

Evaluating the Risk of Tick-Borne Relapsing Fever Among Occupational Cavers — Austin, Texas, 2017

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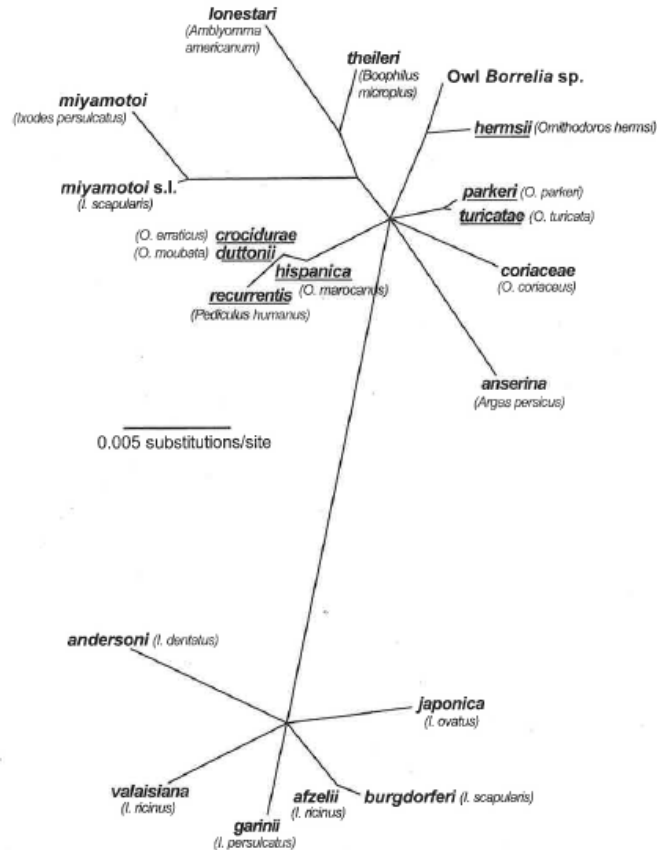
Overview

- **Background on tick-borne relapsing fever**
- **Epi-Aid investigation in Texas**
- **Take aways**

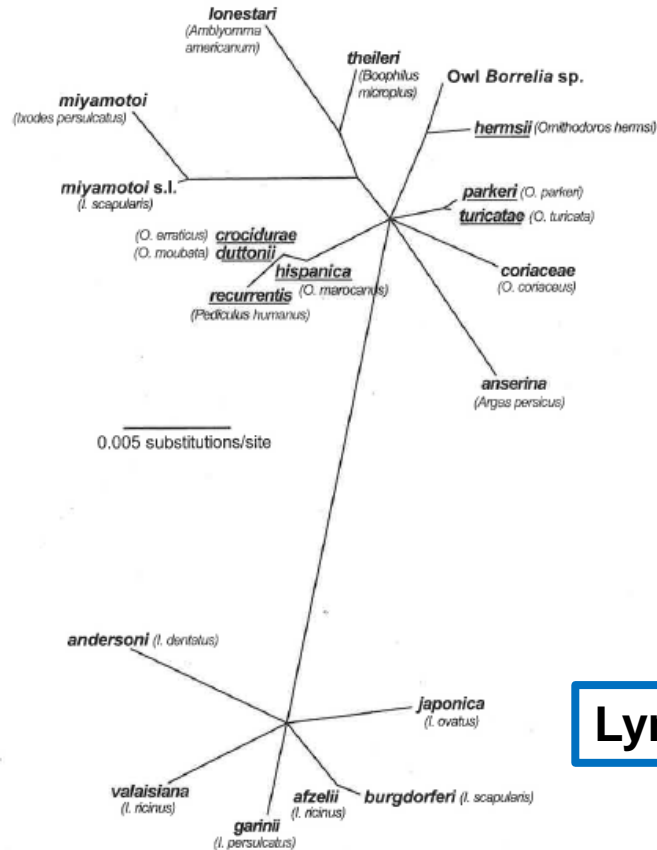
Background



Two genetic groups of *Borrelia* spp.



Two genetic groups of *Borrelia* spp.

