Tick-Borne Infections Council of North Carolina, Inc.

NEWSLETTER 2020, Volume 4

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Quote: - The bottom line is that there is no simple and inexpensive solution for managing chronically overabundant deer in fragmented suburban areas.

Paul D. Curtis, Human–Wildlife Interactions 14(1):111–128, Spring 2020

Special Notice:

COVID-19 vs. Tick-Borne Infections

People are getting outside more due to the pandemic. TIC-NC is aware of at least two NC cases of late diagnosis and treatment for tick-borne infections (TBIs) because patients' symptoms were, at first, thought to be Covid. There are cases now reported in the literature of late treatment of TBIs due to confusing Covid-19 symptoms with those of a tick-borne infection.

See: ***Negative impact of the COVID-19 pandemic on the timely diagnosis of infections***, Diagn Microbiol Infect Dis. Wormser G, et al. 2021 Jan; 99(1): 115226. doi: 10.1016/j.diagmicrobio.2020.115226.

In NC *ticks are active all year*, so even in the winter on a warmer day it is possible to contract an infection.

Highlights…

- **Tick-borne viruses**
- **The black legged tick in Pennsylvania and Lyme disease**
- **Is controlling the deer possible?**
- **Tick and tick-borne pathogen surveillance for public health**
- **European black legged tick found up to 5800 feet elevation**
- **Bartonella species in medically important mosquitoes, Central Europe**
- **CDC study on hospital cost of Lyme disease**
- **Interrupted Blood Feeding and faster pathogen transmission time**
- **Ticks in Alaska**
- **More evidence that lone stars are associated with alpha-gal allergy**

There were no state **Vector-borne Disease Working Group** meetings in 2020 due to the pandemic.

Link to Letter to Medical Providers from the State Department of Public Health on Lyme Disease and Rickettsial Diseases

The state has started issuing only one letter. Please see the home page of our website to access. www.tic-nc.org

From the CDC

Where To Find CDC Case Definitions and their Statement that the Surveillance Case Definitions Are "not to be used as the sole criteria for establishing critical diagnosis"

Case Definition and Report Forms

- Lyme Disease Surveillance Case Definition (revised Jan 2017)
- Lyme Disease Surveillance Case Report FormCdc-pdf PDF – 2 pages] (for public health officials' use)

> **Note:** Surveillance case definitions establish uniform criteria for disease reporting and should not be used as the sole criteria for establishing clinical diagnoses, determining the standard of care necessary for a particular patient, setting guidelines for quality assurance, or providing standards for reimbursement.

Accessed and copied 14 September 2019.

CDC: The Emerging Issues in Tick-borne Diseases webinar, presented June 13, 2019, is now online.

State Tick Research and/or Reports

The 2019 tick bone disease surveillance summaries are now complete. You can view them at the bottom of the NC DHHS Epi Section Facts & Figures page, under Vector Borne Disease section: https://epi.dph.ncdhhs.gov/cd/figures.html [epi.dph.ncdhhs.gov]

Note: By the *former* CDC definition, six counties had confirmed cases of Lyme disease in two persons who had not traveled out of the county for 30 days after their tick exposure. **Therefore, these counties were endemic for Lyme disease by the former CDC definition: Wake, Guilford, Haywood, Alleghany, Buncombe, and Wilkes.** Counties with one case of locally acquired Lyme disease were: Cleveland (2008), Wilson (2009), Pitt (2009), Carteret (2009), Gates (2011), Perquimans (2011), Rowan (2013), Union (2013), Caldwell (2013), Franklin (2014), Stanley (2014), Duplin 2014.

Report from the State or Vector-borne Disease Work Group meeting:
None.

NC TBIs 2017 final, 2018 to November probable/confirmed

NC EDSS Event Data – Cases Submitted to CDC

Disease	Total Cases / Confirmed Cases by year of report 2017	Total preliminary confirmed and probable Events in NC EDSS Created between 1/1/2018 – 11/13/2018*	Total Events Reviewed and closed by NC DPH 1/1/18 – 11/13/18	Total Events Still Under Investigation by LHD 1/1/18 – 11/13/18	Total Events created in NC EDSS 1/1/18 – 11/13/18
Lyme Disease	298/71C	177/51C	736	110	836
RMSF	521/6C	419/10C	2016	346	2362
Ehrlichiosis	72/18C	86/14C	331	54	398
Anaplasmosis	10/4C	4/0C	22	1	23

TIC-NC Activities

An astute TIC-NC member found this Gulf Coast tick (an Amblyomma maculatum female) in October in Chatham County, NC. They may be confused with the American Dog Tick. These ticks are known to carry a Spotted Fever Rickettsiosis called R. parkeri. We are not sure if there have been any official reports of this tick in this county. Thank you, Dr. Cotter. Photo used with permission.

