Tennessee Winter Bat Population and White-nose Syndrome Monitoring Report for 2016-2017

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Region 2

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These surveys could not be conducted with such a high level of effort or as geographically widespread without the assistance of numerous partners and volunteers. Because the majority of caves and winter sites occur on private lands in Tennessee, the number of surveys would be greatly reduced without the support, assistance, and willingness of private landowners. Without the partner, volunteer and landowner support, we would not be able to understand the distribution of winter bat populations and effects of white-nose syndrome in Tennessee.

Acronyms

AAFB……..……..Arnold Air Force Base

COHD.....Copperhead Environmental Consulting

FORT……...…..Fort Campbell Army Installation

NPS……...……..National Park Service

TDEC…….Tennessee Department of Environment and Conservation

TNC…….The Nature Conservancy of Tennessee

TTU.....Tennessee Technological University

TVA……..……Tennessee Valley Authority

TWRA…….….Tennessee Wildlife Resources Agency

UoS..... Sewanee: The University of the South

USFWS……..United States Fish and Wildlife Service

UTK……University of Tennessee at Knoxville

Species Codes

CORA……... *Corynorhinus rafinesquii*

EPFU…….. *Eptesicus fuscus*

LANO……..… *Lasionycteris noctivagans*

MYAU……...… *Myotis austroriparius*

MYGR…….. *Myotis grisescens*

MYLE……... *Myotis leibii*

MYLU……...…. *Myotis lucifugus*

MYSE……...…. *Myotis septentrionalis*

MYSO…… *Myotis sodalis*

MYsp……...…..Unknown Myotis

PESU……... *Perimyotis subflavus*

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Executive Summary

During the 2016-2017 monitoring season, field signs of white-nose syndrome (WNS) were observed in 29 of the 105 caves surveyed, but many of the caves surveyed have previously been confirmed WNS positive. No new counties were confirmed positive during the monitoring period. Swabbing results indicated the presence of *Pseudogymnoascus destructans* (Pd) in caves in Knox and Monroe Counties and as a result, these counties are now deemed suspect. Currently, 50 counties have been confirmed WNS positive and 4 counties remain suspect. WNS and its casual fungal pathogen Pd can now be found in 54 of the 78 (69.2%) counties containing caves and is considered widespread in Tennessee.

The 2016-2017 winter field season was a count year for significant bat species and surveys were performed at priority *Myotis grisescens* (gray bat) and *Myotis sodalis* (Indiana bat) sites. Estimates of wintering *M. grisescens* at the three priority sites increased 6.6% from 1,023,072 (2014-2015) to 1,094,874. Total observations of wintering *M. sodalis* declined 52.8% during the 2016-2017. When comparing *M. sodalis* priority caves surveyed during both the 2014-2015 and 2016-2017 (n=28) winter monitoring period, estimates of *M. sodalis* declined 51.6% between survey periods. Unfortunately, declines of *M. sodalis* at White Oak Blowhole, the only Priority 1 *M. sodalis* site in the state, have now reached 90%.

Since beginning intense surveys of non-threatened and endangered bats during the winter in 2009-2010, observations are declining at alarming rates. Observations of *Permytois subflavus* (tri-colored bat) declined 14.2% during the 2016-2017 survey period. Despite the large decline observed during the winter of 2015-2016, *Myotis lucifugus* (little brown bat) observations declined 50.2% when comparing years priority sites are surveyed. *Myotis septentrionalis* (Northern long-eared bat) have declined 97.2% since the 2009-2010 winter. The lowest number of observations for *P. subflavus*, *M. lucifugus*, and *M. septentrionalis* were made during this winter monitoring period, 1,881, 1,077, and 8 respectively, since intense surveys for these three species began in 2009-2010.

Biologists continue to make observations during winter surveys that indicate bats can and are surviving winters despite the presence of WNS. Extensive efforts have been made in past years to place bands at some sites throughout the state to aid assessing survivorship of bats. Biologists recovered over 60 bands off live bats during the 2016-2017 winter survey period on four species of bat, *M. grisescens*, *M. lucifugus*, *M. sodalis*, and *P. subflavus*. The average years from the year a band was placed to the time of recovery was greatest for *M. lucifugus*, 4.8 years (n=8, range 3-6 years), followed by *M. grisescens* 4.2 years (n=13, range 1-10 years), *M. sodalis* 4.1 years (n=21, range 1-9 years) and *P. subflavus* 2.5 years (n=4, range 1-6 years). These band recoveries indicate some bats have the ability to survive multiple years despite the presence of WNS.

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Introduction

This report summarizes data collected by all cooperating agencies in Tennessee during the winter of 2016-2017. The results of independent research projects are not included.

Historical survey work within the state of Tennessee was conducted to monitor the success of conservation efforts for endangered bats in Tennessee. This was accomplished by state and federal agencies and non-governmental groups conducting winter bat hibernaculum censuses. This work has been either on a bi-annual basis or staggered every three years depending on the species involved and the availability of personnel. At one point, selected sites were monitored annually to establish a dataset that would allow trend analysis of populations. These efforts were disbanded in 2015 because of potential negative impacts as a result of repeated visitation. Historical surveys have generally focused on the two of three endangered species of bat found in Tennessee, *Myotis sodalis* (Indiana bats) and *Myotis grisescens* (gray bats). No winter occurrences of the third species of endangered bat, *Corynorhinus townsendii virginianus* (Virginia big-eared bat), are known from Tennessee.

Beginning in 2009 with the concern of bat population declines due to white-nose syndrome (WNS), there was an increased awareness of the need to not only continue monitoring the status of endangered species, but to also assess the numbers and health of the common species of cave hibernating bats. Prior to the occurrence of WNS, there was very limited information available on bat hibernacula and winter population trends for once common species of cave hibernating bats, that include: *Myotis lucifugus*, (little brown bat), *Myotis septentrionalis* (Northern long-eared bat[1]), *Myotis leibii* (Eastern small-footed bat), *Eptesicus fuscus* (big brown bat), *Perimyotis subflavus* (tri-colored bat), and *Corynorhinus rafinesquii* (Rafinesque's big-eared bat). Because of the paucity of data for these species, assessing trends of winter populations of bats and WNS caused mortality has been difficult.

Initially, a tiered monitoring approach was developed and implemented during initial monitoring efforts with each tier having varying levels of effort for surveys. This approach allowed for survey effort to be adjusted to each cave minimizing potential impacts to hibernating bats, while allowing for the objectives of winter monitoring to be met. A description of the tiered monitoring system can be found in Lamb and Wyckoff (2010) and Flock (2014). As the need to gather data for all species increased, complete censuses of bat populations found within all sites surveyed was implemented in lieu of the tiered monitoring approach.

WNS and its causal pathogen *Pseudogymnoascus destructans* (Pd) fungus were first recorded in Tennessee in the winter of 2010 (Figure 1). Since 2010, Pd has been

[1] *Myotis septentrionalis* was listed as threatened by the USFWS April 2, 2015 because of severe declines attributed to WNS (USFWS 2015).

histopathological confirmed[2] on bats in 50 counties and genetic material of Pd has been located on bats in four counties in Tennessee (Figure 2). Of the 95 counties in Tennessee, over sixty-nine percent of the counties having caves (78) have been confirmed WNS positive or suspect. Appendix A lists all confirmed or suspect sites and the species from which samples were collected in Tennessee. A list of all species in which Pd has been diagnostically confirmed or detected can be found at https://www.whitenosesyndrome.org/about/bats-affected-wns.

Figure 1. Progression of WNS has occurred quickly in Tennessee since being discovered in 2010.