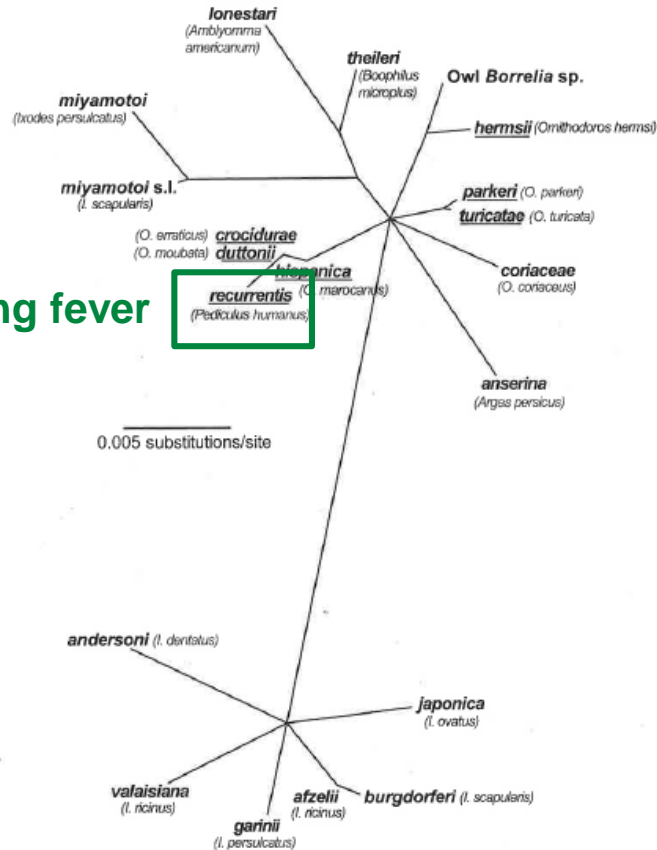


Lyme disease group

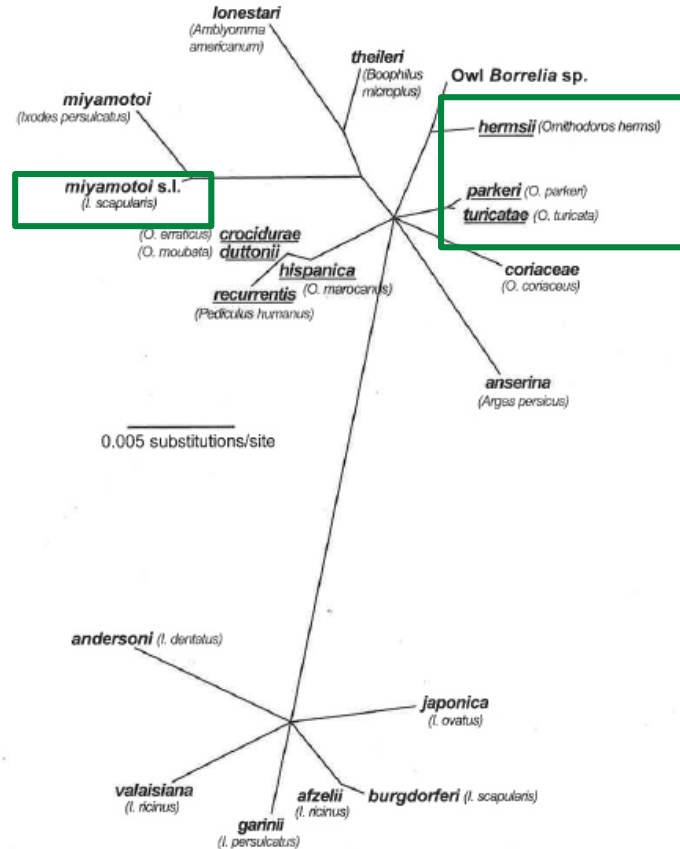
Louse-borne relapsing fever



Louse-borne relapsing fever



Tick-borne relapsing fever (TBRF)

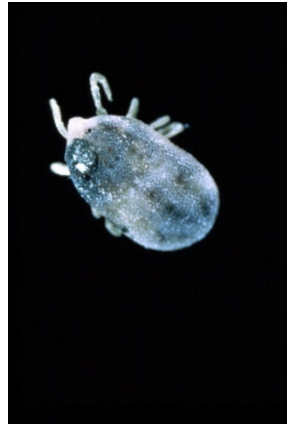


Tick-borne relapsing fever



TBRF background

- First recognized tick-borne disease of humans
 - First report: 1905 case from NY that traveled to TX
- Transmitted by: *Ornithodoros* spp. (soft) tick
 - Rare instances maternal-fetal
- Animal reservoirs
 - Rodents, lagomorphs



TBRF clinical picture

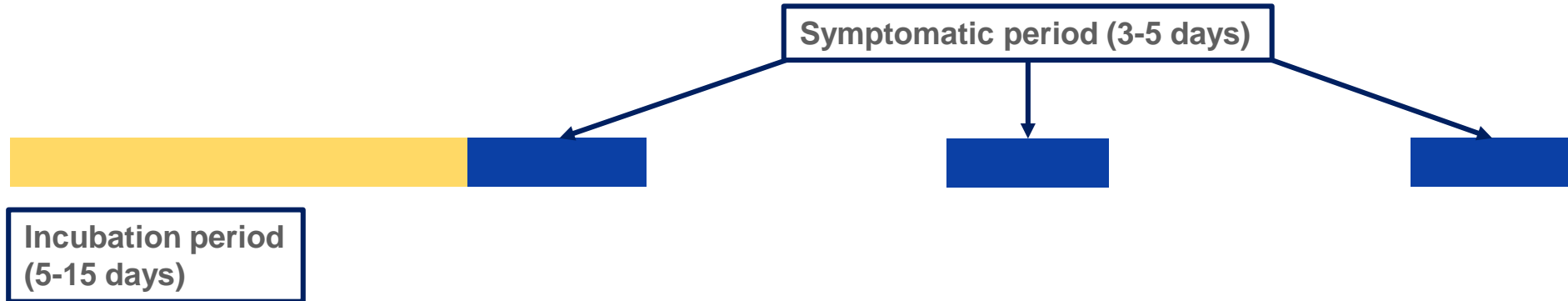
- **Fever, headache, myalgia, arthralgia, abdominal complaints**
- **Ranges from mild and self-limiting illness to death**
- **Episodes resolve after 3-5 days and recur or “relapse” approximately one week later**



