

Tennessee Winter Bat Population and White-nose Syndrome Monitoring Report for 2018-2019



Josh Campbell

Wildlife Diversity Coordinator, Region 2

Tennessee Wildlife Resources Agency

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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, Inc.
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.....	<i>Corynorhinus rafinesquii</i>
EPFU.....	<i>Eptesicus fuscus</i>
LANO.....	<i>Lasionycteris noctivagans</i>
MYAU.....	<i>Myotis austroriparius</i>
MYGR.....	<i>Myotis grisescens</i>
MYLE.....	<i>Myotis leibii</i>
MYLU.....	<i>Myotis lucifugus</i>
MYSE.....	<i>Myotis septentrionalis</i>
MYSO.....	<i>Myotis sodalis</i>
MYsp.....	Unknown Myotis
PESU.....	<i>Perimyotis subflavus</i>

Contributors

AAFB.....	John Lamb, and Shannon Allen
COHD.....	Steve Samoray
FORT.....	Morgan Torres and Gene Zirkle
Middle Tennessee State University.....	Matthew Grisnik and Dr. Donald Walker
NPS.....	Ryan Williamson and Greg Greico
Other.....	Carlin Frost
TDEC.....	Jason Reynolds and David Withers
TNC.....	Cory Holliday
TTU.....	Jesse West
TVA.....	Todd Amacker, J. Argo, J. Bailey, C. Logan Barber, C. Guerry, Liz Hamrick, Sara McLaughlin-Johnson, C. Parker, Jesse Troxler, and B. Whitley
TWRA.....	Josh Campbell, Rob Colvin, Jesse Eakers, Scott Dykes, Darrell England, Daniel Istvanko, Chris Ogle, Chris Simpson, and Dustin Thames
UoS.....	Kevin Fouts, Amy Turner and Nathan Wilson
USFWS.....	Dave Pelren and Sara Sorenson
UTK.....	Taelor Hill, Reilly Jackson, Mallory Tate, and Dr. Emma Willcox

Executive Summary

During the 2018-2019 monitoring season, field signs of white-nose syndrome (WNS) were observed in 25 of the 102 caves surveyed, but many of the caves surveyed have previously been confirmed WNS positive. Two new counties, Loudon and Cocke, were confirmed suspect during the monitoring period. WNS and its causal fungal pathogen *Pd* can now be found in 56 of the 78 (71.8%) counties containing caves and is considered widespread in Tennessee.

The 2018-2019 winter field season was a priority cave monitoring year for significant bat species and surveys were performed at priority *Myotis grisescens* (gray bat) and *Myotis sodalis* (Indiana bat) sites. Estimates of *M. grisescens* in 2019 increased 28.25% to 1,515,677 bats from 1,181,816 estimates in 2017. The percent change in *M. grisescens* estimates between 2010 and 2019 is 42.37%. Unfortunately, *M. sodalis* has not followed the same trend as *M. grisescens*. Estimates of *M. sodalis* declined 2.96% between 2017 and 2019 from 2,396 to 2,325. Sadly, observations of the species have declined 66.2% between 2010 and 2019.

Observations of *Perimyotis subflavus* (tri-colored bat) declined 21.53% between the 2017-2018 and 2018-2019 winter field seasons. Since the 2009-2010 winter survey period, observations of *P. subflavus* have declined 25.20%. *Myotis lucifugus* (little brown bat) observations increased 6.13% between the 2017-2018 and 2018-2019 field seasons. *M. septentrionalis* (Northern long-eared bat) observations increased from two individuals to four individuals. Observations of this species have declined 98.6% since 2010.

Recovery of banded bats took place as biologists made observations during winter surveys and were able to retrieve the bats safely and with minimal disturbance. Biologists recorded 25 band numbers from live bats during the 2018-2019 winter survey period from five species of bat, *Corynorhinus rafinesquii*, *M. grisescens*, *M. lucifugus*, *M. sodalis*, and *P. subflavus*. Band numbers were misread for several bands recovered. The average years from the year a band was placed to the time of recovery was greatest for *M. sodalis*, 7.25 years (n = 4), followed by *M. grisescens*, 6.67 years (n = 3), *M. lucifugus*, 3.5 years (n = 4), and *C. rafinesquii*, 1.33 years (n = 3). These band recoveries indicate some bats have the ability to survive multiple years despite the presence of WNS. Surprisingly, *M. sodalis* shows the greatest longevity from this small sample size. Bands placed on the species at two different sites in 2010 were recovered in 2019.



Photograph. TWRA biologists Chris Ogle and Daniel Istvanko perform the biennial gray bat survey of Rattling Cave. Photos courtesy of Mallory Tate.

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Introduction

This report summarizes data collected by all cooperating agencies and partners in Tennessee during the winter of 2018-2019. 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. Monitoring and surveys of winter bat populations, primarily endangered and threatened species, within the state has been accomplished by state and federal agencies and non-governmental groups. This work occurred 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 due to of potential negative impacts because of repeated visitation. Historical surveys have generally focused on two of three federally endangered species of bat found in Tennessee, *Myotis sodalis* (Indiana bats) and *M. 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 increased awareness 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 white-nose syndrome (WNS), there was very limited information available on bat hibernacula and winter population trends for once common species of cave hibernating bats, that include: *M. lucifugus*, (little brown bat¹), *M. septentrionalis* (Northern long-eared bat²), *M. leibii* (Eastern small-footed bat), *Eptesicus fuscus* (big brown bat), *Perimyotis subflavus* (tri-colored bat¹), and *C. 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 early monitoring efforts with each tier having varying levels of effort. This approach allowed 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.

¹ Both *Myotis lucifugus* and *Perimyotis subflavus* were listed as threatened within Tennessee by TWRA in August 2018.

