2020
WEST VIRGINIA
TICK
SURVEILLANCE REPORT

WEST VIRGINIA Department of Health & Human Resources
BUREAU FOR PUBLIC HEALTH

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2020 TICK SURVEILLANCE SUMMARY

INTRODUCTION

The West Virginia Tick Surveillance Program (WVTSP) was initially developed in 2011 to ascertain 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 classifying population establishment, estimating the human pathogen infection rate, estimating the density of host-seeking nymphs and adults (infected and non-infected), and documenting the host-seeking seasonal phenology of the *I. scapularis* throughout the state. Following the recent increase in state spotted fever group rickettsiosis (SFGR) human cases, the program has increased efforts to document the biology of competent SFGR tick vectors in West Virginia 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.

Tickborne diseases of human health concern in West Virginia are shown in Table 1. Competent tick vectors for the most common tickborne diseases, including Lyme disease and SFGR, are active in the state.

Table 1. Possible tickborne diseases by causative agent based on tick vectors found in West Virginia.

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

[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.

[d] *Ixodes cookei* does not have an official common name. Names that have been used include the groundhog tick, woodchuck tick, and the American castor bean tick.

METHODS

More active tick surveillance projects were initiated in 2020 due to the redirection of the West Virginia Department of Health and Human Resources, Bureau for Public Health, West Virginia Office of Laboratory Services and local health department resources to COVID-19 outbreak response and management, the recent publication of standardized tick surveillance protocols by the Centers for Disease Control and Prevention (CDC), and the dramatic increase in West Virginia human and animal Lyme disease cases seen in the past few years. Standardized active tick surveillance methods and procedures were based on recent CDC protocols (CDC, 2019). Ticks were collected using the tick drag method over a minimum of 750 m^2 area. Active tick surveillance was conducted in 68 localities in 22 counties from April through December. *Ixodes scapularis* nymphs actively collected from two surveillance sites in Kanawha and Greenbrier counties 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.

In addition to passive tick submissions from citizens, human patients, and animal carcasses, the WVTSP collected ticks through the West Virginia Veterinary Tick Submission Project (WVVTSP). The WVVTSP started in 2013 as a sentinel surveillance system for tickborne diseases. Initially, veterinarians from clinics across the state (and one in Pennsylvania) were asked to mail ticks found on their animal clients to the Zoonotic Disease Program. For each submission, a form that collected information about the animal host (e.g., host species, host residence county, tickborne disease testing history of host, tick prevention utilized by the host) and date of collection was enclosed with each tick submission.

Passive and active tick surveillance results, including surveillance information from metastriate ticks (non-*Ixodes* tick species) were electronically submitted to ArboNET.

RESULTS

Amblyomma maculatum

The Gulf Coast tick (*Amblyomma maculatum*) is established in West Virginia (Fig. 1), as defined in Dennis *et al.* (1998) and Eisen, Eisen, and Beard (2016). In 2020, multiple adult *A. maculatum* were recovered by tick drag from a hayfield near Glenwood, West Virginia. One female and one male were collected on May 12. On May 17, two additional males and three additional female *A. maculatum* were collected from the same surveillance site.

