citations and civil or criminal complaints. Civil and criminal enforcement may also be carried out by department referral of violations to the Wisconsin Attorney General, with prosecution and abatement actions in the circuit courts. Criminal enforcement will be limited to intentional violations. Finally, violations of the permits issued under ch. NR 40 also may be enforced by administrative permit revocation proceedings.

Rule Authority

DNR authority for these rules is granted in Sections 23.09 (2) (intro.), 23.091, 23.11 (1), 23.22 (2) (a) and (b), 23.28 (3), 27.01 (2) (j), 29.039 (1) and 227.11(2) (a), Wis. Stats.

Estimated Cost and Funding Source
The department is working with the few commercial caves businesses to address decontamination or exclusion or other measures to assure their business and prevent the spread of Geomyces destructans. The rule may have favorable effects on a number of businesses by preventing the introduction or limiting the spread of WNS, thereby preserving the agricultural, economic and environmental benefits associated with healthy bat populations. The cost of decontamination will be minimal. The cost of excluding bats at a cave with high human visitation would be $100-$1,000. The department is seeking funds to cover these costs. The cost of caving gear typically ranges from $125-$750. Very few sites in Wisconsin require vertical climbing gear. The cost of signage at caves and mines would be $0 because the department will provide the signs.

Early Detection

Background
Since WNS was first discovered in New York in 2006, it has continued to spread to nearby and distant hibernacula in the Northeast. *Geomyces destructans* in North America has only been found in hibernacula where WNS is known to occur (Lindner et al. *In Press*). Data on WNS observations continue to be collected throughout North America but the spread is still poorly understood and no epidemiologic models exists. The spread of the fungus and the disease in the past year has been more rapid than initial movements suggested and winter 2009/Spring 2010 occurrences of WNS were discovered in Missouri and Ontario, Canada. Based solely on what has been observed to date, *Geomyces destructans* may arrive in Wisconsin as early as the winter of 2010/2011 on bats migrating from the north or south, or on humans from any infected site (Turner and Reeder 2009).

Monitoring bat populations in Wisconsin, currently considered WNS free, is crucial for two reasons: pre-WNS baseline data collection and early disease detection. Critical baseline data on parameters such as population densities, hibernaculum locations, health (e.g., pre-torpor body condition and wing damage in unaffected bats), reproductive status, and hibernaculum microclimate data are needed from unaffected locations for on-going research dedicated to understanding the disease and informing a coordinated national and regional response. Furthermore, early detection will give managers and researchers the greatest opportunity to develop and experiment with control methods focused on stopping or slowing the spread of the disease. A better understanding of the bat population in Wisconsin will allow managers to measure the efficacy of management decisions and gauge the overall effect of management and disease-response on the state's bat population as a whole. As well, baseline data will guide conservation and recovery efforts.

Early detection requires active surveillance of hibernating bats. Active surveillance is achieved by visiting the interior of hibernacula to look for signs of WNS, such as fungal growth on bats, abnormal behavior, and changes in distribution within hibernacula. Active surveillance goes along with population monitoring so that in the process of looking for early signs of WNS, the number of bats, species, and location within the hibernacula can also be recorded. Hibernating bats should be disturbed as little as possible during surveillance, and thus visits should be limited (only one or possibly two/season) and should involve as few individuals as possible. Furthermore, researchers should keep as much distance as possible between themselves and the bats to avoid waking them.

The goal of the current, and largely completed, effort to catalogue all of Wisconsin's caves and mines is to identify all important natural and artificial roosts. Sites are to be prioritized for

monitoring, surveillance, management, and conservation efforts based on site details and significance to the population as a whole. For example, sites that contain the largest or most diverse populations and the most threatened or endangered species will be given higher priority. Cave and mine roosts are categorized for prioritization according to 1) total numbers of bats accommodated, 2) number of species sheltered, 3) apparent value of the site in meeting bat needs, 4) long-term safety of the site, if protected, 5) known threats if not protected, and 6) context in relation to nearby hibernacula, and 7) status of the species involved. If time is limiting for surveillance, effort will be given to higher priority sites.

Proposed Action

Because the time and place of *Geomyces destructans* arrival in Wisconsin cannot be known in advance, early detection is critical to: 1) learn more about the epidemiology of the fungus and of WNS, 2) allow managers time to consider all management options and implement using the best available techniques for responding to outbreaks of WNS. Department staff will need landowner permission or must pursue an inspection warrant, to access caves and mines in order to monitor, survey, and inspect for the presence of *Geomyces destructans*.