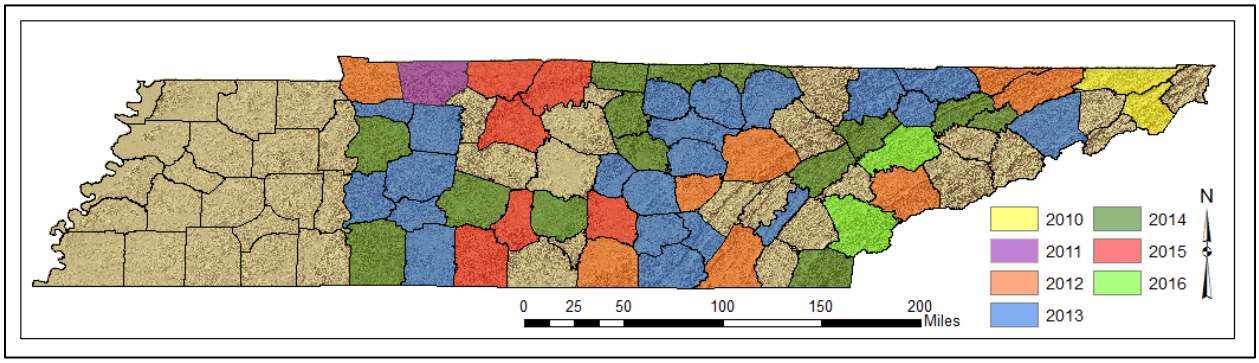
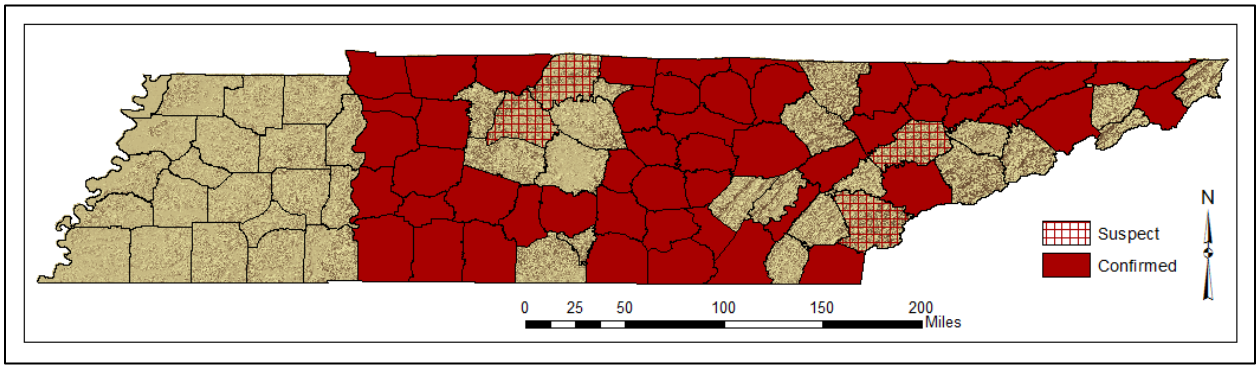


Figure 2. Most counties in Tennessee have been designated WNS confirmed and currently four counties are WNS suspect.



With over 10,000 caves in Tennessee and 20% of the known caves in the United States (The Nature Conservancy of Tennessee n.d.), conducting annual surveys of all caves or of all winter bat populations in Tennessee is not a realistic and feasible approach, and not one considered by the WNS Advisory Council of Tennessee. A significant effort is made each year by all state and federal agencies, non-governmental groups and individuals to perform as many winter surveys as possible. Because of the density of caves throughout the state, less than 1% of the caves are visited each year. As a result of this, any conclusions or predictions concerning the

[2] During monitoring efforts, a site cannot be confirmed positive for the presence of WNS until histologic investigations reveal Pd has infected the tissues of bats. Suspect sites through 2014 are sites which test PCR positive for the presence of Pd and this designation is not removed until histology reports reveal tissue infections. Since 2014, the criteria used to classify WNS suspect sites has changed to minimize the need to euthanize bats and can be found at https://www.whitenosesyndrome.org/resource/revised-case-definitions-white-nose-syndrome-11252014.

spread of WNS across Tennessee and its effect on the bat population should take survey effort into consideration.

The winter of 2016-2017 was a count year for priority caves harboring endangered species. Between mid-January and mid-February, efforts were concentrated on performing surveys at significant *M. grisescens* and *M. sodalis* sites as indicated by individual recovery plans (Brady et al. 1982; USFWS 2007). Efforts were also made to continue surveys conducted at sites monitored in previous years to assess impacts from WNS and to locate potentially new winter sites.

In all years, surveys are conducted in a manner allowing strict adherence to the USFWS WNS Decontamination protocols (https://www.whitenosesyndrome.org/topics/decontamination). Decontamination has been a high priority in all years to minimize the potential of surveys aiding the spread of Pd across the state. As a result of this priority, the number of caves visited per day is limited based on geography, personnel, and maintaining adequate supplies of decontaminated equipment. Despite the large number of caves in Tennessee and issues surrounding decontamination, efforts have helped to identify new bat hibernacula and to allow changes of winter bat populations to be tracked.

Methods

The 2016-2017 winter cave surveys were conducted between December 15, 2016 and April 1, 2017. Extending the survey effort through April 1st, as this is typically later in the season for winter surveys, allows for further development of WNS symptoms as observed during 2009-2010 surveys (Holliday 2012). All surveys performed during this period were designed to continue monitoring the state of WNS in Tennessee and collect data regarding endangered bat populations. Objectives of surveys conducted during the 2016-2017 field season fell into the following four categories with considerable overlap with the last three.

Endangered Species Monitoring

Winter populations of *M. grisescens* and *M. sodalis* are known to congregate in large numbers in just a few caves in Tennessee, although both can be found in low numbers within several other caves. Biennial surveys of both species begin January 15 and all efforts were made to conclude surveys by February 15. While conducting biennial surveys for these species, biologists use the same census technique to reduce sampling biases associated with using differing techniques. During surveys, surveyors use the double-observer method to estimate the number of hibernating bats. Both the area and density of each cluster of bats encountered is determined. To estimate area, laser measuring tapes are used to approximate the size of each cluster and surveyors determine the percentage of total area the cluster covers within the measured area. Cluster densities are based on how tightly bats are clustered using pre-determined information on data sheets describing differences in cluster densities and the understanding of how cave wall surfaces affect these densities (O'Shea et al. 2003). Cluster

densities of 50 bats/ft^2 to 250 bats/ft^2 are multiplied by the percent of area covered to estimate the total bats in each cluster (Loeb et al. 2015). Solitary bats and small clusters are counted as individuals and included in final estimates.

Using the double-observer method, two groups of two biologists perform area and cluster density estimates in each cave surveyed. Personnel are minimized during these counts to aid reduction of disturbance to bats during the winter (Tuttle 1979; Loeb et al. 2015) and observer biases. Efforts are made by both survey groups to estimate as individual groups to reduce influences of group discussions on observed area and density estimates. Upon conclusion of surveys, each group totals all bats observed by adding the estimated the total number of bats within each cluster. An average for individual sites is taken of each bat total taken by both observer groups.

There are numerous techniques used to estimate winter populations and each technique is associated with its own set of issues. At one *M. grisescens* winter site in Tennessee, the majority of the bats roost above a stream within the cave and extreme caution must be given to the surveys to minimize disturbance to the winter colony. Although multiple winter estimate techniques are used across the species range, it is felt the double-observer method is the best technique for Tennessee as it can be performed quicker than other techniques, aids with reducing disturbance to the colony, and allows for the same technique to be used in all known winter sites throughout the state.

WNS Surveillance

Although a majority of the cavernous counties are WNS confirmed or suspect, surveys are still conducted to determine the presence of WNS at all sites. There are countless caves across the state that still appear to be WNS negative despite county WNS designations. Surveys are implemented to gauge the presence of WNS on a site level because of the lack of uniformity of its progression across the state, and as a result of this lack of uniformity, to monitor impacts of WNS on winter bat populations on a site by site basis.

Because of the need to increase knowledge of wintering populations of bat species not listed, complete censuses of all bats observed in caves were conducted. This approach was different from the tiered monitoring approach used in previous years. In the event cooperators deemed presence within the cave was creating unnecessary disturbance to wintering bats, estimates of large clusters of bats were made to decrease the length of time surveyors were in the cave.

WNS Mortality Monitoring

Selected caves previously confirmed or suspected to be WNS positive were visited to assess the level of mortality that may have occurred since prior visits (Samoray 2011). In order to collect the best data possible under survey conditions, a full census of all bats observed within the caves was conducted. Several of the sites selected for mortality monitoring (Lamb and

Wyckoff 2010) were visited again during the 2016-2017 field season to continue these efforts. Two methods have been used at these sites to assess mortality: repeated, annual visits to count all bats or banding of all bats to assess survivorship at sites previously determined to be WNS positive. It should be noted, of the sites previously selected for these efforts in Lamb and Wyckoff (2010), monitoring efforts have been reduced or not occurred annually as a result of manpower concerns, potential impacts from repeated disturbance, eliminating visitation at sites in which severe declines have occurred to the wintering bat populations, or the bat populations declining to critically low levels or levels too low to make these efforts a viable option.

Bat Population Monitoring

Because historic survey efforts were focused on monitoring endangered *M. sodalis* and *M. grisescens*, there is a paucity of data pertaining to other cave hibernating species in Tennessee. A continued goal of the 2016-2017 surveys was to identify new sites which serve as hibernacula for non-listed, but WNS affected bats. These species include: *P. subflavus*, *M. septentrionalis*, *M. lucifugus*, and *M. leibii*. Several of the sites visited during this period have been visited during previous survey years. Despite these repeated visits, full censuses of bats observed in the caves were performed. Several sites not previously surveyed, were visited during this period and, again, complete surveys of all bats were performed. Methods detailed by Holliday (2012) were used to select these new sites to determine if they harbor cave hibernating bats.

