2013 Tennessee Bat Population Monitoring and White Nose Syndrome Surveillance

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Little brown bats with potential white nose syndrome, New Mammoth Cave, Campbell County, TN, Cory Holiday (TNC)

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Volunteers

We thank the many volunteers with caving knowledge and experience who helped identify potential white-nose sites and hibernacula and who assisted with surveys.

Landowners

We thank the many landowners who gave access to their property to conduct surveys of caves in order to better understand bat population distribution and effects of white-nose syndrome on bats.

Executive Summary:

White nose syndrome (WNS) continued to spread across Tennessee. The number of confirmed counties jumped from a total of 11 in 2012 to a total of 31 by the end of the 2013 surveillance period. Of 46 counties surveyed in 2013, 19 counties did not show any signs of WNS. A total of 85 caves were surveyed during 2012-2013 survey period.

The 2013 hibernacula survey period was also an Indiana bat and gray bat hibernacula survey year. Indiana bat numbers appear to be increasing. Gray bat numbers had an overall increase since 2002, but have a declined slightly from the high in 2006.

Unfortunately numbers pre-2010 for many bat species, such as little brown, tri-colored, northern long-eared, big brown, and eastern small-footed are sporadic at best. Using caves surveyed in 2011 and again in 2013, survey numbers for tri-colored and northern long-eared bats appear to be up. Little brown bats showed a slight decline but it does not appear to be significant. We assume with the discovery of WNS in Tennessee in 2010 that any hibernacula data post 2009 potentially is being influenced by WNS. This makes it hard to say whether the change in numbers are actual population change, a result of WNS causing bats to shift location within caves or between caves, or just normal geographic shifts in bats. The number of big brown and eastern small-footed observed during hibernacula counts are so small and sporadic that it is impossible to even begin to assess their wintering status in Tennessee.

TABLE OF CONTENTS

Introduction

Very limited information is available on bat hibernacula and population trends in Tennessee. Only Indiana bat (*Myotis sodalis*) and gray bat (*Myotis grisescens*) hibernacula have been surveyed with any relatively regular frequency. Little brown bat (*Myotis lucifugus*), northern long-eared (*Myotis septentrionalis*), eastern small-footed (*Myotis leibii*), big brown (*Eptesicus fuscus*), tri-colored *(Perimyotis subflavus)*, Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) numbers are sporadic at best. After the discovery of white nose syndrome (WNS) caused by *Pseudogymnoascus destructans* (*P. destructans)*(formerly *Geomyces destructans)* in New York, TWRA and partnering Agencies began an extraordinary task to survey caves in Tennessee for hibernating bats. With close to 10,000 caves identified in the state that task has been difficult. Although there are a large number of caves in the state only a small percentage are likely to contain any significant numbers of hibernating bats. Since 2010 TWRA and partnering agencies (see acknowledgements page for list) have worked to survey new caves with potential hibernating bats, monitor known bat hibernacula populations, and look for signs of WNS.

Methods

Hibernacula were surveyed between December 15th and April 1st. Typically teams of 2 to 4 biologists conducted surveys of caves that were either known to have bats or based on available information may have contained enough bats to justify surveying.

WNS surveillance followed a tiered approach designed to detect possible WNS infection and to minimize disturbance during surveys.

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

- Tier 2 surveys: a quick population estimate, examination of all accessible bats for signs of WNS, and band recovery (where appropriate).

- Tier 3 surveys: observations made outside of cave entrances to check for unusual winter bat behavior (e.g. daytime activity at the cave entrance).

WNS Status Terms:

Field Signs: A site listed as showing field signs means that at least one bat was observed at the site with what appeared to be a white fungus. The observation may or may not be *Pseudogymnoascus destructans* (P.d.) but another fungus or yeast. When a site is listed as having field signs an observation is made, but samples were not available to be sent off for testing. Field sign positive is also used when a county is already positive and submitting additional samples is not warranted.

Suspect: In order for a site to be listed as suspect a swab from a bat or other surface is submitted and *P. destructans* spores or genetic material is detected on the swab.

Confirmed: In order for a site to be confirmed WNS positive a carcass or tissue sample of a bat must be submitted to a disease testing lab. Histopathology identifies that *P. destructans* hypae have penetrated cell walls of the bat tissue. PCR is used to confirm identity of the fungus.