Effects

Disease Control. As with any epidemic, early detection of *Geomyces destructans* increases the probability of success of containing, or slowing the spread of the fungus from the affected site (i.e., early detection strategies for avian influenza, gypsy moth, and emerald ash borer). Furthermore, early detection will give managers the chance to re-prioritize future surveillance, evaluate disease control options before the end of the hibernation season, and participate in disease control research.

Ecologic & Cave Ecosystem. Any time people enter a bat hibernaculum, they may disturb hibernating bats and introduce foreign substances to the cave ecosystem. Hibernating bats cannot survive constant or repeated disturbance, which wakes them during hibernation (Speakman et al. 1991, Thomas et al. 1990) and causes them to deplete energy reserves needed to hibernate until spring. Active surveillance that limits the number of visits and minimizes any potential disturbance to bats, however, is not mortally detrimental to healthy bats (Boyles and Brack 2009). Early detection of WNS is unlikely to change the ultimate fate of infected individuals until a cure for WNS is developed. However, early detection can potentially have a dramatic effect on bats at the population level by giving managers the time to contain the disease outbreak in the hibernaculum. With the proper disinfection protocol there should be minimal effects of early detection on the bats and cave ecosystem.

Socio-economic. WDNR is already receiving positive feedback and concern for the bats from the general public, early detection of a WNS infection within the state of Wisconsin may trigger even greater public concern for native bats. This support may be instrumental in combating and tracking the disease. The loss of cave bats from the environment could mean an increase in the density of pests affecting agriculture and human health. Early detection of WNS would be an early warning to the agricultural industry of the potential need for increased amounts of manufactured pesticides. The loss of bat control on mosquito populations could mean the increase in the number of mosquitoes carrying disease infections to humans and animals (i.e. West Nile Virus). Early detection of WNS will give human health providers an early warning to be vigilant about diseases carried by mosquitoes. The department has provided and will seek additional funds for cave/mine owners to implement preventive measures. Notifying the public that the commercial caves are safe, environmentally friendly sites may increase visitation.

Analysis of Alternatives to Early Detection

No Action. Under the 'no action' alternative there would be no effort to detect the introduction of the fungus *Geomyces destructans* and WNS to Wisconsin hibernacula. Bat population monitoring would not change from current WDNR population monitoring and research effort levels. Disease detection under this alternative would involve late stage manifestation recognized by the public when large numbers of dead and dying bats are found on private property.

Disease Control. In the absence of early detection through active surveillance, researchers lose the ability to track and study the disease, and develop concrete parameters for epidemiological models. Managers may not have a chance to attempt control or containment measures before remaining living bats disperse from the hibernaculum in spring. Early detection may still arise from continued current-level bat population monitoring but is less likely without active surveillance. Under 'no action' bats carrying the fungus are more likely to disperse from the hibernacula and contaminate other individuals and roost sites resulting in a greater rate of increase in *Geomyces destructans* prevalence, more rapid spread of WNS and a quicker regional population collapse.

Ecological & Cave Ecosystem. Because surveillance that limits the number of visits and minimizes any potential disturbance to bats is not mortally detrimental to healthy bats, 'no action' changes little for these individuals. 'No action' may benefit sick bats if the result means no hibernacula visits that disturb them during hibernation. Conversely the bat population on the whole will be negatively affected by 'no action' if it leads to an inability to control the spread of *Geomyces destructans* following the hibernation season. No action changes little for the cave ecosystem.

Socio-economic. 'No action' means there will likely be no early warning for the decline in summer resident bats and the subsequent increased number of pests including disease carrying mosquitoes. The lack of early warning decreases the time to prepare by both human health providers and the agricultural industry, including organic farmers who do not rely on pesticides for pest control.

Passive Surveillance. The alternative of using Passive surveillance involves techniques of compiling information from incidental reporting, such as bat submissions to rabies labs and public calls about dead bats to state wildlife agencies and wildlife rehabilitators. Information from these sources can be unreliable, but can also serve as a "red flag" to identify new areas for priority monitoring and surveillance. Passive data have been useful for locating previously unknown bat hibernacula and late stage WNS affected areas experiencing high mortality.

Disease Control. Passive surveillance for the occurrence WNS relies on incidental detection of the disease making early detection unlikely. If WNS is confirmed, the exact hibernacula a sick bat has emerged from may still not be known and researchers lose the ability to track and study the disease. Managers may not have a chance to attempt control or containment measures before remaining living bats disperse from the hibernaculum in spring. With passive surveillance bats carrying the fungus are more likely to disperse from the hibernacula and contaminate other individuals and roost sites resulting in a greater rate of increase in *Geomyces destructans* prevalence, more rapid spread of WNS and a quicker regional population collapse.

