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UMaine Tick Surveillance Program Annual Report - 2020

INTRODUCTION

The University of Maine Cooperative Extension Tick Lab conducts surveillance of ticks and tick-borne pathogens to track their distribution, detect trends or changes in tick activity, and to identify areas of risk for tick-borne disease in Maine. In 2019, the UMaine Extension Tick Lab began testing tick samples for the causative agents of Lyme disease, anaplasmosis, and babesiosis; the three most common tick-borne diseases. In 2020, an additional testing panel was added to screen applicable tick species for the causative agents of Rocky Mountain spotted fever, ehrlichiosis, and tularemia. A free tick identification program also continues to be offered.

This report summarizes the information gathered through the passive surveillance associated with the 2020 UMaine Extension Tick Surveillance Program. Passive surveillance refers to tick specimens found and submitted by members of the public and can potentially result in a bias toward certain geographic locations or uncertainty about where a specific sample was collected. All samples were submitted to the Tick Lab within the UMaine Cooperative Extension Diagnostic & Research Laboratory. For more information on ticks in Maine or on submitting a tick to the Tick Lab, please visit us online at:

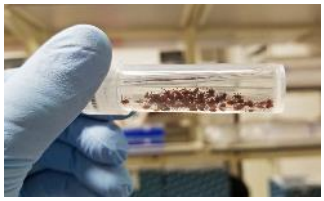
ticks.umaine.edu

BACKGROUND

Ticks and tick-borne diseases have become a significant public health issue in Maine and throughout the United States. Lyme disease is the most commonly reported vector-borne disease in the US, and reported cases have been steadily increasing throughout much of the state. In addition to Lyme disease, cases of anaplasmosis and babesiosis are also on the rise. Other tick-borne diseases known to occur in Maine include *Borrelia miyamotoi* disease and the serious but relatively rare Powassan virus. The primary vector of these diseases, the blacklegged tick has greatly increased in both population size and geographic range within the state.

There are 15 different tick species that have been found in Maine, though not all are permanent residents. Some may arrive on wildlife hosts and do not establish viable populations. Other species have thrived and are now widespread throughout much of the state. The most commonly encountered tick species in Maine are the blacklegged tick (*Ixodes scapularis*), the American dog tick (*Dermacentor variabilis*), and, to a lesser extent, the woodchuck tick (*Ixodes cookei*). Maine also faces threats related to invasive tick species including the lone star tick and Asian longhorned tick, both of which can have impacts on the health of humans, wildlife, and domestic animals.

A note on common names: the blacklegged tick is commonly referred to as the deer tick, though blacklegged tick is the recognized common name. We will generally refer to this species as the blacklegged tick in this report.



PURPOSE

Combatting the threats associated with ticks is an immense challenge that relies heavily on an integrated approach that includes monitoring tick populations, reducing tick and host habitat, managing ticks and their wildlife hosts, and widespread educational outreach on personal protection. The tick surveillance associated with the UMaine Extension Tick Lab is an attempt to gain information on the geographic spread of ticks and tick-borne disease in Maine and to provide information on the risk of encountering ticks.

The Tick Lab is not a medical lab and does not provide medical information. The testing of tick samples is intended to provide information on ticks and their associated pathogens in Maine and is not intended to be used in human health assessment or to be interpreted as a medical diagnosis. If you have been bitten by a tick, do not wait until tick testing results are available to consult with your doctor.

This report was prepared by Griffin Dill, Tom Rounsville, and Ann Bryant, University of Maine Cooperative Extension. Questions regarding the report can be directed to tickID@maine.edu. Additional data, including maps and tables updated daily, are available online at ticks.umaine.edu.

TICK SPECIES IDENTIFICATION

A total of 3,273 ticks were submitted to the UMaine Extension Tick Surveillance Program in 2020, with samples submitted from each of the state's 16 counties and from 354 towns. The first sample arrived to the lab for testing on January 14th and the final sample of 2020 arrived on December 22nd. The majority of the ticks submitted were identified as blacklegged ticks (formerly known as deer ticks) (*Ixodes scapularis*), while American dog ticks (*Dermacentor variabilis*) also made up a significant portion of the submissions. Lone star ticks (*Amblyomma americanum*), a species of significant medical importance, were also submitted. Lone star ticks are not known to have established permanent populations in Maine, but are established in other New England states. They are sporadically found in Maine, most likely the result of being transported by migratory wildlife. Of the 11 lone star ticks that were submitted to the program, six were related to Maine residents travelling to other states, while the other five samples were acquired in Maine, originating from Franklin, Hancock, Knox, and York Counties.

Tick Species Submitted to the UMaine Extension Tick Lab in 2020 (Table 1)

Tick Species	Common Name	Total
Ixodes scapularis	Blacklegged tick (formerly known as deer tick)	2615
Dermacentor variabilis	American dog tick	597
Ixodes cookei	Woodchuck tick	39
Amblyomma americanum	Lone star tick	11
Ixodes marxi	Squirrel tick	2
Unknown	Specimens damaged during removal/delivery	9

Blacklegged Tick (*Ixodes scapularis*) Submissions by Life Stage and Feeding Status (Table 2)

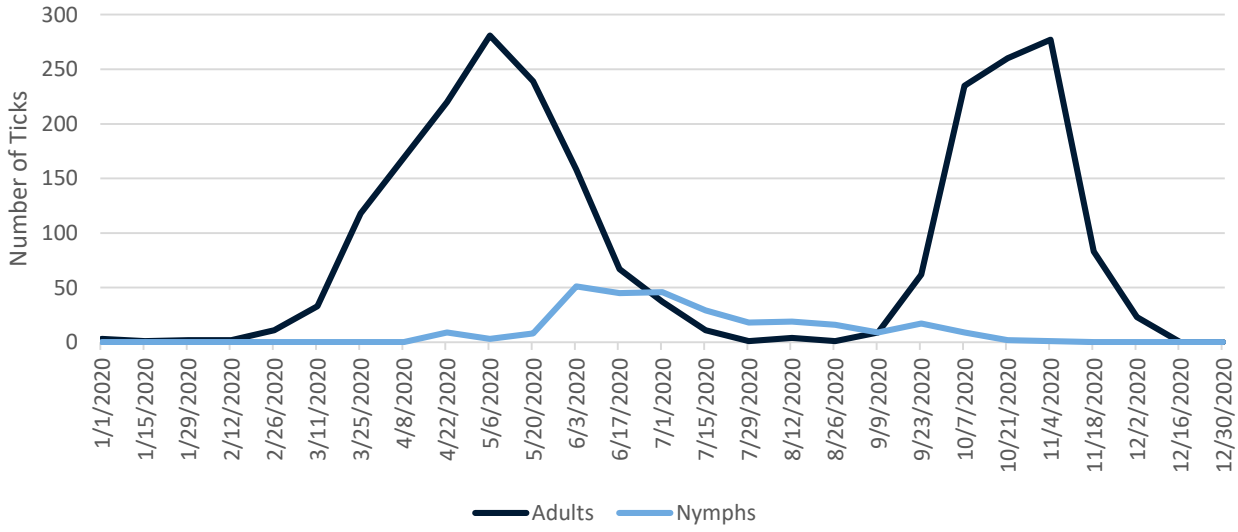
Life Stage	Not Engorged	Partially Engorged	Fully Engorged	Engorgement Unknown*	Total
Adult Females	590	1522	47	96	2255
Adult Males	-	-	-	-	50
Nymphs	36	234	4	8	282
Larvae	7	15	0	1	23

* Some specimens arrived to the lab too damaged to determine feeding status and in some cases life stage. Though male ticks may feed for brief periods, they do not become engorged.

