2021-2023
West Virginia
TICK
SURVEILLANCE REPORT

Office of Epidemiology and Prevention Services
350 Capitol Street, Room 125
Charleston, WV, 25301

West Virginia Department of HEALTH

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2021-2023 TICK SURVEILLANCE SUMMARY

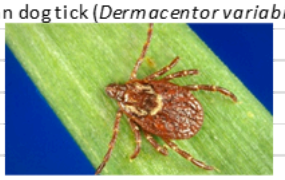
INTRODUCTION

Ticks are vectors for pathogens that cause disease in humans. Tickborne diseases are transmitted to humans through the bite of an infected tick, and many of these diseases are reportable in West Virginia, such as Lyme disease, anaplasmosis, babesiosis, Powassan virus disease, Heartland virus disease, Bourbon virus disease, ehrlichiosis, spotted fever group rickettsiosis, and tularemia.

In West Virginia, the West Virginia Tick Surveillance Program (WVTSP) was developed in 2011 to determine the distribution of the blacklegged tick (*Ixodes scapularis*) and the infection rate of human pathogens transmitted by this tick species throughout West Virginia. Surveillance objectives include 1) classifying population establishment, 2) estimating the human pathogen infection rate, 3) estimating the density of host-seeking nymphs and adults (infected and non-infected), and 4) documenting the host-seeking seasonal phenology of the *I. scapularis* throughout the state. Following the recent increase in spotted fever group rickettsiosis (SFGR) human cases in West Virginia, there has been increased efforts to document competent SFGR tick vectors (e.g. American dog tick (*Dermacentor variabilis*), lone star tick (*Amblyomma americanum*), Gulf Coast tick (*Amblyomma maculatum*) and invasive tick species (e.g., Asian longhorned tick, *Haemaphysalis longicornis*) detected through the network of animal health agencies, human public health partners, local veterinarians, and academic colleagues developed through the WVTSP.

Different tick vectors are found throughout West Virginia, as shown in Table 1.

Table 1. West Virginia ticks that can potentially carry pathogens causing tickborne diseases.[a]

Tick Vectors Present in WV	Pathogen(s)	Tickborne Diseasea
Blacklegged tick (*Ixodes scapularis*)[b] 	*Borrelia burgdorferi*	Lyme disease
	Borrelia mayoniic	
	Anaplasma phagocytophilum	Anaplasmosis
	Babesia microti and other *Babesia* spp.	Babesiosis
	Borrelia miyamotoi[c]	Tickborne Relapsing fever
	Powassan virus[c]	Powassan virus disease
	Ehrlichia muris eauclairensis[c]	Ehrlichiosis
Lone star tick (*Amblyomma americanum*) 	*Ehrlichia chaffeensis*	Ehrlichiosis
	Ehrlichia ewingii	Ehrlichiosis
	Franciscella tularensis	Tularemia
	Rickettsia rickettsii	Rocky Mountain spotted fever
	Heartland virus[c]	Heartland virus disease
	Bourbon virus[c]	Bourbon virus disease
American dog tick (*Dermacentor variabilis*) 	*Rickettsia rickettsii*	Rocky Mountain spotted fever
	Franciscella tularensis	Tularemia
Gulf Coast tick (*Amblyomma maculatum*) 	Panola Mountain *Ehrlichia* sp.[c]	Ehrlichiosis
	Rickettsia parkeri[c]	Spotted fever group rickettsiosis
Brown dog tick (*Rhipicephalus sanguineus*) 	*Rickettsia rickettsii*	Rocky Mountain spotted fever
Groundhog tick (*Ixodes cookei*) 	Powassan virus[c]	Powassan virus disease
Asian longhorned tick (*Haemaphysalis longicornis*) 	*Rickettsia rickettsii*	Rocky Mountain spotted fever
	Heartland virus[c]	Heartland virus disease
	Bourbon virus[c]	Bourbon virus disease

[a] Other tickborne diseases, including but not limited to Colorado tick fever, tick-borne encephalitis, and Crimean-Congo hemorrhagic fever, may result from travel to regions where these illnesses are endemic.

[b] *Ixodes scapularis* is also commonly referred to as the deer tick.

[c] Although circulating in neighboring states, this tickborne disease has not been detected in West Virginia.

METHODS

The WVTSP utilized both active and passive tick surveillance methods to detect and monitor ticks in the state. Passive tick surveillance consists of people submitting ticks found on themselves, their pets, or their property to the Office of Epidemiology and Prevention Services (OEPS) Zoonotic Disease Program. Although this method lacks geographic and temporal precision, it can be used to determine tick distribution, and human exposure in the environment. Active tick surveillance is the systematic field collection using dragging or flagging sampling, walking surveys, removal of ticks from hosts, or CO_2 trapping.

Standardized active tick surveillance methods and procedures were based on recent Center for Disease Control and Prevention (CDC) protocols (CDC, 2019; 2020). Ticks were collected using the tick drag method over a minimum of 750 m^2 area. In general, surveillance sites were selected based upon habitat suitability for *I. scapularis*, permission, and accessibility to conduct active tick surveillance on the property. In 2021, surveillance activities focused on southwestern West Virginia to determine if the very low Lyme disease incidence in this region of the state was caused by comparatively low *I. scapularis* tick densities. Tick surveillance activities focused on central West Virginia in 2022 due to the emergence of Lyme disease in this region of the state and the lack of tick species knowledge in central West Virginia. In 2023, tick surveillance activities focused on northeastern West Virginia due to the high Lyme disease incidence in this region of the state. With the assistance of the Monongalia County Health Department, active tick surveillance was conducted in 28 localities in 18 counties in 2021. In 2022, active tick surveillance was conducted in 20 localities in 16 counties. And with the assistance of three local health departments (Cabell-Huntington Health Department, Kanawha-Charleston Health Department, and Monongalia County Health Department) active tick surveillance was conducted in 43 localities in 22 counties in 2023. For anonymity, the address of the collecting locality is not shown; however, each collecting locality is identified by the county and the closest populated place (ex. unincorporated community, town, city). Each year, *Ixodes scapularis* nymphs actively collected from surveillance sites were submitted to CDC for Lyme disease (*Borrelia burgdorferi*, *Borrelia mayonii*), hard tick relapsing fever (*Borrelia miyamotoi*), human anaplasmosis (*Anaplasma phagocytophilum*), and human babesiosis (*Babesia microti*) testing. Starting in 2022, CDC also tested *I. scapularis* nymphs for ehrlichiosis (*Ehrlichia muris eauclairensis*), *Anaplasma phagocytophilum* (human active variant), and *Anaplasma phagocytophilum* (non-human variant). The human active variant of *A. phagocytophilum* causes illness in humans while other variants do not cause illness in humans. To reduce uncertainty in infection rate estimates attributable to small sample size, only sites with $\geq$25 *I. scapularis* nymphs collected were tested for human pathogens (CDC, 2019). The nymphal stage of *I. scapularis* was selected to be monitored because the nymphal stage is the primary stage responsible for transmitting Lyme disease to humans. Most Lyme disease cases occur in the late spring and early summer months when *I. scapularis* tick nymphs are most active (Falco *et al*., 1999) and tick nymphs are smaller than adults and more difficult to detect, potentially leading to longer duration of feeding that is more likely to result in Lyme disease infection (Eisen, 2018; Nadelman *et al*., 2001).