Ecologic & Cave Ecosystem. Passive surveillance does not require entrance into hibernacula until enough evidence suggests the disease is present and there is enough information about the

possible location of the disease outbreak. The bat population on the whole will be negatively affected by 'passive surveillance' if it leads to an inability to control the spread of *Geomyces destructans* during the hibernation season.

Socio-economic. Early detection through passive surveillance is unlikely and without it there will be no early warning for the decline in summer resident bats and subsequent increased number of pests including disease carrying mosquitoes. The lack of early warning decreases the time to prepare by both human health providers and the agricultural industry, including organic farmers who do not rely on pesticides for pest control. There is concern that undetected WNS infection in human visited caves, including bat occupied commercial caves, would lead to increased human exposure to many moribund bats with potential disease of human concern. Without early detection there is little time to prepare for the proper disposal of large WNS caused die-off events.

Preventive Measures

Early detection and decontamination work hand in hand to slow the spread of the invasive fungus and enable the department to respond in a focused and timely manner with additional preventive measures to reduce fungal transmission. The department will work with those who enter caves or mines – including but not limited to researchers, recreational cavers, tourists, and commercial cave and mine operators – to implement decontamination protocols and additional preventive measures to reduce the risk of fungal movement from site to site. Decontamination is a widely accepted starting point for transmission-risk reduction, and additional preventive measures are outlined here to further reduce risks; suitability of each of these additional measures depends on site characteristics and landowner goals. The department will work with individual landowners to meet their goals with a preventive measures plan approved by the department.

Background

The science of WNS control is under development, and many answers are still emerging. Research throughout the nation is ongoing and regular updates critical to WNS management decision-making are made available to federal and state WNS managers on a regular basis. Implementation of any action will need to be informed by current best available science and by the situation surrounding the site. Therefore any disease management option needs be considered, both for prevention of introduction of WNS into new areas, and for control of WNS where it is detected.

Disease management options need to be chosen in response to a specific WNS detection event. Chosen actions will be based on the specifics of the situation, including, for instance: the species and number of bats judged infected or exposed, the seasonal timing of WNS detection, the characteristics of the cave/mine (including ownership, access, physical features, other cave biota), the potential for implementing various control treatments at the site, the geographic area, and proximity to other hibernacula.

The best available scientific data, including risk analysis results of the structured decision making process (Szymanski et al. 2009), support cave closure for publicly and privately owned caves. The USFWS has a cave moratorium in the states affected by WNS and recommends decontamination in non-affected states to prevent the anthropogenic spread of *Geomyces destructans*. The USFS has closed cave/mine access in the 20 states of Region 9 (Northeastern states), the 13 states of Region 8 (Southeastern states), the five states of Region 2

(Rocky Mountain states), Wayne National Forest, OH; Ottowa National Forest, MI; and Monongahela National Forest, WV. Indiana restricted state-owned cave access and following discovery of WNS in a Missouri cave, other Midwestern states have closed all visitor access to state managed bat caves: Missouri-2010, Illinois-2010, and Iowa-2010.

There are approximately 120 known bat hibernacula in Wisconsin, and approximately 12 of these are public caves. In addition, less than 20 of the caves and mines in Wisconsin are routinely used for recreational caving, and less than 10 are commercially operated caves.

Decontamination

Background

Geomyces destructans can be transferred bat to bat, cave to bat, and from cave to equipment or equipment to cave. Laboratory experiments conducted at the USGS National Wildlife Health Center (Madison, WI), have demonstrated that healthy bats can contract WNS directly from infected bats housed in the same cage. Cave-to-bat contamination was documented in a multi-agency field experiment in which healthy bats from Wisconsin were moved into two WNS-infected hibernacula in the Northeast. Although sick bats were absent from the cave, healthy Wisconsin bats were colonized by *Geomyces destructans* , and developed WNS symptoms. Finally, cave-to-clothing/gear transfer was observed when the New York Department of Environmental Conservation, Wildlife Pathology Unit isolated and cultured *Geomyces destructans* fungal spores on equipment and clothing after exiting an affected cave.

A human role in inadvertently carrying *Geomyces destructans* spores from an infected site to a clean site on clothing, shoes, or gear has been accepted as possible (Sleeman 2009), and is supported by long-distance jumps in the spread of WNS beyond the distance bats would likely transmit the disease. These "jump" sites have been frequently-visited caves, often with small bat populations (Turner & Reeder 2009). The U.S. Geological Survey, National Wildlife Health Center isolated *Geomyces destructans* fungal spores in cave sediment, demonstrating that infected caves are persistent reservoirs of environmental contamination that may continue to spread the disease to other sites via human activities long after the cave's hibernating bats have been wiped out (Lindner et al., *In Press*).