2017 Statewide Results

One hundred five (105) caves were visited across 37 counties during the winter of 2016-2017, and biologists participated in surveys in three surrounding states. This is the highest number of caves visited in Tennessee during any WNS monitoring period since surveys began in 2009-2010. WNS field signs were observed in 29 caves. No new counties were confirmed as WNS positive. Swabbing results indicate the presence of Pd at caves in two counties, Knox and Monroe (Appendix C). These counties are now deemed suspect. The results of all caves surveyed can be found in Appendix B.

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Figure 3. Biologists perform biennial surveys of *M. grisescens.*

Biennial counts were performed at all *M. grisescens* and the majority of *M. sodalis* priority sites within the state. In previous years, survey efforts have shifted from WNS surveillance work to biennial counts and has resulted in a reduction of caves

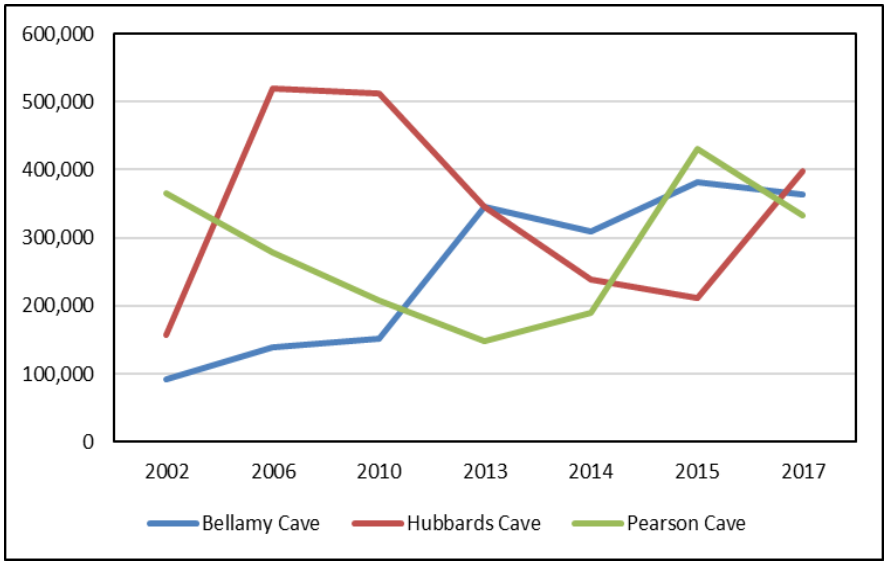
surveyed. As the need to increase WNS surveillance across the state has risen, there has been an increase in the number of personnel trained to work with bats. This increased training allowed for WNS surveillance efforts to be similar to those in past years.

Threatened and Endangered Species Biennial Monitoring

Myotis grisescens

The 2016-2017 winter field season was a "count" year for endangered bat species as a part of biennial monitoring. Total observations of *M. grisescens* at the three priority sites increased from 1,023,072 (2014-2015) to 1,094,874 (2016-2017), a 6.6% increase. Estimates at Hubbard's Cave increased dramatically from recent low estimates of *M. grisescens*. Although estimates from Hubbard's Cave were significantly lower between 2013-2015, winter populations at both Bellamy and Pearsons Cave were increasing during this same period (Figure 4).

Figure 4. Winter trends of *M. grisescens* in Tennessee since 2002.

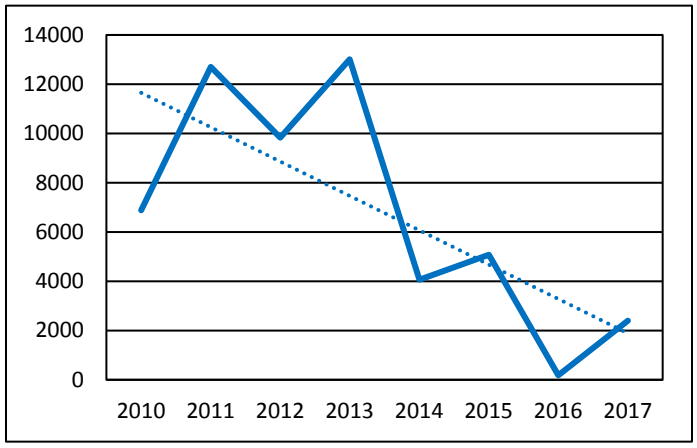


Biologists also surveyed Rattling Cave in Cocke County, which had not been surveyed since 2000. This cave contains a large pit, requiring an extensive decent, and surveys were discontinued because personnel lacked the training necessary to perform surveys at this site. Several personnel have since received the necessary vertical training to perform surveys in caves such as Rattling Cave. Historical data indicated Rattling Cave contained a small winter population, ~18,000 individuals when last surveyed. Biologists estimated 85,955 *M. grisescens* were present during the 2017 survey before discontinuing the survey because the bats were arousing. When combining the results of Rattling Cave with the three significant *M. grisescens* sites in the state, 1,180,829 were estimated in only four caves in Tennessee. A total 1,181,816 *M. grisescens* were counted/estimated across 15 sites surveyed this winter. Despite the declines being observed in other *Myotid* species throughout the state, *M. grisescens* continues to show little impact as the result of *P. destructans*.

Myotis sodalis

The number of total observations of *M. sodalis* decreased during this survey period from 5,077 (2014-2015) to 2,396 in the 2016-2017 survey period, over a 52% decline. Observations of *M. sodalis* at the majority of all Priority sites identified by USFWS (2007) are trending downward (Table 1). At two Priority sites, zero observations of *M.sodalis* were made. Declines at White Oak Blowhole, the only Priority 1 *M. sodalis* site in the state, have now reached 90% as observations of the species continued to decline during this counting period. Despite increased observations during the 2014-2015 winter, declines were also observed at Wolf River Cave during the 2016-2017 monitoring period.

Figure 5. *M. sodalis* observations have dramatically declined since 2010.



Prior to the arrival of WNS, populations of *M. sodalis* were trending upward across much of the eastern portions of its range (Thogmartin et al. 2012), and it is evident WNS is reversing these trends. It is obvious, throughout the species range, the WNS epizootic is greatly impacting *M. sodalis* populations and the "degree of threat" this species faces has been changed from moderate to high (USFWS 2009). It is now believed *M. sodalis* now faces almost certain extinction within the immediate future because of such rapid population declines being observed and the recovery potential of the species is low (USFWS 2009). Currently, biologists and managers have very little ability to alleviate WNS and its impacts leading to continued declines.

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Table 1. Trends of *M. sodalis* at USFWS (2007) identified Priority sites.

Cave Name	Priority Number	Maximum Estimate Since 2000	2011 Estimate	2015 Estimate	2017 Estimate	% Change
Alexander Cave	3	8	6	4	8	+33.3%
Cagle Saltpeter Cave	4	26	19	NC	14	**-26.3%**
Camps Gulf Cave	3	71	14	10	NC	-
Cornstarch Cave	3	293	293	13	0	**-100.0%**
Dragons Breath Cave	3	74	74[1]	40	22	**-70.3%**
East Fork Salteter Cave	3	415	235	210	119	**-49.4%**
Hubbards Cave	2	135	47[1]	78	135	187.2%
Kelly Ridge Cave	3	1,474	1,137	585[3]	89	**-92.2%**
Little Jack Creek Cave	4	25	5	8	4	**-20.0%**
Lost Creek Cave	4	51	0	29	15	1400%
New Mammoth Cave	2	356	12	76	57	+375%
Redbud Cave	4	25	0	0	0	**-100.0%**
Rice Cave	3	87	17	0	3	**-82.4%**
Tobaccoport Saltpeter Cave	3	310	3	160	91	+2933%
White Oak Blowhole	1	9,076	7,495	1,753[3]	746	**-90.0%**
Wolf River Cave	2	2,550	875	1,351	755	**-13.7%**
Ygdrasils Cave	3	325	60[2]	39	17	**-71.7%**
Zarathustras Cave	3	197	53	18	16	**-69.8%**
				4,374	**2,091**	**-52.2%**

[1] 2012 Estimate, [2] 2013 Estimate, [3] 2014 Estimate
NC - Cave was not counted during the survey period.

Overall

Because of the lack of historic data for bat species not typically monitored, the 2009-2010 winter survey period was used as base for which comparisons of current bat numbers could be made. Although this is not a preferred method for reasons that include equal survey effort between sites and across years, difficulty in observing cryptic species, addition or discovery of significant bat sites, and movement of bats across sites within and between

Table 2. Percent increase or decrease for species observed between 2010 and 2017.

	CORA	EPFU	MYLE	MYLU	MYSE	PESU
2010 (n)	313	28	5	2075	292	2159
2017 (n)	635	107	12	1077	8	1881
% Decline	102.8%	282.1%	140%	**-48.1%**	**-97.3%**	**-12.9%**

survey years, it is the best dataset to make comparisons for assessing potential declines of these bats as the result of WNS.