Results

A total of 46 counties with hibernacula were surveyed in 2012-2013 with the number of counties confirmed as WNS jumping to 31 (Figure 1 page7). Surveys were conducted for the biannual Indiana bat hibernacula and gray bat priority 1 hibernacula surveys in 2013. Indiana bat numbers show a 20.6% increase (Figure 2). Gray bats showed a 4% decline from 2010. (Figures 3). With the discovery of WNS, hibernacula surveys now include species of bats other than federally listed species. Three additional species tri-colored, little brown, and northern long-eared bat had enough caves surveyed over multiple years to begin examining early trends There was a 27.9% decline in little brown bats, 61.6% increase in tri-colored bats, and a 95.7% increase in northern long-eared bats (Figure 4).

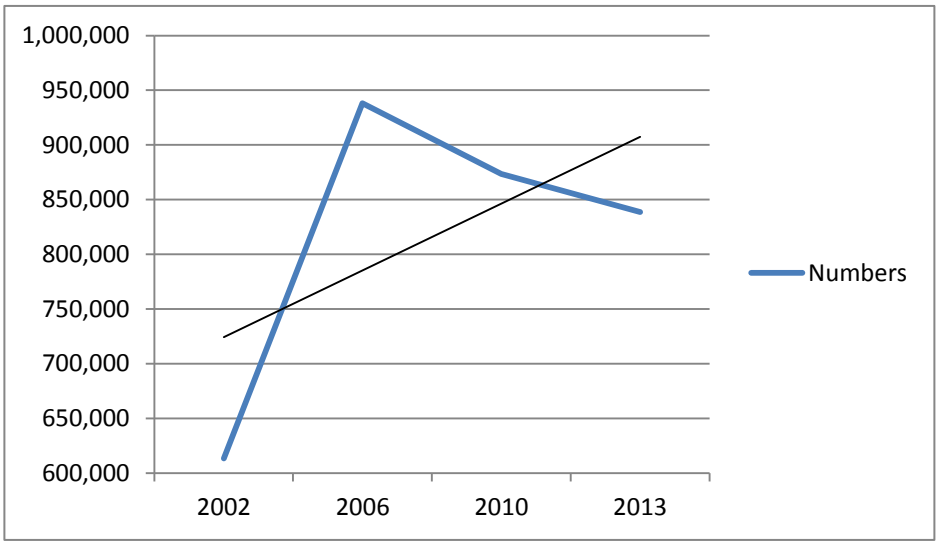


Figure 2. Gray bat hibernacula surveys from 3 priority 1 caves in Tennessee with a positive trend line (2002 to 2013).

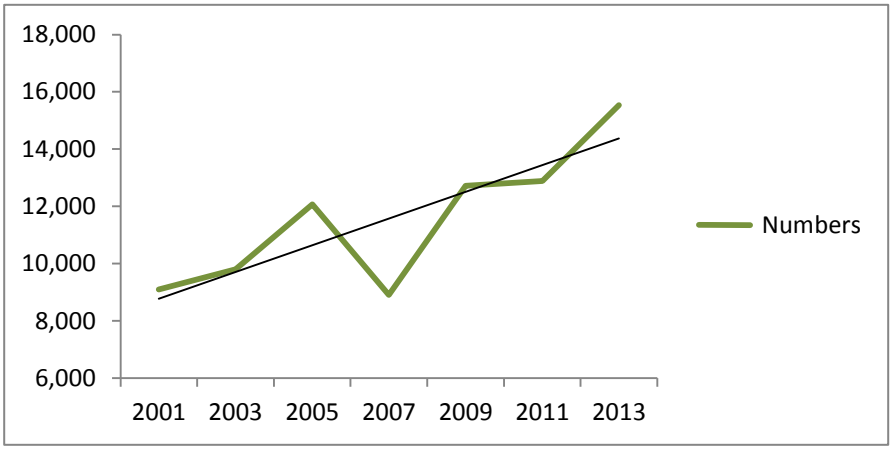


Figure 3. Indiana bat count from known hibernacula with positive trend line (2001 to 2013). 2013 data corrected using U.S. Fish and Wildlife Service estimates.