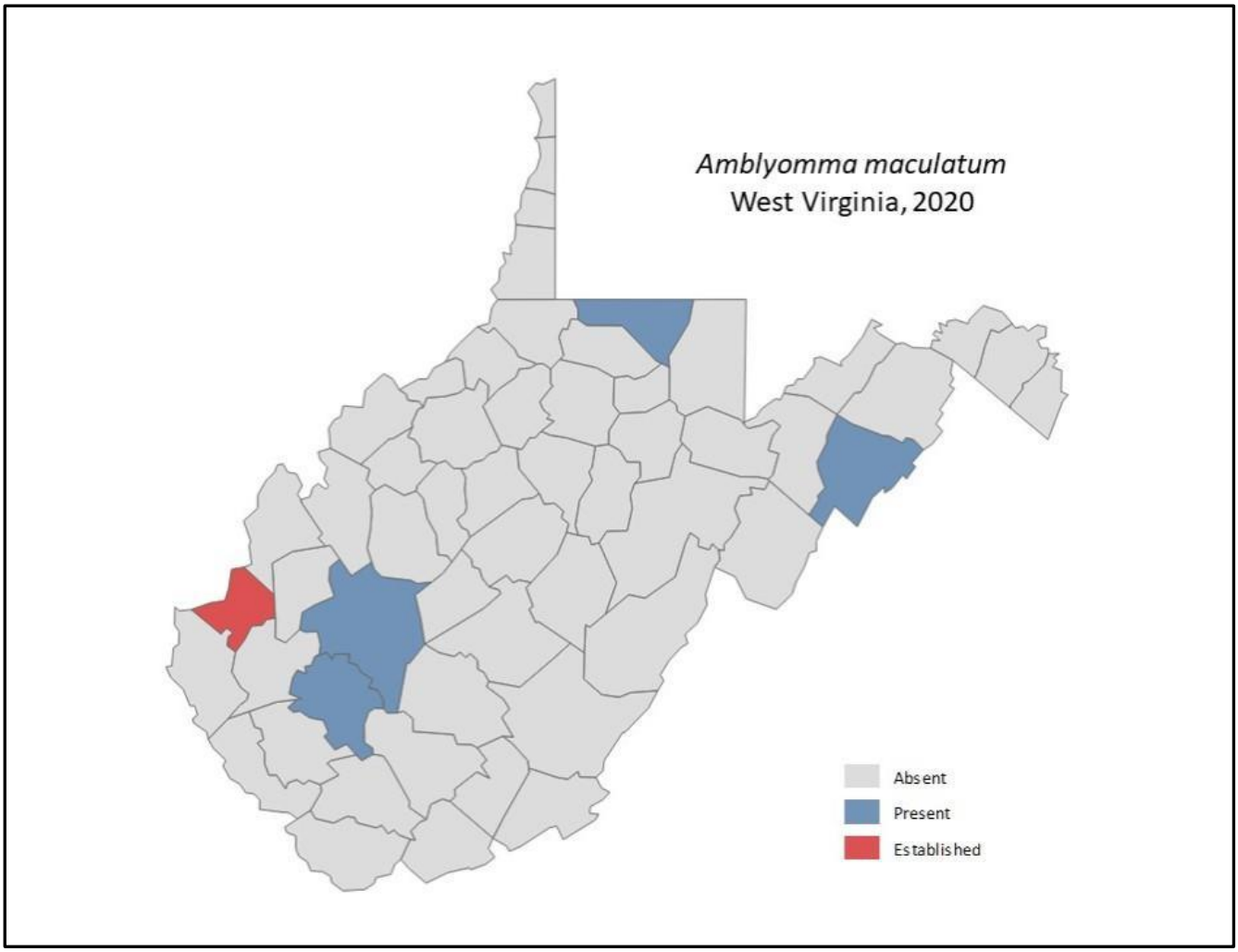

Fig. 1. Gulf Coast tick (*Amblyomma maculatum*) county-scale distribution in West Virginia, 2020.

Passive Tick Surveillance (including WVVTSP)

According to passive tick surveillance, the most common and widely distributed ticks in West Virginia were blacklegged ticks (*Ixodes scapularis*), American dog ticks (*Dermacentor variabilis*), and Asian longhorned ticks (*Haemaphysalis longicornis*) (Table 2). In comparison to previous years, *H. longicornis* has increased in abundance and expanded its distribution. There was no indication of blood feeding by the *H. longicornis* tick recovered from a human host.