**Incubation period
(5-15 days)**

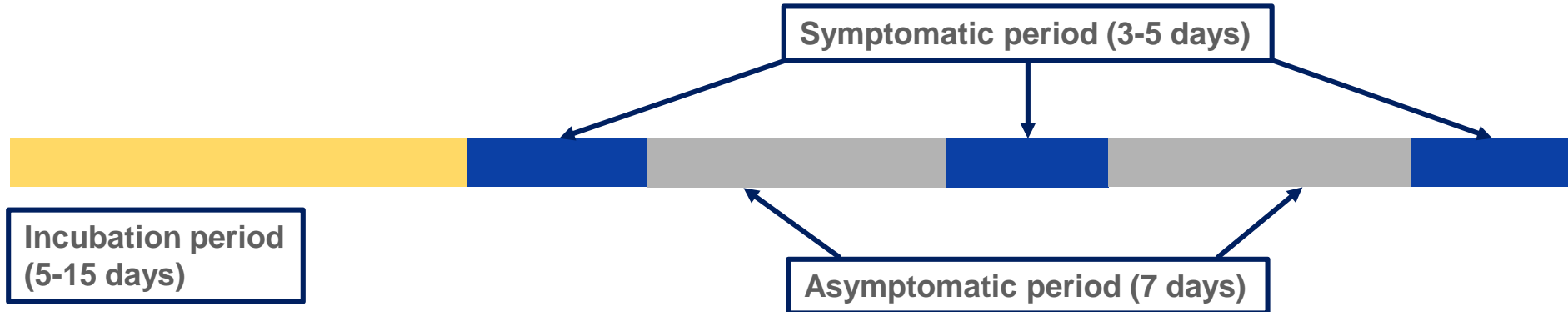
TBRF clinical picture

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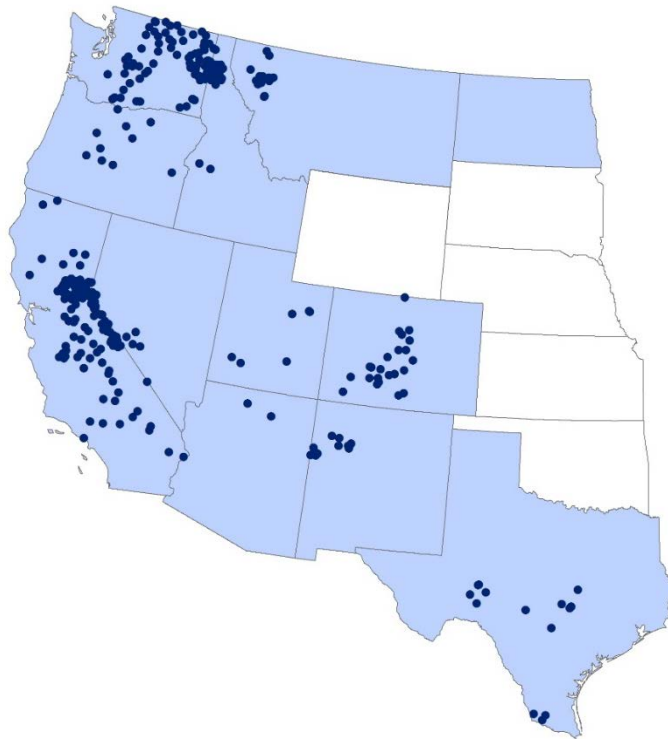


TBRF clinical picture

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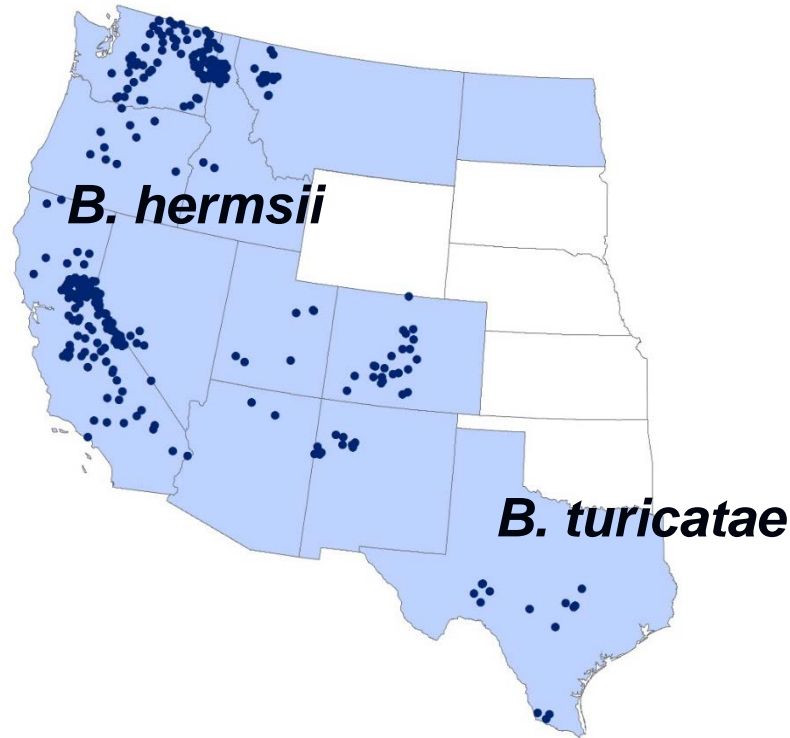


