



2012 White-Nose Syndrome
Disease Surveillance and
Bat Population Monitoring Report

A Report of the Tennessee WNS Response Cooperators

July 2012

Prepared By Cory Holliday
The Tennessee Chapter of The Nature Conservancy

Collaborators

Affiliation

Personnel

Austin Peay State University.....	Robert Arndt, Lindsay Brotherton, Veronica Mullen, Joshua Shulte
Ijams Nature Center.....	Ben Nanny
The Nature Conservancy.....	Cory Holliday, Alex Wyss
National Park Service.....	James Carr, Tabbatha Cavendish, Carrie Gilbert, Bill Stiver, Steve Thomas
Southeastern Cave Conservancy Inc.....	Brian Krebs, Buddy Lane, Ron Miller
TN Dept. of Environment and Conservation.....	David Withers
TN Tech University.....	Brian Carver
TN Wildlife Resources Agency.....	Roger Applegate, Josh Campbell, Rob Colvin, Sterling Daniels, Jeremy Dennison, Brian Flock, Terry Hopkins, Richard Kirk, Chris Simpson, Dustin Thames
TN Valley Authority.....	Holly LeGrand
University of Tennessee.....	Riley Bernard, Justin Boyles, Amanda Janicki, Marci Souza
US Army Dept. of Defense.....	Gene Zirkle
US Fish and Wildlife Service.....	David Pelren
Volunteers.....	Keith Hausman, Ken Pasternack, Cheryl Pratt, Bill Walter
Contractors and Consultants.....	Kristen Bobo, Charles Hofer, Amie Lehman, Morgan Kurz, Angela Warren

A Thank You to Landowners:

Many Tennessee caves are on private property. The scientific community is especially appreciative for the cooperation of the many private landowners represented by the caves in this document. Without your collaboration, our understanding of the caves and bats in Tennessee would be greatly diminished. Please accept this sincere thank you for helping us increase our understanding of caves, bats, and White-nose syndrome in Tennessee.

Background

To monitor the recovery success of endangered bat species in Tennessee, agencies and non-governmental groups within the state have historically conducted winter bat hibernaculum censusing as well as summer surveys at select gray bat sites. The winter censuses have been on either a bi-annual basis or staggered every three years depending on the species involved and availability of personnel. Historic surveys generally focus on the two endangered species of bat found in Tennessee, *Myotis sodalis* (Indiana bats) and *Myotis grisescens* (gray bats). However, with the new concern of bat population decline due to White-Nose Syndrome (WNS), there is an increased awareness of the need to not only continue monitoring the status of these endangered species, but to also assess the numbers and health of the common species of cave hibernating bats. Additionally there is a need to perform WNS disease surveillance as part of a larger effort to better understand White-nose syndrome by studying its spread and patterns of growth.

WNS and the related *Geomyces destructans* fungus (G.d.) were first recorded in Tennessee in the winter of 2010. The fungus was found on three species of bats (*Myotis lucifugus*, *Myotis septentrionalis*, and *Perimyotis subflavus*) in six caves and in six different counties (Table 1). The documented occurrences included two confirmed infection sites where bats showed histological confirmation of fungal infection within the tissue, and four suspect sites. In suspect sites bats observed showed some signs of *G. destructans* but only tested positive for the fungus through genetic testing and did not show the histological fungal infection necessary for a confirmed WNS case. In 2011, WNS spread to Montgomery County, but the overall number of new WNS/G.d. sites in TN was low. East Tennessee WNS sites were beginning to show losses of bats and an increase in % of bats affected by WNS.

In accordance with the 2010 Cooperative White-Nose Syndrome Monitoring and Surveillance Plan for Tennessee (Lamb and Wyckoff, 2010), the winter 2011-2012 hibernaculum monitoring was conducted with the following goals in mind:

- Minimize the potential for monitoring and research projects to contribute to the spread of WNS.
- Continue the WNS surveillance begun in 2009.
- Document the degree of mortality at WNS infected hibernacula.