Large increases were observed in the numbers of *C. rafinesquii*, *E. fuscus*, and *M. leibii* (Table 2, Figure 6). Despite the increase in observations, it is difficult to base conclusions solely on the percent change for these three species. Sites not previously surveyed in recent years accounted for the increased observations of both *C. rafinesquii* and *E. fuscus*. A single site surveyed in 2016-2017 accounts for the large increase in *C. rafinesquii* observations and speaks to how survey effort between years impacts the ability to conduct trend analysis. Unfortunately, observations of *M. leibii* in any year are too low to make any inferences to the status of their winter population in Tennessee.

Figure 6. Total observations of *C. rafinesquii* and *E .fuscus* since 2010.

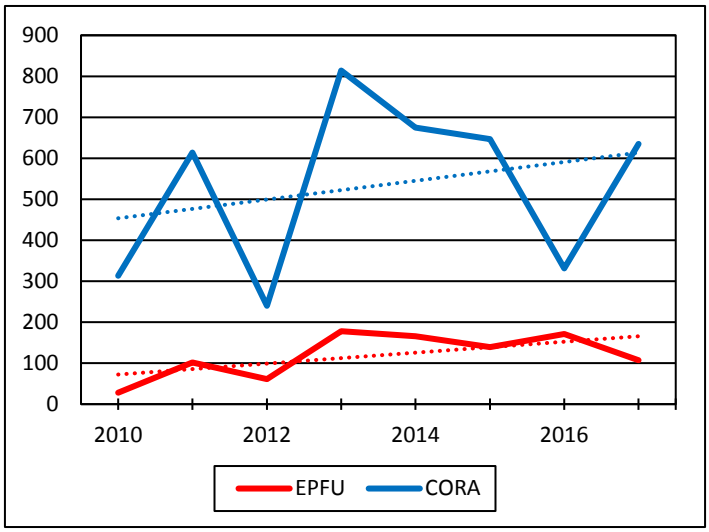
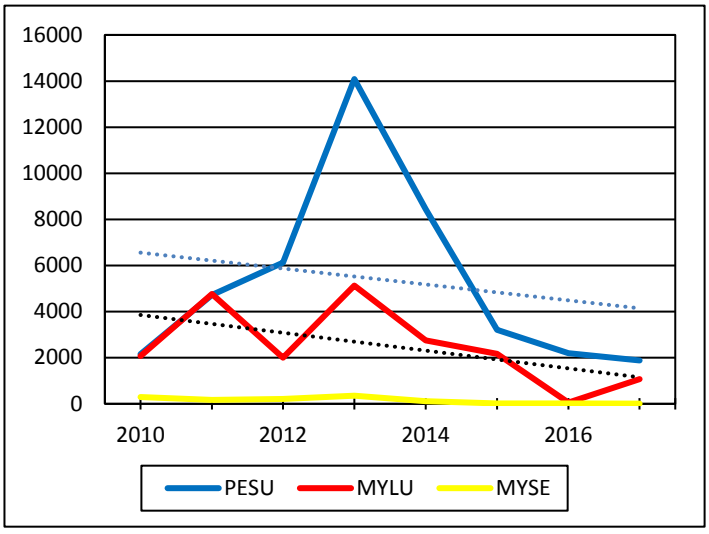


Figure 7. Total observations of *M. lucifugus*, *M. septentrionalis*, and *P. subflavus* since 2010.



Conversely, large population declines have been observed for both *M. lucifugus*, *M. septentrionalis*, and *P. subflavus*, 50.1%, 97.3%, and 87.1% respectively (Figure 7). Campbell (2016) reported a decline of 97.4% for *M. lucifugus*, but known sites for the species were not surveyed during the 2015-2016 winter. Observations of the species drastically increased during the winter of 2016-2017 since significant sites for the species were included and this resulted in a lower percent change. Fewer observations of *M. septentrionalis* were made during this survey period resulting in an increased percent decline for the species between 2015-2016 and 2016-2017 winter survey periods. Despite increased observations of *P. subflavus* during the previous survey period, observations of this species declined 14.2%. *P. subflavus* is more frequently observed by surveyors during WNS

monitoring given it was documented in 85 of the 105 caves visited. Although this species is observed at most caves surveyed, overall observations declined.

Corynorhinus rafinesquii

Occurrences of this species which roost in large numbers are limited to just a few localities in Tennessee. Numerous observations of single individuals are made annually at sites other than those harboring larger populations. It appears this species is stable, as observations were greatly above those made during the 2009-2010 season despite the presence of WNS at numerous winter sites (Figure 6). Presence of Pd has been detected on this species using real-time PCR methods at winter sites in Tennessee (Bernard et al. 2015). Survey effort for this species has not been equal across all years and this is because of the limited number of sites and the sensitivity of the species to repeated visitation increasing the difficulty in assessing trends for the speceis.

Eptesicus fuscus

It appears numbers for this species are trending upward during the winter despite a decrease in observations (Figure 6), but due to the low number of observations it is difficult to determine if this is actually the case. Observations for this species may be difficult to make because of roost preferences or selection during the winter. Many of the observations made during the winter are in plain sight or open areas of caves; however, if *E. fuscus* select roosts such as rock crevices, as observed by Neubaum et al. (2006), observations within caves may become problematic. Also, in other portions of the species range, the use of man-made structures during the winter (Whitaker Jr. and Gummer 2000) may indicate winter surveys should include nontraditional sites. Diagnostic symptoms of WNS have been documented in this species (Blehert et al. 2009).

Myotis leibii

Observations of this species are extremely limited and have never exceeded 12 in any given year since 2009. The most sites this species has been observed at in any year was 4 (2013), making it difficult to ascertain whether populations of this species are stable, increasing or declining. Similar to *E. fuscus*, it is likely the roosting preferences of this species lead it to be under surveyed each winter. In contrast with other cave-roosting bats, *M. leibii* chooses roosts on the cave floor, under talus, or in cracks or crevices within the substrate (Erdle and Hobson 2001). Admittedly, these roosts are under surveyed during the winter, as assessing these areas would increase the time of surveys, visitation, and increase disturbance to other roosting bats. Despite the lack of survey effort for this species, there is still concern WNS may impact this species given diagnostic symptoms have been observed in *M. leibii* (https://www.whitenosesyndrome.org/about/bats-affected-wns).

Myotis septentrionalis

This species was listed as threatened by the USFWS on April 2, 2015 because of populations declines attributed to WNS (USFWS 2015). Historically, observations of *M.*

septentrionalis have been low as it was recorded anecdotally while conducting surveys for species with more significant designations. Unfortunately, the need to increase data collection efforts for this species was recognized just prior the discovery of WNS in Tennessee. Since 2009-2010, efforts have been made to record each observation of *M. septentrionalis* during all cave visits. It should be noted, this species displays roost preferences similar to those of *E. fuscus* and *M. leibii*, roosting in cracks and crevices of the cave substrate likely leading to it being under surveyed across all years. Since 2012, winter populations of *M. septentrionalis* have declined precipitously; only 8 individuals were observed in 2017 (Figure 7). Although the lack of observations can be attributed to roosting preferences of the species, such a drastic decline in the number of observations the past two winters indicates WNS is having detrimental impacts to *M. septentrionalis*. Given the decrease in observations and known WNS impacts, there is high cause of concern for this species in Tennessee.

Myotis lucifugus

Numbers of *M. lucifugus* have mirrored the cyclical surveys conducted for *M. sodalis*, as these two species are often observed within the same hibernacula; however, there are sites within the state where the two species do not occur together. Numbers for this species peaked in 2013 and declines mirror those for *M. septentrionalis*. Only 1,077 individual *M. lucifugus* were observed at a total of 31 sites during the winter of 2016-2017 (Figure 7). Observations of *M. lucifugus* have declined 50.2% since the 2014-2015 field season. *M. lucifugus* is often observed roosting in the more open parts of caves, but it is possible it may go under surveyed as surveyors may not have access to all parts of caves where the bats may hibernate. Despite this species once occurring in large numbers at winter sites in northern portions of its range (Davis and Hitchcock 1965) and populations in Tennessee constituting a small portion of the overall population (Kunz and Reichard 2010), the decline of *M. lucifugus* within the state resemble those modeled by Frick et al. (2010), in which a 99% chance of regional extinction of the species was possible. Conservation and recovery efforts for *M. lucifugus* will prove both challenging and difficult given the declines observed in Tennessee.

Perimyotis subflavus

P. subflavus was one of the most commonly encountered solitary roosters within caves during the winter, being observed in 80% or more caves surveyed annually. Sadly, this is species is no longer observed at historic densities and its numbers at sites have declined significantly over the past three years. As with other species, numbers peaked in 2013, but have declined at an alarming rate since. Observations declined 14.2% from 2,193 (2015-2016) to 1,881 (2016-2017).