The USFWS has recognized and responded to the possibility of human WNS transmission by creating decontamination protocols for field researchers and recreational cave users - the two most frequent groups to visit caves and therefore likely to contaminate sites (Appendix C & D). Although gear and clothing can be disinfected, there is currently no safe way to decontaminate an infected cave without substantially impacting the cave ecosystem, nor is there a protocol to decontaminate infected bats. Based on the devastating effects of WNS on bats populations in other states – and the fact that *Geomyces destructans* cannot be safely removed from a cave at this time – the USFWS National Response Plan and Strategic Decision Making Initiative (Szymanski 2009) recommend that WNS-free states implement strict biosecurity measures to minimize the risk of anthropogenic transmission of the fungus into caves.

The proposed rules to add restrictions regarding gear being used in Wisconsin and require decontamination before and after entering caves or handling bats are among the few tools currently available to slow the spread of WNS.

Proposed Action

The decontamination measures include 1) a prohibition on equipment, gear, clothing and other objects used in or near a cave in a state outside WI from being brought near or placed into a cave

or mine in Wisconsin, 2) decontamination of equipment, gear, clothing and other objects that have been in or near a cave or mine within WI before they can be brought into another Wisconsin cave or mine, 3) decontamination of all equipment, gear, clothing and other objects that have been in or near a cave or mine in Wisconsin immediately upon exit, and 4) decontamination of all equipment, gear, clothing and other objects that will be or have come in contact with bats (including, but not limited to nets, traps, weighing tubes, bat bags, wing punches, rulers, clothing, gloves, electronic equipment and exclusion materials) and all individuals handling bats prior to and immediately after contact.

Effects

Disease Control. Simple disinfection procedures can play a big role in infectious–disease prevention and control. It is not possible to decontaminate bats, but decontamination of equipment and clothing can help prevent the anthropogenic transmission of *Geomyces destructans*, and may slow the spread of WNS to and throughout Wisconsin.

Ecological & Cave Ecosystem. Decontamination procedures benefit bats and caves by reducing the risk of anthropogenic transfer of *Geomyces destructans* to the cave ecosystem. Decontamination may also help prevent the introduction of other foreign fungi, bacteria or viruses to the cave ecosystem. These steps may slow the spread of WNS and buy time while ongoing research works to develop suitable treatments for bats and/or the cave environment.

Socio-economic. Decontamination places a time and cost burden on individuals traveling to caves or working with bats for research, recreation, or rehabilitation, but does not preclude these activities. Extra costs may include the purchase of appropriate decontamination materials and detergents and the purchase of a set of gear for dedicated use within Wisconsin. Time costs include extra time to disinfect clothing and equipment before and after entering a cave or mine, or coming into contact with bats. The general public is well versed in simple methods to prevent the spread of infectious disease (i.e. wash your hands with soap and warm water, or cover your mouth when you cough…) and will likely support the necessary steps to control the spread of the disease.

Analysis of Alternatives to Decontamination

No Action

Under the 'no action' alternative there would be no obligation to decontaminate before or after entering a cave environment or when working with bats. Furthermore, no restrictions would exist for gear coming from other states including known WNS-affected states.

Disease Control. 'No action' provides zero control on the anthropogenic transmission or spread of the disease. WNS may arrive in the state of Wisconsin much sooner than environmental routes (bat-to-bat transmission) alone would bring it here, and the spread of the disease would be faster throughout the state after it has arrived.

Ecological & Cave Ecosystem. 'No action' could lead to an earlier introduction of WNS into Wisconsin's caves. Decontamination has only a potential positive effect on a cave while no action can only lead to a negative outcome or more rapid spread of WNS.

Socio-economic. 'No action' would place no requirement for decontamination so there would be no financial or time burden on individuals involved with cave and/or bat research, recreation or rehabilitation. Because decontamination procedures are relatively simple and inexpensive, albeit

potentially time consuming, no action may be perceived by the public and nationwide bat researchers as negligence when actions to protect the WNS status of Wisconsin can be taken.

Partial Decontamination. Under the 'partial decontamination' alternative, not all avenues of decontamination would be required. Decontamination is an effort to minimize risk or human transmission; any compromise in this approach results in a higher risk of human transmission.

Disease Control. *Geomyces destructans* conidia can easily go undetected on clothing or gear, especially from an infected sight where white-nose syndrome has not yet been observed. By requiring only partial decontamination, whether it is certain items of equipment or times when decontamination is required, there is still an elevated risk, relative to full decontamination, that inadvertent anthropogenic spread of the fungus can occur. The risk that human transfer of the fungus could occur reduces the disease control effort of any decontamination procedures.

Ecological & Cave Ecosystem. Decontamination has only a potential positive effect on a cave. Partial decontamination benefits the ecosystem when used but when not required leaves caves at risk of WNS introduction, similar to when no action is taken.