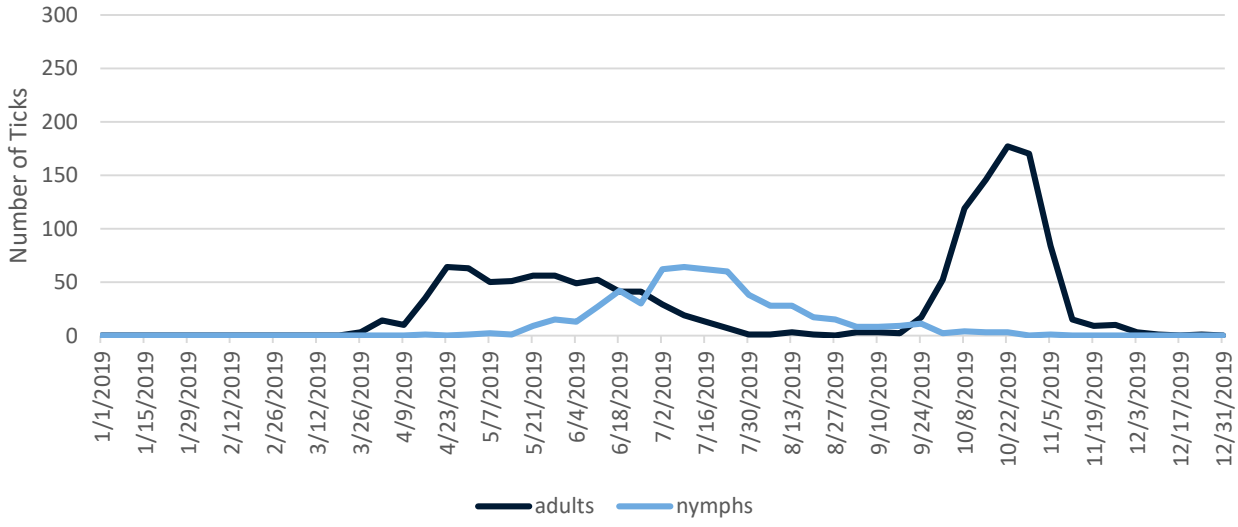
SEASONALITY OF TICK SUBMISSIONS

Tick activity can vary by season, based upon multiple factors including the tick's life cycle, weather, and host availability. While both blacklegged tick adults and nymphs can transmit pathogens, the nymphs play an important role in the disease transmission cycle due to their small size and ability to go unnoticed while feeding. Adult blacklegged ticks are most active from spring to late fall with two peaks, a small one in April or May and another larger peak in late October or early November. In 2020, possibly as a result of increased outdoor human activity associated with COVID-19 combined with warm spring temperatures, adults were encountered at exceptionally high rates during spring and early summer. Nymph numbers usually peak in June and early July. Nymphal blacklegged tick activity was down in 2020, possibly due to the hot, dry weather during mid-summer.

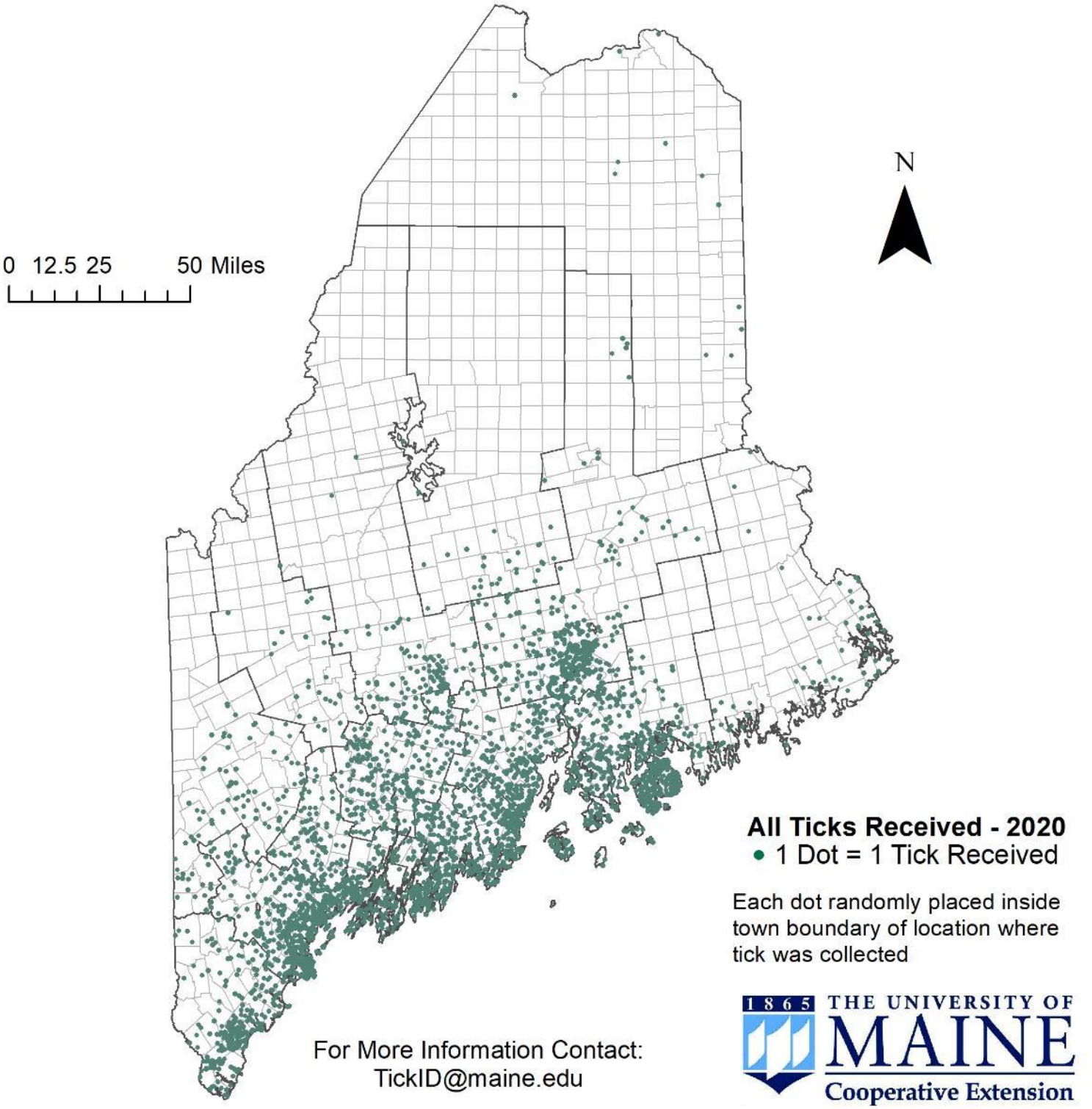
Blacklegged Ticks (*Ixodes scapularis*) Collected by Week - 2020 (Fig. 1)