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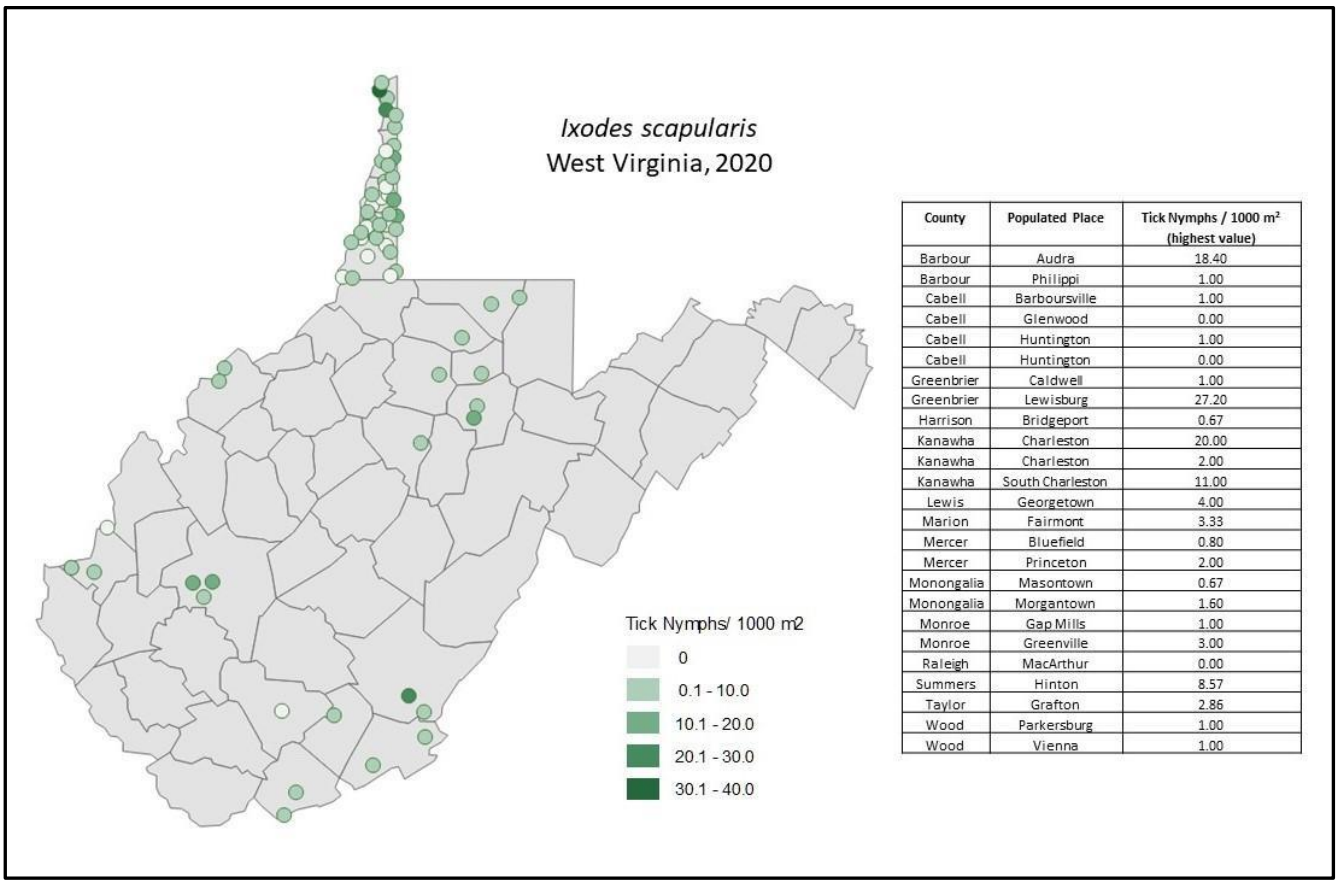
Table 2. Data from passive tick surveillance activities (WVVTSP, health care facility submissions, citizen submissions, and animal carcass retrieval).