Socio-economic. In requiring only partial decontamination some of the burden of decontamination (financial and time) may be alleviated. However, any investment into decontamination is made obsolete if the risk of WNS introduction to Wisconsin is the same as 'no action' with its subsequent consequences.

Additional Preventive Measures Options
The department will work with cave/mine owners to implement one or more of the following preventive measures to meet the goals of the landowner and minimize the spread of *Geomyces destructans*, as part of a department-approved plan:

1. Management of the WNS-associated fungus (*Geomyces destructans*)

Controlling spread of the fungal agent, *Geomyces destructans* is an approach for preventing further spread of WNS into Wisconsin and into new areas of Wisconsin. The fungus *Geomyces destructans* would need to be removed from the cave environment, as well as from the agents potentially carrying it between hibernacula (i.e., humans and bats). A key strategy to control spread of *Geomyces destructans* is to control those agents potentially carrying *Geomyces destructans*, e.g. humans and bats. There is little yet known about the efficacy, and most important, the practical application, of various fungicidal agents or techniques. Although current experimental trials are under way, proven treatments do not currently exist for bats affected by WNS, and nor have vaccines to prevent fungal colonization been developed. Future development of treatments/ vaccines may play an increasingly important role in reducing the disease incidence and mortality, and in recovery of population viability. Tools to manage the WNS–associated fungus are: 1) Fungicide applications to cave environments or bats and 2) Excluding bats from high human-transmission risk caves.

Effects. Under this alternative, rather than trying to prevent the anthropogenic spread of *Geomyces destructans* to caves, a fungicide treatment would be used to eradicate or reduce the fungal load in the cave ecosystem upon its detection to prevent further spread. This option is not available at this time. Premature use of this option could incur negative and counterproductive effects. At present, this option would only be used under a research scenario.

Disease Control. The first step for any disease control program is prevention. Relying on a fungicide treatment for caves ignores any preventative options for disease control, such as steps to prevent anthropogenic transmission of *Geomyces destructans*. With early-detection surveillance for WNS, a fungicide treatment could take place before any living bats disperse from hibernation, thus offering some control on further spread of the disease. With vaccine treatments, it is also possible to offer some control on further spread of the disease. However broad-scale fungicide application in a cave environment would be experimental and efficacy is unknown. Efficacy in unknown, and a bat vaccine for WNS has yet to be created.

Ecological & Cave Ecosystem. Currently there are no fungicide treatments for *Geomyces destructans* that would not affect the cave ecosystem. There are a plethora of native soil fungi, some closely related to *Geomyces destructans*, found within the cave environment that may be impacted by a treatment, and these impacts may have broader and unknown effects on cave ecology. It is unclear exactly how it would change the ecology in the cave but the likely effect is presumed negative since fungicides are often powerful and could potentially affect living creatures in the cave ecosystem.

Socio-economic. Fungicide application may present some risk to humans. Experience with anti-fungal drugs used to treat humans infected with blastomycosis, caused by the soil fungus *Blastomyces dermatitidis*, has revealed side effects including life-threatening effects. Use of fungicides with possible health risks to humans would require management to minimize such risks.

Excluding bats from high human-transmission risk caves. Bat exclusion would reduce likelihood of human-to-bat WNS transmission by encouraging bats to hibernate elsewhere. Bat exclusion would also reduce WNS risk to the statewide population, by minimizing bat-to-bat transfer from high human-traffic sites. Loss of guano would reduce nutrient input to the cave ecosystem. Possible bat mortality, post-exclusion. Reduced disturbance to hibernating bats at high human-traffic sites.

2. Management through Disease Identification and Testing in Bat Populations

Host biology is always a key factor in the occurrence and management of disease. Research to date has shown that *G. destructans* will, for a period of time, co-exist with healthy bats in caves. Therefore, it is worth considering management of bat populations to decrease the transmission of *G. destructans* through a colony, or increase the WNS resistance of individual bats and decrease exposure of healthy members of a colony to the fungus.

Not every bat in a colony will become infected at the same time or even in the same hibernation period. Consequently, reducing the hibernaculum's fungal spore load may improve the chance that non-affected bats will survive through hibernation and reduce the overall fungal impact on the population. Reducing WNS-associated mortality rates at a site will reduce the long-term WNS impact both to that colony and to the statewide population. Tools to manage the disease through disease-identification and testing bat populations are: 1) In selected situations (e.g. small colonies, sole WNS detections in the area [i.e., "jump" site], other key bat hibernacula in the area at risk), removal of bats from the colony for testing, 2) Selective removal of *Geomyces destructans*-infected bats and their immediate neighbors for testing, 3) Mid-winter containment of *Geomyces destructans*-infected bat colonies, 4) Exclusion of bats from *Geomyces destructans*-infected hibernacula.