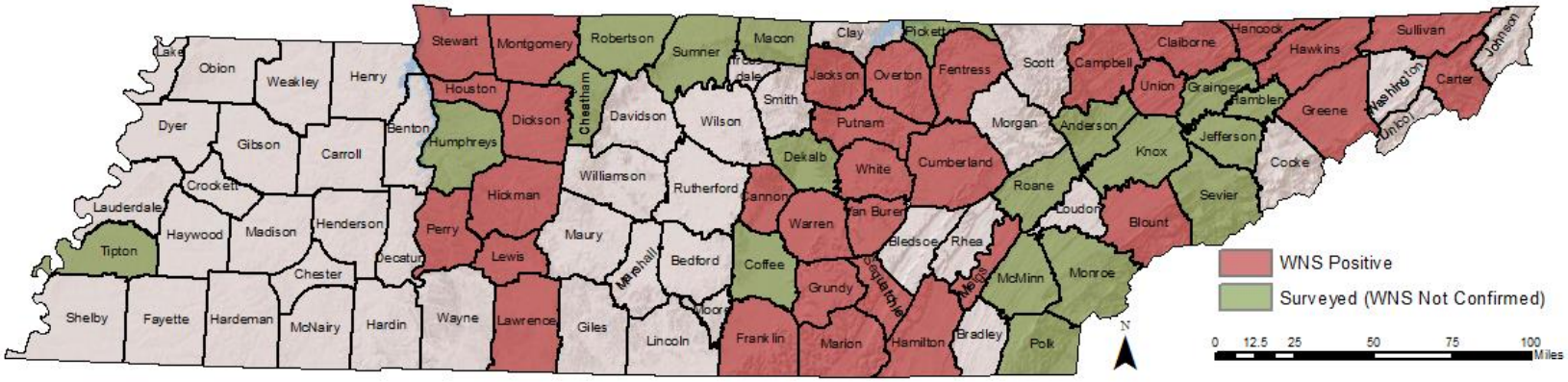
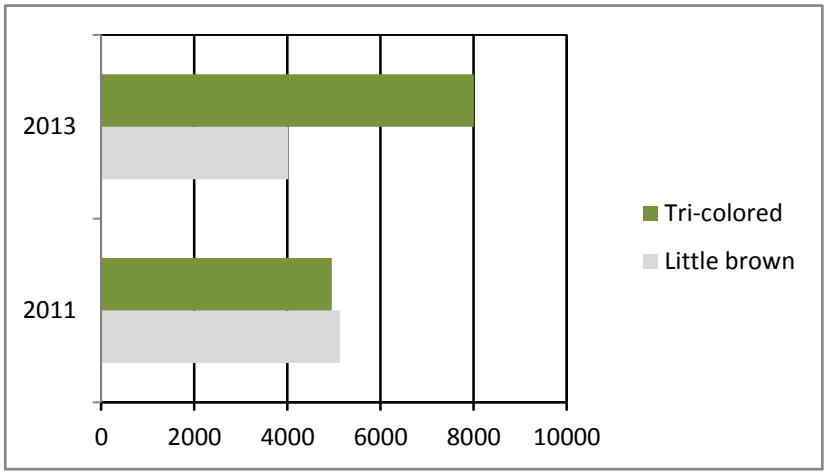


Figure 1. 2013 surveillance for White Nose Syndrome and final distribution of counties confirmed as having at least one positive record.

Note: Sequatchie County listed as WNS positive is the result of a bat found at a private residence in an area where caves occur.