TIC-NC Talks and Materials Distributed

Brochures/booklets:
Locations in Winston-Salem & Asheville

Booth: none due to Covid-19

Talks:
NC Mosquito and Vector Control Association, Nov 5, 2020. Virtual conference.

North and South Carolina

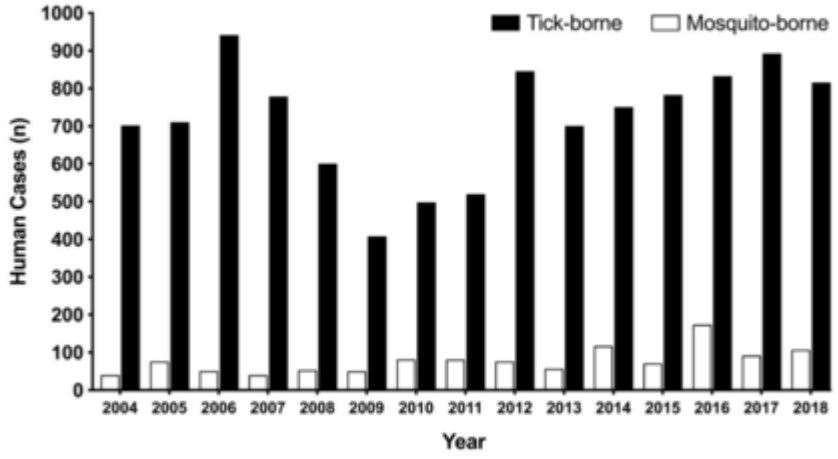
Vector-borne Diseases and Climate Change

North Carolina's Policy Should Promote Regional Resilience

Emerging and endemic vector-borne diseases remain significant causes of morbidity and economic burden in North Carolina. Effective policies must promote climate change resilience through public health preparedness at local and regional scales to proactively address the diverse environmental, climatic, and demographic factors amplifying vector-borne disease risk.