Tick Species	# of Ticks Identified	Animal Species From Which Tick was Removed	# of Counties With Tick Species
Amblyomma americanum	83	Cat, Dog, and Human	7
Dermacentor variabilis	203	Cat, Dog, Human, and Raccoon	24
Haemaphysalis longicornis	241	Cat, Dog, Fox, Goat, and Human	10
Ixodes cookei	16	Cat, Dog, and Raccoon	5
Ixodes scapularis	325	Cat, Dog, Horse, and Human	27
Ixodes spp.	1	Dog	1
Total	**869**		

Active Tick Surveillance

Ixodes scapularis ticks were active throughout West Virginia. The localities with the highest *I. scapularis* nymph densities were in counties in northern (Barbour, Brooke, Hancock, Ohio, Marshall), central (Kanawha), and southeastern (Greenbrier) West Virginia (Figs. 2, 3). *Ixodes scapularis* nymphs were detected in 48 of the 65 localities surveyed from April through July, when the nymphal stage is active. Three surveillance sites had no record of *I. scapularis* ticks; two were in Cabell County, and one was in Raleigh County (not shown).



County	Populated Place	Tick Nymphs / 1000 m² (highest value)
Barbour	Audra	18.40
Barbour	Philippi	1.00
Cabell	Barboursville	1.00
Cabell	Glenwood	0.00
Cabell	Huntington	1.00
Cabell	Huntington	0.00
Greenbrier	Caldwell	1.00
Greenbrier	Lewisburg	27.20
Harrison	Bridgeport	0.67
Kanawha	Charleston	20.00
Kanawha	Charleston	2.00
Kanawha	South Charleston	11.00
Lewis	Georgetown	4.00
Marion	Fairmont	3.33
Mercer	Bluefield	0.80
Mercer	Princeton	2.00
Monongalia	Masontown	0.67
Monongalia	Morgantown	1.60
Monroe	Gap Mills	1.00
Monroe	Greenville	3.00
Raleigh	MacArthur	0.00
Summers	Hinton	8.57
Taylor	Grafton	2.86
Wood	Parkersburg	1.00
Wood	Vienna	1.00

Fig. 2. Blacklegged tick (*Ixodes scapularis*) nymph maximum density in West Virginia, 2020.

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County	Populated Place	Tick Nymphs / 1000 m² (highest value)
Brooke	Valley Grove	7.50
Brooke	Weirton	1.25
Brooke	Wellsburg	13.75
Brooke	Wellsburg	5.00
Brooke	Wellsburg	1.25
Brooke	Wellsburg	0.00
Hancock	Grant	40.00
Hancock	New Cumberland	25.00
Hancock	New Cumberland	8.75
Hancock	Newell	2.50
Hancock	Weirton	3.75
Hancock	Weirton	1.25
Marshall	Cameron	3.75
Marshall	Cameron	2.50
Marshall	Cameron	1.25
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Dallas	16.25
Marshall	Dallas	0.00
Marshall	Moundsville	6.25
Marshall	Moundsville	1.25
Marshall	Moundsville	1.25
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	New Moundsville	0.00
Marshall	New Vrindaban	0.00
Marshall	Proctor	3.75
Marshall	Wheeling	10.00
Marshall	Wheeling	2.50
Ohio	Valley Grove	18.75
Ohio	Valley Grove	0.00
Ohio	Valley Grove	0.00
Ohio	Valley Grove	0.00
Ohio	West Liberty	8.75
Ohio	Wheeling	3.75
Ohio	Wheeling	2.50
Ohio	Wheeling	2.50
Ohio	Wheeling	0.00