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

WNS and its causal fungal pathogen *Pseudogymnoascus destructans* (*Pd*) were first recorded in Tennessee in the winter of 2010 (Figure 1). Since 2010, *Pd* has been histopathological confirmed³ on bats in 50 counties and genetic material of *Pd* has been located on bats in six counties in Tennessee (Figure 2). More than seventy-one percent of the counties with caves in Tennessee (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. Two caves were designated WNS suspect during the 2018-2019 monitoring period.

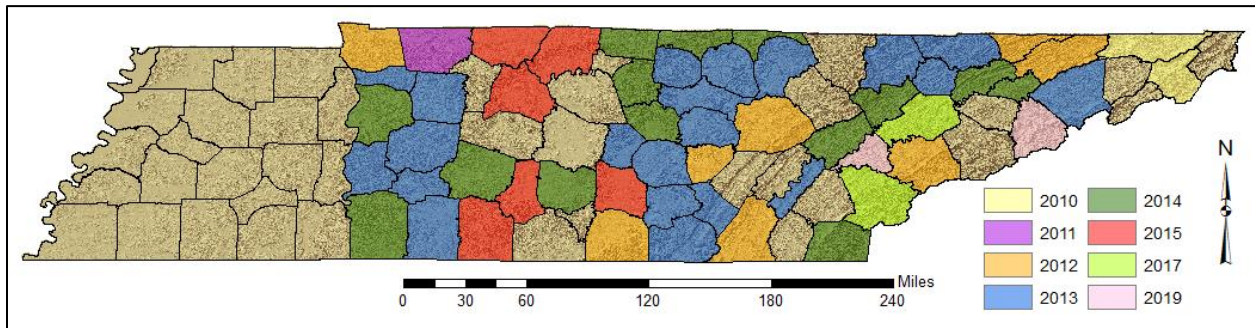
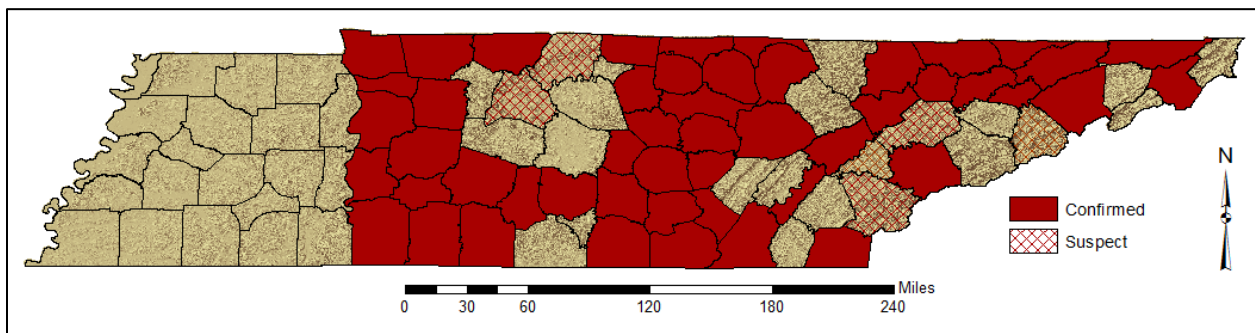


Figure 2. As of 2019, most cavernous counties in Tennessee have been designated WNS confirmed and currently six counties are WNS suspect.



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

³ 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>.

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

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 2018-2019 winter cave surveys were conducted between December 10, 2018 and March 28, 2019. 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). Objectives of surveys conducted during the 2018-2019 field season fell into the following three categories with considerable overlap with the last two.

WNS Surveillance

Although a majority of 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.

Given the need to increase knowledge of wintering populations of bat species not listed, complete censuses of all bats observed in caves was implemented. 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 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 2018-2019 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 bats with uniquely marked bands allowing identification of individuals to assess survivorship at sites previously determined to be WNS positive. It should be noted, of the sites previously selected for these efforts (Lamb and Wyckoff 2010), monitoring efforts have been reduced or not occurred annually as a result of manpower concerns and potential impacts from repeated disturbance. Visitation was reduced at sites in which severe declines have been observed bat populations.

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 2018-2019 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.



Figure 3. Banding bats illustrates site fidelity and survivorship across years.

2019 Statewide Results

One hundred two (102) caves were visited across 32 counties during the winter of 2018-2019. Over one hundred caves have been surveyed during the monitoring period for three consecutive years. WNS field signs were observed in 25 caves. Two new counties, Loudon and Cocke, were confirmed suspect during the monitoring period (Appendix C). The results of all caves surveyed can be found in Appendix B.

Endangered species dominated all bat observations, constituting over 99% of all observations, 1,521,746. Over 3,700 observations were made of species not federally listed when removing endangered species observations. *P. subflavus* account for over 43% and *C. rafinesquii* 22% of all observations of non-listed species. Unfortunately, less than 1% of the total observations were of *M. septentrionalis*. Declines continue to be observed yet again during the

2018-2019 winter monitoring period for several species at statewide levels and at individual cave sites. Although increased observations were made for *M. septentrionalis* given only four individuals were observed, the lack of observations now being made each year during the winter for this species is alarming.