County of exposure for 504 cases of TBRF reported in the U.S., 1990–2011



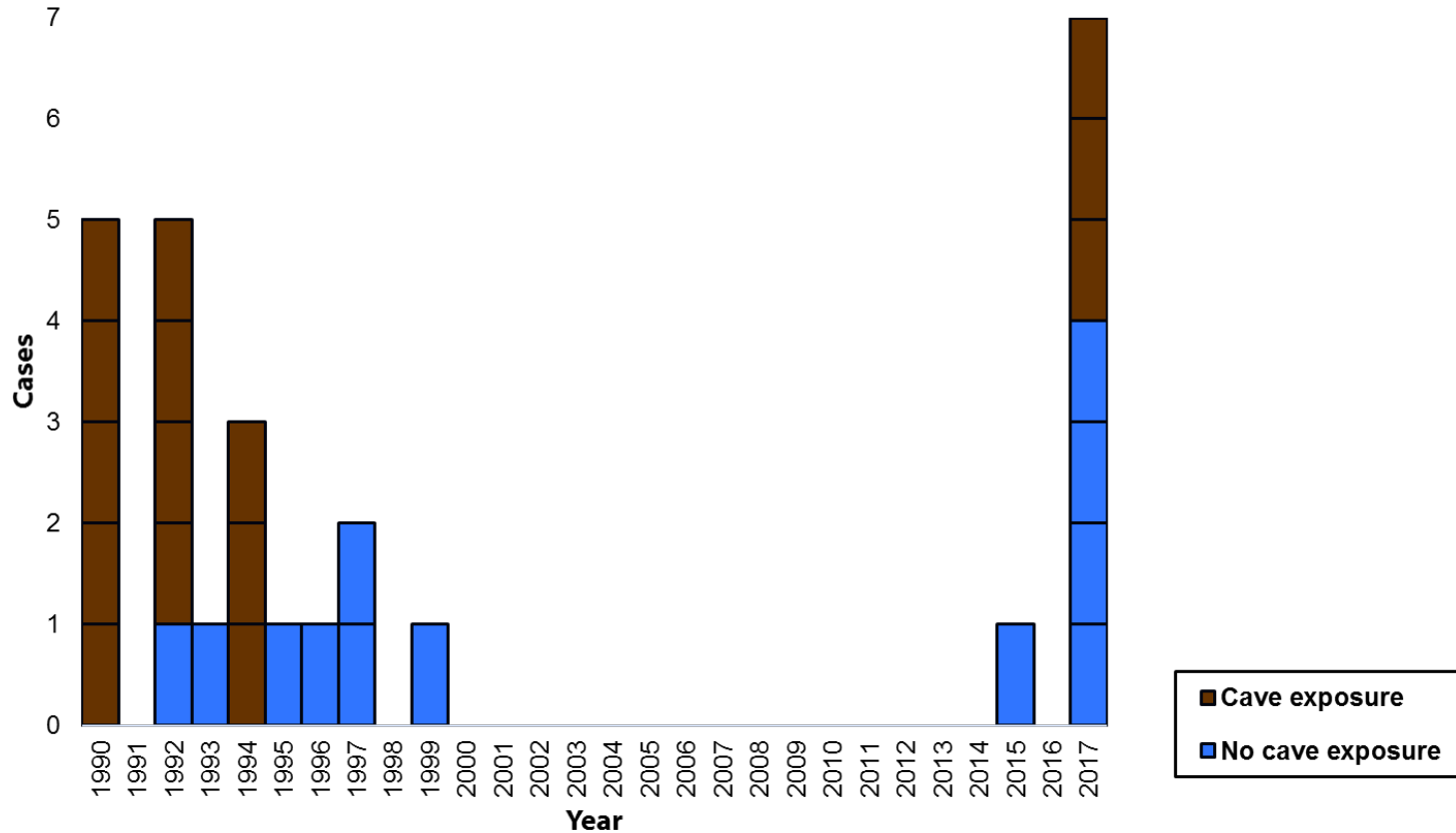
*One dot placed randomly within county of exposure where known; shading indicates states where TBRF was reportable

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TBRF cases in Texas (1990-2017)



2017 Texas cases of TBRF with known cave exposure

April, 2017

- **A student entered a cave and reported experiencing tick bites**
- **Develops febrile illness one week later**
- **Tested by CDC Division of Vector-Borne Diseases laboratory and positive for TBRF**

2017 Texas cases of TBRF with known cave exposure

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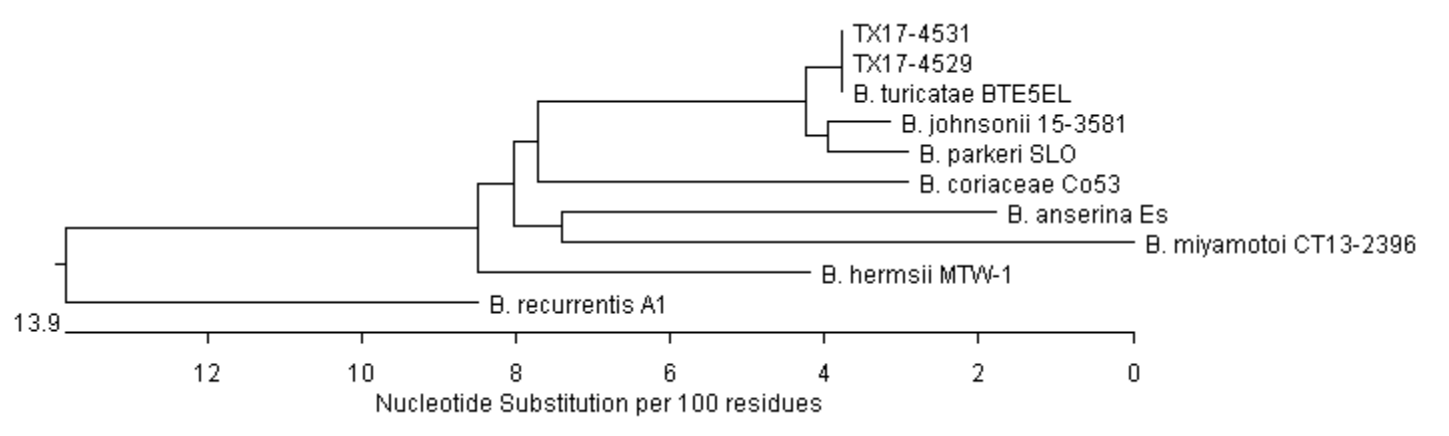
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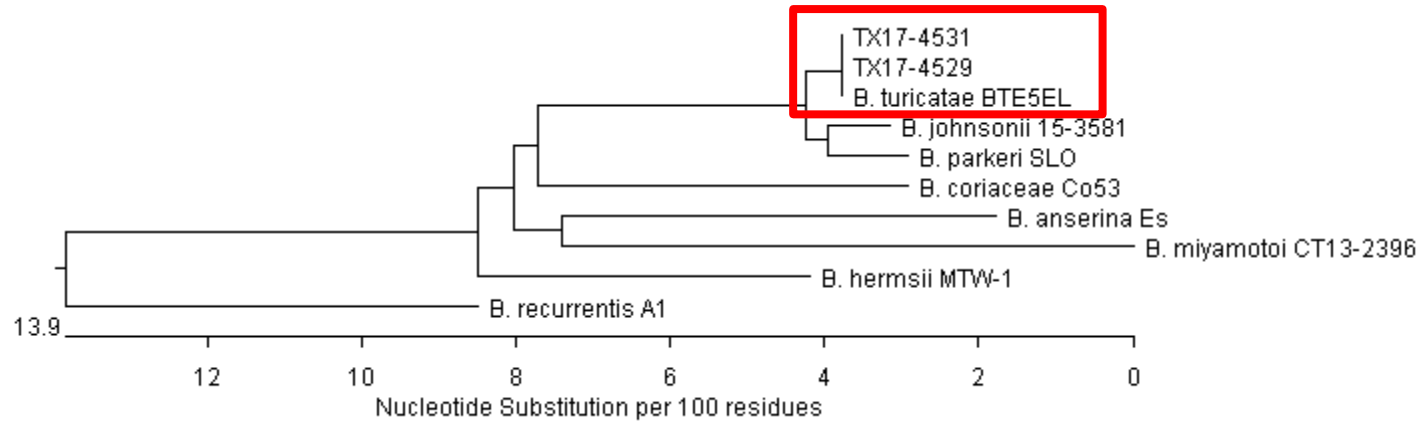
June-July, 2017