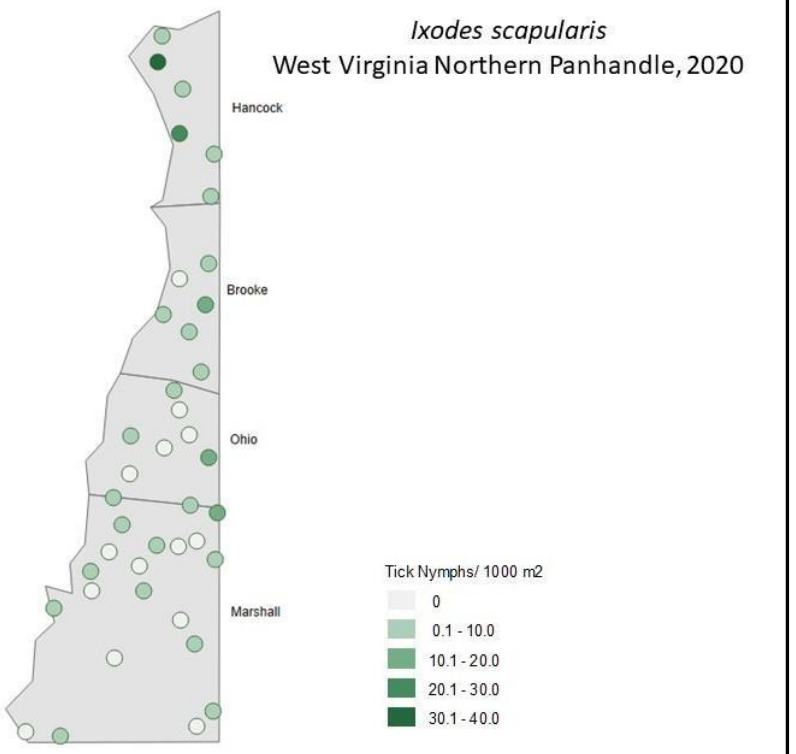

Fig. 3. Blacklegged tick (*Ixodes scapularis*) maximum nymph density in West Virginia Northern Panhandle, 2020.

Conversely, *A. americanum* ticks were predominantly confined to southwestern West Virginia. The localities with the highest *A. americanum* nymph densities were in Cabell and Kanawha counties (Figs. 4, 5). *Amblyomma americanum* nymphs were also active in Greenbrier and Wood counties. All surveillance sites in Cabell and Kanawha counties had records of *A. americanum* (not shown).

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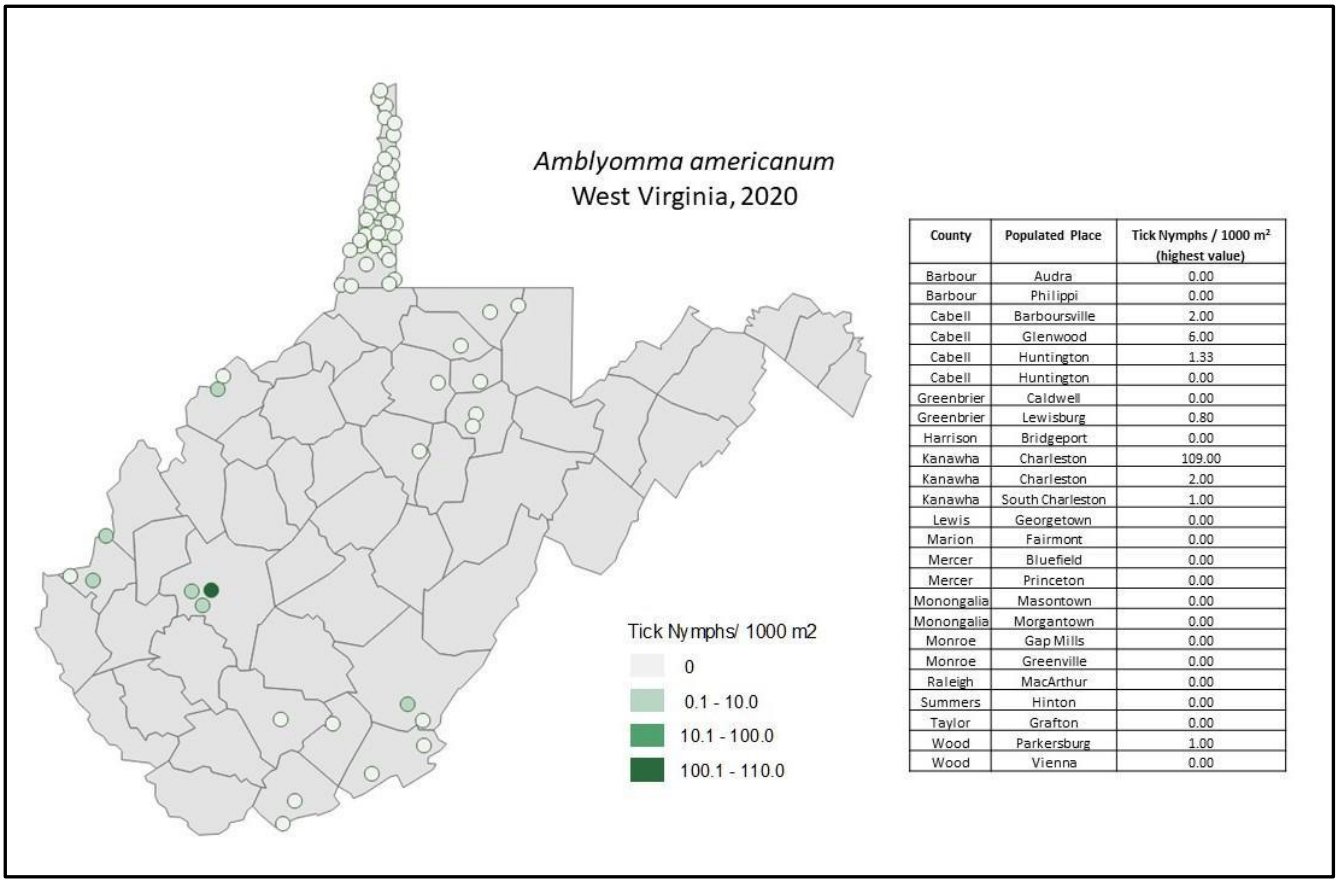