WNS Mortality / Bat Population Monitoring

Numerous sites across the state have been visited annually or multiple times since the widespread, multi-species focused survey efforts began in 2009-2010. Ninety-three caves have

been visited at least 2 times during this period. Table 3 illustrates the observed declines at sites visited a minimum of 4 times between 2009-2010 and 2016-2017. Declines now exceed 40% for all sites surveyed a minimum of 4 years, and the majority of these declines exceed 80%. Although roost switching occurs by bats throughout the winter, it is evident WNS is greatly impacting winter bats in Tennessee, especially *M. lucifugus*, *M. septentrionalis*, and *P. subflavus*. Some bat researchers and biologists believe WNS is causing extirpation of species from sites.

Table 3. Trends of wintering bats by individual sites monitored a minimum of 4 years.

Cave Nam e	No. Years Surveyed	% Increase or Decrease by Species			
		EPFU	M YLU	M YSE	PESU
Alexander Cave	5	-	100.0%	-	30.8%
Cagle Saltpeter Cave	4	-	200.0%	-	-59.5%
Carlton Cave	6	-	-	-	-91.8%
Coleman Cave	5	-100.0%	-100.0%	-100.0%	-87.5%
Cooper Creek Cave	7	-70.6%	-98.4%	-100.0%	-100.0%
Cornstarch Cave	5	-	-91.2%	-100.0%	-64.5%
East Fork Saltpeter Cave	7	-	-92.2%	-97.5%	15.6%
Grassy Cove Saltpeter	5	100.0%	-93.1%	-100.0%	-78.1%
Great Expectations Cave	7	100.0%	100.0%	-	-58.5%
Gregory's Cave	5	-	-100.0%	-100.0%	-97.0%
Jaybird Cave	5	-100.0%	-95.3%	-100.0%	-93.1%
Kelly Ridge Cave	4	-	-97.4%	-	-84.4%
Little Jack Creek Cave	6	-	-	-	100.0%
Lost Creek Cave	7	50.0%	-25.0%	-	-67.0%
Marble Bluff Cave	7	-	-	-	-50.0%
Mason Cave	4	-	-	-	-92.9%
New Mammoth Cave	7	50.0%	-89.5%	-97.5%	-85.9%
Norris Dam Cave	6	-	-	-	-19.0%
Oaks Cave	5	-100.0%	-	-	-90.0%
Redbud Cave	6	-	-100.0%	-	-94.8%
Rice Cave	6	-	-66.7%	-	-74.3%
Rose Cave	6	-50.0%	-100.0%	-	192.3%
Scott Gap Cave	5	-	-94.6%	-100.0%	-56.3%
Signature Cave	4	-	-	-	-45.5%
Tobaccoport Saltpeter Cave	6	4.2%	-90.7%	-100.0%	-77.3%
Trussell Cave	4	-	-	-	-56.7%
Whiteside Cave	7	-	-	-	-87.1%
Wolf River Cave	6	-	-41.9%	-	62.8%

Conclusions

With each year of survey effort, the impact of WNS to winter bats in Tennessee becomes clearer. During the past two years, large declines of *M. lucifugus*, *M. septentrionalis*, and *P. subflavus* have been made, and these declines are even more apparent when assessing WNS impacts at individual winter sites. Unfortunately, the declines are magnified by the increased effort it now takes researchers, biologists and consultants to captures these species on the landscape during summer months. Despite the widespread declines being observed at many winter sites, there are winter bat populations stable or trending upward at some sites. Biologists are cautiously optimistic populations at these sites will maintain as such given similar increases have been observed at sites prior to declines.

Over 60 bands were recovered during the 2016-2017 winter season throughout Tennessee. These recoveries indicate the longevity of bats, ability of bats to survive WNS, fidelity of bats to individual sites, and movement of bats between sites. In some cases, movements of bats exceed 150 miles between recoveries. Almost 50% of the bands recovered during the 2016-2017 were placed on the individuals at least three years ago. Although multiple bands were recovered for *M. grisescens*, whose longevity is well documented, there were numerous other bands recovered for *M. lucifugus*, *M. sodalis*, and *P. subflavus* at sites in which WNS was documented several years ago. The average years from the year a band was placed to the time of recovery was greatest for *M. lucifugus*, 4.8 years (n=8, range 3-6 years), followed by *M. grisescens* 4.2 years (n=13, range 1-10 years), *M. sodalis* 4.1 years (n=21, range 1-9 years) and *P. subflavus* 2.5 years (n=4, range 1-6 years). Recoveries for these species indicate their ability to survive in caves despite the presence of WNS. *One M. lucifugus*, recovered in Cooper Creek Cave, was recovered during both the 2015-2016 and 2016-2017 winters. Cooper Creek Cave was confirmed WNS positive in 2011 and steep declines have been observed since.

Banding has occurred at multiple sites in Tennessee since 2009-2010 and for some species these efforts were initiated several years prior to this time. Recovery of bands at selected sites has indicated some bats do have the ability to survive WNS post invasion and can survive for multiple years following individual infection. However, it should be noted the number of confirmed survivors only constitutes a very small portion of historic populations at these sites. Having only a few survivors will increase the difficulty of recovery efforts over the next decade.

Table 4. A list of bands recovered during the 2016-2017 monitoring season and years since the bands were originally placed on the bats.

Recovery Location					Years Since Originally Banded	Recovered Where Originally Banded	Total Times Band Recovered
Date	Band ID	Species	Location	State			
2/11/2017	AAFB TN 2617	MYGR	Fern Cave	AL	10	N	1
2/11/2017	AAFB TN 2980	MYGR	Fern Cave	AL	10	N	1
2/11/2017	AAFB TN 4201	MYGR	Fern Cave	AL	8	N	1
2/11/2017	AAFB TN 6199	MYGR	Fern Cave	AL	1	N	1
2/16/2017	KY F&W B00530	MYGR	Rattling Cave	TN	6	N	1
2/11/2017	TWRA 02083	MYGR	Fern Cave (Morgue Pit)	AL	5	N	1
2/16/2017	TWRA 02242	MYGR	Tobaccoport SLP Cave	TN	1	N	1
2/11/2017	TWRA 02457	MYGR	Fern Cave (Morgue Pit)	AL	5	N	1
2/11/2017	TWRA 02847	MYGR	Fern Cave (Morgue Pit)	AL	1	N	1
2/9/2017	TWRA 05101	MYGR	Rattling Cave	TN	1	N	1
2/9/2017	VGDIF A56309	MYGR	Rattling Cave	TN	3	N	1
2/9/2017	VGDIF A56339	MYGR	Rattling Cave	TN	3	N	1
2/9/2017	VGDIF A60432	MYGR	Rattling Cave	TN	1	N	1
1/24/2017	TNC 0333	MYLU	Cornstarch		6	Y	1
2/16/2017	TNC 0381	MYLU	Tobaccoport SLP Cave	TN	3	Y	2
2/16/2017	TNC 0388	MYLU	Tobaccoport SLP Cave	TN	3	Y	1
1/24/2017	TNC 0328	MYLU	Cornstarch	TN	6	Y	1
1/25/2017	TNC 1021	MYLU	East Fork SLP Cave	TN	6	Y	1
1/25/2017	TNC 1041	MYLU	Eastfork Saltpeter	TN	6	Y	1
2/2/2017	TNC 0154	MYLU	Cooper Creek Cave	TN	5	Y	2
1/11/2017	UTK 0262	MYLU	New Mammoth Cave	TN	4	Y	1
2/21/2017	AAFB TN 4672	MYSO	Zarathustras Cave	TN	7	Y	1
2/21/2017	AAFB TN 4674	MYSO	Zarathustras Cave	TN	7	Y	1
2/10/2017	AAFB TN 4796	MYSO	Rice Cave	TN	7	Y	1
2/21/2017	AAFB TN 5403	MYSO	Zarathustras Cave	TN	7	Y	1
2/16/2017	KY F&W B04091	MYSO	Tobaccoport SLP Cave	TN	1	Y	1
2/16/2017	KY F&W B15285	MYSO	Tobaccoport SLP Cave	TN	1	Y	1
2/16/2017	KY F&W B15292	MYSO	Tobaccoport SLP Cave	TN	1	Y	2
2/16/2017	KY F&W B15297	MYSO	Tobaccoport SLP Cave	TN	1	Y	1
2/16/2017	KY F&W B15336	MYSO	Tobaccoport SLP Cave	TN	1	Y	1
1/23/2017	KY F&W B16010	MYSO	Wolf River Cave	TN	1	N	1
1/23/2017	TN Tech 0861	MYSO	Wolf River Cave	TN	9	Y	1
1/25/2017	TNC 1021	MYSO	Eastfork Saltpeter	TN	6	Y	1
1/25/2017	TNC 1043	MYSO	Eastfork Saltpeter	TN	6	Y	1
1/25/2017	TNC 1044	MYSO	Eastfork Saltpeter	TN	6	Y	1
3/20/2017	TWRA 00751	MYSO	Signature Cave	TN	6	Y	3
3/20/2017	TWRA 00767	MYSO	Signature Cave	TN	6	Y	1
3/20/2017	TWRA 04395	MYSO	Signature Cave	TN	3	Y	1
1/13/2017	TWRA 05816	MYSO	Rose Cave	TN	3	Y	2
1/13/2017	TWRA 06000	MYSO	Rose Cave	TN	3	Y	2
10/25/2016	TWRA04390	MYSO	Hytop Drop	TN	3	N	1
12/6/2016	TWRA04433	MYSO	Wind Cave	KY	2	N	1
2/16/2017	TNC 0275	PESU	Tobaccoport SLP Cave	TN	6	Y	3
2/27/2017	TWRA A00054	PESU	Whiteside Cave	TN	1	Y	1
2/27/2017	TWRA A01039	PESU	Whiteside Cave	TN	1	Y	1
2/27/2017	TWRA A01064	PESU	Whiteside Cave	TN	2	Y	1

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Appendix A

- A list of all WNS confirmed, suspect, or negative counties in Tennessee based on diagnostic reports.