Threatened and Endangered Species Biennial Monitoring

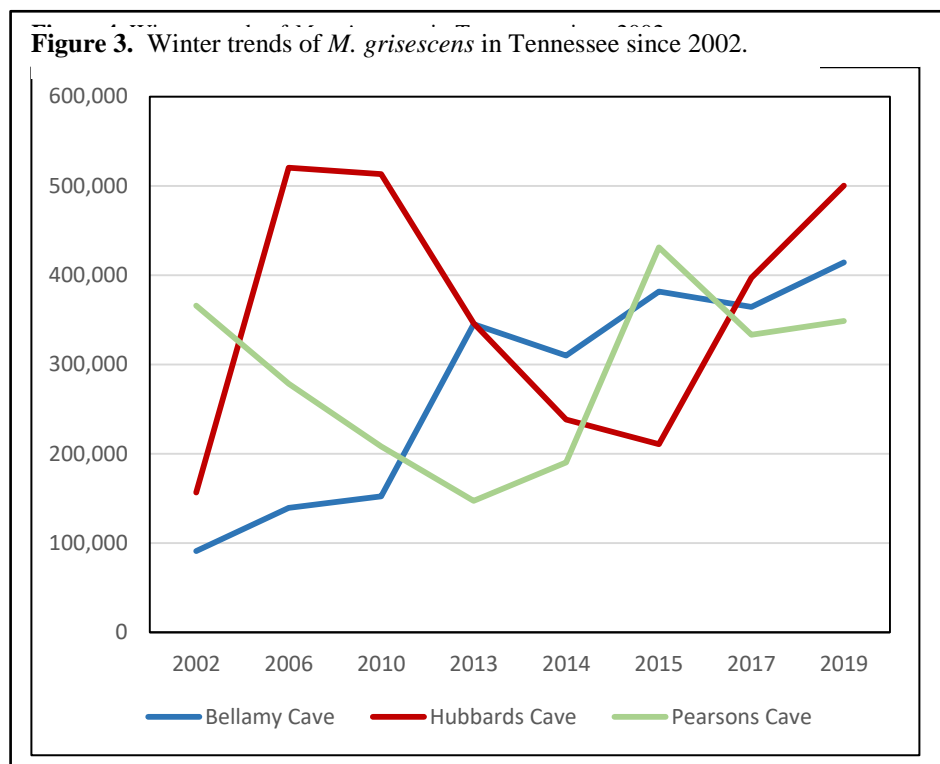
Myotis grisescens

The 2018-2019 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 1,094,874 (2016-2017) to 1,263,302 (2018-2019), a 15.38% increase. Estimates of winter *M. grisescens* populations increased at each priority site with the largest increase observed at Hubbards Cave. Winter populations of *M. grisescens* have increased significantly since 2013, the year significant impacts from white-nose syndrome were observed (Figure 3).

Biologists also surveyed Rattling Cave in Cocke County. This cave contains a large

pit, requiring an extensive descent, and surveys were discontinued in 2000 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. Biologists estimated 250,689 *M. grisescens* were present during the 2019, a dramatic increase from the 2017 estimate of 85,955. When combining the results of Rattling Cave with the three significant *M. grisescens* sites in the state, 1,513,991 were estimated in only four caves in Tennessee.

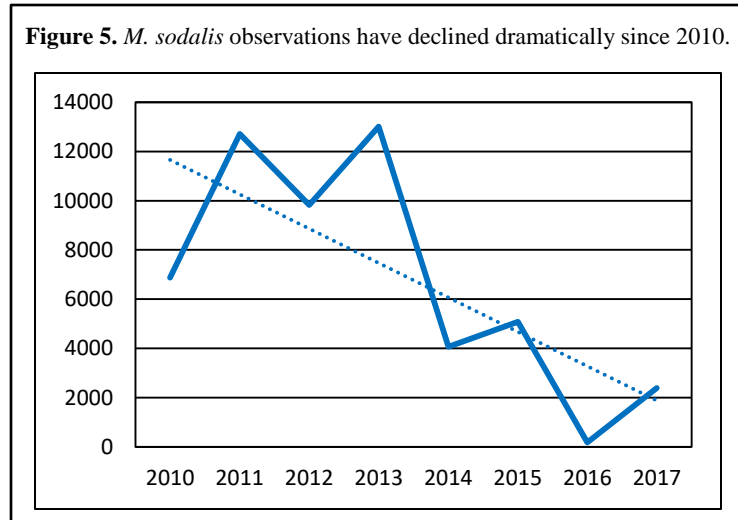
A total 1,515,677 *M. grisescens* were counted/estimated across 19 sites surveyed this winter. White-nose syndrome or *Pd* has been observed in each of the four *M. grisescens* priority sites and many other sites where the species is observed during the winter. Despite declines



being observed in other *Myotis* 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 2,396 (2016-2017) to 2,325 in the 2018-2019 survey period, a 2.96% decline (Figure 4).



Observations of *M. sodalis* at the majority of all Priority sites identified by USFWS (2007) continue to trend downward (Table 1). There was only a single Priority site in which zero observations were made, but observations of less than five were made at several others. Declines at White Oak Blowhole, the only Priority 1 *M. sodalis* site in the state, have now reached 93% when comparing estimates from 2019 to all-time high estimates from 1981.

Declines also exceed 91% when comparing 2019 estimates to 2013 observations, the year when observations for all species increased in the state. One positive for *M. sodalis* in Tennessee, observations at Wolf River Cave appear to be trending upward following steep declines observed in 2015. Eight hundred eighty-four (884) *M. sodalis* were observed at this Priority 2 cave during the 2018-2019 winter survey period.

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.

Table 1. Trends of *M. sodalis* observed at Priority sites (USFWS 2007). Percent decline was estimated using the formula $((y^2/y^1)-1)*100$, where y^2 = 2019 estimates and y^1 = 2011 estimates unless otherwise specified.

Cave Name	Priority	Maximum Estimate Since 2000	2011 Estimate	2013 Estimate	2015 Estimate	2017 Estimate	2019 Estimate	% Decline 2011-2019
Alexander Cave	3	8	6	NS	4	8	3	-50.00
Cagle Saltpeter Cave	4	26	19	NS	NS	14	13	-31.58
Camps Gulf Cave	3	71	14	71	10	NS	6	-57.14
Cornstarch Cave	3	293	293	236	123	0	1	-99.66
Dragon's Breath ¹	3	74	NS	NS	40	22	14	-65.00
East Fork Saltpeter	3	415	235	171	210	119	56	-76.17
Hubbards Cave ²	2	153	NC	133	78	135	153	15.04
Kelly Ridge Cave	3	1,474	1,137	1,474	188	89	63	-94.46
Little Jack Creek Cave	4	25	5	2	8	4	8	60.00
Lost Creek Cave ²	4	51	NC	33	29	15	21	-36.36
New Mammoth Cave	2	356	12	75	76	57	34	183.33
Redbud Cave	4	25	0	3	0	0	0	100.00
Rice Cave	3	53	17	12	0	3	4	-76.47
Tobaccoport Saltpeter Cave	3	310	3	137	160	91	73	2,333.33
White Oak Blow Hole	1	9,076	7,495	9,076	NS	746	736	-90.18
Wolf River Cave	2	2,550	875	1,048	1,351	755	884	1.03
Ygdrasils Cave ²	3	325	NS	60	39	17	11	-81.67
Zarathustras Cave	3	197	53	32	18	16	14	-73.58
Total y^2			10,430			Total y^1	2,094	-79.92