Effects.

Disease Control. *Geomyces destructans*-infected bats are a risk for movement of the fungus to new sites in the hibernaculum and to nearby hibernacula. Preventing mid-winter movements of affected bats would reduce the spread and impact of WNS. Removing *Geomyces destructans*-infected bats may reduce the load of agent in the affected colony (and thus reduce transmission risk to other bats). Preventing these mid-winter movements of affected bats to clean sites will minimize wintertime disease transmission among nearby hibernacula.

Ecological & Cave Ecosystem. Preventing clean bats from entering infected sites will maintain as many clean sites in Wisconsin for as long as possible. Preventing additional infection and spread will also directly increase bat survival. Maintaining clean sites could have additional benefits for caves, because the full impact of *Geomyces destructans* on cave ecosystems and their biota is unknown.

Socio-economic. Bats provide ecological services to the general public, particularly in terms of insect pest control. Reducing *Geomyces destructans* spread diminishes bat mortality and therefore helps retain bats and their ecological services on the landscape. Identification and testing provides the information to inform ongoing WNS research and management responses. Testing provides data.

3. Management through Environmental Modification

Environmental factors can play a role in the development/mortality impacts of WNS when *Geomyces destructans* infects a cave. Studies show that bats themselves appear to be practicing "environmental modification", e.g. moving to different areas of a cave, once they are WNS-affected. In theory, a cave environment could be modified to be made less suitable for *Geomyces destructans* growth, while still being suitable for bat hibernation. Tools to manage *Geomyces destrucans* through environmental modification are: 1) Modify temperature and humidity through air-flow manipulation to reduce fungal growth, 2) Provide temporary-harbor thermal refugia ("hot boxes") for *Geomyces destructans*-infected bats, 3) Create insulated roosting structures to maintain more stable temperature and humidity near cave/mine entrances, which normally experience high variability, and 4) Reduce roosting opportunities in parts of hibernacula where the microclimate most strongly favors *Geomyces destructans* growth, to encourage bats to roost where conditions are suitable for hibernation but less so for fungal growth.

Effects.

Disease Control. These approaches may not completely eliminate mortality, however they may increase annual WNS survival rates and help retain a larger potential recovery population. Such approaches need proper design and testing before broad application, to ensure that bats respond by seeking suitable roosting alternatives. Research with bat-to-bat transmission of WNS needs to be conducted to determine effectiveness of removal of infected and surrounding individuals. These actions may help identify prevalence and distribution of infected animals within hibernacula, as they relate to environmental conditions.

Ecological & Cave Ecosystem. Temperature and humidity modifications may alter sensitive and generally stable microclimates within cave systems – particularly pristine and generally undisturbed sites. In contrast, man-made mine hibernacula are novel environments that are largely devoid of endemic and sensitive native life forms, and therefore are suitable for such environmental-modification experiments.

Socio-economic. Environmental manipulation in abandoned or active mines could potentially incur initial setup and also long-term operational costs (e.g., installation or modifications of air-flow technology).

4. Management of Human Activities

The USFWS has recommended a moratorium on cave entries, and many federal and state public lands have been closed to human access. In Wisconsin, the USFS has closed abandoned mines on their lands, and a few private landowners have excluded unauthorized human access to their sites. Restriction on human access to caves is an effective disease control method and perhaps the only way to prevent potential human *Geomyces destructans* transmission. Under this option, humans would be restricted from entering caves. Because of the rapidly changing nature of WNS infection and management, cave-access restrictions are likely to be temporary, except where the landowner wishes otherwise.

The decision to limit access to caves or mines is the decision of the property owner. The rule proposes to work with property and business owners to find effective and practical management strategies at each site that both meet the commercial, recreational or other purposes while still slowing the spread of the fungus

The option of physically excluding bats is highly dependent on the unique characteristics of each site and is not an option for many caves. The feasibility of physical exclusion depends on the number and accessibility of entryways, as well as number of bats using the cave or mine. For example, to allow continued human visitation, WDNR physically excluded bats from a single commercially run cave beginning in late fall 2010. This cave deemed suitable for the technique due to the small number of bats hibernating in the cave, and limited number of bat entrances.

Human-facilitated introduction and spread of *Geomyces destructans* is a significant risk that warrants an abundance-of-caution approach. Unlike bat transmission, human transmission is something we can manage, and in fact control of human transmission is one of the most effective preventive actions we can take. Tools to manage human transmission of WNS include: 1) Cave access restrictions for humans or bats, 2) Permit and schedule coordinated research entry to caves, and 3) Require decontamination of equipment, clothing, and gear, or use of dedicated gear for a site.