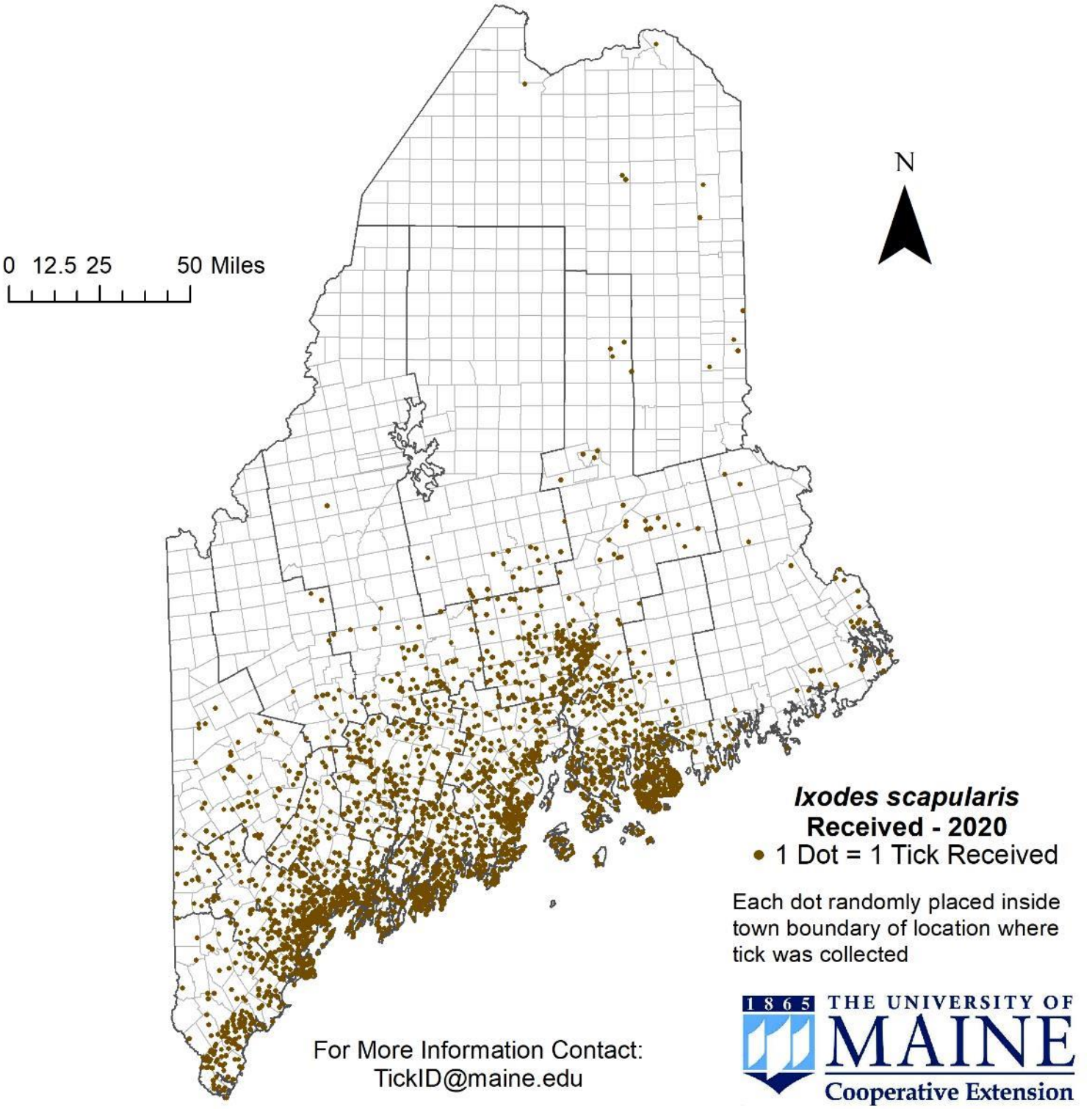
Blacklegged Ticks (*Ixodes scapularis*) Collected by Week - 2019 (Fig. 2)



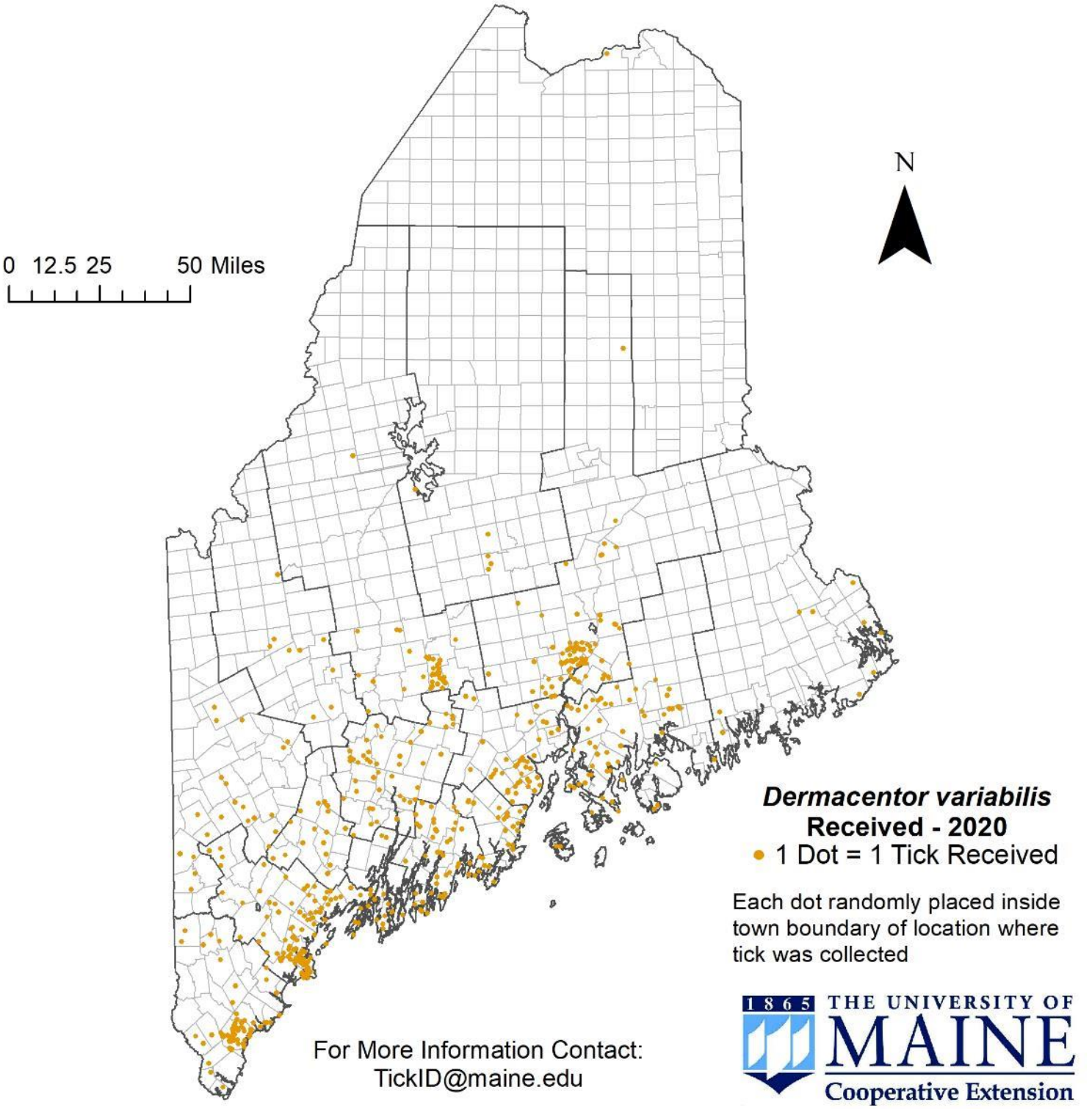
All Ticks Received for Identification and/or Testing (Map 1)



Ixodes scapularis (Blacklegged Ticks) Received for Identification and/or Testing (Map 2)



Dermacentor variabilis (Dog Ticks) Received for Identification and/or Testing (Map 3)



TICK PATHOGEN TESTING

Pathogen testing was conducted on blacklegged ticks and related species for the causative agents of Lyme disease (*Borrelia burgdorferi*), anaplasmosis (*Anaplasma phagocytophilum*), and babesiosis (*Babesia microti*), using a multiplex real-time polymerase chain reaction (PCR) assay. The following tables include testing data from all samples, including those that may have been acquired outside of the state of Maine.