NS - No survey was conducted during specified year

NC - Species was not counted during the specified year

1 - 2015 count was used as y^2 given no survey was conducted in previous survey period

2 - 2013 estimate was used as y^2 given no survey occurred in previous survey period

Other Bat Species

Because of the lack of historic data for bat species not typically monitored, the 2009-2010 winter survey period is used as the 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 survey years, it is the best dataset to make comparisons for assessing potential declines of these bats as the result of WNS.

	CORA	EPFU	MYLE	MYLU	MYSE	PESU
2010 (n)	313	28	5	2,075	292	2,159
2019 (n)	850	108	24	1,143	4	1,615
% Decline	171.57%	285.71%	380.00%	-44.92%	-98.63%	-25.20%

Corynorhinus rafinesquii

Winter populations of *C.*

rafinesquii appear stable to increasing despite the presence of WNS at many sites. Presence of *Pd* has been detected on this species using real-time PCR methods at winter sites in Tennessee (Bernard et al. 2015). Winter counts have exceeded over 600 individuals since 2013 when most priority sites are surveyed. The impact of survey effort has on observations is apparent for this species given the reduced observations made in 2012 and 2016 when only a portion of priority sites were surveyed (Figure 5). Survey effort for this

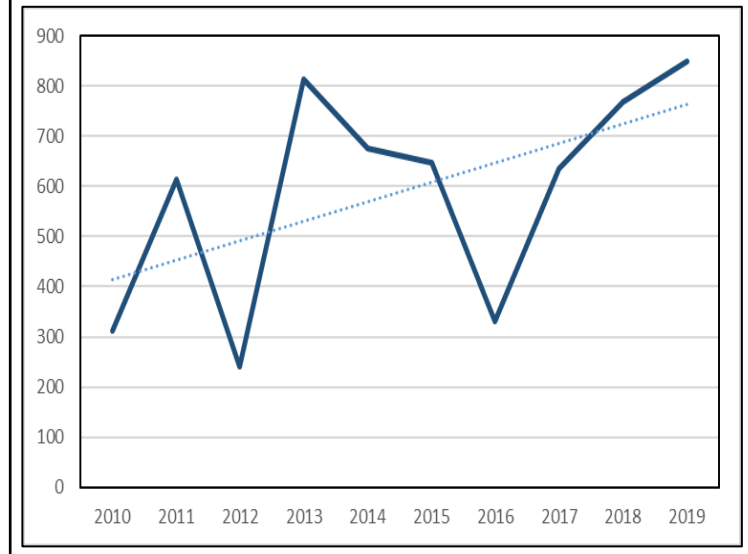
species has not been equal across all years and this is because of the limited number of sites and the sensitivity of the species to repeated visitation increasing the difficulty in assessing trends for the species.

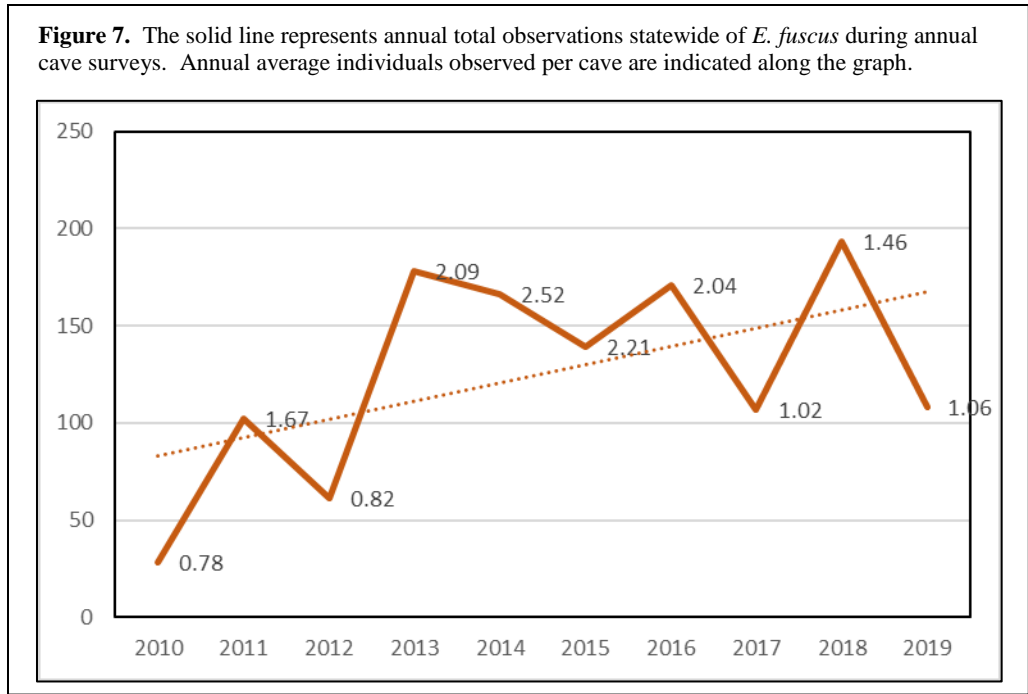
Eptesicus fuscus

The number of *E. fuscus* observed annually has increased since the 2009-2010 winter survey period and this is most likely attributed to increased survey effort. During the 2009-2010 winter monitoring, 36 caves were surveyed compared to the 102 caves surveyed during the 2018-2019 winter. The average number of individual *E. fuscus* observed during each cave surveyed was 1.06 during 2018-2019 compared to just 0.78 individuals per cave surveyed in 2009-2010 (Figure 6). The number of *E. fuscus* observed during the 2018-2019 (108) survey period increased significantly compared to 2009-2010 (28) observations (Table 2), but observations for the same period were lower than those from the 2017-2018 (193) monitoring period.