- Five people with occupational cave exposure in Central TX
- All have febrile illness one week later
- Three tested by CDC Division of Vector-Borne Diseases laboratory and two positive for TBRF

Genetic Analysis of Two Texas TBRF Cases



Genetic Analysis of Two Texas TBRF Cases



The Epi-Aid investigation



Objectives

- **Identify seropositivity and occurrence of illnesses consistent with TBRF among occupational cavers near Austin, Texas**
- **Define the clinical spectrum of illnesses**
- **Describe cave exposure and use of personal protective equipment**
- **Establish prevention strategies to mitigate risk**

Methods

- Enrolled consenting employees of organizations that employed at least one person who entered caves
- Interviews conducted, blood samples collected, tested for TBRF antibodies
- Exposure information and protective measures compared between seropositive and seronegative employees





Tick-Borne Relapsing Fever Among Workers with Cave Exposure October 2017



What is Relapsing Fever?

- Tick-Borne Relapsing Fever (TBRF) is caused by infection with a *Borrelia* bacteria species
- Transmission to humans occurs through *Ornithodoros spp.* tick bites (soft ticks)
- *Ornithodoros spp.* are commonly found in low elevations, dry habitats, and can inhabit rodent dwellings and caves (Figure 1)
- In Texas, *Ornithodoros spp.* are believed to transmit *Borrelia turicatae*
- Reports of TBRF in the Austin area are rare, with no cases during 2013-2016

Why is Austin Public Health and the CDC investigating?

- In the Spring of 2017, Austin Public Health was notified of multiple cavers who had developed concurrent febrile illnesses
- Blood samples were positive for *Borrelia turicatae*
- Austin Public Health and CDC believe that more workers might have been ill or are at risk for TBRF
- Austin Public Health and CDC are asking workers whose job includes going into caves in central Texas within the past 5 years to participate in the investigation
- Austin Public Health and CDC are also asking workers in environmental positions, whose job description does not include going into caves to participate in the investigation as a comparison group.

What medical tests will be offered?

- Participation is voluntary. You may answer some or all questions asked, and participate in some or all of the medical tests offered.

Questionnaire

- An Austin Public Health employee or CDC employee will administer a questionnaire to you. This will take about 20 minutes.

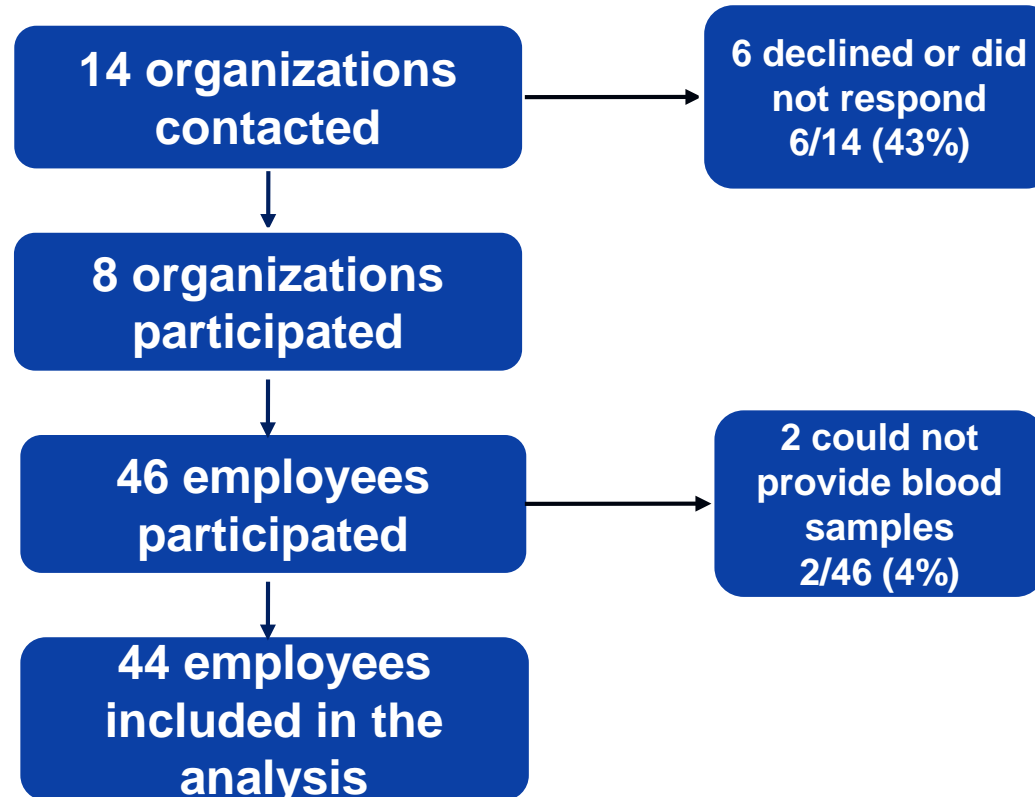
Blood Tests

- We will take a small blood sample (about 2 tsp) for TBRF serology. This test typically takes 5 minutes. No fasting or special instructions are required for the blood test.