The first of these goals was accomplished through strict adherence to the U.S. Fish and Wildlife White-nose Syndrome Decontamination Protocols found on the service's website (<http://www.fws.gov/whitenosesyndrome/research.html>). The remaining goals were addressed through surveys at a total of 69 caves in 35 Tennessee counties with increased emphasis on common species of bat. It is important to note that although significant effort was made by all agencies and individuals involved in this year's surveys, the number of caves visited represents less than 1% of the approximate 9,600 caves found in Tennessee. Any conclusions or predictions concerning the spread of WNS in Tennessee and it's effect on the bat population should take this into consideration.

Executive Summary

White-nose syndrome disease surveillance was performed at approximately 74 sites in 37 counties in Tennessee during the winter of 2011-2012. WNS was documented using laboratory histopathology analysis at eight new sites in TN during the survey period. Field signs of WNS and/or G.d. were observed at three additional sites in previously confirmed counties.

Photography was used to document conditions at these sites (figure 5). The number of counties in Tennessee that have received WNS confirmations doubled from six to twelve during the 2011-2012 hibernation season. One of the most notable discoveries this year was the discovery of WNS affecting gray bats at two of Tennessee's three major gray bat hibernation caves. Also, bat population declines were detected at two of the three Tennessee sites which have been WNS+ since 2010. The data presented here represents tremendous effort from many individuals. Collectively, we continue our pursuit to better understand WNS and its effects on the health of Tennessee bats and caves.

Methods

The 2011-2012 winter hibernacula surveys were conducted between January 10, 2012 and April 14, 2012. The surveys were purposefully scheduled later in the season to allow for the development of WNS symptoms which seemed to appear later during the 2009-2010 hibernation season. Since this was not a census year for either of our two endangered species, the majority of surveys performed were expressly designed to monitor the state



Figure 1: UT and TWRA use UV to look for WNS

of WNS in TN and to census non threatened and endangered bat species (as determined by USFWS endangered species classification). Objectives of the 2011-2012 surveys fell into the following three categories with much overlap:

1. WNS Surveillance

Conducted at all the caves visited, WNS surveillance followed a tiered approach designed to detect possible WNS infection and to minimize disturbance during surveys (Lamb and Wyckoff, 2010).

- Tier 1 surveys: a full hibernaculum count, examination of all accessible bats for signs of WNS, and band placement and/or recovery (where appropriate).

- Tier 2 surveys: a quick population estimate, examination of all accessible bats for signs of WNS, and band recovery (where appropriate).
- Tier 3 surveys: observations made outside of cave entrances to check for unusual winter bat behavior (e.g. daytime activity in the cave entrance). A summary of caves visited and corresponding survey tier can be found in Table 1.

2. WNS Mortality Monitoring

The caves that were either confirmed or suspected to be WNS positive in 2011 were visited to assess the levels of mortality that may have occurred during the 2011-2012 hibernation period. These surveys were essentially Tier 1 surveys as described in the previous section on WNS Surveillance but specifically targeted WNS sites that may not have been normally scheduled for visitation in 2012. Bat banding also occurred at these sites to monitor survivorship of individuals at these WNS impacted sites.

3. Bat Population Monitoring

Because of historic emphasis on our two endangered species in TN, we have limited knowledge of other cave hibernating species in Tennessee. One of the goals of the 2011-2012 surveys was to identify new sites which serve as hibernacula for non-listed, but WNS affected bats.

Specifically: *Perimyotis subflavus* (Tricolored bat), *Myotis septentrionalis* (Northern long-eared bat), *Myotis lucifugus* (Little brown bat), and *Myotis leibii* (Eastern small-footed bat). Many of the sites in the following table were visited by bat biologists for the first time this winter. These sites were largely tier 1 survey sites. New survey sites were selected based on a combination of factors including:

morphological characteristics, location, accessibility, and personal accounts or other reports of bats. With Tennessee's astounding number of caves, it is no surprise that we found several new, significant sites that were formerly unknown to biologists. Similarly, as the data will show, some sites



Figure 2: Ken Pasternack descending a pit in Fentress County to count bats

contained very few bats.