[1]Tapelift sample taken and the bat was not euthanized; [2]Bat submitted was found dead at site; [C]WNS confirmed; [S]WNS suspect; [N]WNS Negative [SW]Only a swab sample was taken from the bat tested and was not euthanized; [N/A]Report not available.

Cave Name or Structure	County	Year	WNS Status	Species	Diagnostic Report Number
Camps Gulf Cave	Van Buren	2010	Suspect	PESU[S], MYSO[1,N]	NWHC-22984
Dunbar Cave	Montgomery	2010	Suspect	MYSE[S]	NWHC Event 15950
East Fork SLP Cave	Fentress	2010	Suspect	MYLU, MYSE[S]	NWHC Event 15979
Grindstaff Cave	Carter	2010	Confirmed	MYSE[C], PESU[C]	NWHC
Hubbards Cave	Warren	2010	Negative	MYGR[N]	NWHC
White Oak Blowhole	Blount	2010	Suspect	N/A	N/A
Worleys Cave	Sullivan	2010	Confirmed	MYSE, PESU	NWHC Event 15948
Bellamy Cave	Montgomery	2011	Negative	MYGR[N]	NWHC-23532
Camps Gulf Cave	Van Buren	2011	Suspect	PESU[S]	NWHC-23481
Cooper Creek Cave	Montgomery	2011	Confirmed	MYLU[C], MYSE[C], PESU[C]	NWHC-23444
East Fork SLP Cave	Fentress	2011	Suspect	MYLU[S]	NWHC-23482
Under a House	Polk	2011	Negative	MYGR[2]	SCWDS CC11-188
White Oak Blowhole	Blount	2011	Suspect	MYLU[N]	NWHC-23466
Austin Peay State University	Montgomery	2012	Suspect	MYLU[S]	SCWDS CC12-235
Bellamy Cave	Montgomery	2012	Confirmed	MYGR, PESU[C]	SCWDS WNS12-54, WNS12-55
Bull Cave	Blount	2012	Negative	PESU[N]	SCWDS WNS12-50
Camps Gulf Cave	Van Buren	2012	Confirmed	N/A	N/A
Cantwell Valley Cave	Hancock	2012	Confirmed	N/A	N/A

[1]Tapelift sample taken and the bat was not euthanized; [2]Bat submitted was found dead at site; [C]WNS confirmed; [S]WNS suspect; [N]WNS Negative [SW]Only a swab sample was taken from the bat tested and was not euthanized; [N/A]Report not available.

Cave Name or Structure	County	Year	WNS Status	Species	Diagnostic Report Number
Carlton Cave	Franklin	2012	Confirmed	PESU[C]	SCWDS WNS12-56
Fort Campbell Nerd Hole	Stewart	2012	Confirmed	PESU[C]	NWHC-23846
Grassy Cove SLP Cave	Cumberland	2012	Confirmed	MYLU[C]	SCWDS WNS12-064 A-B
Gregory Cave	Blount	2012	Negative	PESU[N]	SCWDS WNS12-50
Hubbards Cave	Warren	2012	Negative	MYGR[N]	SCWDS WNS12-067
Hurricane Creek Cave	Humphreys	2012	Negative	PESU[N], MYSO[N]	NWHC-23848
Lookout Mtn. Battlefield Pit #1	Hamilton	2012	Confirmed	PESU[C]	SCWDS WNS12-86
Lost Creek Cave	White	2012	Negative	MYGR[N,SW], MYLU[N, SW], PESU[N,SW]	SCWDS WNS12-41, WNS12-42, WNS12-43
New Mammoth Cave	Campbell	2012	Negative	MYLU[N]	SCWDS WNS12-068
Pearsons Cave	Hawkins	2012	Confirmed	MYGR[C]	SCWDS WNS12-70
Rainbow Cave	Blount	2012	Negative	PESU[N]	SCWDS WNS12-50
Upstream Cave	Hancock	2012	Confirmed	PESU[C]	SCWDS WNS12-072
White Oak Blowhole	Blount	2012	Confirmed	MYLU[C], PESU[C]	SCWDS WNS12-061, WNS12-062
Afton Cave	Greene	2013	Confirmed	PESU[C]	SCWDS WNS13-72 A-C
Big Mouth Cave	Grundy	2013	Confirmed	MYLU[C]	SCWDS WNS13-56

[1]Tapelift sample taken and the bat was not euthanized; [2]Bat submitted was found dead at site; [C]WNS confirmed; [S]WNS suspect; [N]WNS Negative
[SW]Only a swab sample was taken from the bat tested and was not euthanized; [N/A]Report not available.

Cave Name or Structure	County	Year	WNS Status	Species	Diagnostic Report Number
Blowing Cave	Hickman	2013	Confirmed	MYLU[C], MYSE[C], PESU[C]	SCWDS WNS13-38, WNS13-39, WNS13-40
Buggytop Cave	Franklin	2013	Confirmed	PESU[C]	SCWDS WNS13-103
Buis SLP Cave	Claiborne	2013	Confirmed	MYLU[C]	SCWDS WNS13-74 A-B
Cornstarch Cave	Fentress	2013	Confirmed	MYLU[C], PESU[C]	SCWDS WNS13-10, WNS13-11
Depriest Branch Cave	Lewis	2013	Confirmed	MYLU[C], MYSE[C], PESU[C]	SCWDS WNS13-46, WNS13-47, WNS48
Dunbar Cave	Montgomery	2013	Confirmed	PESU[C]	SCWDS WNS13-98, WNS13-101
East Fork SLP Cave	Fentress	2013	Confirmed	MYLU[C]	SCWDS WNS13-12
Espey Cave	Cannon	2013	Confirmed	PESU[C]	SCWDS WNS13-95
Eve's cave	Meigs	2013	Confirmed	PESU[C]	SCWDS WNS13-76
Gunter's Cave	Cannon	2013	Negative	PESU[N]	SCWDS WNS13-91
Herd O' Coons Cave	Union	2013	Confirmed	MYLU[C], PESU[C]	SCWDS WNS13-70 A-B, WNS13-71
Hubbards Cave	Warren	2013	Confirmed	PESU[C]	SCWDS WNS13-13
Hunt Cave	Dickson	2013	Confirmed	PESU[C]	SCWDS WNS13-49 A-C
Jaybird Cave	Perry	2013	Confirmed	MYLU[C]	SCWDS WNS13-44
Knob Creek Cave	Lawrence	2013	Confirmed	PESU[C]	SCWDS WNS13-54

[1]Tapelift sample taken and the bat was not euthanized; [2]Bat submitted was found dead at site; [C]WNS confirmed; [S]WNS suspect; [N]WNS Negative [SW]Only a swab sample was taken from the bat tested and was not euthanized; [N/A]Report not available.

Cave Name or Structure	County	Year	WNS Status	Species	Diagnostic Report Number
Lost Creek Cave	White	2013	Confirmed	PESU[C]	SCWDS WNS13-53 A-B
New Mammoth Cave	Campbell	2013	Confirmed	MYSE[C], MYLU[C]	SCWDS WNS13-25 A-B, WNS13-26
North Spivey Cave	Jackson	2013	Confirmed	MYLU[C]	SCWDS WNS13-94
Private Residence	Sequatchie	2013	Confirmed	PESU[C]	SCWDS WNS13-99
Pearsons Cave	Hawkins	2013	Confirmed	MYGR[2,N]	SCWDS WNS13-45
Richardson Cave	Houston	2013	Confirmed	MYLU[C]	SCWDS WNS13-02
Rose Cave	White	2013	Suspect	MYLU[S]	SCWDS WNS13-14
Sour Kraut Cave	Claiborne	2013	Confirmed	PESU[C]	SCWDS WNS13-75
Three Forks Cave	Overton	2013	Confirmed	PESU[C]	SCWDS WNS13-90
Trussell Cave	Grundy	2013	Confirmed	PESU[C]	SCWDS WNS13-55 A-C
Trussell Downstream Cave	Grundy	2013	Confirmed	PESU[C]	SCWDS WNS13-55 A-C
Virgin Falls Cave	White	2013	Confirmed	PESU[C]	SCWDS WNS13-50
Welch-Blowing Cave	Putnam	2013	Confirmed	PESU[C]	SCWDS WNS13-64
Whiteside Cave	Marion	2013	Confirmed	PESU[C]	SCWDS WNS13-63
Wolf River Cave	Fentress	2013	Confirmed	MYLU[C]	SCWDS WNS13-9
Zarathustrus Cave	Fentress	2013	Confirmed	PESU[C]	SCWDS WNS13-27
Aunt Beck Simmons Cave	Macon	2014	Confirmed	N/A	N/A
Biffle Cave	Wayne	2014	Confirmed	PESU[C]	SCWDS WNS14-10 A-C

[1]Tapelift sample taken and the bat was not euthanized; [2]Bat submitted was found dead at site; [C]WNS confirmed; [S]WNS suspect; [N]WNS Negative [SW]Only a swab sample was taken from the bat tested and was not euthanized; [N/A]Report not available.