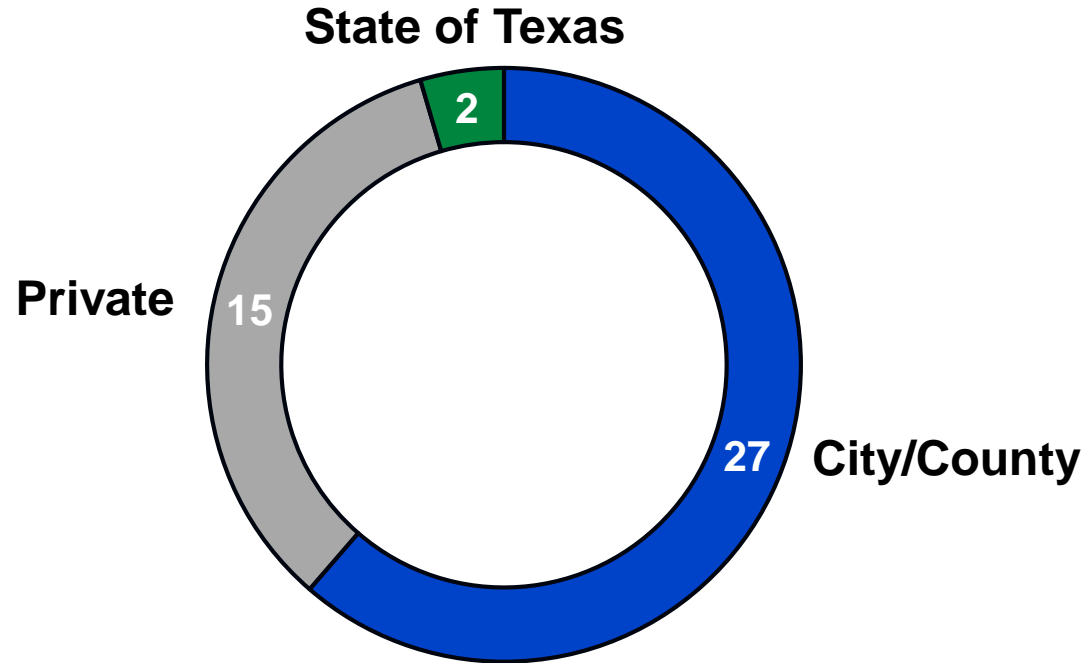
Are there any special instructions?

- The investigation is planned for October 9-13, 2017.
- It is free and voluntary.
- History of illness is not a requirement to take part in the investigation.
- The more people who take part in the investigation, the better Austin Public Health and CDC will understand the occupational risks of TBRF among workers with cave exposures.

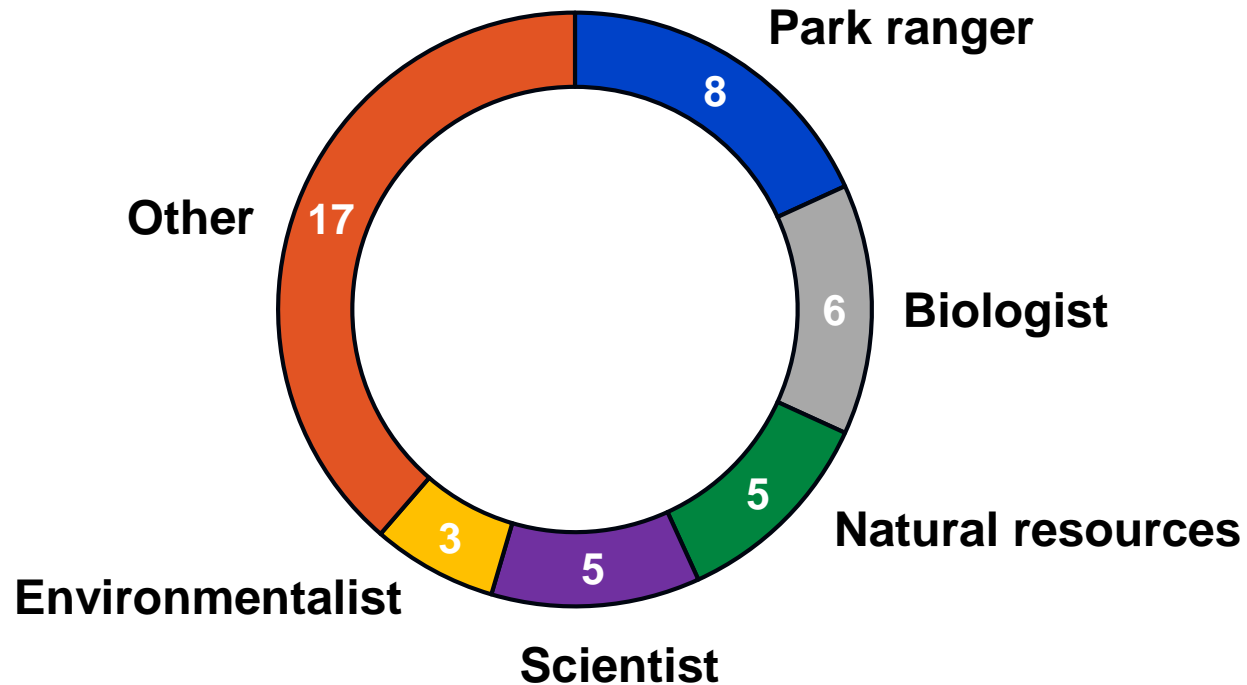
Organization and employee inclusion



Who do occupational cavers work for (N = 44)



What job titles do occupational covers have (N = 44)








Serology results and report of illness

Employees with seropositivity
5/44 (11%)