Ticks were also collected from incidental, passive encounters of ticks on human and animal hosts. Through the West Virginia Veterinary Tick Submission Project (WVVTSP), veterinarians from clinics across the state (and one in Pennsylvania) submit ticks found on their animal clients to the OEPS Zoonotic Disease Program. For each submission from a veterinarian, a form that contains animal host species, host residence county, date of collection, tickborne disease testing, travel history of host, and tick prevention is included. Tick species identification for ticks collected from animal patients submitted through the WVVTSP were provided to the veterinarian submitting the tick specimen. Healthcare providers and the general public also submitted ticks for tick species identification. The submitter provides the dead tick specimen and information on the collection locality, collection date, and their contact information to their local health department. The local health department forwards the tick specimen to the state public health entomologist. The state public health entomologist provides tick species identification and a list of pathogens the tick species could transmit to the submitter. Ticks were also recovered sporadically from animals submitted to the West Virginia Office of Laboratory Services (WVOLS) for rabies testing. Unlike the blacklegged tick nymphs collected through active surveillance, ticks collected passively through WVVTSP, healthcare providers, general public, or rabies animal submissions were not tested for human pathogens. One reason blacklegged ticks were tested for human pathogens was to determine prevalence of human pathogens from a locality. Since blacklegged ticks can remain attached to their host for seven to 10 days, it is not entirely known where the host could have acquired the blacklegged tick. In addition, it can be difficult to detect *Bo. burgdorferi* bacteria from a blood-engorged blacklegged tick recovered from an animal host.

Passive and active tick surveillance results, including surveillance information from metastriate ticks (non-*Ixodes* tick species) were electronically submitted to CDC through ArboNET. ArboNET is the national arboviral surveillance system managed by the CDC and state health departments. ArboNET originally only maintained data on arboviral infections among humans, presumptive blood donors, veterinary disease cases, mosquitoes, dead birds, and sentinel animals. However, starting in 2018, ArboNET served as a national electronic depository for tick surveillance information.

RESULTS

Tick Surveillance 2021

In 2021, 7,410 ticks were collected through both active and passive tick surveillance. Among the 278 blacklegged tick nymphs tested for human pathogens by the CDC, 35 were infected with *Bo. burgdorferi* (12.59%) and four were infected with *A. phagocytophilum* (undifferentiated) (1.44%). None of the 278 blacklegged tick nymphs were infected with *Bo. mayonii*, *Bo. miyamotoi*, or *Ba. microti*.

Passive Tick Surveillance (including WVVTSP) (2021)

The most common and widely distributed ticks in West Virginia through passive surveillance were blacklegged ticks and American dog ticks (Table 2). Asian longhorned ticks were never recovered from a human host.

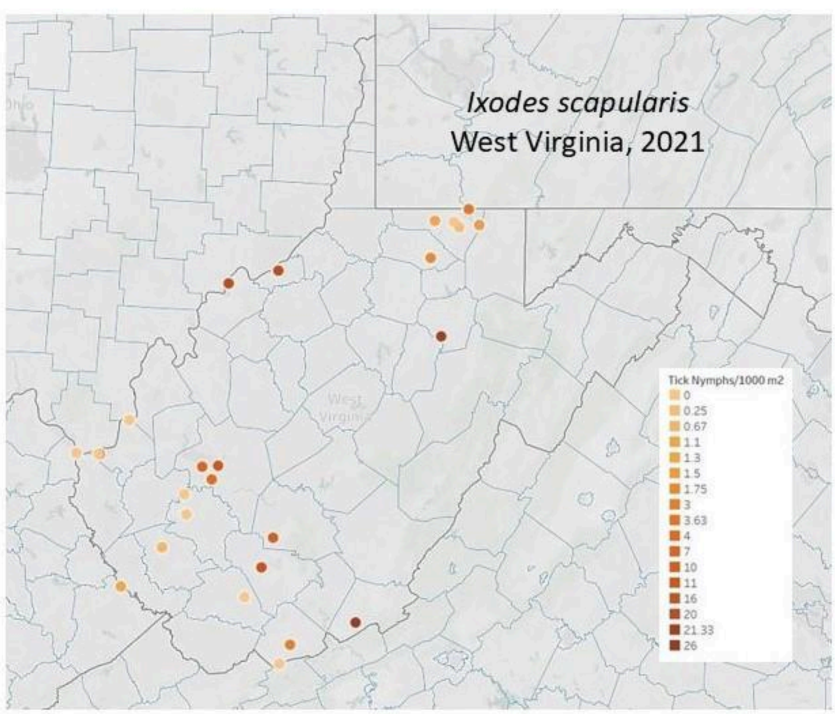
Table 2. Data from passive tick surveillance activities (WVVTSP, health care facility submissions, citizen submissions, and animal carcass retrieval).

Tick Species (2021)	# of Ticks Identified	Animal Species From Which Tick Was Removed	# of Counties With Tick Species
Lone star tick	30	Cat, Dog, Human	5
Gulf Coast tick	1	Dog	1
American dog tick	195	Cat, Dog, Human, Raccoon	20
Asian longhorned tick	61	Cat, Dog	9
Groundhog tick	1	Raccoon	1
Blacklegged tick	327	Cat, Dog, Human	26
Total	**615**		

Active Tick Surveillance (2021)

Blacklegged ticks were collected throughout West Virginia. The localities with the highest blacklegged tick nymph densities were in counties in northern (Barbour, Pleasants, Wood), central (Kanawha), and southeastern (Fayette, Monroe, Raleigh) West Virginia (Fig. 1). Blacklegged tick nymphs were detected in 18 of the 26 localities surveyed from May through July, when the nymphal stage is active. Five of the eight surveillance sites with no record of blacklegged tick nymphs were in southwestern West Virginia.

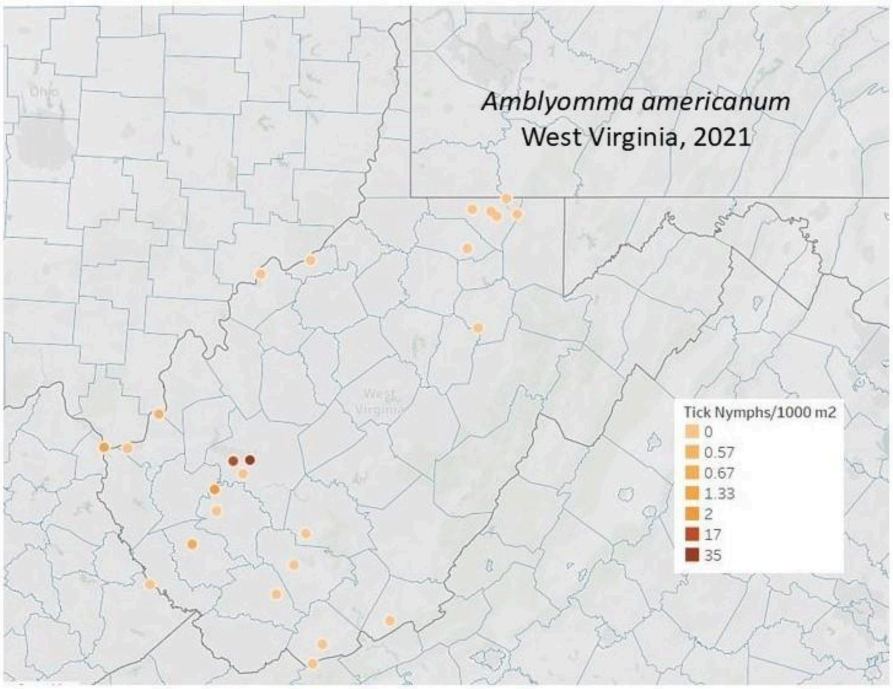
Fig. 1. Blacklegged tick (*Ixodes scapularis*) nymph maximum density in West Virginia, 2021. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	Tick Nymphs / 1000 m2 (Highest Value)
Barbour	Bellington	21.33
Boone	Julian	0.00
Boone	Madison	0.00
Cabell	Glenwood	0.00
Cabell	Huntington	0.00
Cabell	Huntington	4.00
Fayette	Pax	10.00
Kanawha	Charleston	4.00
Kanawha	Charleston	11.00
Kanawha	South Charleston	7.00
Logan	Logan	0.67
Marion	Fairmont	1.75
Mercer	Bluefield	0.00
Mercer	Princeton	3.00
Mingo	Williamson	1.30
Monongalia	Cheat Lake	3.63
Monongalia	Core	1.10
Monongalia	Morgantown	0.00
Monongalia	Morgantown	0.25
Monroe	Greenville	26.00
Pleasants	St. Marys	20.00
Preston	Psigah	1.50
Raleigh	Glen Daniel	16.00
Wayne	Kenova	0.00
Wood	Vienna	20.00
Wyoming	Mullens	0.00

Conversely, lone star ticks were predominantly confined to southwestern West Virginia. The localities with the highest lone star tick nymph densities were in Kanawha County (Fig. 2). Lone star tick nymphs were also active in Boone, Cabell, Logan, and Wayne counties in southwestern West Virginia.