Effects.

Disease Control. Access restrictions, if implemented without exception, would negatively affect WNS early-detection surveillance efforts and ongoing WNS research. Some level of authorized entry will be needed for WNS surveillance, monitoring, research, and management. Physical exclusion to caves is an effective disease control method to prevent potential for humans to spread *Geomyces destructans*, or to prevent bat exposure to the fungus in a potentially infected cave.

Ecological & Cave Ecosystem. Cave ecosystems can be biologically rich and highly sensitive to disturbance. Similar to the decontamination option, access restrictions will have a positive effect on cave ecology as they limit and prevents human introduction of any foreign fungus, bacteria or virus to the cave ecosystem. Bats themselves contribute to the cave ecosystem with nutrients (i.e nutrient supplement from guano or dead bats) and there are potential negative effects of bat exclusion depending on how integral bats in that site are to the cave nutrient cycle. Through fall

swarming and natural dispersal exploration, bats are potentially familiar with multiple caves throughout the landscape. Excluding bats from a cave before the hibernation period begins is critical to give them time to move to an alternative hibernaculum, and thus bat exclusions are not expected to have a high mortal effect on the bats.

Socio-economic. Cave and mine access for the general public presents a unique educational and recreational opportunity that may be reduced due to cave access restrictions. Caves and mines are integral for the recreation and exploration of cavers and spelunkers who would be negatively impacted by access restrictions, and commercial cave owners would be negatively impacted. Physical exclusions affect commercial caves and mines, active underground mines, private cave and mine owners, recreational cavers, agriculture and forest industries, and conservation organizations. WDNR cost-sharing for installation of bat gates or other physical barriers, cost-sharing for conservation actions, providing cave closure signage and decontamination protocols, and providing locations of caves that may be used for recreational caving activities (where bats are known to have been excluded) will alleviate some concerns and financial burdens of physical exclusion. Agriculture industries, forest industries and conservation organizations would be negatively affected by not attempting to control or slow the spread of WNS.

Permanent access restrictions are unlikely at most sites across the state. Identifying the process for removing or reducing these temporary access restrictions may lessen the impact of these restrictions on user groups.

Analysis of Alternatives to Preventative Measures
No Action
Under the 'no action' alternative there would be no attempt to prevent the introduction or spread of WNS in the state of Wisconsin as a measure of disease control.

Disease Control. 'No action' provides zero control on the transmission or spread of WNS by humans or wildlife. WNS may arrive in the state of Wisconsin much sooner than environmental routes. Under 'no action' bats carrying the fungus are more likely to disperse from the hibernacula and contaminate other individuals and roost sites. No preventative measures would result in a greater rate of increase in *Geomyces destructans* prevalence, more rapid spread of WNS and a quicker regional population collapse.

Ecological & Cave Ecosystem. 'No action' could lead to an earlier introduction of WNS into Wisconsin's caves and possible collapse of the Wisconsin cave bat population. Extirpation of bats from the cave environment removes a potentially important component of the cave ecosystem, as it removes a top predator and the nutrition from bat droppings.

Socio-economic. 'No action' would place no restrictions for cave or mine access and therefore no conflict of interest among cave users, and no financial or time burden on managers and individuals involved with cave and/or bat research, management, or recreation.

Literature Cited

Arnold Air Force Base et al. 2009. White-nose Syndrome cooperative Monitoring and Response Plan for Tennessee.

Blehert, DS, Hicks AC, Behr M, Meteyer CU, Berlowski-Zier BM, Buckles EL, Coleman JTH, Darling SR, Gargas A, Niver R, Okoniewski JC, Rudd RJ, and Stone WB. 2009. Bat white-nose syndrome: An emerging fungal pathogen? Science 323: 227.

Cleveland, C. J., M. Betke, P. Federico, J. D. Frank, T. G. Hallam, J. Horn, J. D. López, Jr., G. F. McCracken, R. A. Medellín, A. Moreno-Valdez, C. G. Sansone, J. K. Westbrook, and T. H. Kunz. 2009. Economic value of the pest control service provided by Brazilian free-tailed bats in south-central Texas. Frontiers of Ecology and the Environment 4:238–243.

Frick WF, Pollock JF, Hicks AC, Langwig KE, Reynolds DS, Turner GG, Butchkoski CM, and Kunz TH. 2010. An Emerging Disease Causes Regional Population Collapse of a Common North American Bat Species. Science 329:679-682.

Gargas A, Trest MT, Christensen M, Volk TJ, and Blehert DS. 2009. *Geomyces destructans* sp. nov. associated with bat white-nose syndrome. *Mycotaxon 108*: 147–154.