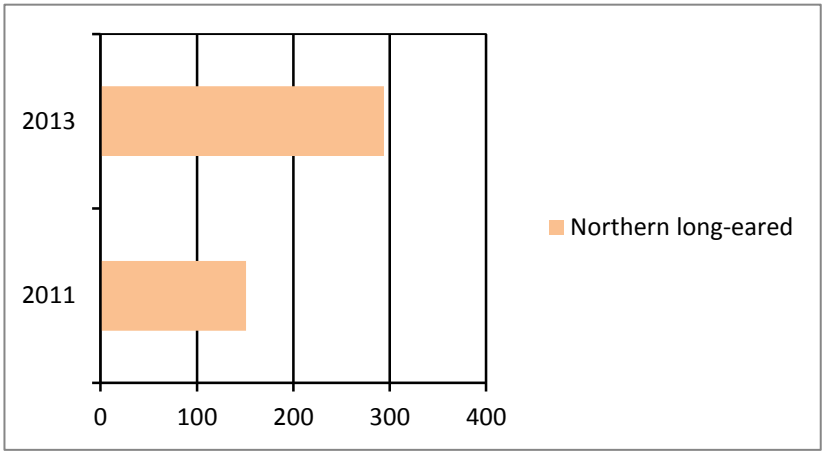


Figure 4. Comparison between 2011 and 2013 bat hibernacula surveys for tri-colored (34 caves), little brown (24 caves), and northern long-eared bat (17 caves). Some caves were not surveyed in 2011 in those cases data is from 2012.

White Nose Syndrome Cave Status and Observed Mortalities

White nose syndrome was confirmed in 2 caves and suspect in 1 in 2010. One cave was confirmed in 2011 and 9 caves were confirmed in 2012 with 2 of those moving from suspect in 2011 to confirmed in 2012. A total of 29 caves were confirmed and 1 was suspect in 2013 (Table 1). The number of field sign caves has also increased from 1 in 2011 to 6 in 2013 (Table 2). A total of 19 counties that were surveyed in 2013 did not show signs of WNS (Figure 1).

The highest number of observed mortalities was at Camps Gulf cave in Van Buren County, with close to 100 observed dead bats clinging to the walls or found on the ground. Other caves had mortalities of <6 observed. Tri-color bats were the highest proportion of observed mortalities with little brown and northern long-eared bats having the fewest observed mortalities.

Table 1. Caves that have had bats submitted for testing which came back as suspect or confirmed (2010-2013).

Cave Name	County	Year	WNS Status
White Oak Blowhole Cave	Blount	2010	Suspect
Grindstaff Cave	Carter	2010	Confirmed
East Fork Saltpeter Cave	Fentress	2010	Suspect
Dunbar Cave	Montgomery	2010	Suspect
Worleys Cave	Sullivan	2010	Confirmed
Camps Gulf Cave	Van Buren	2010	Suspect
Cooper Creek Cave	Montgomery	2011	Confirmed
White Oak Blowhole Cave	**Blount**	2011, **2012**	**Confirmed**
Grassy Cove Saltpeter Cave	Cumberland	2012	Confirmed
Carlton Cave	Franklin	2012	Confirmed
Lookout Mt. Battlefield Pit #1	Hamilton	2012	Confirmed
Cantwell Valley Cave	Hancock	2012	Confirmed
Pearsons Cave	Hawkins	2012	Confirmed
Bellamy Cave	Montgomery	2012	Confirmed
Fort Campbell Nerd Hole Cave	Stewart	2012	Confirmed
Camps Gulf Cave	**Van Buren**	2011**, 2012**	**Confirmed**
New Mammoth Cave	Campbell	2013	Confirmed
Espey Cave	Cannon	2013	Confirmed
Buis Saltpeter Cave	Claiborne	2013	Confirmed
Sour Kraut Cave	Claiborne	2013	Confirmed
Hunt Cave	Dickson	2013	Confirmed
East Fork Saltpeter Cave	**Fentress**	2011**, 2013**	**Confirmed**
Zarathustrus Cave	Fentress	2013	Confirmed
Cornstarch Cave	Fentress	2013	Confirmed
Wolf River Cave	Fentress	2013	Confirmed
Buggytop (Lost Cove Cave)	Franklin	2013	Confirmed
Afton Cave	Greene	2013	Confirmed
Big Mouth Cave	Grundy	2013	Confirmed
Trussell Downstream Cave	Grundy	2013	Confirmed
Trussell Cave	Grundy	2013	Confirmed
Blowing Cave	Hickman	2013	Confirmed
Richardson Cave	Houston	2013	Confirmed

Table 1. continued.