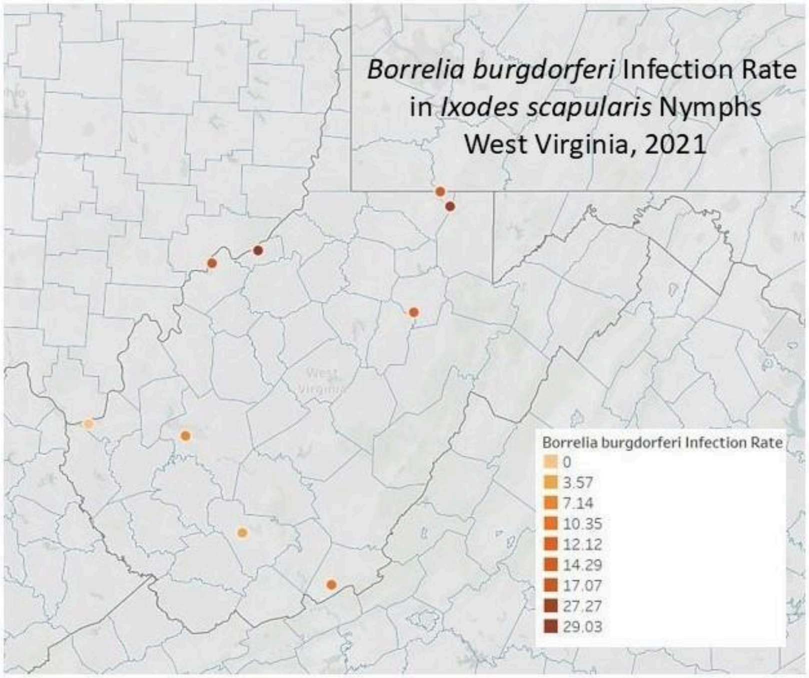
Fig. 2: Lone star tick (*Amblyomma americanum*) maximum nymph density in West Virginia, 2021. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	Tick Nymphs / 1000 m2 (Highest Value)
Barbour	Bellington	0.00
Boone	Julian	2.00
Boone	Madison	0.00
Cabell	Glenwood	0.57
Cabell	Huntington	1.33
Cabell	Huntington	0.00
Fayette	Pax	0.00
Kanawha	Charleston	35.00
Kanawha	Charleston	0.00
Kanawha	South Charleston	17.00
Logan	Logan	0.67
Marion	Fairmont	0.00
Mercer	Bluefield	0.00
Mercer	Princeton	0.00
Mingo	Williamson	0.00
Monongalia	Cheat Lake	0.00
Monongalia	Core	0.00
Monongalia	Morgantown	0.00
Monongalia	Morgantown	0.00
Monroe	Greenville	0.00
Pleasants	St. Marys	0.00
Preston	Psigah	0.00
Raleigh	Glen Daniel	0.00
Wayne	Kenova	1.33
Wood	Vienna	0.00
Wyoming	Mullens	0.00

At almost every surveillance site in the state where ticks were tested for human pathogens, blacklegged tick nymphs were infected with *Borrelia burgdorferi*, the pathogen responsible for Lyme disease (Fig. 3). Blacklegged tick nymphs were carrying *Bo. burgdorferi* in counties in northern (Barbour, Monongalia, Preston, Wood, Pleasants), central (Kanawha), and southeastern (Raleigh, Monroe) West Virginia. The surveillance site in Cabell County in southwestern West Virginia was the only locality where blacklegged tick nymphs were not infected with *Bo. burgdorferi*. Blacklegged tick nymphs from counties in northern West Virginia (Pleasants, Preston, Wood, Barbour) had the highest *Bo. burgdorferi* infection rates. *Anaplasma phagocytophilum* (undifferentiated) was detected in blacklegged tick nymphs from Marion (8.33%), Raleigh (3.57%), Barbour (3.03%), and Monongalia (2.04%) counties (not shown). None of the tick nymphs were infected with *Bo. mayonii*, *Bo. miyamotoi*, or *Ba. microti* (not shown).

Fig. 3: Lyme disease (*Borrelia burgdorferi*) infection rate in blacklegged tick (*Ixodes scapularis*) nymphs, West Virginia, 2021. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	*Borrelia burgdorferi* Infection Rate
Barbour	Bellington	12.12
Cabell	Huntington	0.00*
Kanawha	South Charleston	7.14
Monongalia	Cheat Lake	14.29
Monroe	Greenville	10.35
Pleasants	St. Marys	29.03
Preston	Psigah	27.27*
Raleigh	Glen Daniel	3.57
Wood	Vienna	17.07

*Less than recommended 25 tick nymphs tested from surveillance site

Tick Surveillance 2022

In 2022, 3,714 ticks were collected through both active and passive tick surveillance. Among the 164 blacklegged tick nymphs tested for human pathogens, 24 were infected with *Bo. burgdorferi* (17.14%) and two were infected with *A. phagocytophilum* (non-human variant) (1.44%).

Passive Tick Surveillance (including WVVTSP) (2022)

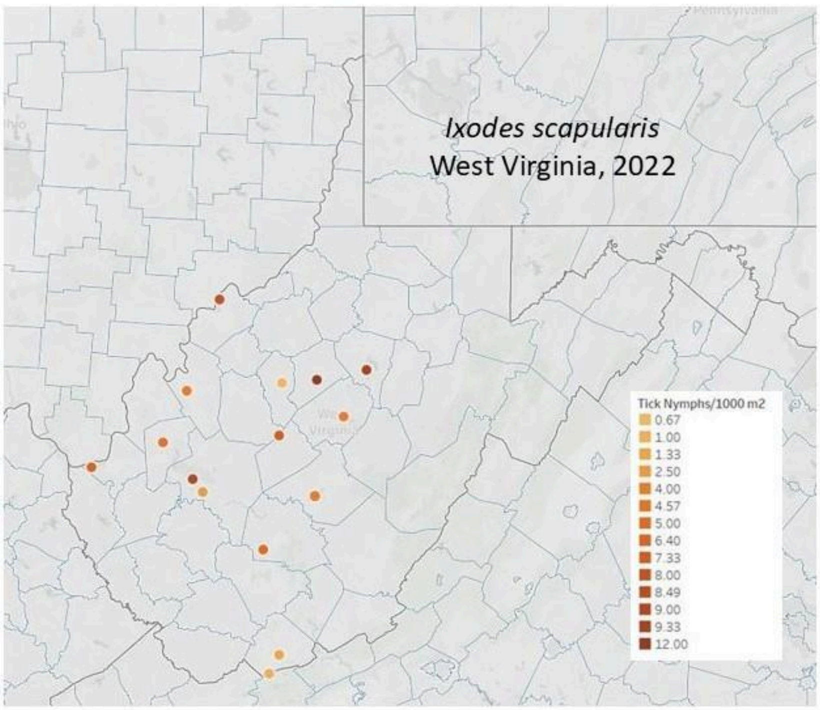
Through passive surveillance, the most common and widely distributed ticks in West Virginia were Asian longhorned ticks, blacklegged ticks, and American dog ticks (Table 3). The Asian longhorned tick was never recovered from a human host.