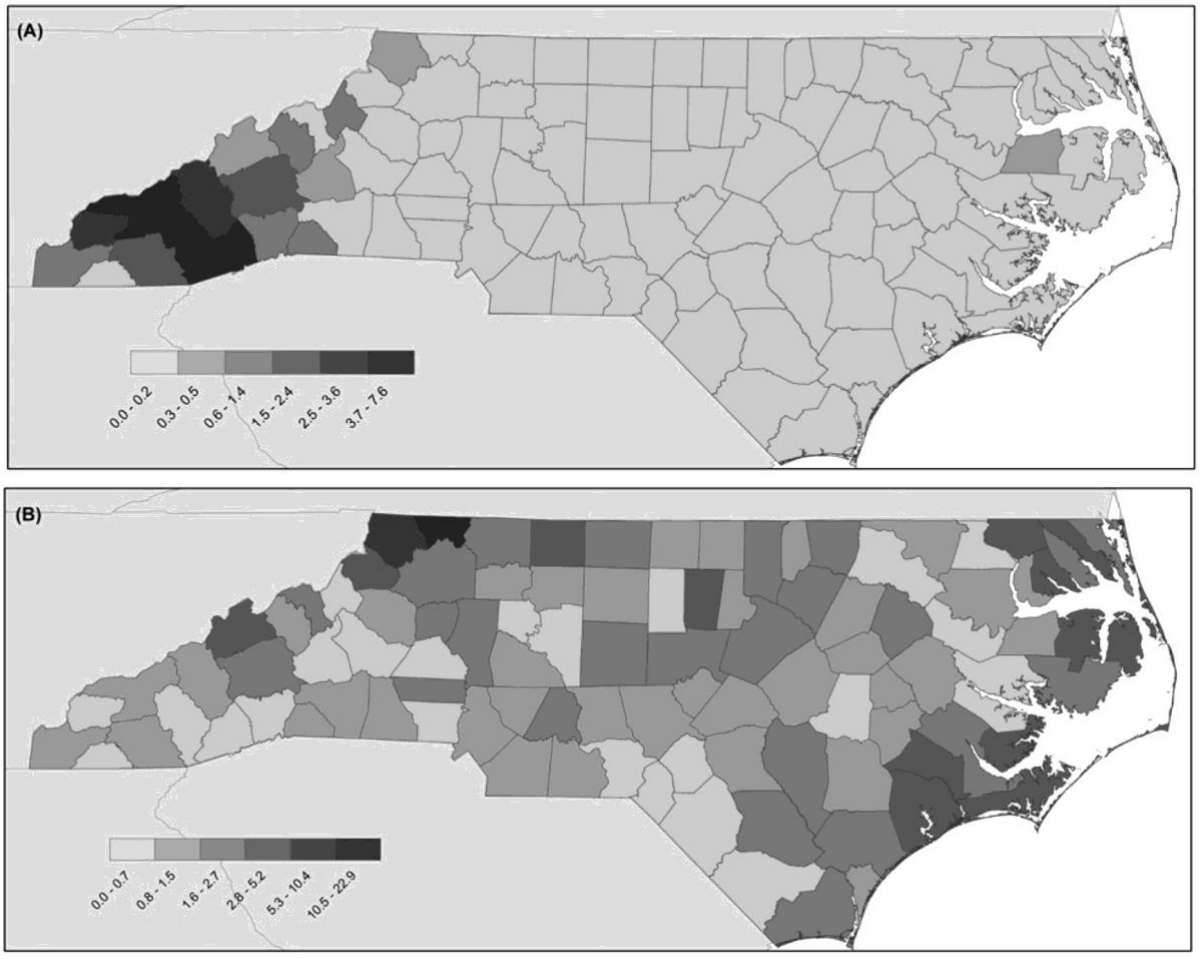
During 2004-2018, pathogens were responsible for more than 90% of reportable human VBD cases in North Carolina.

FIGURE 1.
Mosquito-borne and Tick-borne Human Disease Cases in North Carolina (2004-2018)



Source. Centers for Disease Control and Prevention. National Notifiable Diseases Surveillance Systems, Annual Tables of Infectious Disease Data. CDC Division of Health Informatics and Surveillance.

FIGURE 2.
(A) La Crosse Encephalitis (2000-2019) per 100,000 (crude rate) at the County Level for North Carolina
(B) Lyme Disease (2000-2018) per 100,000 people (crude rate) at the County Level for North Carolina



Source. Centers for Disease Control and Prevention and U.S. Census Bureau

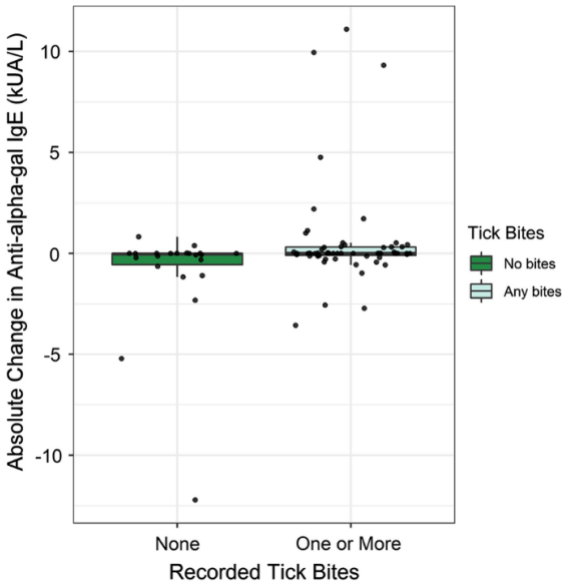
Brian Byrd, Stephanie L. Richards, Jennifer D. Runkle and Margaret M. Sugg
North Carolina Medical Journal September 2020, 81 (5) 324-330; DOI:
www.ncmedicaljournal.com/content/81/5/324 full.

Association between lone star tick bites and increased alpha-gal sensitization: evidence from a prospective cohort of outdoor workers

Alpha-gal is an oligosaccharide implicated in delayed anaphylaxis following red meat consumption. Exposure to tick bites has been correlated with development of an allergic response to alpha-gal. However, evidence prospectively linking exposure to a single tick species and an immune response to alpha-gal is lacking.