Cave Name or Structure	County	Year	WNS Status	Species	Diagnostic Report Number
Big Jordan Cave	Pickett	2014	Confirmed	PESU[C], MYLU[C]	SCWDS WNS14-32, WNS14-33
Bridgewater Cave	Smith	2014	Confirmed	PESU[C]	SCWDS WNS14-20 A-B
Cave Creek Cave	Roane	2014	Confirmed	PESU[C]	SCWDS WNS14-31 A-B
Corner Store Cave	Hamblen	2014	Confirmed	PESU[C], MYLU[C]	SCWDS WNS14-29, WNS 14-30
Cripps Mill Cave	Dekalb	2014	Confirmed	PESU[C]	SCWDS WNS14-9
Dunbar Cave area	Montgomery	2014	Confirmed	PESU[C]	SCWDS WNS14-13, WNS14-14, WNS14-16, WNS14-16
Gee Cave	Polk	2014	Confirmed	PESU[C]	SCWDS WNS14-53
Hubbards Cave	Warren	2014	Confirmed	MYGR[2,N]	SCWDS WNS14-7
Hurricane Creek Cave	Humphreys	2014	Confirmed	PESU[C]	SCWDS WNS14-12
Indian Cave	Grainger	2014	Confirmed	PESU[C]	SCWDS WNS14-128, WNS14-129
Leonard Cave	Clay	2014	Confirmed	PESU[C]	SCWDS WNS14-130, WNS14-131, WNS14-132
Mason Cave	Sumner	2014	Suspect	PESU[S]	SCWDS WNS14-52 A-B
Rummage Cave	Maury	2014	Confirmed	PESU[C]	SCWDS WNS14-11 A-C
Springhill SLP Cave	Anderson	2014	Confirmed	MYLU[C]	SCWDS WNS14-8 A
Ward Cave	Bedford	2014	Confirmed	PESU[C]	SCWDS WNS14-51 A-C

[1]Tapelift sample taken and the bat was not euthanized; [2]Bat submitted was found dead at site; [C]WNS confirmed; [S]WNS suspect; [N]WNS Negative [SW]Only a swab sample was taken from the bat tested and was not euthanized; [N/A]Report not available.

Cave Name	County	Year	WNS Status	Species	Diagnostic Report Number
Crumpton Creek SLP Cave	Coffee	2015	Confirmed	PESU[C]	SCWDS CC15-124
Hardin's Junkyard Cave	Davidson	2015	Suspect	MYLU[S]	Field Signs Observed, UV positive, Photos Taken
Magnussen Cave	Giles	2015	Confirmed	PESU[C]	SCWDS CC15-26
Mason Cave	Sumner	2015	Suspect	N/A	Field Signs Observed, UV positive
Petty Cave	Marshall	2015	Confirmed	PESU[C]	SCWDS CC15-123 A-C
Silvertooth Cave	Moore	2015	Suspect	PESU[N]	SCWDS CC15-125
Stark Cave	Robertson	2015	Confirmed	PESU[C]	SCWDS CC15-127
Civil War Bunker	Tipton	2016	Negative	EPFU[N], PESU[N]	SCWDS 16-92 A-B
Ball Play Cave	Monroe	2017	Suspect	PESU[SW]	CCB137
Blackmans Cave	Knox	2017	Suspect	PESU[SW]	CCB332

Appendix B

- 2016-2017 Winter Survey Results

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	Mysp	PESU	Total Bats	Surveyors
Bedford	1/4/2017	Fountain		2						1		1	21	25	TWRA, AAFB, TNC
Bedford	1/4/2017	Four Points of Light Cave		2										2	TWRA, AAFB, TNC
Bedford	1/4/2017	Harrison Saltpeter											9	9	TWRA, TNC
Bedford	1/4/2017	Harrison Spring Cave											2	2	TWRA, TNC
Bedford	1/4/2017	Horseshoe Cave												0	TWRA, TNC
Bedford	1/4/2017	Critter Cave												0	TNC
Blount	1/23/2017	Gregory	2				0		0	0	0		37	39	NPS
Blount	1/27/2017	Kelly Ridge	4				3		12	0	89		11	119	NPS, TWRA
Blount	2/6/2017	Saltpeter					1			0			4	5	NPS
Blount	1/30/2017	Scott	10				0		8	0	5		28	51	NPS, TVA
Blount	2/6/2017	White Oak Blow Hole					0		17	3	746		38	804	NPS, TWRA, TVA, USFWS, USGS
Campbell	3/7/2017	Lingney's Cave		1									3	4	TWRA
Campbell	1/11/2017	New Mammoth Cave		3				8	34	2	57		11	115	TNC, TWRA
Campbell	1/23/2017	Norris Dam Cave		5									34	39	TVA
Cannon	1/3/2017	Conscript Cave												0	TWRA
Cannon	1/3/2017	Espey Cave		3			3						33	39	TNC, TWRA, AAFB
Cannon	1/3/2017	Gunters Cave											2	2	TWRA
Carter	3/6/2017	Sculpture Cave											16	16	TWRA, UTK
Cocke	2/9/2017	Rattling Cave		3			85,955						7	85,965	TWRA
Coffee	3/16/2017	Carrol Cave		1			6					11	10	28	TVA, TWRA
Coffee	3/16/2017	Crumpton Creek Slp					4						3	7	TVA, TWRA
Cumb. KY	12/22/2016	Fire Pit	110										1	111	TNC
Cumb. KY	12/22/2016	Dale Hollow Ridge Caves (16)		3										3	TNC
Cumberland	1/30/2017	Grassy Cove SLP		2					29				7	38	TWRA, TNC
Cumberland	1/30/2017	Run to the Mill							5		17		27	49	TWRA, TNC
Dekalb	2/1/2017	Cripps Mill Cave		7					5		4		90	106	TWRA, TNC, FWS
Dekalb	3/8/2017	Echo Lake Cave												0	TWRA, TNC
Dekalb	3/8/2017	Log Jam Cave												0	TWRA, TNC
Dekalb	3/8/2017	Sink Creek Cave												0	TWRA, TNC
Dekalb	2/1/2017	Summer Sump Cave											4	4	TWRA, USFWS

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	Mysp	PESU	Total Bats	Surveyors
Dekalb	3/8/2017	Toney Cave												0	TWRA, TNC
Dekalb	2/1/2017	Winter Cave		2									29	31	TWRA, USFWS
Fentress	1/24/2017	Cornstarch							43				8	51	TNC, TWRA, USFWS
Fentress	1/24/2017	Cornstarch Cave							45				11	56	TWRA, TNC, USFWS
Fentress	2/14/2017	Dragon's Breath							69		22		79	170	TWRA, TNC
Fentress	3/15/2017	Dwight Eisenhower Cave												0	TWRA
Fentress	1/25/2017	East Fork Slp Cave							35	1	119		74	229	TNC, TWRA
Fentress	3/13/2017	Lepidonderon Pit	1										1	2	TWRA
Fentress	1/24/2017	Little Jack Creek Cave	2								4		2	8	TWRA, TNC, USFWS
Fentress	3/9/2017	Millard Filmore Cave											1	1	TWRA, TNC
Fentress	1/26/2017	Mountain Eye		4				3	3		125		36	171	TWRA, TNC
Fentress	2/13/2017	Pygmalion		1					60				61	122	TWRA, TNC
Fentress	1/24/2017	Redbud Cave											3	3	TWRA, TNC, USFWS
Fentress	2/26/2017	Roaring Panther Cave							5				13	18	TWRA
Fentress	3/9/2017	Stinging Nettle Cave							1				11	12	TWRA, TNC
Fentress	3/15/2017	William H. Harrison Cave	1										5	6	TWRA
Fentress	1/23/2017	Wolf River Cave					1		426		755		55	1,237	TWRA, TNC, FWS
Fentress	3/10/2017	Ygdrasils Cave									17		2	19	TWRA, TNC
Fentress	2/21/2017	Zarathustras Cave									16		86	102	TWRA
Franklin	3/3/2017	Carlton Cave											33	33	TWRA, TTU
Franklin	2/1/2017	Grapevine											5	5	AEDC, UoS
Franklin	11/25/2016	Hytop Drop Cave							1		35	3	10	49	TWRA
Franklin	3/20/2017	Signature									5		12	17	TWRA, COHD
Greene	3/13/2017	Unknown Cave (Lick Creek #1)											2	2	TWRA, UTK
Greene	3/13/2017	Unknown Cave (Lick Creek #2)												0	TWRA, UTK
Grundy	1/31/2017	Trussell Cave					6		1	1	10		13	31	AAFB
Hancock	2/27/2017	Kyle's Ford Cave												0	TWRA, UTK
Hancock	2/27/2017	L. Johnson Cave												0	TWRA, UTK
Hawkins	1/19/2017	Pearsons Cave		4			333,430							333,434	TNC, TWRA
Jackson	12/29/2016	BlackburnFork Pit											1	1	TWRA