It appears numbers for this species are trending upward during the winter, but due to the low number of observations through the years it is difficult to determine if the trend is statistically significant. 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).

Figure 6. Total annual observations of *C. rafinesquii* since 2010.





Myotis leibii

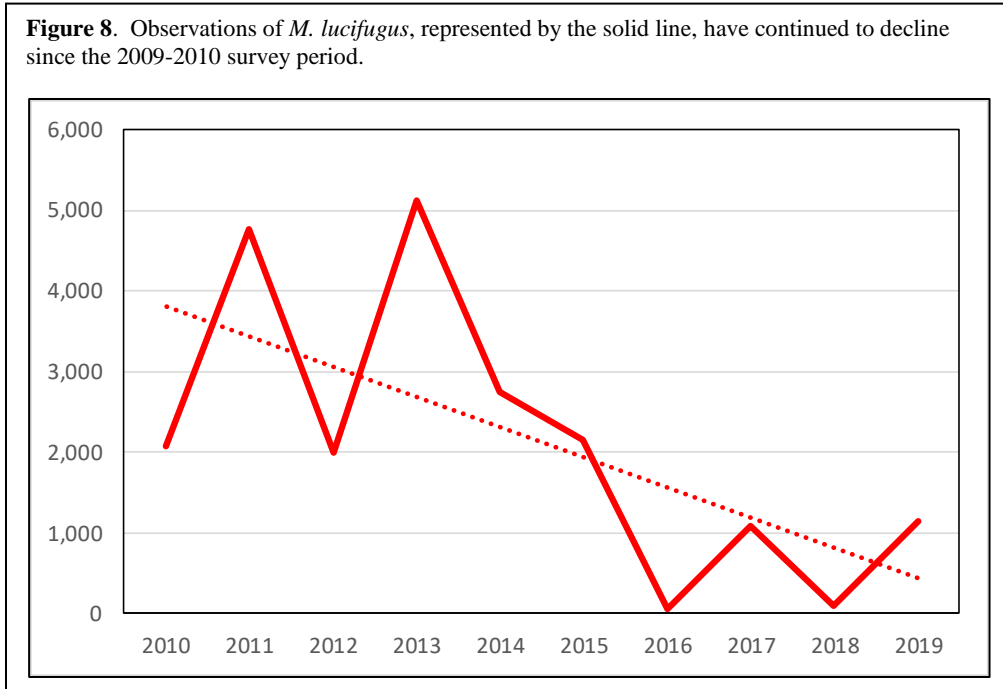
The 2018-2019 survey period marks the first time observations of *M. leibii* have exceeded 12 as 24 individuals were observed in 8 caves . This doubles number the number of sites this species has been observed at in any year and the previous maximum sites was just four (2013). The low number of observations and occurrence in caves makes 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 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. Observations of *M. lucifugus* increased in 2018-2019 to 1,143 from 1,077 observations in 2016-2017, the last survey period in which endangered species counts occurred (Figure 7). Although observations have increased slightly (6.13%), observations have declined 44.92% since the 2009-2010 survey period Table 2).

Historically, this species once occurred in large numbers at winter sites in northern portions of its range (Davis and Hitchcock 1965) and populations in Tennessee constituted 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.

Myotis septentrionalis

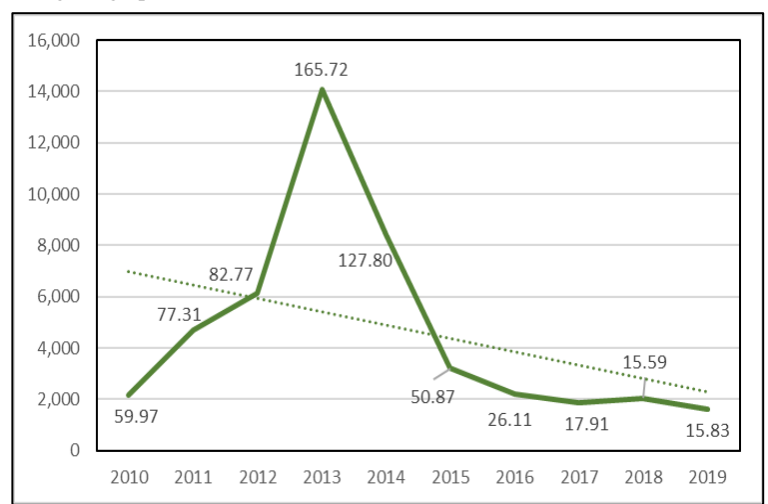
Historically, observations of *M. septentrionalis* have been low as it was recorded anecdotally while conducting surveys for species with more significant designations. During 2009-2010, surveyors collected data with increased emphasis on this species. *M. septentrionalis* displays roost preferences 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 4 individuals were observed in 2019 (Table 2). Although the lack of observations can be attributed to roosting preferences of the species, such a drastic decline in the number of observations across multiple 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 the state.

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. It was observed in less than 80% of caves surveyed (74.5%) for the first time since full census surveys began in 2009-2010. Sadly, this species is no longer observed at historic densities and its numbers at sites

Figure 9. Annual total observations statewide of *P. subflavus* are represented by the solid line. Annual average individuals observed per cave are indicated along the graph.



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 decreased 21.53% from 2,058 (2017-2018) to 1,615 (2018-2019). During 2009-2010, the average number of *P. subflavus* observed per cave survey was 59.97; however, the average number of individuals observed during 2018-2019 cave surveys was 15.83.