**Seropositive employees with compatible
clinical illness**
4/5 (80%)

Reported symptoms of seropositive employees

Symptoms	1 	2 	3 	4 	5 
Fever	X	X	X	X	
Chills	X	X	X	X	
Sweats	X	X	X	X	
Fatigue	X	X	X	X	
Loss of appetite	X	X	X	X	
Aching		X	X	X	
Confusion	X	X		X	
Hallucinations	X		X	X	
Headache	X	X		X	
Nausea	X		X	X	
Photophobia	X	X		X	
Paresthesia		X	X	X	
Vivid dreams	X		X	X	
Vomiting	X	X		X	

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Comparison of cave exposure among employees

Cave exposure	Seropositive (n=5)	Seronegative (n=39)	OR (95% CI)	P-value
Occupation	5 (100%)	37 (88%)	0.54 (0.02-13.75)	
Recreation	3 (60%)	15 (39%)	2.40 (0.36-16.08)	
Median number of caves entered in previous 12 months (range)	25 (5-41)	4 (0-50)		0.04

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Comparison of protective measures among employees

Protective measure	Seropositive (n=5)	Seronegative (n=39)	OR (95% CI)
Long pants	5 (100%)	34 (87%)	1.16 (0.09-41.19)
Long shirt	4 (80%)	28 (72%)	1.57 (0.13-84.33)
Boots	3 (60%)	30 (77%)	0.45 (0.04-6.30)
Permethrin	1 (20%)	3 (8%)	2.75 (0.23-33.16)
Repellents	1 (20%)	13 (33%)	0.50 (0.05-4.94)

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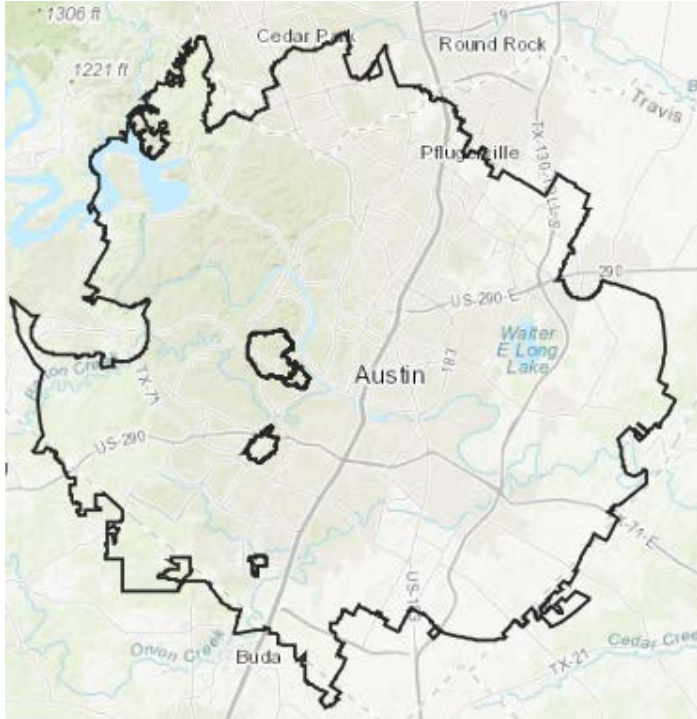
Employee reasons for not using permethrin/repellents

Primary reason for not using	Permethrin (n=37)	Repellents (n=22)
Does not work well	1 (3%)	1 (5%)
Harmful to cave ecosystem	17 (46%)	10 (46%)
Don't know what it is	3 (8%)	0
Don't want to	8 (22%)	5 (23%)
No risk of ticks	8 (22%)	6 (27%)

Permethrin/repellents not used to protect cave ecosystem

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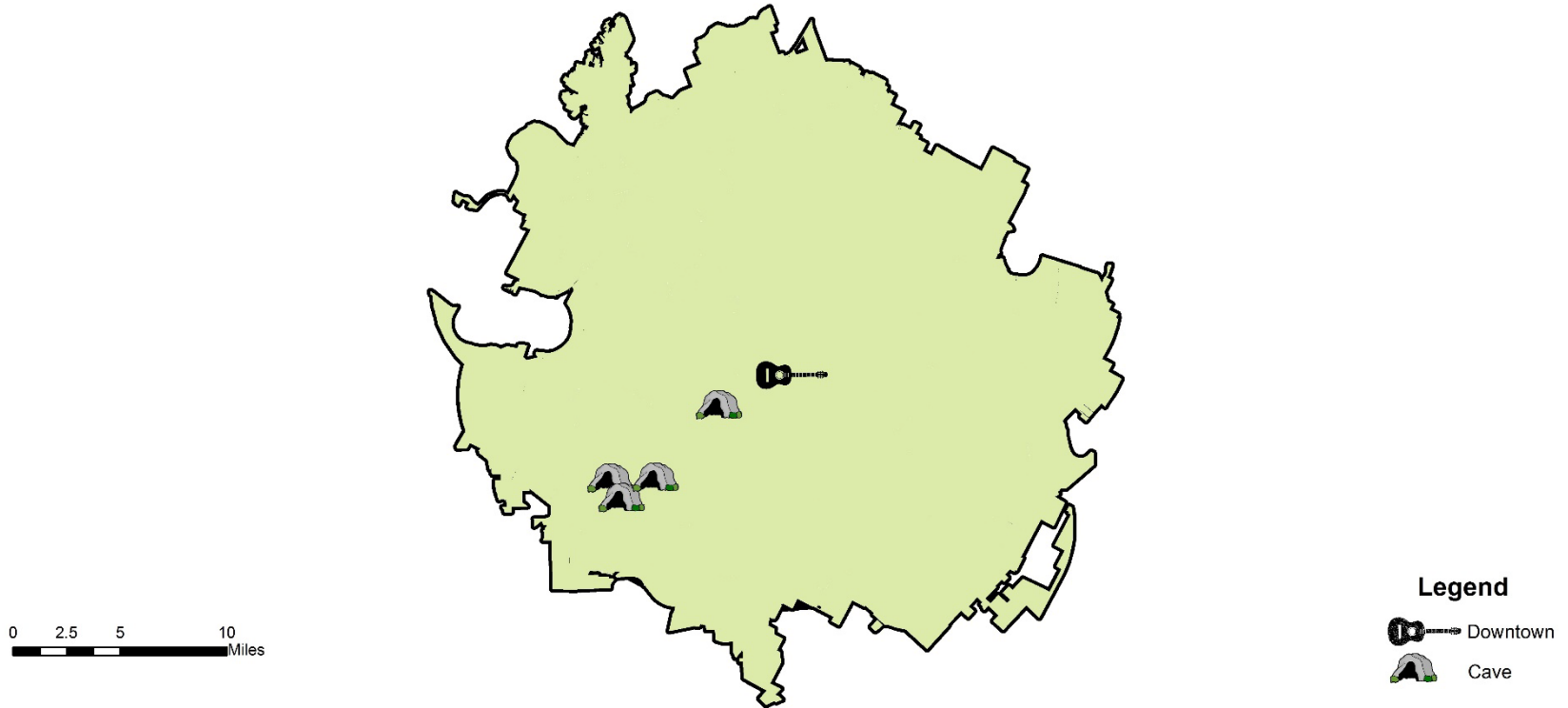
Austin city limits boundaries