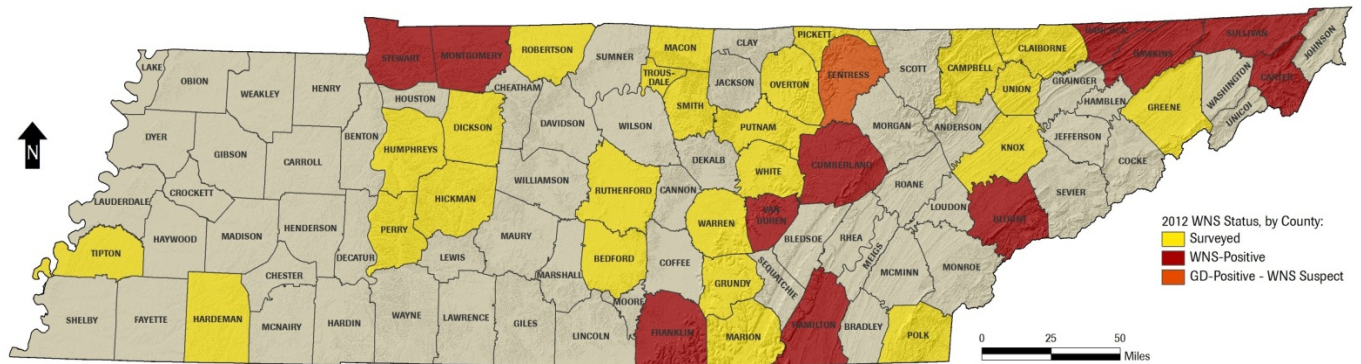
Table 1: 2012 Hibernacula Survey Data

Cave Name	County	Date	WNS/G.d. Status	Survey		PESU	MYAU	MYLU	MYSE	MYGR	MYSO	EPFU	Mvotis sp.	Survey Agency/Org.
				Tier	CORA									
Alex Harris Cave #2	Trousdale	3.3.12		1		12								TNC
Alexander Cave	Perry Co.	2.8.12		1		13		7		1		6		TNC
Ament Cave	Putnam	3.20.12		2		5				2995				FWS/TWRA
Bellamy Cave	Montgomery Co.	2.27.12	WNS +	2		100+		2	1	Not Counted				TNC/TWRA
Big Mouth Cave	Grundy	2.17.12		2	1	20						2		TNC
Big Room Cave	Grundy	2.17.12		2		85		2				1		TNC
Blowing Cave	Hickman	3.4.12		2		493		146	45	2		24	2	13 TNC
Bunkum Cave	Pickett	3.20.12		2	1	147				2				TNC/TWRA
Camps Gulf Cave	Van Buren	3.8.12	WNS+	2		450		25				20	5	FWS/TWRA
Cantwell Valley Cave	Hancock	3.27.12		2		24								TNC/TWRA
Carlton Cave	Franklin	2.29.12	WNS+ (45% affected)	2		400	1	4						2 TNC/TWRA
Christian Cave	Knox	1.20.12		1		60								TNC
Clouse Cave	Putnam	2.13.12		1		15						4		TNC
Cochran Cave (previously unnamed cave)	Greene	3.1.12		1		1						1		TVA
Coleman Cave	Montgomery Co.	2.27.12	WNS field signs observed	1		45								TNC/TWRA
Cooper Creek Cave	Montgomery Co.	1.10.12	WNS+ Gd field signs observed	2		209		76	6			12		6 TNC/TWRA
Coriolis Cave	Fentress	2.10.12		1		56		27	2					2 TNC/TWRA
Cornstarch Cave	Fentress	3.5.12		2				Not counted, but several hundred MYLU present				Not counted, but several hundred MYSO present		TNC/TWRA
Covington Slp Cave	Robertson	1.24.12		1		46								TNC
Critter Cave	Bedford	3.12.12		1										TNC
Double Mouth Cave	Greene	3.28.12		1	14									TNC/TWRA
Dunbar Cave	Montgomery Co.	1.27.12	WNS+	1		46		5						APSU/TWRA
East Fork Slp. Cave	Fentress	3.15.12	Suspect	2		20		7						TNC/TWRA
English Cave	Claiborne	3.18.12		2		182		5		10				2 TNC/TWRA
Fort Campbell Nerd Hole	Stewart	2.7.12	WNS+	1		5								3 TNC/DOD-Colorado State
Fountain Cave	Bedford	3.12.12		1		64			2	4				1 TNC/TWRA