Cave Name	County	Year	WNS Status
Knob Creek Cave	Lawrence	2013	Confirmed
Depriest Branch Cave	Lewis	2013	Confirmed
Whiteside Cave	Marion	2013	Confirmed
Eve's Cave	Meigs	2013	Confirmed
Dunbar Cave	Montgomery	2013	Confirmed
Three Forks Cave	Overton	2013	Confirmed
Jaybird Cave	Perry	2013	Confirmed
Welch-Bowling Cave	Putnam	2013	Confirmed
Herd O' Coons Cave	Union	2013	Confirmed
Hubbards Cave	Warren	2013	Confirmed
Virgin Falls Cave	White	2013	Confirmed
Lost Creek Cave	White	2013	Confirmed
Rose Cave	White	2013	Suspect

* Bold text means that the cave initially was suspect, but then was confirmed WNS positive during the year listed in bold.

Table 2. Observations of caves with what appeared to be field signs of WNS and the year of initial observation. No bats were submitted for testing for various reasons.

Cave Name	County	Year
Bellamy Cave	Montgomery	2011
Saltpeter Cave	Blount	2012
Coriolis Cave	Fentress	2012
Dragon's Breath Cave	Fentress	2012
Coleman Cave	Montgomery	2012
Tobaccoport Saltpeter Cave	Stewart	2012
Springhill Saltpeter Cave	Anderson	2013
Redbud Cave	Fentress	2013
Yggdrasil Cave	Fentress	2013
Eblen Cave	Roane	2013
Rice Cave	Van Buren	2013
Great Expectations Cave	White	2013

Conclusions

Caution needs to be observed in drawing any major conclusions from changes in bat numbers due to the limited data available pre-WNS (2009). It is still too early to determine the overall effects of WNS on bats in Tennessee. Continued monitoring of hibernacula will be needed to determine if WNS will have a significant impact on bats in Tennessee as it has in the Northeast.

Our bat numbers from 2011 to 2013 show mixed effects some may be the result of variation in weather between count years, some due to WNS, and others to increased survey efforts. For instance Indiana bats increased 20.6% while little browns decreased 27.9%. The little brown numbers may not actually have decreased as much. We observed more gray bats in the little brown and Indiana bat section of Rose cave this year and very few little browns. Gray bats have been known to push out other bat species from section of caves. If we remove Rose Cave from 2011 the decline in little browns was only 9.3%. Due to the shift in gray bats it is possible that little browns at Rose Cave either shifted to a portion of the cave that was not surveyed or to another cave. For instance there was a large number of little browns (>400) found at Fox Hole cave not very far from Rose Cave. The only way to determine if these trends will continue is to continue long term monitoring of bat hibernacula.

Mortalities are occurring in hibernacula. A higher proportion of observed mortalities appear to be tri-colored bats. Both Grindstaff Cave (Carter County) and Worly's Cave (Sullivan county) in 2010 were the first caves in Tennessee confirmed with WNS. These caves have shown decreases in bats. No surveys were conducted at Grindstaff Cave this year. Worly's Cave in 2011 had >90% loss of bats from 2010, but no pre-WNS survey data is available. Worly's Cave did see in increase in gray bats this year compared to previous years, but other bat numbers remained low.

Unlike the drastic loss of bat numbers after the confirmation of WNS at Grindstaff and Worly's, other caves in Tennessee have fared better. Winter activity has been observed with the most drastic observation having occurred this year in the Great Smoky Mountains National Park where hikers and Park staff observed bats flying around during cold days away from White Oak Blowhole and other known hibernacula. These types of activities have been observed in the northeast, but often result in large number of dead bats being found. However no large number of bats were found dead and the number of Indiana bats was higher than in 2011 for White Oak Blowhole Cave. However, little brown bat and northern long-eared bat numbers were down slightly.

Recommendations

1) Use current data to identify hibernacula for population monitoring which will be completed over a 2 year period similar to Indiana bat surveys to provide a species baseline for Tennessee.
2) Shift gray bat hibernacula surveys to a minimum of every other year. Ideally these surveys should be conducted in even years opposite of Indiana bat survey year.
3) Continue working to identify new significant hibernacula.
4) Continue over the next 3 years to identify new WNS positive caves in currently undocumented counties within the karst region of Tennessee.
5) Continue to partner with Universities to study the effects of WNS on bat hibernacula in the Tennessee.

Figure 5. Dead tri-colored bat on cave floor Cannon County.