Infection Prevalence in Submitted Blacklegged Ticks (*Ixodes scapularis*) - 2020 (Table 3)

Pathogen	% of nymphs infected	% of adults infected	% of ticks infected
Positive for at least 1 pathogen	28.1%	45.2%	42.9%
Borrelia burgdorferi	23.7%	38.8%	36.8%
Anaplasma phagocytophilum	5.0%	7.8%	7.5%
Babesia microti	3.6%	7.8%	7.3%
Borrelia + Anaplasma	1.8%	3.1%	3.0%
Borrelia + Babesia	2.5%	4.5%	4.3%
Anaplasma + Babesia	0.0%	0.2%	0.2%
Borrelia + Anaplasma + Babesia	0.0%	0.6%	0.6%

An additional testing panel was used to screen non-*Ixodes* species, including the American dog tick and lone star tick for the causative agents of Rocky Mountain spotted fever (*Rickettsia ricketsii*), ehrlichiosis (*Ehrlichia spp.),* and tularemia (*Francisella tularensis*). Two lone star ticks, one from Franklin county and one from Knox county, tested positive for *Ehrlichia* with subsequent sequencing identifying the Franklin county sample as *Ehrlichia ewingii*.

Infection Prevalence in American Dog Ticks and Lone Star Ticks – 2020 (Table 4)

Pathogen	American Dog Ticks (*Dermacentor variabilis*)	Lone Star Ticks (*Amblyomma americanum*)
Rickettsia rickettsii	0/416 (0%)	0/11 (0%)
Ehrlichia spp.	0/416 (0%)	2/11 (18%)
Francisella tularensis	0/416 (0%)	0/11 (0%)

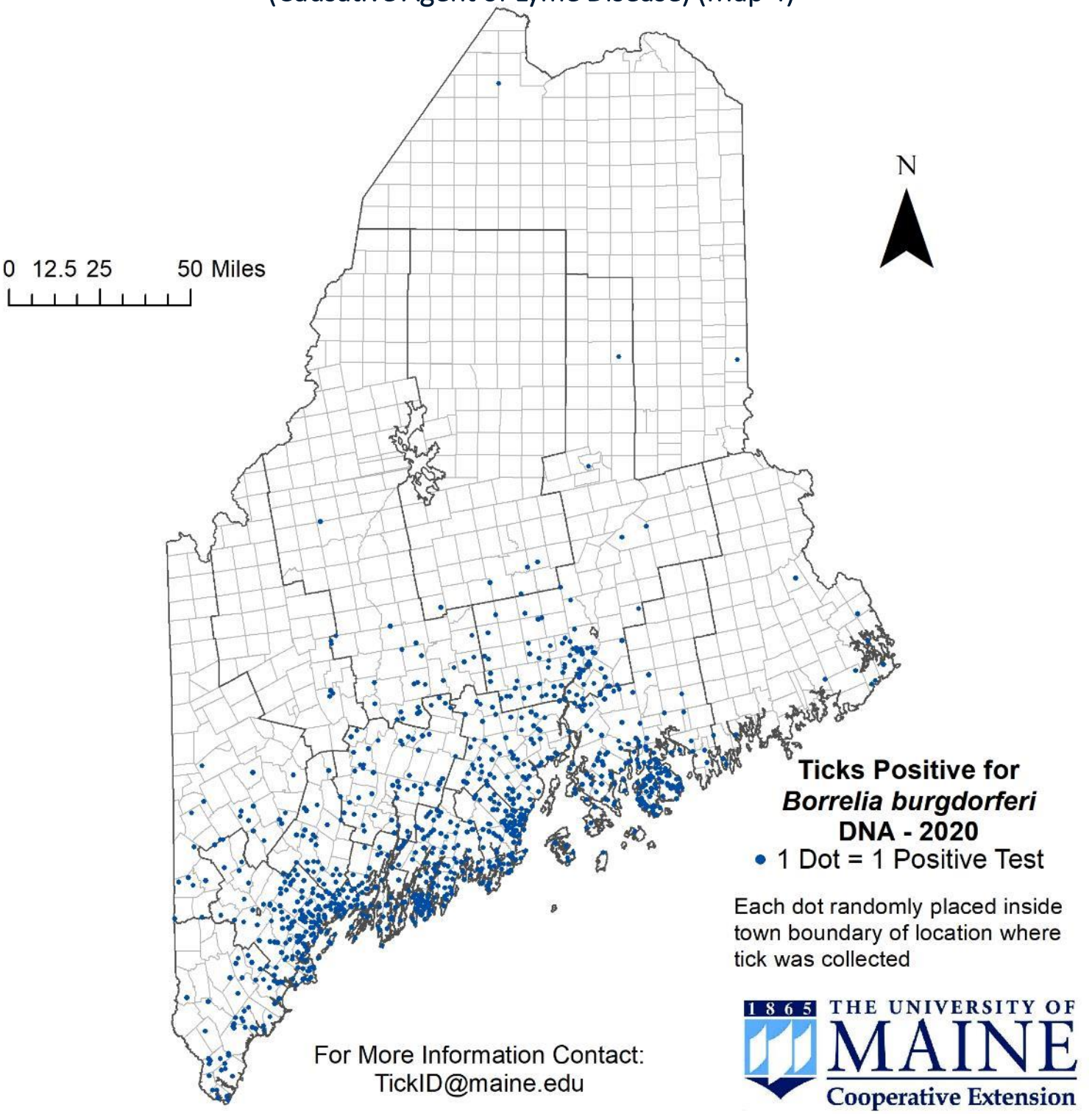
TICK PATHOGEN TESTING

Tick populations and infection rates can vary greatly over both large and small geographic distances. The numbers in the following table represent the number of blacklegged ticks that tested positive from each county. The percentage indicates the number of ticks that tested positive divided by the total number of deer ticks that were tested from that county. Submissions testing positive for each pathogen are mapped on the following three pages. In addition to the information listed below, another 21 samples were submitted from locations outside of Maine.