County	Populated Place	Tick Nymphs / 1000 m² (highest value)
Barbour	Audra	0.00
Barbour	Philippi	0.00
Cabell	Barboursville	2.00
Cabell	Glenwood	6.00
Cabell	Huntington	1.33
Cabell	Huntington	0.00
Greenbrier	Caldwell	0.00
Greenbrier	Lewisburg	0.80
Harrison	Bridgeport	0.00
Kanawha	Charleston	109.00
Kanawha	Charleston	2.00
Kanawha	South Charleston	1.00
Lewis	Georgetown	0.00
Marion	Fairmont	0.00
Mercer	Bluefield	0.00
Mercer	Princeton	0.00
Monongalia	Masontown	0.00
Monongalia	Morgantown	0.00
Monroe	Gap Mills	0.00
Monroe	Greenville	0.00
Raleigh	MacArthur	0.00
Summers	Hinton	0.00
Taylor	Grafton	0.00
Wood	Parkersburg	1.00
Wood	Vienna	0.00

Fig. 4: Lone star tick (*Amblyomma americanum*) maximum nymph density in West Virginia, 2020.

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County	Populated Place	Tick Nymphs / 1000 m² (highest value)
Brooke	Valley Grove	0.00
Brooke	Weirton	0.00
Brooke	Wellsburg	0.00
Brooke	Wellsburg	0.00
Brooke	Wellsburg	0.00
Brooke	Wellsburg	0.00
Hancock	Grant	0.00
Hancock	New Cumberland	0.00
Hancock	New Cumberland	0.00
Hancock	Newell	0.00
Hancock	Weirton	0.00
Hancock	Weirton	0.00
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Cameron	0.00
Marshall	Dallas	0.00
Marshall	Dallas	0.00
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	Moundsville	0.00
Marshall	New Martinsville	0.00
Marshall	New Vrindaban	0.00
Marshall	Proctor	0.00
Marshall	Wheeling	0.00
Marshall	Wheeling	0.00
Ohio	Valley Grove	0.00
Ohio	Valley Grove	0.00
Ohio	Valley Grove	0.00
Ohio	Valley Grove	0.00
Ohio	West Liberty	0.00
Ohio	Wheeling	0.00
Ohio	Wheeling	0.00
Ohio	Wheeling	0.00
Ohio	Wheeling	0.00