Four Points of Light Cave	Bedford	3.12.12		1		3								TNC/TWRA
Gee Cave	Polk	3.29.12		1		2								FWS/TWRA
Grassy Cove Slp Cave	Cumberland	3.22.12	WNS+	2		32		418	2			1		TNC/TWRA
Great Expectations Cave	White	2.18.12		2	117	200						1		TNC/TWRA
Gregory Cave	Blount	3.14.12		1		1250		5	2					NPS
Grindstaff Cave	Carter	3.29.12	WNS +	2		1								TNC/TWRA
Herron cave	Rutherford	3.12.12		1		26				73				1 TNC/TWRA
House Basement	Hardeman	2.23.12		1	2							2		TWRA
Hubbard's Cave	Warren	3.23.12		2						Not Counted		47		TNC/TWRA
Hurricane Creek Cave #1	Humphreys	2.9.12		1		20						11		TWRA
Hurricane Creek Cave #2	Humphreys	2.9.12		1		10								TWRA
Jaybird Cave	Perry	3.9.12		2		306		191	91	1		14	1	TNC
Keith Cave	Franklin	2.23.12		2		197								TNC/TWRA
Little Jack Creek Cave	Fentress	3.5.12		2	1			9				5		TNC/TWRA
Lookout Mt. Battlefield Pit #1	Hamilton	4.14.12	WNS+	1		11								NPS/SCCI
Lookout Mt. Battlefield Pit #2	Hamilton	4.13.12		1		20				11				NPS/SCCI
Lost Creek Cave	White	2.2.12		2		several hundred		4		39		3		TNC/TWRA
Lost Creek Cave	Union	3.17.12		1		26		1						TNC/TWRA
Marble Bluff Cave	Roane	3.7.12		2		82			4					TVA
Cave Springs Cave Nr. 2 aka Maude Moore's Cave	Knox	1.19.12		1		2						1		TNC
Meade's Quarry Cave	Knox	1.19.12		1		58						9		TNC
Natural Bridge Cave	Pickett	3.20.12		1		4								TNC/TWRA
New Mammoth Cave	Campbell	3.26.12		2		13		178	1	1		17		TNC/TWRA
Nimrod Pit	Fentress	3.5.12		1	100	15								TNC
Norris Dam Cave	Campbell	3.12.12		2		63						1		TVA
Oaks Cave	Union	3.17.12		2		66				2250		1		TNC/TWRA
Pearson Cave	Hawkins	3.27.12	WNS+	2						Not Counted				TNC/TWRA
Piper Cave	Smith	1.30.12		1		38		3	1					1 TNC
Poplar Cave	Greene	3.28.12		1		106								TNC/TWRA
Randolph Bluff Civil War Magazine	Tipton	2.15.12		1	4	6						4		TWRA
Redbud Cave	Fentress	3.5.12		2		50		12				6		FWS/TWRA

Table 1: 2012 Hibernacula Survey Data (continued)