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. Table 3 illustrates the observed declines at sites visited a minimum of four times between 2009-2010 and 2018-2019. Increases in observations of *P. subflavus* have occurred at sites listed, but over half of the sites have seen 70% or more declines between the two field survey seasons assessed. Sadly, declines of greater than 98% have occurred for this species at multiple caves. A similar trend is unfolding for *M. lucifugus*, as declines greater than 90% are evident from many sites. A similar, but more significant trend has occurred for *M. septentrionalis*, as declines have reached 100% at ten sites. Although roost switching occurs by bats throughout the winter, it is evident WNS is greatly influencing winter bats in Tennessee, especially *M. lucifugus*, *M. septentrionalis*, and *P. subflavus*. Extirpation of *M. septentrionalis* is occurring at caves within the state and it is likely evident other species will follow a similar fate based on large declines being observed within the last ten years.

Table 3. The percent decline in observations of four species of bats in Tennessee. Percentages in red indicate declines at sites when comparing 2009-2010 surveys to 2018-2019 surveys.

Cave Name	EPFU	MYLU	MYSE	PESU
Camps Gulf Cave	100.00	-98.04	-	-88.55
Coleman Cave	-	-100.00	-100.00	-95.00
Cooper Creek Cave	-76.47	-99.22	-100.00	-90.63
Cornstarch Cave	-	-90.37	-100.00	-74.19
Cripps Mill Cave	+	+	-	-60.48
East Fork Saltpeter Cave	-	-91.96	-97.50	-12.50
Grassy Cove Saltpeter	0.00	-88.52	-100.00	-84.38
Great Expectations Cave	-25.00	-50.00	-	36.14
Gregory Cave	+	-	-	-98.98
Jaybird Cave	+	-97.97	-100.00	-92.29
Little Jack Creek Cave	+	-	-	0.00
Lost Creek Cave	+	+	-	-50.00
New Mammoth Cave	-50.00	-87.69	-100.00	-47.44
Norris Dam Cave	+	-	-	-52.38
Oaks Cave	0.00	-	-	-78.33
Redbud Cave	-	-100.00	-	-89.66
Rice Cave	-100.00	+	-	-69.23
Saltpeter Cave	100.00	-	-	-72.69
Scott Gap Cave	+	-92.90	-100.00	-92.17
Signature Cave	-100.00	0.00	-	21.43
Tobaccoport Saltpeter Cave	-20.83	-95.12	-100.00	-81.82
Trussell Cave	-	-	-	-70.00
Whiteside Cave	-	-	-	-83.18
Wolf River Cave	-	-31.47	-100.00	-55.41
Ygdrasils Cave	+	-97.47	-100.00	-97.37
Zarathustras Cave	+	-100.00	-	80.65

+: Indicates an increase in observations from 0 observations during the initial survey

-: No change in observations were made between the initial survey and the 2019 survey

Conclusions

With each year of survey effort, the impact of WNS to winter bats in Tennessee becomes clearer. During the past three 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 capture 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.

Biologists recorded information from banded bats during surveys conducted during the 2018-2019 winter field season and banding data only occurred if bats could be retrieved safely and with minimal disturbance. Biologists observed 25 bands on live bats during the 2018-2019 winter survey period from five species of bat, *Corynorhinus rafinesquii*, *M. grisescens*, *M. lucifugus*, *M. sodalis*, and *P. subflavus*. Band numbers were misread for several bands recovered. The average years from the year a band was placed to the time of recovery was greatest for *M. sodalis*, 7.25 years (n = 4), followed by *M. grisescens*, 6.67 years (n = 3), *M. lucifugus*, 3.5 years (n = 4), and *C. rafinesquii*, 1.33 years (n = 3). These band recoveries indicate some bats have the ability to survive multiple years despite the presence of WNS. Surprisingly, *M. sodalis* shows the greatest longevity from this small sample size. Bands placed on the species at two different sites in 2010 were recovered in 2019. Recovery of this data allows for optimism in the survivorship of bats despite the presence of white-nose syndrome.

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Appendix A

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

¹Tapelift sample taken and the bat was not euthanized; ²Bat submitted was found dead at site; ^CWNS confirmed; ^SWNS suspect; ^NWNS 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

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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

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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

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^{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

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^{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

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^{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
Crompton 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
Ghost Cave	Loudon	2019	Suspect	PESU ^{SW}	CCB786, CCB787, CCB788, CCB789, CCB790, CCB791, CCB792, CCB793, CCB794
Williams Mine	Cocke	2019	Suspect	PESU ^{SW}	CCB1160, CCB1162

Appendix B

- 2018-2019 Winter Survey Results

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	MYsp	PESU	Total Bats	Surveyors
Anderson	3/28/2019	(no name)											3	3	TVA
Anderson	2/5/2019	Hill Cave											11	11	TVA
Bedford	01/08/19	Critter Cave												0	TNC, TWRA
Bedford	1/8/2019	Fountain Cave											6	6	TNC, TWRA
Bedford	1/8/2019	Four Points of Light Cave												0	TNC, TWRA
Blount	1/28/2019	Gregory Cave		2									15	17	NPS, UTK
Blount	2/4/2019	Kelly Ridge Cave	2	1				1	30	2	63		22	121	NPS, UTK
Blount	1/31/2019	Saltpeter Cave	2	1									13	16	NPS
Blount	2/5/2019	Scott Cave	19	1				2	11				30	63	NPS, UTK
Blount	2/15/2019	White Oak Blow Hole							20		736		78	834	NPS, TWRA, UTK
Campbell	2/8/2019	New Mammoth Cave		1				8	40		34		41	124	TNC, TWRA
Campbell	1/15/2019	Norris Dam Cave		3			1						20	24	TVA
Cannon	1/9/2019	Espy Cave		2			3						29	34	TNC, TWRA
Carter	1/9/2019	Sculpture Cave											14	14	TWRA
Clay	3/6/2019	Brown Saltpeter Cave		7									2	9	TWRA
Clay	3/6/2019	Brown SLP Bluff Cave												0	TWRA
Clay	3/6/2019	Unnamed Cave											1	1	TWRA
Cocke	2/1/2019	Rattling Cave					250,689							250,689	TWRA, UTK
Cumberland	1/3/2019	Grassy Cove SLP		1					48				5	54	TWRA, UTK
Cumberland	2/6/2019	Run to the Mill Cave							7		18		45	70	TWRA
Dekalb	2/26/2019	Cripps Mill Cave		5					1		1		98	105	TNC, TWRA
Dekalb	12/11/2018	Summer Sump Cave											1	1	TWRA
Dekalb	12/11/2018	Winter Cave		2										2	TWRA
Fentress	12/13/2018	Bills Creek Cave												0	TWRA
Fentress	12/5/2018	Bob Cave												0	TWRA
Fentress	1/22/2019	Cornstarch Cave						1	49		1		8	59	TWRA, TNC
Fentress	1/25/2019	Dragons Breath Cave							70		14		58	142	TWRA, TNC
Fentress	1/24/2019	East Fork SLP Cave					1		36	1	56		56	150	TWRA, TNC
Fentress	1/22/2019	Easter Cave											1	1	TNC, TWRA
Fentress	12/3/2018	Helter Skelter Cave											12	12	TWRA