Table 3. Data from passive tick surveillance activities (WVVTSP, health care facility submissions, citizen submissions, and animal carcass retrieval).

Tick Species (2022)	# of Ticks Identified	Animal Species From Which Tick Was Removed	# of Counties With Tick Species
Lone star tick	26	Cat, Dog, Human	5
American dog tick	97	Cat, Dog, Human, Raccoon	20
Asian longhorned tick	446	Cat, Dog	9
Groundhog tick	7	Cat, Fox, Raccoon	3
Blacklegged tick	132	Cat, Dog, Fox, Human	18
Ixodes spp.	2	Cat, Dog	2
Total	**710**		

Active Tick Surveillance (2022)
Blacklegged ticks were active throughout West Virginia. Blacklegged tick nymphs were detected in all 16 of the 16 localities surveyed from May through July, when the nymphal stage is active (Fig. 4).

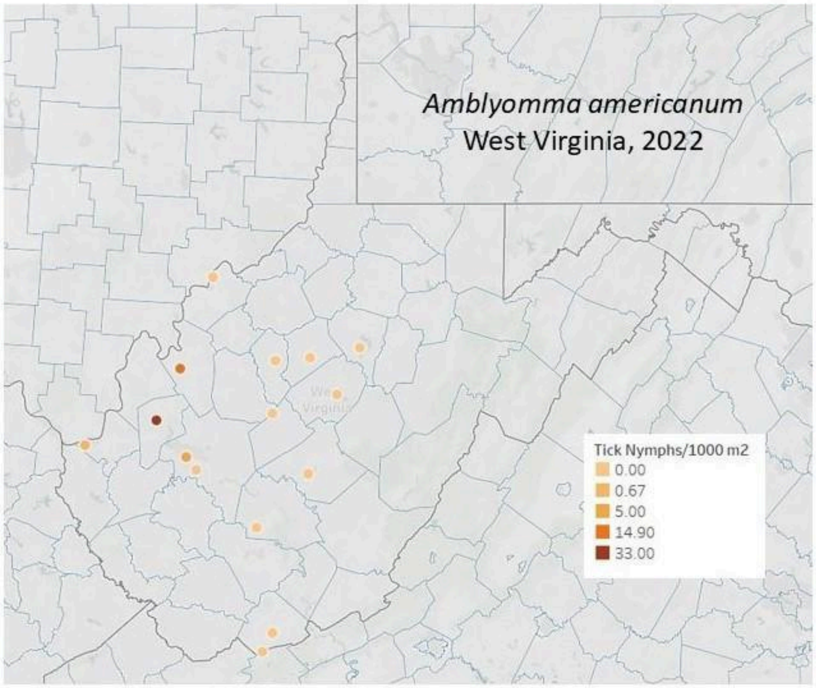
Fig. 4. Blacklegged tick (*Ixodes scapularis*) nymph maximum density in West Virginia, 2022. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	Tick Nymphs / 1000 m2 (Highest Value)
Braxton	Sutton	4.00
Cabell	Huntington	6.40
Calhoun	Grantville	0.67
Fayette	Pax	5.00
Gilmer	Glenville	12.00
Jackson	Evans	4.00
Kanawha	Charleston	2.50
Kanawha	South Charleston	9.00
Lewis	Roanoke	9.33
Mercer	Bluefield	1.00
Mercer	Princeton	1.33
Nicholas	Summersville	8.49
Nicholas	Summersville	4.00
Putnam	Eleanor	5.47
Roane	Wallback	7.33
Wood	Vienna	8.00

Conversely, lone star ticks were predominantly confined to southwestern West Virginia. The localities with the highest lone star tick nymph densities were in Putnam and Jackson counties (Fig. 5). Lone star tick nymphs were also active in nearby Cabell and Kanawha counties.

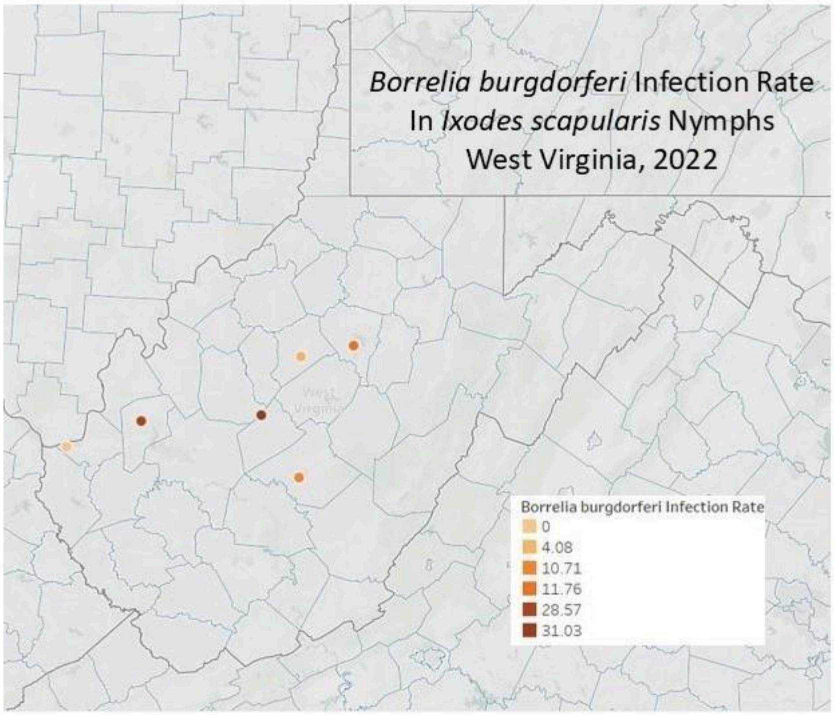
Fig. 5: Lone star tick (*Amblyomma americanum*) maximum nymph density in West Virginia, 2022. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	Tick Nymphs / 1000 m2 (Highest Value)
Braxton	Sutton	0.00
Cabell	Huntington	0.67
Calhoun	Grantville	0.00
Fayette	Pax	0.00
Gilmer	Glenville	0.00
Jackson	Evans	14.90
Kanawha	Charleston	0.00
Kanawha	South Charleston	5.00
Lewis	Roanoke	0.00
Mercer	Bluefield	0.00
Mercer	Princeton	0.00
Nicholas	Summersville	0.00
Nicholas	Summersville	0.00
Putnam	Eleanor	33.00
Roane	Wallback	0.00
Wood	Vienna	0.00

At almost every surveillance site in the state where ticks were tested for human pathogens, blacklegged tick nymphs were infected with *Bo. burgdorferi*, the pathogen responsible for Lyme disease (Fig. 6). Blacklegged tick nymphs were carrying *Bo. burgdorferi* in Gilmer, Lewis, Roane, Putnam, and Nicholas counties. The surveillance site in Cabell County in southwestern West Virginia was the only locality where blacklegged ticks were not infected with *Bo. burgdorferi*. Blacklegged tick nymphs from Roane and Putnam counties had the highest *Bo. burgdorferi* infection rates. Unlike *Bo. burgdorferi*, *Anaplasma phagocytophilum* (non-human variant) was only detected at a single surveillance site. Two of 29 (6.90%) blacklegged tick nymphs from Roane County were infected with *A. phagocytophilum* (non-human variant). None of the tick nymphs were infected with *A. phagocytophilum* (human variant), *Bo. mayonii*, *Bo. miyamotoi*, *Ba. microti, or E. muris eauclairensis* (not shown).