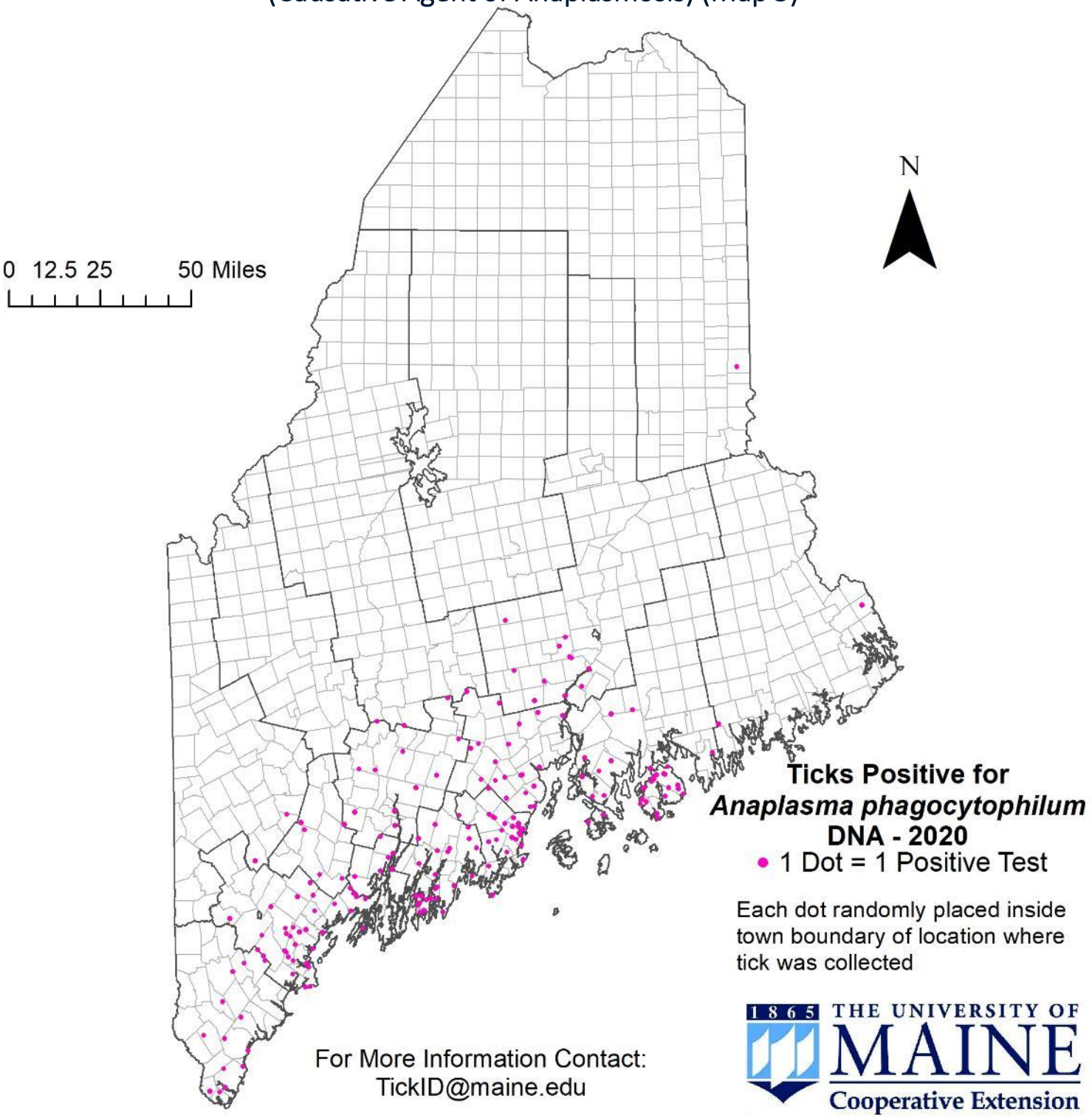
Infection Prevalence in Submitted Blacklegged Ticks (*Ixodes scapularis*) (All Life Stages) by County - 2020 (Table 5)

County	Ticks Submitted	Ticks Tested	*Borrelia* (Lyme)	*Anaplasma*	*Babesia*
Androscoggin	75	74	28 (37.8%)	4 (5.4%)	9 (12.2%)
Aroostook	10	8	2 (25.0%)	1 (12.5%)	0 (0.0%)
Cumberland	469	465	174 (37.4%)	34 (7.3%)	52 (11.2%)
Franklin	16	16	3 (18.8%)	0 (0.0%)	0 (0.0%)
Hancock	480	458	151 (33.0%)	32 (7.0%)	11 (2.4%)
Kennebec	189	180	50 (27.8%)	11 (6.1%)	15 (8.3%)
Knox	248	244	101 (41.4%)	25 (10.2%)	25 (10.2%)
Lincoln	259	257	115 (44.7%)	24 (9.3%)	20 (7.8%)
Oxford	67	66	23 (34.8%)	2 (3.0%)	3 (4.5%)
Penobscot	240	222	78 (35.1%)	11 (5.0%)	10 (4.5%)
Piscataquis	20	20	5 (25.0%)	0 (0.0%)	1 (5.0%)
Sagadahoc	75	75	29 (38.7%)	5 (6.7%)	7 (9.3%)
Somerset	64	60	24 (40.0%)	2 (3.3%)	2 (3.3%)
Waldo	179	175	72 (41.1%)	20 (11.4%)	13 (7.4%)
Washington	45	43	12 (27.9%)	2 (4.7%)	1 (2.3%)
York	158	123	48 (39.0%)	13 (10.6%)	12 (9.8%)
TOTAL	**2594**	**2486**	**916 (36.8%)**	**186 (7.5%)**	**181 (7.3%)**

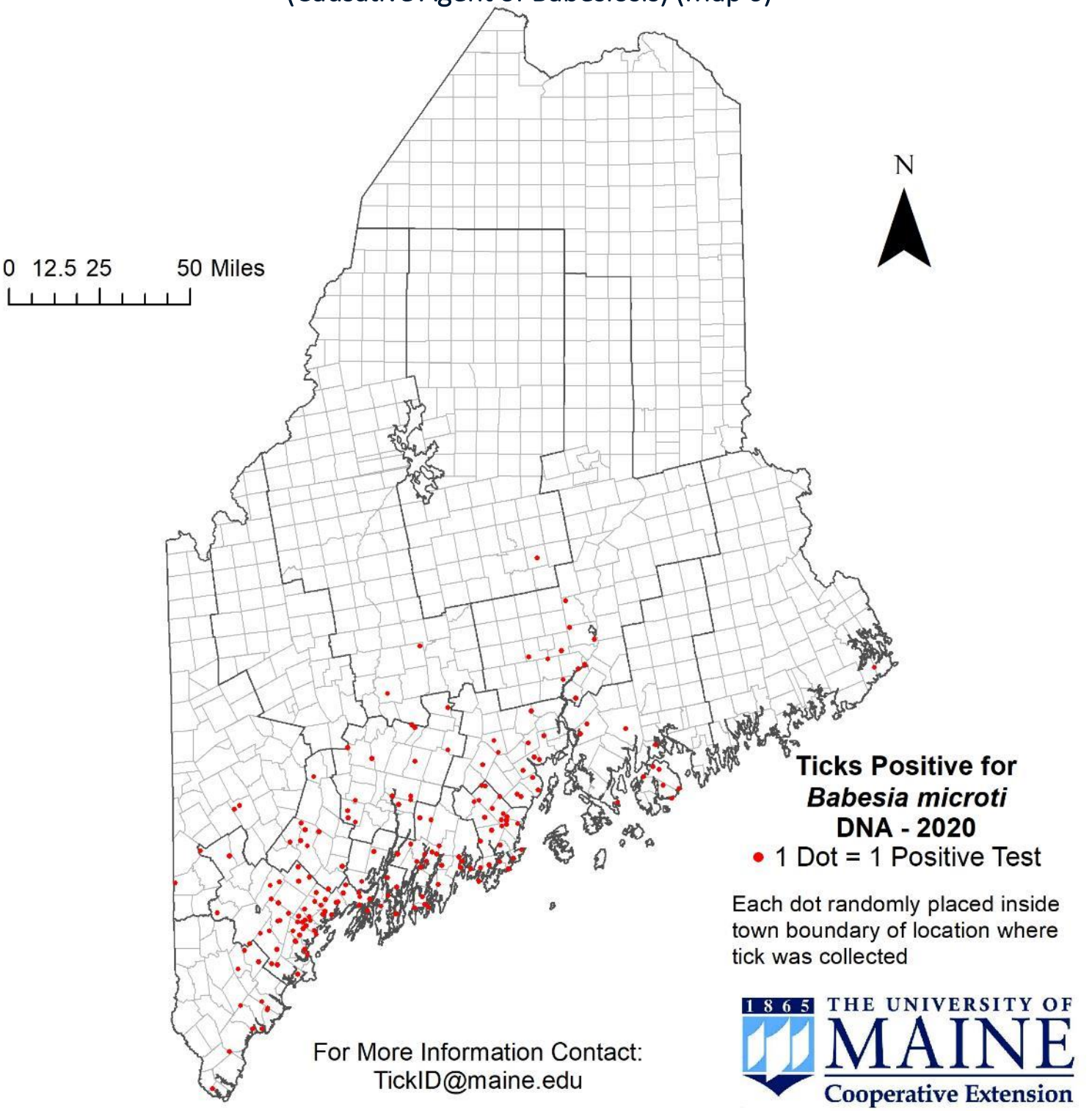
Ixodes scapularis (Blacklegged Ticks) Positive for *Borrelia burgdorferi* sensu lato (Causative Agent of Lyme Disease) (Map 4)