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	MYsp	PESU	Total Bats	Surveyors
Fentress	1/22/2019	Little Jack Creek Cave	7	2							8		1	18	TWRA, TNC
Fentress	12/4/2018	Little Sweet Cave											2	2	TWRA
Fentress	1/11/2019	Mountain Eye System - Lott Dean Ent.											28	28	TWRA, UTK
Fentress	12/13/2018	Matt Batt Pit	478											478	TWRA
Fentress	12/13/2018	Millard Fillmore Cave					1				1			2	TWRA
Fentress	2/4/2019	Mountain Eye (Cobb Creek)		2			30	6			83		12	133	TWRA, TNC
Fentress	12/27/2018	Nimrod Pit	11										1	12	TWRA
Fentress	1/22/2019	Redbud Cave											4	4	TWRA, TNC
Fentress	12/4/2018	Sweetgum Cove Cave	1											1	TWRA
Fentress	1/22/2019	Temple Falls												0	TWRA, TNC
Fentress	1/21/2019	Wolf River Cave					1		503		884		66	1,454	TWRA, TNC, USFWS
Fentress	1/25/2019	Ygdrasils Cave	1	1					2		11		1	16	TWRA, TNC
Fentress	12/20/2018	York Cave							0				12	12	TWRA
Fentress	2/4/2019	Zarathustras Cave		3	1		14	3	0		14		56	91	TWRA, TNC
Fentress	1/7/2019	Zephyrus Cave											1	1	TWRA, UTK
Franklin	2/27/2019	Dry Cave											7	7	AAFB, UoS
Franklin	2/14/2019	Indian Cave	66										4	70	TWRA, TDEC
Franklin	2/26/2019	McCrary Cave											3	3	AAFB, UoS
Franklin	1/24/2019	Signature Cave			1				1		3		17	22	TWRA
Franklin	2/26/2019	Solomon's Temple											7	7	AAFB, UoS
Franklin	2/27/2019	Wet Cave							1				7	60	AAFB, UoS
Franklin	1/24/2019	Holy Moly Canyon	1											1	TWRA
Grundy	2/28/2019	Trussel Cave					4				2		9	15	AAFB, UoS
Hancock	1/17/2019	Cantwell Valley Cave											4	4	TNC, TWRA
Hancock	1/17/2019	Dry Cave											6	6	TWRA, TNC
Hancock	1/17/2019	Upstream Cave											2	2	TNC, TWRA
Hawkins	1/17/2019	Pearsons Cave					348,656							348,656	TWRA, TNC
Hickman	2/13/2019	Bat Cave		2									19	21	TNC, TWRA
Hickman	2/13/2019	Hickman County Bat Cave												0	TNC, TWRA
Houston	2/13/2019	Richardson Cave					1						1	2	TNC

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	MYsp	PESU	Total Bats	Sum
Jackson	12/31/2018	Blackburn Fork Pit											1	1	TV
Jackson	2/15/2019	Casey Cave												0	TV
Knox	2/12/2019	Blackmans Cave											21	21	TV
Loudon	2/12/2019	Ghost Cave											24	24	TVA,
Mammoth Cave NP	2/6/2019	Long Cave												0	TNC,
Marion	2/25/2019	Whiteside Cave											55	55	TWR
Meigs	2/6/2019	Blythe Ferry											8	8	T
Meigs	1/23/2019	Eaves Cave		1					2				14	17	T
Montgomery	1/15/2019	Bellamy Cave					414,393						1	414,394	TWRA, T
Montgomery	2/19/2019	Broom Hollow Cave											6	6	TNC,
Montgomery	2/18/2019	Coleman Cave		1									2	3	TNC,
Montgomery	2/18/2019	Cooper Creek Cave		4			1		1		1		12	19	TNC, TV
Perry	2/12/2019	Alexander Cave					2		2		3		3	10	T
Perry	2/12/2019	Jaybird Cave		1					5		1		34	41	TNC,
Pickett	1/21/2019	Big Jordan Cave		5					4	1	6		1	17	TWR
Roane	2/14/2019	Marble Bluff										1	17	18	T
Robertson	1/28/2019	Cheek's Stand Cave		5									15	20	TNC,
Robertson	1/28/2019	Stark Cave											25	25	TNC,
Stewart	2/14/2019	Tobaccoport Slp Cave		19			845		12		73	3	8	960	TNC, TV
Sullivan	1/9/2019	Big Springs Cave												0	TV
Sullivan	1/9/2019	Hickory Tree Cave											4	4	TV
Sullivan	1/9/2019	Red Legs Rift											0	0	TV
Union	2/18/2019	Jolley Saltpeter							286				20	306	TV
Union	1/22/2019	Oaks Cave		1			2						13	16	TV
Van Buren	1/29/2019	Camps Gulf Cave	4	6			1		2		6		19	38	TWR
Van Buren	1/29/2019	Case Brothers Cave												0	TWR
Van Buren	1/3/2019	Dark River Cave	8										2	10	TWR
Van Buren	1/29/2019	Palliser Cave											1	1	TWR
Van Buren	1/29/2019	Phineas Finn Cave	1											1	TWR
Van Buren	1/28/2019	Rice Cave							2		4		44	50	TWRA