Appendix

Survey data from 2013 hibernacula surveys conducted from December 2012 to April 2013. Bat species observed during survey include Rafinesque's big-eared bat (CORA), big brown (EPFU), gray bats (MYGR), eastern small footed (MYLE), little brown bat (MYLU), Indiana bat (MYSO), northern long-eared (MYSE), tri-colored (PESU), and unidentified Myotis sp. (MYsp).

County	Cave Name	Survey Date	CORA	EPFU	MYGR	MYLE	MYLU	MYSE	MYSO	PESU	MYsp	Surveyors
Anderson	Toilet Bowl Cave	3/21/2013					1			27		TWRA, TNC
Anderson	Springhill Saltpeter Cave	3/21/2013		17		1	217			39		TWRA, TNC
Blount	White Oak Blowhole	2/8/2013					487	25	9,076	590		NPS, TWRA, FWS
Blount	Scott Cave	2/20/2013					33		156	293		NPS, UT
Blount	Saltpeter	2/1/2013		1			8	6	2	49		NPS, UT
Blount	Gregory	1/27/2013					5	1		2016		NPS, UT
Blount	Kelly Ridge Cave	2/9/2013	300	1			184	19	1474	839		NPS, UT
Campbell	New Mammoth Cave	1/28/2013		4		5	278	125	75	75		TWRA, TNC
Campbell	Norris Dam Cave	2/1/2013		1			1			42		TVA, UT
Cannon	Espey Cave	3/28/2013			148		1	13		174	1	TNC
Cheatham	Winding Cave	2/26/2013								151		TNC
Claiborne	Buis Saltpeter Cave	3/14/2013		5			26	1		94		TWRA, TNC
Claiborne	Sour Kraut Cave	3/14/2013		2			1	2		14		TWRA, TNC
Coffee	Jarrells Cave	12/13/2013								10	4	TWRA, FWS
Cumberland	Grassy Cove Saltpeter	3/15/2013		1			323	2	3	15	1	TWRA
Dekalb	Turner Cave	3/8/2013	1	1			6	3		93		TNC
Dickson	Hunt Cave	2/19/2013								39		TNC
Fentress	Cornstarch Cave	1/18/2013				1	505		236	22		TWRA, TNC, FWS
Fentress	Dragon's Breath Cave	12/17/2012					209	2	74	537	2	TWRA, TNC
Fentress	East Fork Saltpeter Cave	1/17/2013					267	1	171	78		TWRA, TNC, UT
Fentress	Little Jack Creek Cave	1/18/2013		3			4		2	5		TWRA, TNC, FWS

County	Cave Name	Survey Date	CORA	EPFU	MYGR	MYLE	MYLU	MYSE	MYSO	PESU	MYsp	Surveyors
Fentress	Redbud Cave	1/18/2013					21		3	18		TWRA, TNC,FWS
Fentress	Wolf River Cave	1/15/2013			2		1193	1	1048	177		TWRA, TNC, FWS
Fentress	Yggdrasil Cave	2/7/2013					79	1	60	38		TWRA,FWS
Fentress	Zarathustras Cave	1/24/2013		1			15	2	32	267	2	TWRA, FWS
Fentress	Blue Crayfish Cave	1/17/2013								13		TWRA, TNC
Franklin	Carlton Cave	3/21/2013		1	3		3			1764		TWRA
Franklin	Signature Cave	1/15/2013	2						27	22	1	TWRA
Grainger	Indian Cave	12/20/2012		22						68		TNC
Grainger	Indian Cave	3/20/2013		3	416					80		TWRA, TNC
Greene	Afton Cave	3/13/2013								125		TWRA, TNC
Greene	Cochran Cave	3/11/2013			2					1		TVA
Grundy	Big Mouth Cave	2/28/2013					1			23		TNC
Grundy	Trussell Cave	2/28/2013			3		1		18	169		TWRA, TNC
Grundy	Trussell Downstream Cave	2/28/2013								11		TWRA, TNC
Hamblen	Soard Cave	1/10/2013		15						46		TNC
Hamilton	Raccoon Mt. Caverns	3/5/2013					1			25		TWRA, FWS
Hawkins	Pearson Cave	1/29/2013			147,265							TWRA, TNC, FWS
Hawkins	Phipps Bend Nuclear Site (TVA)	1/7/2013		3			1					TVA, TNC
Hickman	Blowing Cave	2/6/2013		4	2		180	33	49	570		TWRA, TNC
Houston	Richardson Cave	1/3/2013					8	1		59		TWRA, TNC
Jackson	Carter Cave	1/23/2013								8		TNC
Jackson	North Spivey Cave	3/29/2013	1	6			7			79	1	TNC
Jefferson	Rouse Cave	1/10/2013		1	6					148		TNC
Jefferson	Tater Cave	3/20/2013		1						1		TWRA, TNC
Knox	Blowing Hole Cave	1/11/2013		1						16		TNC
Lawrence	Knob Creek Cave	2/25/2013		11						309		TNC
Lewis	Depriest Branch Cave	2/18/2013		2			4	26		390		TNC