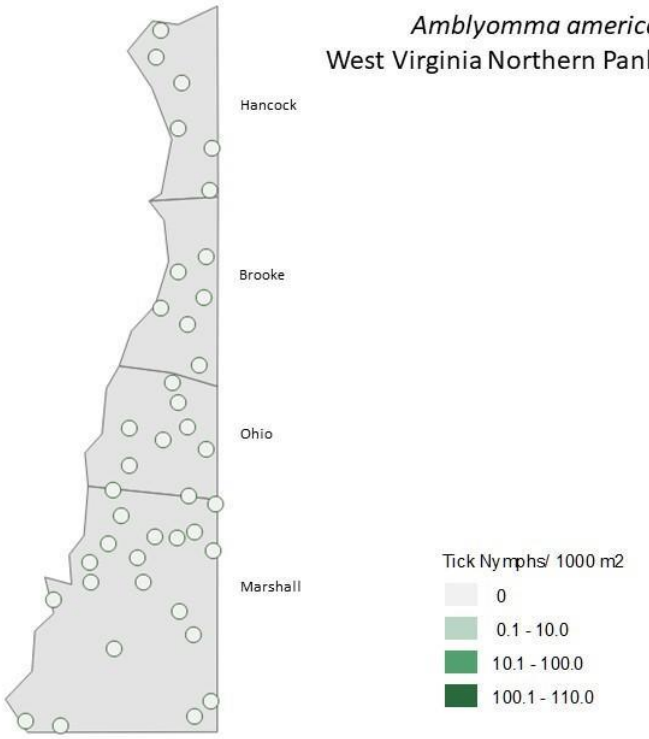

Fig. 5: Lone star tick (*Amblyomma americanum*) maximum nymph density in West Virginia Northern Panhandle, 2020.

Ixodes scapularis in West Virginia were infected with *Borrelia burgdorferi*, the pathogen responsible for Lyme disease, and *Anaplasma phagocytophilum*, the pathogen responsible for anaplasmosis. Eight of 50 (16%) *I. scapularis* nymphs from the Kanawha County surveillance site were infected with *B. burgdorferi* while six of 46 (15%) Greenbrier County *I. scapularis* nymphs were carrying *B. burgdorferi*. One of 50 (2%) Kanawha County *I. scapularis* nymphs were infected with *A. phagocytophilum* while seven of 46 (15%) *I. scapularis* nymphs from Greenbrier County were infected with *A. phagocytophilum*. None of the tick nymphs were infected with *B. mayonii*, *B. miyamotoi*, or *B. microti*.

DISCUSSION

Amblyomma maculatum

The Gulf Coast tick (*Amblyomma maculatum*) has been recorded sporadically throughout the state since 2011. The first record of this tick species in the state was based upon a submission of a male and female Gulf Coast tick from a veterinary clinic in Monongalia County in 2011. Unfortunately, collecting event information from these tick specimens was not recorded by the veterinary clinic. Isolated records of *A. maculatum* have been detected sporadically throughout the state since 2011.

The West Virginia locality would be conducive for *A. maculatum* establishment. The West Virginia site was near neighboring Kentucky counties including Martin, Knott, and Wolfe counties with established *A. maculatum* populations (Lockwood *et al*., 2018). The open, non-shaded habitats dominated by grasses and shrubs at the surveillance site would be conducive to *A. maculatum* establishment (Paddock & Goddard, 2015; Nadolyny & Gaff, 2018). Adult ticks could have been introduced by cattle, feral swine, or white-tailed deer (Nadolyny & Gaff, 2018). Migratory birds could have also introduced immature ticks to the site (Teel *et al*., 2010).