County	Survey Date	Cave Name	CORA	EPFU	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	MYsp	PESU	Total Bats	Sum
Van Buren	2/14/2019	Cagle Saltpeter Cave	4								13		16	33	TWRA
Warren	1/16/2019	Hubbard's Cave		3			500,253				153		47	500,456	TNC, TV
Wayne	2/11/2019	Biffle Cave		4			5		1				56	66	TNC,
White	1/15/2019	Clifty Creek Cave	2	4										6	TV
White	12/19/2018	Davis Cave	22											22	TV
White	1/30/2019	Great Expectations Cave	219	3				2	5		29		113	371	TWRA,
White	12/10/2018	JR Crack Hill NR2												0	TV
White	1/18/2019	Little Canine Cave		2										2	TV
White	1/30/2019	Lost Creek Cave	2	7	1				2		21		100	133	TWRA, TI L
White	2/5/2019	Rose Cave		6			774				86		41	907	TWR
White	2/5/2019	Feral Carole Cave												0	T
White	2/5/2019	Rusted Lantern Cave						1	0		0			1	T

Appendix C

- 2018-2019 Diagnostic Reports
- Diagnostic Reports from prior years can be found in Annual Monitoring Reports at:
<https://www.tn.gov/content/tn/twra/wildlife/wildlife-diversity-programs.html#whitenose>

**MIDDLE
TENNESSEE**
STATE UNIVERSITY

DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB786
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES *Perimyotis subflavus* SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

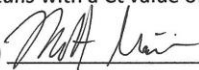
HISTOLOGIC FINDINGS: None reported

MORPHOLOGICAL DIAGNOSIS: None reported

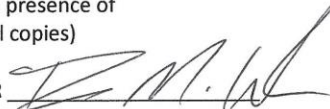
MYCOLOGY FINDINGS: None reported

MOLECULAR BIOLOGICAL FINDINGS: The real time qPCR assay indicated the presence of *Pseudogymnoascus destructans* with a Ct value of 35 (quantified at 18 fungal copies)

DIAGNOSTICIAN (signature)



SUPERVISOR





DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB787
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 31 (quantified at 196 fungal copies)

DIAGNOSTICIAN (signature) SUPERVISOR

**MIDDLE
TENNESSEE**
STATE UNIVERSITY

DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB788
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 31 (quantified at 266 fungal copies)

DIAGNOSTICIAN (signature) 

SUPERVISOR 



DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB789
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: UV light indicated fungal presence

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* with a Ct value of 37 (quantified at 4 fungal copies)

DIAGNOSTICIAN (signature) SUPERVISOR

**MIDDLE
TENNESSEE**
STATE UNIVERSITY

DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB790
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES *Perimyotis subflavus* SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 37 (quantified at 4 fungal copies)

DIAGNOSTICIAN (signature) 

SUPERVISOR 

**MIDDLE
TENNESSEE**
STATE UNIVERSITY

DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB791
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES *Perimyotis subflavus* SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: WNS observed both visually and using UV light

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* with a Ct value of 25 (quantified at 12,463 fungal copies)

DIAGNOSTICIAN (signature) 

SUPERVISOR 



DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB792
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 36 (quantified at 6 fungal copies)

DIAGNOSTICIAN (signature) SUPERVISOR



DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
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1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB793
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

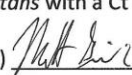

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 35 (quantified at 20 fungal copies)

DIAGNOSTICIAN (signature)  SUPERVISOR 

**MIDDLE
TENNESSEE**
STATE UNIVERSITY

DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB794
Date collected/received (mm/dd/yy) 03/07/2018
Date of report 10/01/2019

STATE TN COUNTY Loudon SPECIFIC LOCALITY Ghost Cave

SPECIES *Perimyotis subflavus* SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/7/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 35 (quantified at 14 fungal copies)

DIAGNOSTICIAN (signature) 

SUPERVISOR 



DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB1160
Date collected/received (mm/dd/yy) 03/08/2018
Date of report 10/01/2019

STATE TN COUNTY Cocke SPECIFIC LOCALITY Williams Mine

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/8/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 31 (quantified at 182 fungal copies)

DIAGNOSTICIAN (signature) SUPERVISOR



DIAGNOSTIC SERVICE REPORT

Walker Lab
Middle Tennessee State University
Department of Biology, Box 60, Rm SCI 2044
1672 Greenland Drive
Murfreesboro TN 37132
(615) 904-8382

FINAL REPORT

Specimen number CCB1162
Date collected/received (mm/dd/yy) 03/08/2018
Date of report 10/01/2019

STATE TN COUNTY Cocke SPECIFIC LOCALITY Williams Mine

SPECIES Perimyotis subflavus SEX NA AGE NA WEIGHT NA

CASE HISTORY: An individual of *Perimyotis subflavus* was sampled by TWRA officials on 3/8/2018. One swab sample was obtained and processed in the Walker Lab at MTSU. The swab was used to run real time quantitative PCR using the Muller et al. (2013) assay to detect WNS presence.

FINAL DIAGNOSIS: Positive WNS results from quantitative PCR assay

COMMENTS: NA

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

PUBLIC HEALTH IMPLICATIONS: None reported

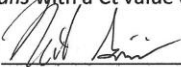
GROS NECROPSY FINDINGS: None reported

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* with a Ct value of 37 (quantified at 4 fungal copies)

DIAGNOSTICIAN (signature)  SUPERVISOR 