Humphrey SR, Cope JB. 1976. Population Ecology of the Little Brown Bat, Myotis lucifugus, in Indiana and North-Central Kentucky. American Society of Mammalogists: Special Publication No. 4.

Kurta A, and Murray SW. 2002. Philopatry and migration of banded Indiana Bats (Myotis Sodalis) and effects of radio transmitters. Journal of Mammalogy, 83(2): 585-589.

Lindner DL, Gargas A, Lorch JM, Banik MT, Glaeser J, Kunz TH, Blehert DS. 2010. DNA-Based detection of the fungal pathogen *Geomyces destructans* in soils from bat hibernacula. Mycologia. *In Press.*

Martinkova N, Backor P, Bartonicka T, Blazkova P, Cerveny J, et al. 2010. Increasing incidence of Geomyces destructans fungus in bats from the Czech Republic and Slovakia. PLoS ONE 5(11): e13853. Doi:10.1371/journal.pone.0013853.

Sleeman, Jonathan. 2009. Update on White-Nose Syndrome. *USGS Wildlife Health Bulletin*, 2009-03:1-2. http://www.nwhc.usgs.gov/publications/wildlife_health_bulletins/index.jsp

Speakman J.R., P.I. Webb, and P.A. Racey. 1991. Effects of disturbance on the energy expenditure of hibernating bats. The Journal of Applied Ecology. 58:797-813.

Szymanski JA, Runge MC, Parkin MJ, Armstrong M. 2009. White-nose syndrome management: report on structured decision making initiative. Department of the Interior, U.S. Fish and Wildlife Service, Fort Snelling, MN, USA.

Thomas, D.W., M. Dorais, and JM. Bergeron. 1990 Winter energy budgets and cost of arousals for hibernating little brown bats, *Myotis Lucifugus*. Journal of Mammology. 71(3): 475-479

Turner GG, Reeder DM. 2009. Update of White Nose Syndrome in Bats, September 2009. Bat Research News 50(3):47-53.

Wibbelt G, Kurth A, Hellmann D, Weishaar M, Barlow A, Veith M, Pruger J, Gorfol T, Grosche L, Bontadina F, Zophel U, Seidl H-P, CCryan PM, and Blehert DS. 2010. White-nose syndrome fungus (Geomyces destructans) in bats, Europe. Emerging Infectious Diseases 16(8):1237-1242.

Wobeser GA. 2006. Essentials of disease in Wild Animals. Blackwell Publishing.

Appendices

Appendix A. USFWS Cave Advisory March 26, 2009.
http://www.fws.gov/WhiteNoseSyndrome/caveadvisory.html

Appendix B – A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats. Draft 21 October 2010.
http://www.fws.gov/WhiteNoseSyndrome/pdf/WNSNational%20Plan_DRAFT_10.21.2010.pdf

Appendix C. Disinfection Protocol for Bat Field Research/Monitoring U.S. Fish and Wildlife Service June 2009.
http://www.fws.gov/northeast/whitenose/FINALDisinfectionProtocolforBatFieldResearchJune2009.pdf

Appendix D. White-Nose Syndrome Decontamination Protocol (v.3) USFWS – Draft 7.31.2010
http://www.fws.gov/whitenosesyndrome/pdf/WNS1pageDecontaminationProtocol_073110.pdf

Appendix E. Supporting Decontamination Document for Cavers (WNS Decontamination Supplement 1 of 2) USFWS. Draft July 2010.
http://www.fws.gov/whitenosesyndrome/pdf/Supplement1of2_WNSDeconforCaversJuly2010.pdf

Appendix F. Alabama White-Nose Syndrome Management Plan. Alabama bat working Group, June 2, 2010. http://goodworkscomm.com/bats/AL_WNS_Management_Plan_Final_6-2010.pdf

Appendix G. Georgia White-nose Syndrome (WNS) Response Plan. Last revised July 19, 2010.
http://goodworkscomm.com/bats/AL_WNS_Management_Plan_Final_6-2010.pdf

Appendix H. Bat Handling/Disinfection Protocol for Summer Bat Field Studies in Kentucky. May 1, 2009. http://fw.ky.gov/pdf/batdisinfection.pdf

Appendix I. White Nose Syndrome Action Plan, Missouri Department of Conservation 4-12-2010. http://www.fws.gov/whitenosesyndrome/pdf/MissouriDCStateResponsePlan2010.pdf

Appendix J. Final White-nose Syndrome Interagency Response Plan for New Mexico. November 5, 2010. http://www.blm.gov/pgdata/etc/medialib/blm/nm/programs/wildlife/white-nose_syndrome.Par.78519.File.dat/Final_NM_Interagency_wns_ResponsePlan_05Nov2010_wAppendices.pdf