Ixodes scapularis (Blacklegged Ticks) Positive for *Anaplasma phagocytophilum* (Causative Agent of Anaplasmosis) (Map 5)



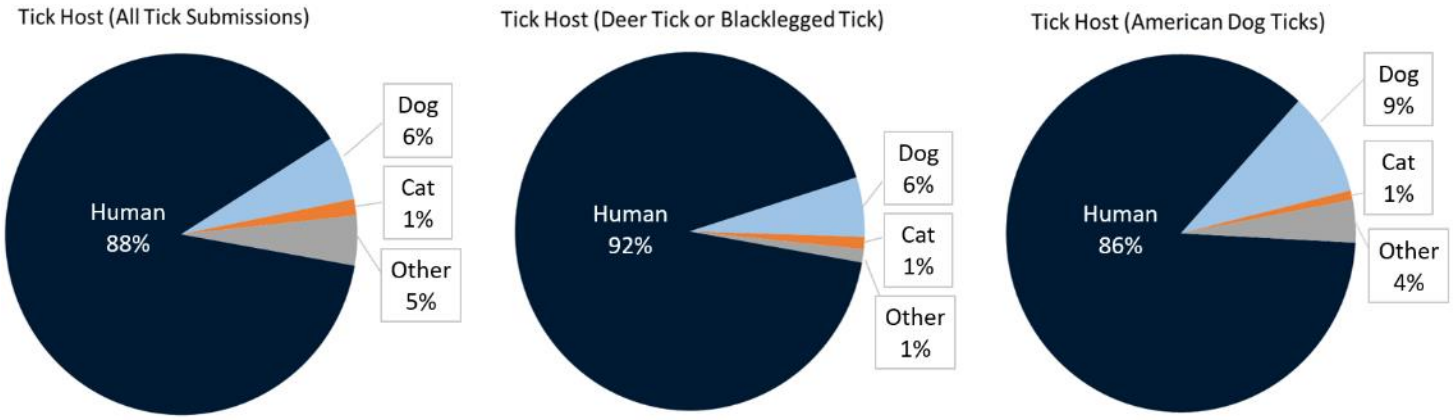
Ixodes scapularis (Blacklegged Ticks) Positive for *Babesia microti* (Causative Agent of Babesiosis) (Map 6)



HOST ASSOCIATIONS

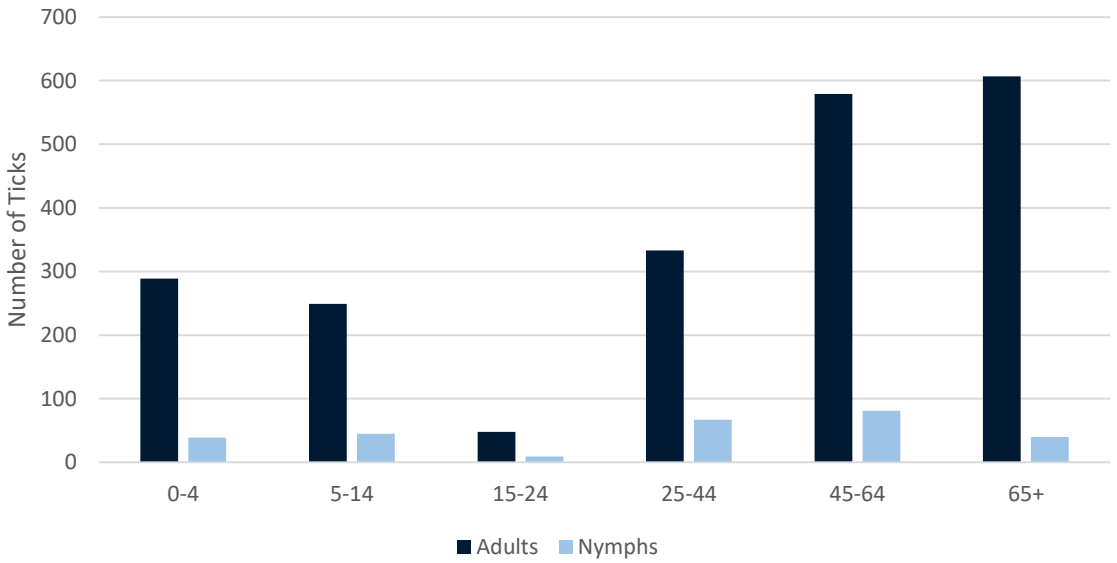
Many of the tick species in Maine are host specific, in that they feed on a limited range of wildlife species and are not commonly found on humans. The tick species most commonly encountered by humans, the blacklegged tick and American dog tick, are generalist feeders that will attach and feed upon humans as well as a wide variety of different animal species. The ticks submitted to the UMaine Tick Lab were overwhelmingly found on human hosts (88%), with pets and other hosts making up the remaining small percentage of submissions.

Tick Submissions by Host - 2020 (Fig. 3)



Tick submissions can vary widely based upon age, with ticks frequently submitted from those over the age of 45 and under the age of 15. During 2020, blacklegged tick nymph submissions were relatively evenly distributed by age group, while adult blacklegged ticks were most commonly submitted by those over the age of 45.

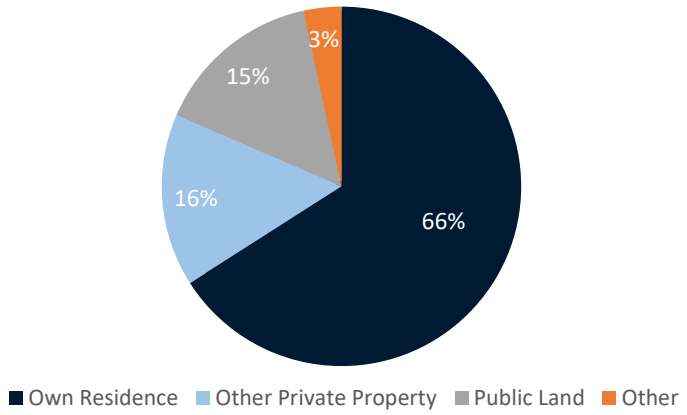
Blacklegged Tick (*Ixodes scapularis*) Submissions by Age Group - 2020 (Fig. 4)



HUMAN ACTIVITY

One of the goals of UMaine Extension's Tick Surveillance Program is to identify potential risk factors for contacting ticks. Certain habitats and human activities may increase this potential for contact and subsequently lead to increased risk of contracting a tick-borne illness. Approximately, 66% of those who submitted deer ticks encountered them on their own property. Table 6 summarizes the human activities associated with the deer ticks that were submitted to the UMaine Tick Lab in 2020. The listed activities represent just some of the potential ways in which contact with ticks can be made.