County	Cave Name	Survey Date	CORA	EPFU	MYGR	MYLE	MYLU	MYSE	MYSO	PESU	MYsp	Surveyors
Macon	Aunt Beck Simmins Cave	3/1/2013		4			9	6		61		TNC
Marion	Nickajack Cave	2/4/2013			18					4		TWRA TNC, TVA
Marion	Whiteside Cave	3/5/2013								142		TWRA, TNC, FWS
McMinn	Unknown	1/4/2013								6		TWRA
Meigs	Eve's Cave	3/14/2013			1		1			57		TWRA, TVA
Monroe	Luther Cave	2/27/2013								9		TWRA, FWS
Montgomery	Bellamy Cave	2/4/2013		1	345,002		19			86		
Montgomery	Coleman Cave	2/4/2013					7	1		52		TWRA, TNC
Montgomery	Cooper Creek	2/18/2013		10			30			111		TWRA
Montgomery	Dunbar Cave	3/26/2013		1						61		APSU
Overton	Mill Hollow Cave	3/27/2013					1			47		TNC
Overton	Three Forks Cave	3/27/2013					2	3		7		TNC
Overton	Wilson Cemetery Cave	3/7/2013								31		TWRA, TNC
Perry	Jaybird Cave	2/8/2013			1		246	70	19	441		TWRA, TNC
Pickett	Bunkum	3/4/2013	2	2		5		1		96	1	TWRA, TNC
Pickett	Frog Cave	3/4/2013										TWRA, TNC
Polk	Gee Cave	2/27/2013								12		TWRA, FWS
Putnam	Kuykendall	3/12/2013		1						49		TWRA
Putnam	Welch-Bowling	3/6/2013		3						254		TWRA, TNC
Roane	Marble Bluff Cave	3/6/2013					3			100		TVA
Robertson	Jesse James Cave #1	1/4/2013		1	1					53		TNC
Robertson	Jesse James Cave #2	1/4/2013		9						1		TNC
Robertson	Whiskey River Cave	1/4/2013		8	1		3	1		244	3	TNC
Smith	Bridgewater Cave	2/20/2013					32			34		TNC
Stewart	Tobaccoport Saltpeter	2/5/2013		10	52		182		137	69		TWRA, TNC
Sullivan	Worley's/Morrill Cave	3/19/2013		1	300					11		TWRA, TNC

County	Cave Name	Survey Date	CORA	EPFU	MYGR	MYLE	MYLU	MYSE	MYSO	PESU	MYsp	Surveyors
Sumner	Escue Cave	2/20/2013		7	1		1			88		TNC
Sumner	Portland Lake Cave	2/20/2013								4		TNC
Union	Herd O' Coons Cave	3/12/2013		3			68	2		150		TWRA, TNC
Van Buren	Camps Gulf	1/31/2013	21	2	7		11	2	71	555	1	TWRA, FWS
Van Buren	Fox Hole	12/18/2012	2				400		15	93		TWRA, FWS
Van Buren	Rice	2/28/2013			12		1	1	12	144		TWRA, TDEC, FWS
Warren	Hubbards Cave	1/21/2013		1	346,286		2		133	38		TWRA, TNC
White	Virgin Falls Cave	2/19/2013					3		9	293	1	TWRA, TDEC, FWS
White	Great Expectations Cave	2/21/2013	485	1	1		1	1		529		TWRA, TDEC, FWS
White	Lost Creek Cave	2/21/2013		2	19		3		33	322		TWRA, TDEC, FWS
White	Rose Cave	1/21/2013		4	683		33		77	203		TWRA, TNC, UT