Fig. 6: Lyme disease (*Borrelia burgdorferi*) infection rate in blacklegged tick (*Ixodes scapularis*) nymphs, West Virginia, 2022. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	*Borrelia burgdorferi* Infection Rate
Cabell	Huntington	0.00*
Gilmer	Glenville	4.08
Lewis	Roanoke	11.76
Nicholas	Summersville	10.71
Putnam	Eleanor	28.57
Roane	Wallback Lake	31.03

*Less than recommended 25 tick nymphs tested from surveillance site

Tick Surveillance 2023

In 2023, 6,636 ticks were collected through both active and passive tick surveillance. Among the 301 blacklegged tick nymphs tested for human pathogens, 40 were infected with *Bo. burgdorferi* (13.29%), nine were infected with *A. phagocytophilum* (non-human variant) (2.99%) and one was infected with *Bo. miyamotoi* (0.33%). None of the 301 blacklegged tick nymphs were infected with *A. phagocytophilum* (human variant), *Bo. mayonii*, *Ba. microti*, or *E. muris eauclairensis*.

Passive Tick Surveillance (including WVVTSP) (2023)

The most common and widely distributed ticks in West Virginia through passive surveillance were Asian longhorned ticks, blacklegged ticks, and American dog ticks (Table 4). The Asian longhorned tick was never recovered from a human host.

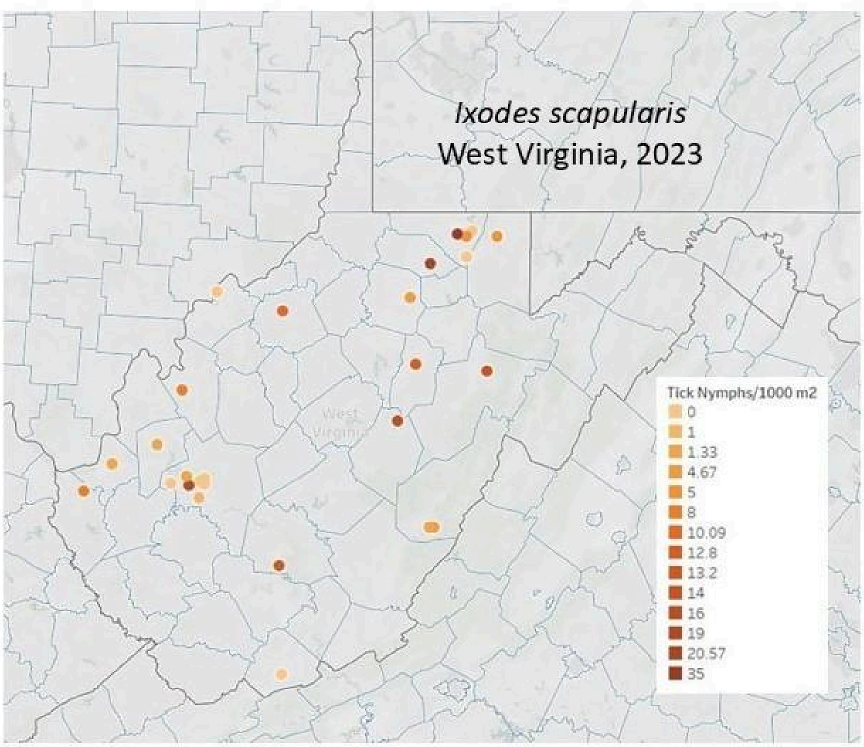
Table 4. Data from passive tick surveillance activities (WVVTSP, health care facility submissions, citizen submissions, and animal carcass retrieval).

Tick Species (2023)	# of Ticks Identified	Animal Species From Which Tick Was Removed	# of Counties With Tick Species
Lone star tick	15	Dog, Human	2
American dog tick	67	Cat, Dog, Human, Raccoon	11
Asian longhorned tick	89	Cat, Dog, Horse	4
Groundhog tick	2	Raccoon	1
Blacklegged tick	68	Cat, Dog, Human	14
Ixodes spp.	1	Dog	1
Total	**242**		

Active Tick Surveillance (2023)

Blacklegged ticks were active throughout West Virginia. The localities with the highest blacklegged tick nymph densities were in counties in northern (Monongalia, Marion, Ritchie, Upshur, Randolph, Webster), central (Kanawha), and southeastern (Fayette) West Virginia (Fig. 7). Blacklegged tick nymphs were detected in 20 of the 29 localities surveyed from May through July, when the nymphal stage is active. Blacklegged tick nymphs were not detected in four sites in Monongalia County, three sites in Kanawha County, and one site in Wood County.

Fig. 7. Blacklegged tick (*Ixodes scapularis*) nymph maximum density in West Virginia, 2023. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.

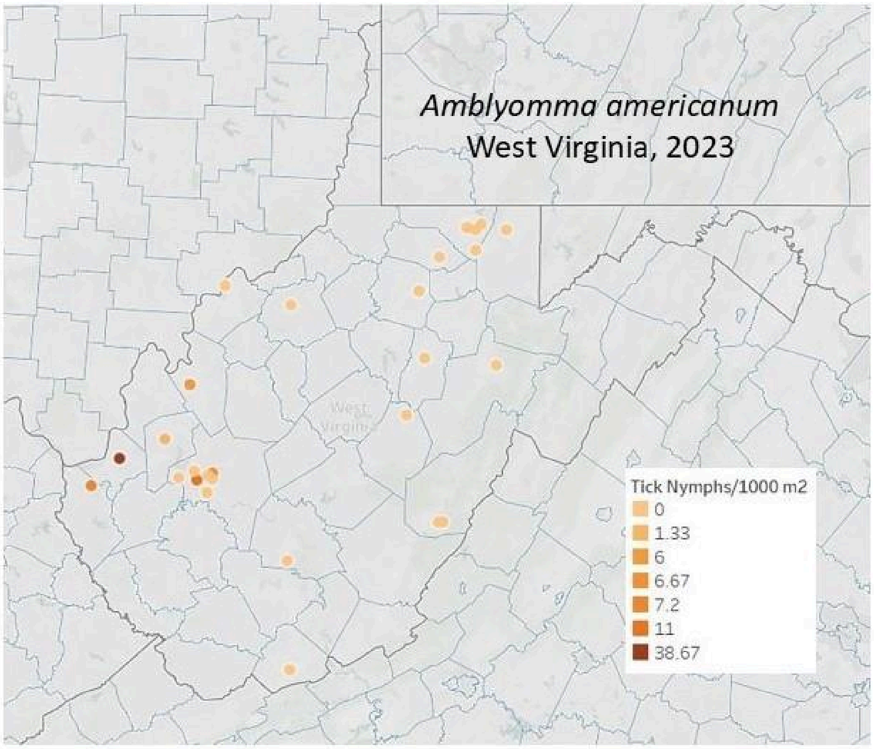


County	Populated Place	Tick Nymphs / 1000 m2 (Highest Value)
Cabell	Ona	1.33
Fayette	Glen Jean	13.20
Harrison	Bridgeport	4.67
Jackson	Evans	8.00
Kanawha	Charleston	1.00
Kanawha	Charleston	0.00
Kanawha	Charleston	0.00
Kanawha	Charleston	0.00
Kanawha	Dunbar	1.33
Kanawha	South Charleston	19.00
Kanawha	St. Albans	0.00
Marion	Fairmont	20.57
Mercer	Princeton	0.00
Monongalia	Morgantown	35.00*
Monongalia	Morgantown	5.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Pocahontas	Seebert	4.67
Pocahontas	Seebert	1.33
Preston	Bruceton Mills	5.00*
Putnam	Eleanor	1.33
Randolph	Elkins	14.00
Ritchie	Cairo	10.09
Upshur	Buchannon	12.80
Wayne	Lavalette	8.00
Webster	Hacker Valley	16.00
Wood	Vienna	0.00

*Tick nymph density based upon sample collected at <750 m2

Conversely, lone star ticks were predominantly confined to southwestern West Virginia. The localities with the highest lone star tick nymph densities were in Cabell and Kanawha counties (Fig. 8). Lone star tick nymphs were also active in nearby Jackson, Putnam, and Wayne counties in southwestern West Virginia.

Fig. 8: Lone star tick (*Amblyomma americanum*) maximum nymph density in West Virginia, 2023. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.