Legend



Location of caves more frequently visited by seropositive employees within Austin city limits



At risk..



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Spelunking in Texas

TRAVEL TIPS

Nancy Wagner, Leaf Group Updated February 21, 2017



The state of Texas contains thousands of caves, including seven show caves open to the public and requiring no special equipment to view the natural wonders inside. Spelunking enthusiasts, however, might want to explore the state's numerous wild caves located on private land and rarely open to the public. Joining a club that offers field trips gives you the best opportunity to explore the state's wild caves.

Public health actions

Tick-borne Relapsing Fever in Texas: Key Information and Recommendations

Stefanie Campbell, DVM, MS, Epidemic Intelligence Service Officer, Centers for Disease Control and Prevention

Philip Huang, MD, MPH, Medical Director and Health Authority, Austin Public Health

Jeffery Taylor, MPH & Anna Klioneva, MPH, Austin Public Health

WHAT IS TBRF?

Tick-borne relapsing fever (TBRF) is a bacterial infection characterized by recurring episodes of fever and other nonspecific symptoms. The bacteria that cause TBRF are corkscrew-shaped spirochetes transmitted through the bite of an infected soft tick. In Texas, *Ornithodoros turicata* ticks transmit the bacteria *Borrelia turicatae*. In the western United States and mountainous regions, *Ornithodoros bermis* ticks transmit the bacteria *Borrelia bermis*^{1,2}.

WHAT ARE THE SYMPTOMS OF TBRF?

Symptoms usually resolve within 3-5 days (range 2-7 days) but may recur or "relapse" within 7 days (range 4-14 days). The relapse occurs due to antigenic variation of outer surface proteins on the spirochete bacteria during the course of the infection. Although these relapsing episodes can occur up to 10 times, typically patients have three or less episodes^{1,3}.

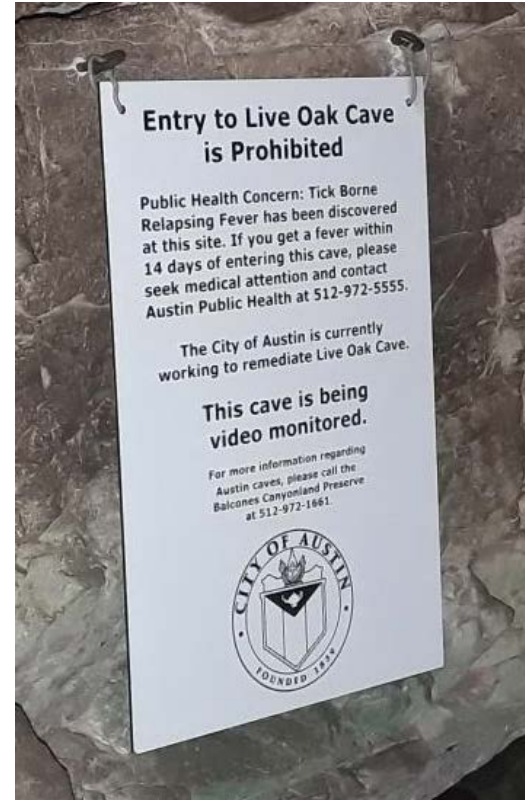
TBRF IN TEXAS

In 2017, Austin Public Health noticed an increase in reported cases of TBRF. In February, 11 people became ill after attending a

people become infected in dry habitats at low elevation, including in caves¹. In western states, people most often become infected while vacationing in cabins in rural, wooded, mountainous areas⁴.

DISTRIBUTION OF TBRF CASES IN THE UNITED STATES

In the United States, TBRF occurs most commonly in western states. There were 504 cases reported during 1990-2011, of which 20 occurred in Texas⁵.



Take aways

- Rare disease, likely underdiagnosed
- Described association of TBRF and cave exposure in Texas
- Advanced understanding of TBRF (*B. turicatae*) clinical picture
- Identified “risky” cluster of caves
- On the radar of health professionals/public health personnel

CDC Division of Vector-Borne Diseases

- Alison Hinckley
- Christina Nelson
- Kiersten Kugeler
- Natalie Kwit
- Marty Schriefer
- Adam Replogle
- Jeannine Petersen
- Becky Eisen
- Amy Schwartz
- Christopher Sexton

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

NIOSH

- Suzanne Tomasi
- Randall Nett

Austin Public Health

- Jeffery Taylor
- Anna Klioueva
- Cindy Jaso
- Betsy Kirkpatrick
- Sabine Berghammer

Texas Department of State Health Services

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Thank you!

“The cave floor was covered with three inches of dry, powdery sand, which was literally alive with ticks. A handful of sand yielding thirty or forty of different sizes.”

-Clinical Notes, Suggestions, and New Instruments, Burford Weller, Dec. 1939