Cave Name	County	Date	WNS/ G.d. Survey		CORA	PESU	MYAU	MYLU	MYSE	MYGR	MYSO	EPFU	Myotis sp.	Survey Agency/Org.
			Status	Tier										
Rice Cave	Van Buren	3.8.12			2		190		4			6		FWS/TWRA/TDEC
Ruskin Cave	Dickson	3.8.12			2		11				11			TNC
Salt peter Cave	Blount	3.13.12	WNS field signs observed		1		300		20	1				NPS
Scott Cave	Blount	3.13.12			1		50					200		NPS
Smith Cave	Roane	2.28.12			2		23							TVA
Stillhouse Cave	Greene	3.28.12			2		32			1500 (active)				TNC/TWRA
Tobaccoport Slp Cave	Stewart	3.7.12	WNS field signs observed		2		Not counted, but several hundred PESU present		Not counted, but several hundred MYLU present	0	111	35		TNC/TWRA
Trussell Cave	Grundy	2.17.12			2		30				60			TNC
TTU Cave	Putnam	2.13.12			2		10							TNC
Upstream Cave	Hancock	3.27.12	WNS+		1		32				1400			TNC/TWRA
Washlee Cave	Overton	2.13.12			2		45							TNC
White Oak Blowhole Cave	Blount	3.12.12	WNS+		2		160		560	40		7200		FWS/NPS
White Oak Slp Cave	Macon				1		43							TNC
Whiteside	Marion	2.23.12			2		100+ (not counted)		3					TNC/TWRA
Wolf River Cave	Fentress	3.15.12			2				260			Not Counted		TNC/TWRA/SCCI
Worley's/Morrell Cave	Sullivan	3.29.12	WNS +		2		9			90 (active)				TNC/TWRA
Wright Cave	Union	3.17.12			1		185		6	1	1			TNC/TWRA

Figure 3: Map indicating surveyed counties and county level WNS status in TN



Results

Approximately 74 sites were surveyed in 37 counties. Two sites are not indicated in Table 1 or figure 3 as they were opportunistic surveys which yielded no WNS or bat population data. All but two sites are caves. The two sites west of the Tennessee River are both man-made structures which house cave hibernating species.

Since this is not a census year for either Indiana bats (*Myotis sodalis*) or gray bats (*Myotis grisescens*) the known Tennessee hibernacula of these species were entered only for rapid WNS disease surveillance and coordinated research. WNS was newly discovered in 2012 at two gray bat hibernacula: Bellamy Cave and Pearson Cave. These two observations represent the first confirmation of WNS on gray bats. In 2010, the fungus *Geomyces destructans* was found on gray bats in Missouri, but histopathology was not consistent with the disease White-nose syndrome. White Oak Blowhole Cave in the Great Smoky Mountains National Park is

Tennessee's largest Indiana bat hibernaculum. Its status changed from G.d. positive/WNS suspect to WNS+ in 2012.

In all, the number of confirmed WNS+ counties in Tennessee doubled between 2011 and 2012. Several new sites were confirmed through laboratory analysis, and bats at some sites in already confirmed counties were observed to have field signs consistent with WNS. In an effort to reduce the number of euthanized bats, surveyors did not submit bats from sites in previously confirmed WNS+ counties. One exception is the Bellamy Cave case, in which the disease affected a species not previously known to be susceptible to WNS.



Figure 4: Gray bat in Bellamy Cave showing wing damage

Most of our hibernating bat colonies in TN remain stable, excepting the two easternmost WNS sites, where WNS has been confirmed for three years now: Grindstaff Cave and Worley's Cave. Grindstaff Cave bat numbers were down 99.5% compared to 2010 when WNS was first discovered there. Worley's Cave hibernating bats were down 96.6% from 2011. This is not including the 90 active gray bats discovered in an upper chamber in 2012. This part of the cave is not normally accessed during winter surveys and gray bats have not previously been documented at the site during winter months. This is believed to be an anomaly associated with the unusually warm winter in 2011-2012. So far, these two sites seem to follow the pattern of bat population loss associated with WNS in the northeast. These are two of our longest infected sites in Tennessee. Conversely East Fork Saltpeter Cave in Fentress County has been G.d. positive for three winters now. We have yet to identify the disease White-nose syndrome at the site.