The Gulf Coast tick is a human and animal public health pest. *Amblyomma maculatum* is a relatively large tick, whose bite can cause inflammation, edema, abscesses, predisposition to myiasis, anemia, and tick paralysis. *Amblyomma maculatum* is a competent reservoir for the protozoan *Hepatazoon americanum*, pathogen responsible for canine heptatozoonosis (Ewing *et al.*, 2002), and a competent tick vector for *Ehrlichia ruminantium*, the causal agent for heartwater in ruminants (Mahan *et al*., 2000). In the southern United States, *Amblyomma maculatum* are infected with *E. ewingii*, *E. chaffeensis*, and Panola *Ehrlichia* (Williamson *et al*., 2010; Loftis *et a*l. 2016, Mays *et al.,* 2016). The Gulf Coast tick is a competent vector for *Rickettsia parkeri*, a causative agent for spotted fever group rickettsiosis (Paddock *et al*. 2004, 2010).

Active Tick Surveillance

Ixodes scapularis expanded its distribution across West Virginia. In 2020, *Ixodes scapularis* nymphs were active in most localities throughout the state. *Ixodes scapularis* ticks were active in 66 of the 68 tick surveillance sites. Conversely, in 2014 *I. scapularis* ticks were active in only one of the 11 surveillance sites in West Virginia (WV DHHR 2015). *Ixodes scapularis* nymphs were only detected in four of the 16 surveillance sites in 2015; 3/8 sites in northeastern West Virginia and 1/8 sites in southern West Virginia (Mark-Carew *et al*., 2016).

The geographic distribution of Lyme disease cases in humans mirrored the geographic distribution of its tick vector *I. scapularis*. Like its tick vector (Dotseth *et al.*, 2020), Lyme disease cases were dispersed across the state (Dailey *et al.*, 2022, Lewis *et al.*, 2020). There were counties like Hancock, Marshall, and Kanawha, with both high Lyme disease case counts (Dailey *et al.*, 2022) and localities with high *I. scapularis* nymph densities in 2020. Conversely, other counties with high Lyme disease case counts, like Monongalia and Preston counties, had comparatively low *I. scapularis* nymph densities in 2020. Additional active tick surveillance may discover hotspots of high *I. scapularis* tick activity in these high Lyme disease burden counties in northeastern West Virginia.

Furthermore, *I. scapularis* had higher *B. burgdorferi* infection rates. For example, none of the 13 *I. scapularis* nymphs in Kanawha County were infected with *B. burgdorferi* in 2012 (Mark-Carew *et al.*, 2014). Meanwhile, *I. scapularis* nymphs from this same Kanawha County surveillance site had a 16% *B. burgdorferi* infection rate in 2020.

Unlike *I. scapularis*, *A. americanum* were predominantly active in southwestern West Virginia. *Amblyomma americanum* ticks were not collected at surveillance sites in northeastern or northern panhandle counties of West Virginia. In 2015, *A. americanum* ticks were also only detected in southwestern West Virginia (Mark-Carew *et al*., 2016). *Amblyomma americanum* was not detected in any of the eight surveillance sites in Gilmer, Marion, Monongalia, Preston, or Taylor counties in northern West Virginia in 2015. Among the eight surveillance sites in five counties in southern West Virginia (Fayette, Greenbrier, Kanawha, Mercer, and Raleigh counties), *A. americanum* was only recovered from a single surveillance site in Kanawha County in 2015. The geographic distribution of ehrlichiosis cases in humans (*E. chaffeensis*, *E. ewingii*) complemented the geographic distribution of its tick vector *A. americanum*. Human ehrlichiosis cases have not recently been reported in the northeastern and northern panhandle counties (Dailey *et al*., 2022; Lewis *et al.*, 2020; Lewis *et al*., 2019, Mark-Carew *et al.*, 2018) beyond the established geographic range for *A. americanum* (Dotseth *et al*., 2020; CDC, 2022).

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