Property Type Where Ticks Were Encountered (Figure 5)



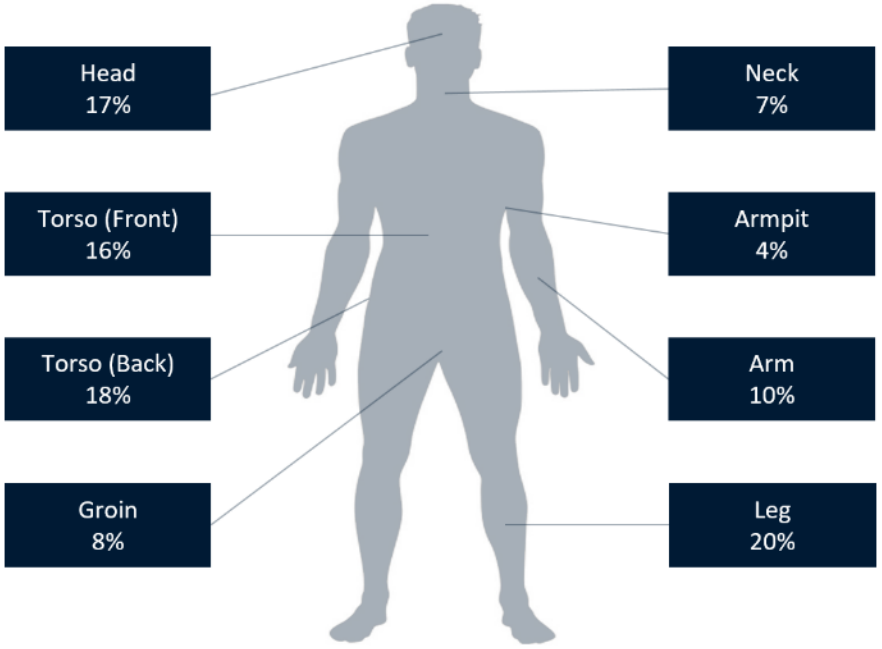
Human Activity at the Time of Blacklegged Tick (*Ixodes scapularis*) Encounter (Table 6)

Activity	Adults	Nymphs	Total
Yardwork / Gardening	679	102	781 (32.6%)
Playing Outside	423	79	502 (21.0%)
Walking	374	43	417 (17.4%)
Hiking	304	22	326 (13.6%)
Other	146	17	163 (6.8%)
Hunting / Trapping	41	0	41 (1.7%)
Occupational – Other	34	4	38 (1.6%)
Occupational – Agriculture	36	1	37 (1.5%)
Occupational – Forestry / Logging	23	0	23 (1.0%)
Fishing	13	7	20 (0.8%)
Playing Sports	11	1	12 (0.5%)
Bicycling	10	1	11 (0.5%)
Running	10	1	11 (0.5%)
Camping	6	3	9 (0.4%)
ATV Riding	2	0	2 (0.1%)

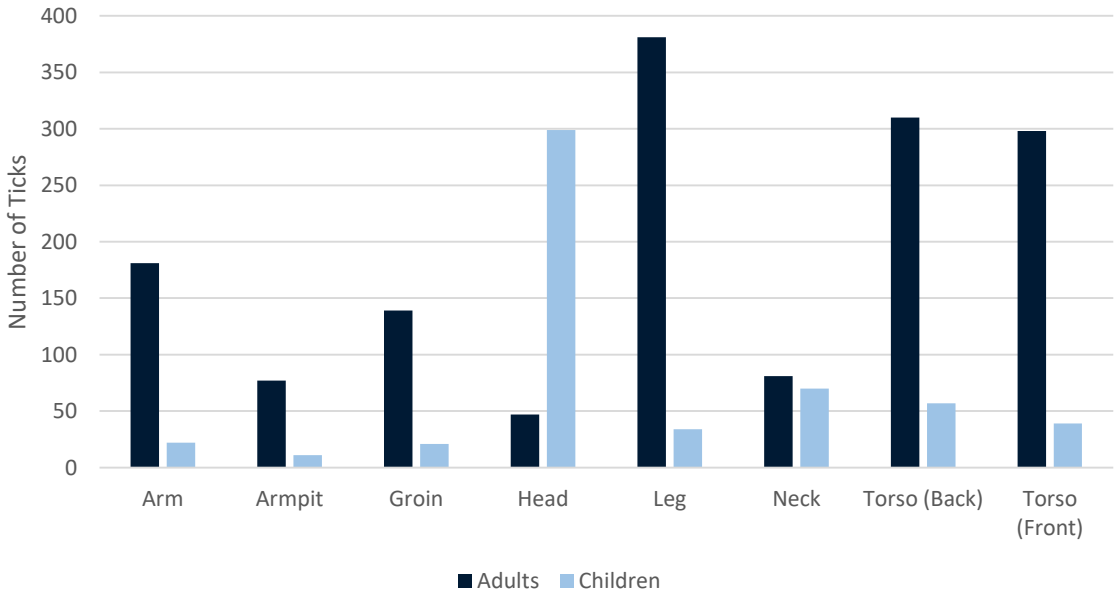
TICK FEEDING SITES

Once the tick is on a host it may immediately attach and start feeding or it may wander around before settling on a spot. Feeding may last several days or more than a week depending on the species and life stage. Females utilize these extended feedings, while adult males only take small occasional blood meals, if they feed at all. The vast majority of ticks submitted from human hosts (95%) were discovered while attached and feeding, while the remaining 5% were found crawling on the body. Feeding sites were fairly evenly distributed across the body on average (Fig. 6), however, there were some differences based upon age (Fig. 7). Blacklegged ticks were most commonly found on the head of children under the age of 15, however, they were more often attached to the legs of adults. The tick's life stage was also a factor, with nymphs more often attached to the legs than other parts of the body.

Deer Tick (*Ixodes scapularis*) Attachment Sites – All Ages (Fig. 6)



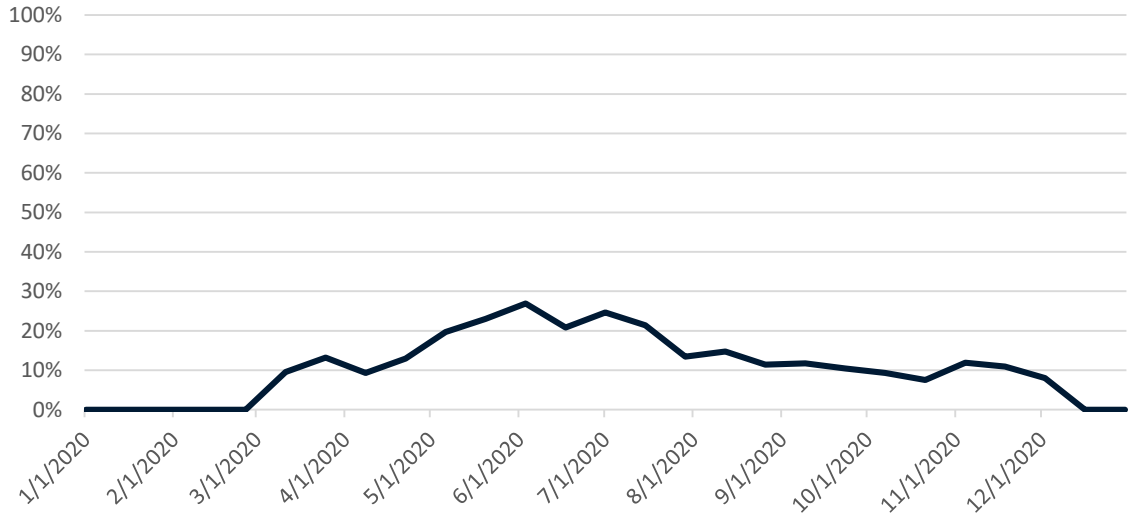
Blacklegged Tick (*Ixodes scapularis*) Attachment Sites by Age – 2020 (Fig. 7)