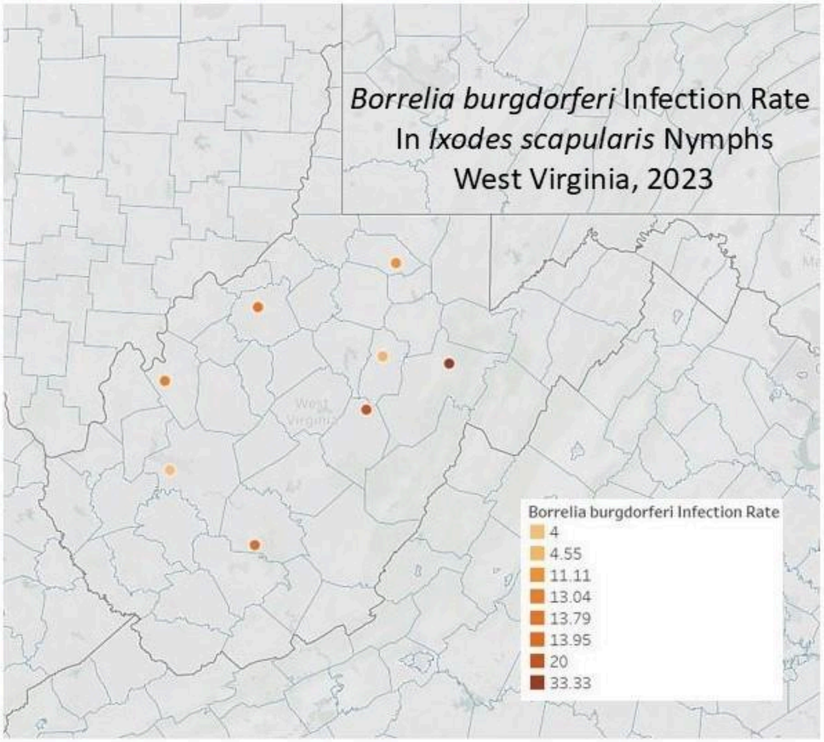


County	Populated Place	Tick Nymphs / 1000 m2 (Highest Value)
Cabell	Ona	38.67
Fayette	Glen Jean	0.00
Harrison	Bridgeport	0.00
Jackson	Evans	6.00
Kanawha	Charleston	6.67
Kanawha	Charleston	0.00
Kanawha	Charleston	0.00
Kanawha	Charleston	0.00
Kanawha	Dunbar	0.00
Kanawha	South Charleston	11.00
Kanawha	St. Albans	0.00
Marion	Fairmont	0.00
Mercer	Princeton	0.00
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Monongalia	Morgantown	0.00*
Pocahontas	Seebert	0.00
Pocahontas	Seebert	0.00
Preston	Bruceton Mills	0.00*
Putnam	Eleanor	1.33
Randolph	Elkins	0.00
Ritchie	Cairo	0.00
Upshur	Buchannon	0.00
Wayne	Lavalette	7.20
Webster	Hacker Valley	0.00
Wood	Vienna	0.00

*Tick nymph density based upon sample collected at <750 m2

Blacklegged tick nymphs were infected with *Bo. burgdorferi*, the pathogen responsible for Lyme disease, at every surveillance site (Fig. 9). Blacklegged tick nymphs were carrying *Bo. burgdorferi* in counties in northern (Marion, Ritchie, Upshur, Randolph, Webster), central (Kanawha), southeastern (Fayette), and southwestern (Jackson) West Virginia. Blacklegged tick nymphs from counties in northeastern West Virginia (Randolph, Webster) had the highest *Bo. burgdorferi* infection rates. Ticks from counties in northern (Marion, Ritchie), southeastern (Fayette), and southwestern (Jackson) West Virginia also had moderate infection rates with *Bo. burgdorferi* (10-19.99%). *Anaplasma phagocytophilum* (non-human variant) was detected in blacklegged tick nymphs from Fayette (9.30%), Marion (5.56%), Jackson (4.35%), Randolph (3.70%), and Kanawha (2.00%) counties (not shown). A single tick from Ritchie County was infected with *Bo. miyamotoi*, resulting in a 3.45% infection rate with *Bo. miyamotoi* (not shown). None of the tick nymphs were infected with *A. phagocytophilum* (human variant), *Bo. mayonii*, *Ba. microti*, or *E. muris eauclairensis* (not shown).

Fig. 9: Lyme disease (*Borrelia burgdorferi*) infection rate in blacklegged tick (*Ixodes scapularis*) nymphs, West Virginia, 2023. The county and the closest populated place (ex. unincorporated community, town, city) are identified for each collecting locality.



County	Populated Place	*Borrelia burgdorferi* Infection Rate
Fayette	Glen Jean	13.95
Jackson	Evans	13.04*
Kanawha	South Charleston	4.00
Marion	Fairmont	11.11
Randolph	Elkins	33.33
Ritchie	Cairo	13.79
Upshur	Buchannon	4.55
Webster	Hacker Valley	20.00

*Less than recommended 24 tick nymphs tested from surveillance site

DISCUSSION

West Virginia has been on the emerging front for two tick species. The northern populations of the blacklegged tick from the northeastern United States have been establishing in northern and eastern West Virginia (Dotseth, Lewis, & Abshire, 2020; Dotseth *et al.,* 2021; Eisen & Eisen, 2023). Meanwhile, lone star tick populations from the southern United States have been recolonizing northern states including southwestern West Virginia (Dotseth, Lewis, & Abshire, 2020; Dotseth *et al*., 2021; Rochlin, Egizi, & Lindström, 2022). From 2021-2023, blacklegged tick nymph densities have consistently increased at the same tick surveillance sites monitored each year in South Charleston in Kanawha County, Huntington in Cabell County, and Evans in Jackson County in southwestern West Virginia; therefore, southwestern West Virginia may be an emerging front for blacklegged ticks. Conversely, the tick surveillance sites in Vienna in Wood County and Princeton in Mercer County had a decrease in blacklegged tick nymph densities from 2021-2023. From 2021-2023, densities of lone star tick nymphs have decreased at the same tick surveillance sites monitored each year in Huntington in Cabell County, Eleanor in Putnam County, and Evans in Jackson County in southwestern West Virginia.

The geographic distribution of Lyme disease cases in humans mirrored the geographic distribution of its tick vector, the blacklegged tick. Like its tick vector, Lyme disease cases were dispersed across the state (Dailey, Abshire, & Dotseth, 2023) in 2021. The tick surveillance site in Pleasants County, a high Lyme incidence county, had both a high blacklegged tick nymph density (>20 nymphs per 1000 m^2) and high *Bo. burgdorferi* infection rate ($\geq$20%) in 2021. Although the blacklegged tick nymph density was low (1-9.99 nymphs per 1000 m^2) in surveyed localities in high Lyme disease burden counties, like Monongalia and Preston counties in northern West Virginia, the *Bo. burgdorferi* infection rate in the ticks in Preston County was high and moderate

(10-19.99%) in Monongalia County. In other high Lyme disease incidence counties, like Barbour and Monroe counties, the blacklegged tick nymph densities were high at tick surveillance sites, but the *Bo. burgdorferi* infection rates were moderate (10-19.99%). Meanwhile, there were counties like Wayne, Boone, and Wyoming counties in southwestern West Virginia with both low Lyme disease incidence and an absence of blacklegged tick nymphs at the tick surveillance sites. Logan and Cabell counties in southwestern West Virginia also had low Lyme disease incidence and localities with very low densities of blacklegged tick nymphs (<1 nymph per 1000 m^2).