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	Mysp	PESU	Total Bats	Surveyors
Jackson Co., AL	2/11/2017	Fern Cave/ Morgue Pit					900,000						P	900,000	TWRA, USFWS
Knox	3/13/2017	Blackmans Cave											20	20	TWRA, UTK
Lewis	2/8/2017	Depriest Branch Cave		1									13	14	TNC
Marion	2/3/2017	Nickajack Cave					42						13	55	TWRA, TVA
Marion	2/27/2017	Whiteside Cave											69	69	TWRA, TNC, USFWS, AAFB,
Marshall	3/1/2017	Petty Cave											64	64	TNC
Maury	3/1/2017	Godwin Cave											18	18	TNC
Meigs	2/14/2017	Eves Cave							1				11	12	TVA
Meigs	2/14/2017	Blythe Ferry Cave											7	7	TVA
Monroe	2/6/2017	Ballplay Cave		4									62	66	TWRA, TVA
Montgomery	1/16/2017	Bellamy Cave		4			364,328						4	364,336	TWRA, TNC, COHD
Montgomery	2/2/2017	Coleman											5	5	TNC, TWRA
Montgomery	2/2/2017	Cooper Creek		5					2					7	TWRA, TVA, TDEC, FORT,
Perry	2/7/2017	Alexander Cave							1		8		17	26	TNC, TWRA
Perry	2/8/2017	Campbell Cave		3									21	24	TNC
Perry	2/7/2017	Jaybird Cave							9		3		21	33	TNC, TWRA
Putnam	12/20/2016	Ament Cave											4	4	TWRA
Putnam	12/19/2016	Benson Cave		1									1	2	TWRA
Putnam	12/19/2016	Capshaw Cave											2	2	TWRA
Putnam	1/9/2017	Indian Cave											10	10	TWRA
Putnam	2/28/2017	Window Cliff Cave		2									5	7	TWRA, USFWS
Roane	1/31/2017	Marble Bluff Cave											46	46	TVA
Robertson	1/12/2017	Stark Cave		4									75	79	TNC
Stewart	2/6/2017	Tobaccoport Slp Cave		25			379		23		91		10	528	TNC, TWRA
Sullivan	3/6/2017	Hickory Tree Cave		4										4	TWRA, UTK
Sumner	1/5/2017	Mason Cave											13	13	TWRA, TNC
Unicoi	3/14/2017	Bumpus Cove Mine #1											1	1	TWRA
Unicoi	3/14/2017	Bumpus Cove Mine #3											2	2	TWRA
Union	1/25/2017	Bridges Hollow Cave							1				2	3	TWRA, UTK
Union	2/8/2017	Jolly Saltpeter							221				5	226	TWRA

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	Mysp	PESU	Total Bats	Surveyors
Union	1/25/2017	Little Coon Cave		1									1	2	TWRA, UTK
Union	1/20/2017	Oaks Cave											6	6	TWRA, UTK
Van Buren	2/10/2017	Cagle Saltpeter Cave		2					2		14		32	50	TWRA, USFWS, TDEC
Van Buren	1/16/2017	Campfire Shelter Cave												0	TWRA, UTK
Van Buren	1/16/2017	Dark River Cave											4	4	TWRA, UTK
Van Buren	1/16/2017	Natural Bridge Sinks NR1	53										2	55	TWRA, UTK
Van Buren	2/10/2017	Rice Cave					11		2		3		43	59	TWRA, USFWS, TDEC
Warren	1/17/2017	Hubbard's Cave		1			397,116		1		135		22	397,275	TNC, TWRA, AAFB
Warren	12/19/2016	Jaco Cave		2									11	13	TNC
Wayne	2/9/2017	Biffle Cave		2					1		6		71	80	TNC, TWRA
White	12/30/2016	Berkshire Gap												0	TWRA
White	12/30/2016	Caney Fork Conduit												0	TWRA
White	3/8/2017	Falls Hollow Crawl Cave											1	1	TNC, TWRA
White	12/30/2016	Ghost River Cave												0	TWRA
White	1/31/2017	Great Expectations	253	4				1	10		36		83	387	TWRA, TNC, USFWS
White	1/31/2017	Lost Creek Cave	2	5					3		15		66	91	TWRA, TNC, TDEC, USFWS
White	1/13/2017	Rose Cave	1	1			531				56		51	640	TWRA, TTU, UTK
White	2/23/2017	El Abismo	306						1		3		5	315	TWRA
Wilson	1/5/2017	Valley Cave											15	15	TNC, TWRA

Appendix C

- 2016-2017 Diagnostic Services Reports

TENNESSEE TECH UNIVERSITY

DIAGNOSTIC SERVICE REPORT

The Walker Lab
Tennessee Technological University
Pennebaker Hall 306
1100 N. Dixie Ave.
Cookeville, TN 38505
dmwalker@tntech.edu
Telephone: 931-372-3780
Fax: 931-372-6257

FINAL REPORT
Specimen number CCB137
Date collected/received 2/06/17
Date of report 7/02/17

STATE Tennessee **COUNTY** Monroe **SPECIFIC LOCALITY** Ballplay cave

SPECIES *Perimyotis subflavus* **SEX** Unknown **AGE** Unknown **WEIGHT** Unknown

CASE HISTORY: A *Perimyotis subfalvus* was sampled by TWRA officials on February 6th 2017. The bat had no visible white nose syndrome symptoms. Two swab samples were obtained and processed in the Walker Lab at TTU. One swab was used to isolate microbes and the other for real time quantitative PCR using the Muller et al. (2013) assay.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: None reported

WILDLIFE IMPLICATIONS: This is a new county of Tennessee in which WNS was not previously found.

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: No symptoms were reported while in the field.

HISTOLOGIC FINDINGS: None reported

MORPHOLOGICAL DIAGNOSIS: None reported

MYCOLOGY FINDINGS: None reported

MOLECULAR BIOLOGICAL FINDINGS: The real time qPCR assay indicated the presence of *Pseudogymnoascus destructans* on *Perimyotis subfalvus* CCB 137.

TENNESSEE TECH UNIVERSITY

DIAGNOSTICIAN (signature) _____

SUPERVISOR (signature) _____

TENNESSEE TECH UNIVERSITY

DIAGNOSTIC SERVICE REPORT

The Walker Lab
Tennessee Technological University
Pennebaker Hall 306
1100 N. Dixie Ave.
Cookeville, TN 38505
dmwalker@tntech.edu
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Fax: 931-372-6257

FINAL REPORT
Specimen number CCB332
Date collected/received 3/13/17
Date of report 7/02/17

STATE Tennessee **COUNTY** Knox **SPECIFIC LOCALITY** Marble dale

SPECIES *Perimyotis subfalvus* **SEX** Unknown **AGE** Unknown **WEIGHT** Unknown

CASE HISTORY: A *Perimyotis subfalvus* was sampled by TWRA officials on March 13th 2017. The bat had visible white nose syndrome symptoms. Two swab samples were obtained and processed in the Walker Lab at TTU. One swab was used to isolate microbes and the other for real time quantitative PCR using the Muller et al. (2013) assay.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: None

WILDLIFE IMPLICATIONS: This is a new county of Tennessee in which WNS was not previously found.

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: The presence of *Pd* was assumed after visual inspection.

HISTOLOGIC FINDINGS: None reported

MORPHOLOGICAL DIAGNOSIS: None reported

MYCOLOGY FINDINGS: None reported

MOLECULAR BIOLOGICAL FINDINGS: The real time qPCR assay indicated the presence of *Pseudogymnoascus destructans* on the *Perimyotis subfalvus* CCB332.

TENNESSEE TECH UNIVERSITY

DIAGNOSTICIAN (signature) _____

SUPERVISOR (signature) _____

Researchers exiting a significant priority gray bat site and discussing observations made during the survey.