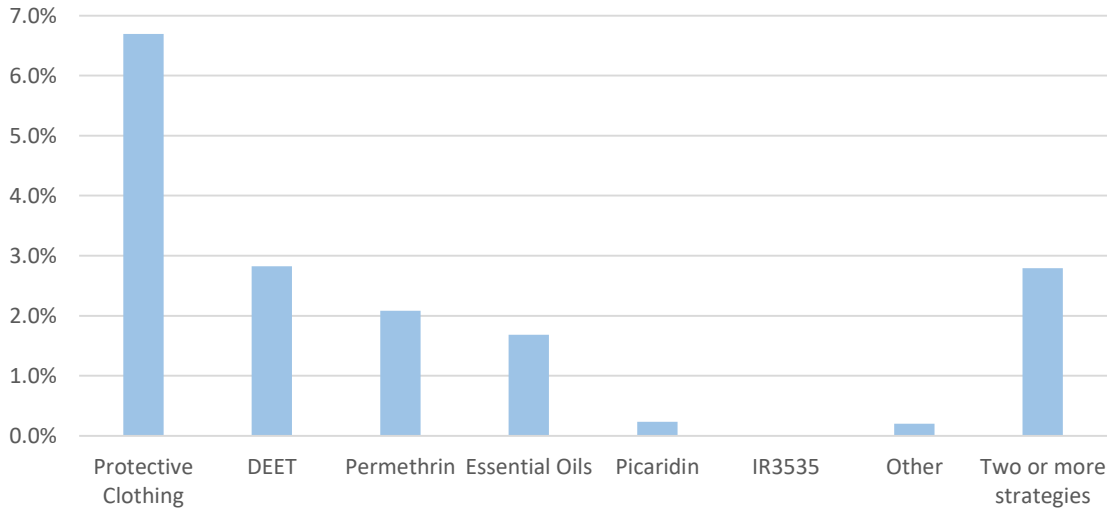
PERSONAL PROTECTION

Managing tick populations can be a challenge, thus the use of personal protection strategies is important in reducing tick encounters. Avoiding tick habitat, wearing appropriate clothing, and using tick repellents can significantly reduce exposure to ticks. Of those who submitted ticks to the Tick Lab in 2020, approximately 17% reported using some type of personal protection measure at the time of their tick encounter, with protective clothing being the most commonly used, followed by DEET, permethrin, and a combination of strategies. The use of personal protection peaked at 27% in early June and remained low (approximately 10%) during the spring and fall peaks in adult blacklegged tick activity.

Percentage of Tick Submitters Using Personal Protection Measures (Calculated Bi-Weekly) – 2020 (Figure 8)



Percentage of Tick Submitters Using Different Personal Protection Measures Against Ticks – 2020 (Figure 9)



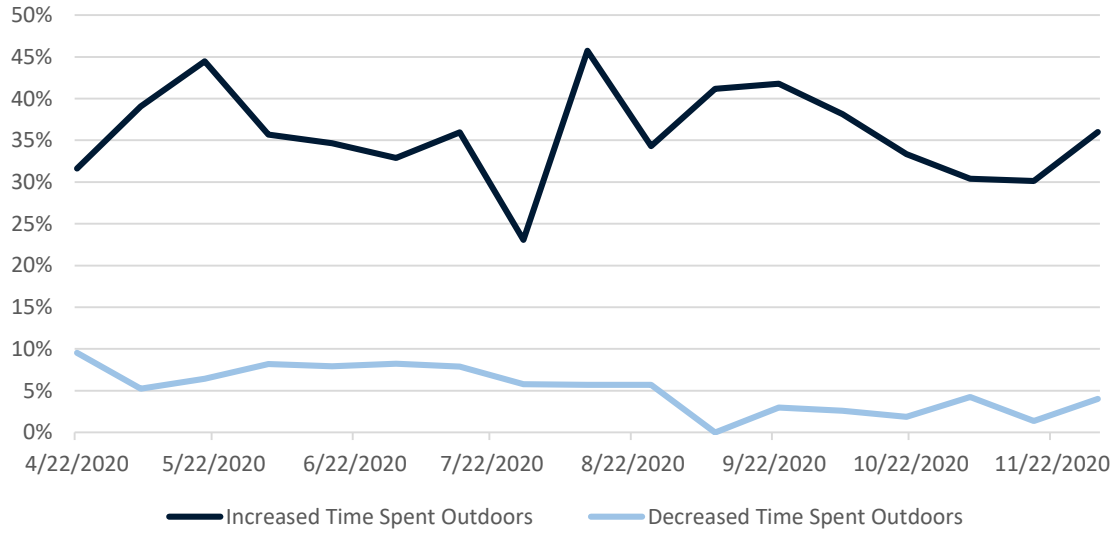
LIMITATIONS OF THE DATA

The information in this report is preliminary as of December 31, 2020. Tick samples collected in 2020 that are submitted after this date will be added to the data set and included in future reports. As this is an annual report, it represents only a snapshot in time and cannot be used to examine long-term trends. This report provides a general summary of the data collected and does not attempt to draw specific conclusions. Each tick is counted individually, but multiple ticks may be submitted from a single host or person, which can thus impact the interpretation of geographic data. Towns without tick submissions or positive test results should not be interpreted as not having tick populations or tick-borne disease. The data in this report is generated from passive surveillance (tick specimens found and submitted by members of the public) and can potentially result in a bias toward certain geographic locations or uncertainty about where a specific sample was collected.

COVID-19

The COVID-19 pandemic has changed nearly every facet of daily life, including altering the University of Maine's research activities. The Tick Lab was fortunate to be able to remain open and continue offering uninterrupted tick testing services throughout the entirety of 2020. In addition to the potential for disruptions in data collection, changes to normal routines resulting from stay-at-home and shelter-in-place recommendations may have changed the risk of encountering ticks. Of those who submitted ticks to the UMaine Tick Lab, 36% reported an increase in time spent outdoors. Of those spending more time outside, 42% indicated that they spent more time in the yard/garden, while 35% spent more time in forested habitats. This increase in outdoor activity, coupled with ideal weather conditions during the spring and fall peaks in adult blacklegged tick activity may have contributed to increased tick encounters statewide.

Percentage of Tick Lab Clients Reporting Change in Time Spent Outdoors – 2020 (Figure 10)



LOOKING AHEAD

The University of Maine Cooperative Extension Tick Lab is continually looking to expand and improve upon the Tick Surveillance Program. The COVID-19 pandemic altered plans to increase active surveillance during 2020, however, we plan to increase field monitoring for disease-carrying ticks throughout Maine in 2021. In addition to an increase in field surveillance, we plan to enhance our laboratory research capabilities through the use of emerging next-generation sequencing technologies. We will also be focusing on analyzing the vast amounts of data that has already been generated through this program and producing peer-reviewed publications to help better understand the dynamics of tick-borne disease in Maine.

ACKNOWLEDGEMENTS

Special thanks to the Tick Lab's student research assistant Claudia Desjardins, as well as all those who submitted ticks to the program, the Maine state government, and the people of Maine for supporting this program.

The Tick Lab is part of the Pest Management Unit within the University of Maine Cooperative Extension Diagnostic and Research Laboratory. The Diagnostic and Research Lab is coordinated by Jim Dill and combines veterinary diagnostics, pest management, and aquatic animal health research under one roof.

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