The tick surveillance sites from the low to moderate Lyme disease incidence counties in central West Virginia also had low to moderate blacklegged tick nymph densities and low to moderate *Bo. burgdorferi* infection rates in 2022. There were counties, like Cabell, with very low Lyme disease incidence (Dailey, Abshire, & Dotseth, 2024) and low blacklegged tick nymph densities with no *Bo. burgdorferi* infection at tick surveillance sites in 2022. Moderate Lyme disease incidence counties in central West Virginia, including Gilmer, Lewis, and Nicholas counties, had low to moderate blacklegged tick nymph densities and low to moderate *Bo. burgdorferi* infection rates at the tick surveillance sites. Anomalies included counties, such as Putnam and Roane counties, with a low Lyme disease burden but a high *Bo. burgdorferi* infection rate in the blacklegged tick nymphs from tick surveillance sites in their counties.

In 2023, the moderate to very high Lyme disease incidence counties in northern and southeastern West Virginia also had moderate to high blacklegged tick nymph densities and moderate to high *Bo. burgdorferi* infection rates in blacklegged tick nymphs. Webster County, a high Lyme disease incidence county in northern West Virginia (Abshire, Dailey, & Dotseth, 2025), also had a moderate blacklegged tick nymph density and high *Bo. burgdorferi* infection rate from blacklegged tick nymphs at the surveillance site. Conversely, the surveillance sites at very low Lyme disease incidence counties in southwestern West Virginia also had low to moderate blacklegged tick nymph densities and low to moderate *Bo. burgdorferi* infection rates in these ticks. Kanawha County, with low Lyme disease incidence, continued to have a moderate blacklegged tick nymph density and low *Bo. burgdorferi* infection rate in their ticks from the tick surveillance site. Meanwhile, Jackson County, a very low Lyme disease incidence county in southwestern West Virginia, also had low blacklegged tick nymph density and moderate *Bo. burgdorferi* infection rate in the ticks collected from this county.

Unlike blacklegged ticks, lone star ticks were predominantly active in southwestern West Virginia from 2021-2023. The geographic distribution of ehrlichiosis cases in humans (*E. chaffeensis*, *E. ewingii*) reflected the geographic distribution of its tick vector, the lone star tick. In 2021, lone star tick nymphs were active in counties with human ehrlichiosis cases, including Kanawha, Cabell, and Wayne counties. In 2022, lone star tick nymphs were active in counties with human ehrlichiosis cases, including Kanawha, Cabell, Wayne, Jackson, and Putnam counties. And in 2023, lone star tick nymphs were active in counties with human ehrlichiosis cases, including Kanawha, Cabell, Jackson, and Putnam counties. Meanwhile, lone star ticks were not detected in any of the surveillance sites in northern (Wood, Pleasants, Ritchie, Harrison, Marion, Monongalia, Preston Barbour, Upshur, Randolph), central (Braxton, Gilmer, Lewis, Calhoun, Roane, Randolph) or southeastern (Nicholas, Fayette, Raleigh, Wyoming, Mercer) West Virginia in 2021-2023. Except for neighboring Wood County in 2023 and counties in the Eastern Panhandle in 2021-2022, human ehrlichiosis cases have not recently been reported beyond the established geographic range for lone star tick (Dotseth, Lewis, & Abshire, 2020) in 2021 (Dailey, Abshire, & Dotseth, 2023), 2022 (Dailey, Abshire, & Dotseth, 2024), and 2023 (Abshire, Dailey, & Dotseth, 2025).

There are limitations to the current report. First, the number of times active tick surveillance was conducted each year at each tick surveillance site was limited. Only 20.41% of tick surveillance sites were monitored three or more times during the year. Second, the tick density value and *Bo. burgdorferi* tick infection rate at the single tick surveillance site may not be representative of tick activity in the entire county. There is variation in tick nymph densities and *Bo. burgdorferi* infection rate at the community and county scale (Foster *et al*., 2023; Foster, Holcomb & Eisen 2024; Pardanani & Mather, 2004) that could be attributable to microhabitat variables, microclimatic factors, or host dynamics (Burtis *et al.*, 2016; Ginsberg *et al.*, 2020; Howard, LaBonte, & Stafford, 2014; Ostfeld *et al.,* 2006; Rand et al., 2003).

Tickborne disease can be managed and prevented. *Borrelia burgdorferi* infection rates >20% in blacklegged tick nymphs generally occur in high Lyme disease incidence states and regions and not in low Lyme disease incidence states and regions (Foster *et al*., 2022; Wormser *et al.,* 2006). Therefore, based upon the >20% *Bo. burgdorferi* infection rate in blacklegged tick nymphs in West Virginia, health care providers are encouraged to provide Lyme disease prophylaxis to patients with a blood-engorged blacklegged tick (CDC, 2025; Harms *et al.*, 2001; Nadelman *et al*., 2001; WV DHHR, 2023).

With the 2022 detection of high *Bo. burgdorferi* infection rate in blacklegged tick nymphs in Putnam County, a low Lyme incidence county (Dailey, Abshire, & Dotseth, 2024), and the trend in increasing blacklegged tick nymph densities at tick surveillance sites in nearby Jackson, Cabell, and Kanawha counties from 2021-2023, residents of southwestern West Virginia should be prepared for Lyme disease. Health care providers in southwestern West Virginia should prepare for an increase in Lyme disease patients. Additional Lyme disease detection and management training for healthcare professionals will continue to be provided to healthcare professionals especially in emerging Lyme disease regions in West Virginia (The Center for Rural Health Development, 2023). Tickborne disease public health messages and updates will continue to be available through the OEPS website (https://oeps.wv.gov/Pages/default.aspx). The OEPS Zoonotic Disease Program, in cooperation with local health departments, will continue to provide Lyme and other tickborne disease updates, educational presentations, pamphlets, and booklets to community members including veterinarians, academic partners, outdoor professionals, nature enthusiasts, school groups, and communities. Local health departments will resume tick and tickborne disease trainings and distribute educational material through the West Virginia Association of Sanitarians Mid-year Conference, West Virginia Public Health Association, Northern Panhandle Regional Public Health Conference, District Sanitarian In-Service, and West Virginia Center for Local Health 'Lunch and Learn' Series meetings. And the Potomac Regional Veterinary Conference, West Virginia Medical Entomology Working Group, Appalachian Vegetation Management Association Conference, West Virginia Nursery and Landscape Association, and West Virginia Pest Management Association meetings will continue to serve as venues for tick and tickborne disease trainings and educational material.

Tick and tickborne disease public health messaging and education / outreach programs in West Virginia will be modified based upon VectorED Network initiatives. Starting in 2024, the West Virginia OEPS Zoonotic Disease Program became a partner agency with the VectorED Network. The VectorED Network was established as a Vector-borne Disease Training and Evaluation Center developed via a cooperative agreement with the CDC to build vectorborne disease prevention and control capacity through training and evaluation of programming and creating partnerships with academic, federal, and state institutions in the Mid-Atlantic and Ohio River Valley. VectorED projects include 1) provide student training to increase vector-borne disease response, 2) provide targeted training for pest control managers, veterinarians, and other occupationally at-risk groups, 3) evaluate current vector-borne disease prevention and control methods, and 4) expand the capacity of education networks.

Prevention of tickborne illnesses also involves personal protection against tick bites. CDC recommendations for the prevention of tickborne diseases are located on the CDC website at https://www.cdc.gov/ticks/communication-resources/index.html. Because ticks are more active in warmer months, it is also important to make the public aware of the risk of becoming infected with any tickborne disease from late spring to early fall.