Some of the newly visited sites in 2012 revealed significant populations of bats. Two outstanding examples include Western Highland Rim caves: Blowing Cave in Hickman Co., and Jaybird Cave in Perry Co. Both of these caves contain significant numbers of hibernating bats as well as both gray bats and Indiana bats. Also of note are the relatively high numbers of northern long-eared bats (*Myotis septentrionalis*) at these sites. Additionally, several new summer gray bat sites were discovered either through the detection of guano/staining or more often through the presence of active gray bats during surveys in March.

Table 2

Cave Name	County	Infection Status
Bellamy Cave	Montgomery	Confirmed WNS Histopathology
Camps Gulf Cave	Van Buren	Confirmed WNS Histopathology
Carlton Cave	Franklin	Confirmed WNS Histopathology
Coleman Cave	Montgomery	Field signs of WNS, no bats submitted for analysis
Cooper Creek Cave	Montgomery	Confirmed WNS Histopathology
Coriolis Cave	Fentress	Field signs of Gd, no bats submitted for analysis
East Fork Saltpeter Cave	Fentress	Presence of Gd Confirmed through PCR: WNS Suspect
Fort Campbell Nerd Hole	Stewart	Confirmed WNS Histopathology
Grassy Cove Saltpeter Cave	Cumberland	Confirmed WNS Histopathology
Grindstaff Cave	Carter	Confirmed WNS Histopathology
Lookout Mt. Battlefield Pit #1	Hamilton	Confirmed WNS Histopathology
Pearson Cave	Hawkins	Confirmed WNS Histopathology
Saltpeter Cave	Blount	Field signs of WNS, no bats submitted for analysis
Tobaccoport Saltpeter Cave	Stewart	Field signs of WNS, no bats submitted for analysis
Upstream Cave	Hancock	Confirmed WNS Histopathology
White Oak Blowhole Cave	Blount	Confirmed WNS Histopathology
Worley's/Morrell Cave	Sullivan	Confirmed WNS Histopathology

Figure 5: Field signs of WNS from Tobaccoport Saltpeter Cave



Final Notes

The cooperators listed in this document performed more surveys of bat hibernacula in 2012 than in any previous year. This level of action requires a tremendous collaborative effort and a good deal of planning. Certainly our knowledge and understanding of White-nose syndrome in Tennessee is limited, as we have so much available habitat for bats to hibernate.

To put it in perspective, there are just over 56,000 caves known in the United States. Approximately 17% of those are in Tennessee. With 16 species of bats and a diversity of karst regions and cave habitats, Tennessee has an incredible array of potential caves suitable for bat hibernation.

Because of this, scientists are cautious about speculation based on imperfect and incomplete data. Many remain optimistic about the potential effects of White-nose syndrome in the southeast, hoping that our warmer climate and shorter hibernation season will reduce the impacts of WNS. The same is true for our gray bat. Many are hopeful about their ability to cope with *Geomyces destructans* and WNS. Nonetheless, we are in a wait and see pattern, with an annual winter window where we gather data in attempts to better understand this alarming disease.



The level of cave surveys in Tennessee and the amount of WNS related data being gathered each winter in Tennessee, is second to none. Funding for this work is diverse, but a major portion of the surveys reflected in this report are made possible through the US Fish and Wildlife Service and Tennessee Wildlife Resources Agency. Tennessee collaborators work together to gather disease surveillance data, bat population data, and to

assist/inform specific WNS research. The collaborators listed in this document have taken great steps and worked many long hours to make this data available. We are fortunate to have such hard-working and passionate partners working together in Tennessee.