Below are CDC recommended steps for tick bite prevention:

- Be extra vigilant in warmer months (April-September) when ticks and people are most active.
- Avoid wooded and bushy areas with high grass and leaf litter.
- Walk in the center of trails.
- Use repellents that contain 20% to 30% DEET on exposed skin and clothing for protection that lasts up to several hours. Always follow product instructions. Parents should apply this product to their children, avoiding hands, eyes, and mouth.
- Use products that contain permethrin on clothing. Treat clothing and gear, such as boots, pants, socks, and tents with products containing 0.5% permethrin. It remains protective through several washings. Pre-treated clothing is available and may be protective longer.
- Bathe or shower as soon as possible after coming indoors (preferably within two hours) to wash off and more easily find ticks that are crawling on you.
- Conduct a full-body tick check using a hand-held or full-length mirror to view all parts of your body upon return from tick-infested areas. Parents should check their children for ticks under the arms, in and around the ears, inside the belly button, behind the knees, between the legs, around the waist, and especially in the hair.
- Examine gear and pets. Ticks can ride into the home on clothing and pets, then attach to a person later, so carefully examine pets, coats, and day packs. Ensure pets also have tick personal protection.
- Tumble clothes in a dryer on high heat for an hour to kill remaining ticks. (Some research suggests that shorter drying times may also be effective, particularly if the clothing is not wet.

REFERENCES

Abshire, M., K. Dailey & E. Dotseth. 2025. West Virginia 2023 annual zoonotic disease report.

Burtis, J. C., P. Sullivan, T. Levi, K. Oggenfuss, T. J. Fahey & R. S. Ostfeld. 2016. The impact of temperature and precipitation on blacklegged tick activity and Lyme disease incidence in endemic and emerging regions. *Parasites & Vectors* **9**: 606.

CDC. 2019. Surveillance for *Ixodes scapularis* and pathogens found in this tick species in the United States. https://www.cdc.gov/ticks/resources/TickSurveillance_Iscapularis-P.pdf. Date retrieved 28 April 2025.

CDC. 2020. Guide to the surveillance of metastriate ticks (Acari: Ixodidae) and their pathogens in the United States. https://www.cdc.gov/ticks/pdfs/Tick_surveillance-P.pdf. Date retrieved 28 April 2025.

CDC. 2025. Lyme Disease: Clinical Resources. https://www.cdc.gov/lyme/hcp/communication-resources/index.html. Date retrieved 9 May 2025.

Dailey, K., M. Abshire & E. Dotseth. 2023. West Virginia annual zoonotic disease surveillance report, 2021. https://oeps.wv.gov/Zoonotic/documents/data/2021_ZD_report.pdf. Date retrieved 28 April 2025.

Dailey, K., M. Abshire & E. Dotseth. 2024. West Virginia Department of Health annual zoonotic disease report, 2022. https://oeps.wv.gov/Zoonotic/Documents/Data/2022_ZD_report.pdf. Date retrieved 28 April 2025.

Dotseth, E., K. Dailey, M. Abshire & T. Prochaska. 2021. 2020 West Virginia tick surveillance report. https://oeps.wv.gov/arboviral/documents/tick/data/Tick_Surveillance_Report_2020.pdf. Date retrieved 29 June 2025.

Dotseth, E., C. Lewis & M. Abshire. 2020. 2019 West Virginia mosquito and tick surveillance report. https://oeps.wv.gov/arboviral/documents/tick/data/Tick_Surveillance_Report_2019.pdf. Date retrieved 28 April 2025.

Eisen, L. 2018. Pathogen transmission in relation to duration of attachment by *Ixodes scapularis* ticks. *Ticks and Tick-borne Diseases* **9** (**3)**: 535-542.

Eisen, L. & R. Eisen. 2023. Changes in the geographic distribution of the blacklegged tick, *Ixodes scapularis*, in the United States. *Ticks and Tick-borne Diseases* **14** (**6**): 102233.

Falco, R. C., D. F. McKeena, T. J. Daniels, R. B. Nadelman, J. Nowakowski, D. Fish & G. P. Wormser. 1999. Temporal relation between *Ixodes scapularis* abundance and risk for Lyme disease associated with erythema migrans. *American Journal of Epidemiology* **149** (**8**): 771-776.

Foster, E., K. M. Holcomb & R. J. Eisen. 2024. Density of host-seeking Ixodes scapularis nymphs by region, state, and county in the contiguous United States generated through national tick surveillance. *Ticks and Tick-borne Diseases* **15** (**3**): 102316.

Foster, E., S. A. Maes, K. M. Holcomb & R. J. Eisen. 2023. Prevalence of five human pathogens in host-seeking Ixodes scapularis and Ixodes pacificus by region, state, and county in the contiguous United States generated through national tick surveillance. *Ticks and Tick-borne Diseases* **14** (**6**): 102250.

Ginsberg, H. S., E. L. Rulison, J. L. Miller, G. Pang, I. M. Arsnoe, G. J. Hickling, N. H. Ogden, R. A. LeBrun & J. I. Tsao. 2020. Local abundance of *Ixodes scapularis* in forests: Effects of environmental moisture, vegetation characteristics, and host abundance. *Ticks and Tick-borne Diseases* **11** (**1**): 101271.

Harms, M. G., A. Hofhuis, H. Sprong, S. C. Bennema, J. A. Ferreira, M. Fonville, A. Docters van Leeuwn, W. J. J. Assendelft, H. C. P. M. Van Weert, W. Van Pelt & C. C. Van den Wjingaard. 2021. A single dose of doxycycline after an *Ixodes ricinus* tick bite to prevent Lyme borreliosis: An open-label randomized controlled trial. *Journal of Infection* **82** (**1**): 98-104.

Kilpatrick, H. J., A. M. LaBonte & K. C. Stafford. 2014. The relationship between deer density, tick abundance, and human cases of Lyme disease in a residential community. *Journal of Medical Entomology* **51** (**4**): 777-784.

Nadelman, R. B., J. Nowakowski, D. Fish, R. C. Falco, K. Freeman, D. McKenna, P. Welch, R. Marcus, M. E. Agũero-Rosenfeld, D. T. Dennis & G. P. Wormser. 2001. Prophylaxis with single-dose doxycycline for the prevention of Lyme disease after an Ixodes scapularis tick bite. *The New England Journal of Medicine* **345** (**2**): 79-84.

Ostfeld, R. S., C. D. Canham, K. Oggenfuss, R. J. Winchcombe & F. Keesing. 2006. Climate, deer, rodents, and acorns as determinants of variation in Lyme-disease risk. *Public Library of Science Biol.* **4**: e145.

Pardanani, N. & T. N. Mather. 2004. Lack of spatial autocorrelation in fine-scale distributions of *Ixodes scapularis*. *Journal of Medical Entomology* **41** (**5**): 861-864.

Rand, R. W., C. Lubelczyk, G. R. Lavigne, S. Elias, M. S. Holman, E. H. Lacombe & R. P. Smith. 2003. Deer density and the abundance of *Ixodes scapularis* (Acari: Ixodidae). *Journal of Medical Entomology* **40** (**2**): 179-184.

Rochlin, I., A. Egizi & A. Lindström. 2022. The original scientific description of the lone star tick (*Amblyomma americanum*, Acari: Ixodidae) and implications for the species' past and future geographic distributions. *Journal of Medical Entomology* **59** (**2**): 412-420.

The Center for Rural Health Development. 2023. Webinar: Tick Talk > Tik Tok. https://wvruralhealth.org/event/webinar-tick-talk-tik-tok/. Date retrieved 9 May 2025.

Wormser, G. P., R. J. Dattwyler, E. D. Shapiro, J. J. Halperin, A. C. Steere, M. S. Klempner, P. J. Krause, J. S. Bakken, F. Strle, G. Stanek, L. Bockenstedt, D. Fish, J. S. Dumler & R. B. Nadelman. 2006. The clinical assessment, treatment, and prevention of Lyme disease, human granulocytic anaplasmosis, and babesiosis: Clinical practice guidelines by the Infectious Diseases Society of America. *Clinical Infectious Disease* **43** (**9**): 1089-1134.

WV DHHR. 2023. Health Advisory #213: Lyme Disease and Other Tickborne Diseases in West Virginia. https://oeps.wv.gov/healthalerts/Documents/WV/WV%20HAN%20213%20Lyme%20Disease%20and%20Other%20Tickborne%20Diseases%20in%20West%20Virginia%2005.03.2023%20-%20FINAL.pdf. Date retrieved 9 May 2025.