We used serum samples from a prior study cohort of outdoor workers in North Carolina, USA, with high exposure to the lone star tick, *Amblyomma americanum*, to prospectively evaluate the relationship between tick bites and anti-alpha-gal IgE antibodies.

Individuals who reported exposure to one or more tick bites were significantly more likely to have a positive change in anti-alpha-gal IgE compared to individuals with no reported tick bites. This relationship was not dependent on time. A trend toward increasing number of tick bites and increased anti-alpha-gal IgE levels was observed but not statistically significant.



To our knowledge, this is the first study to prospectively link documented exposure to *A. americanum* bites and increased sensitization to alpha-gal in a cohort of outdoor workers. Our results support the role of *A. americanum* as likely agents for eliciting an allergic response to red meat, and highlight the importance of preventing tick bites. Mitchell, CL, *et al. Parasites Vectors* **13,** 470 (2020).
https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-020-04343-4

Tick-borne viruses

The global incidence of infectious diseases has increased since the beginning of the 21st century. The expansion of tick populations into new geographic locations and a variety of anthropogenic and natural factors are all drivers of the increase. In addition to the establishment of known pathogens in new areas, several novel agents, including many viruses, have also emerged.

At present in North America, there are five viruses that are known to cause human disease: deer tick virus, Powassan virus, Colorado tick fever virus, Heartland virus, and Bourbon virus. Although uncommon causes of disease, these viruses pose formidable threats to the health of individuals residing in regions of endemicity, especially since there are currently no medical countermeasures available to combat them. This review focuses on the basic biology, ecology, epidemiology, transmission, clinical presentation, diagnosis, treatment, and prevention of these North American arboviruses.
https://doi.org/10.1016/j.clinmicnews.2020.05.001Get rights and content

Two articles on tick-borne viruses vectored by the lone star tick below – heartland virus and Bourbon virus

Investigation of Heartland virus disease throughout the United States, 2013–2017

Heartland virus (HRTV) was first described as a human pathogen in 2012. From 2013–2017, CDC implemented a national protocol to evaluate patients for HRTV disease, better define its geographic distribution, epidemiology, and clinical characteristics, and develop diagnostic assays for this novel virus.

Individuals aged ≥12 years, whose clinicians contacted state health departments or CDC about testing for HRTV infections, were screened for recent onset of fever with leukopenia and thrombocytopenia. A questionnaire was administered to collect data on demographics, risk factors, and signs and symptoms; blood samples were tested for the presence of HRTV RNA and neutralizing antibodies.

Of 85 individuals enrolled and tested, 16 (19%) had evidence of acute HRTV infection, 1 (1%) had past infection, and 68 (80%) had no infection. Patients with acute HRTV disease were residents of 7 states, 12 (75%) were male, and median age was 71 years (range: 43–80 years). Illness onset occurred from April to September. The majority reported fatigue, anorexia, nausea, headache, confusion, arthralgia, or myalgia. Fourteen (88%) cases were hospitalized; 2 (13%) died. Fourteen (88%) participants reported an attached tick in the 2 weeks prior to illness onset. HRTV-infected individuals were significantly older ($P<0.001$) and more likely to report an attached tick ($P=0.03$) than uninfected individuals.

Healthcare providers should consider HRTV disease testing in patients with an acute febrile illness with either leukopenia or thrombocytopenia not explained by another condition or were suspected to have a tick-borne disease but did not improve following appropriate treatment. Staples et al. *Open Forum Infectious Diseases*, ofaa125, https://doi.org/10.1093/ofid/ofaa125.

Lone Star ticks and Bourbon virus antibodies in deer in North Carolina suggests humans may be at risk

Indirect Evidence of *Bourbon Virus (Thogotovirus, Orthomyxoviridae)* Infection in North Carolina

To the Editor—Bourbon virus *(Thogotovirus, Orthomyxoviridae)* was discovered in 2014 when a patient with history of multiple tick bites in Kansas died from an unknown infection. Human infections from Bourbon virus have now been recognized in several states (i.e., Kansas, Oklahoma, Missouri). The virus was detected in collections of the lone star tick *(Amblyomma americanum)* in Missouri. A serosurvey of domestic and wild mammals in Missouri noted the presence of Bourbon virus-neutralizing antibodies in serum samples collected from a variety of species, but most frequently in white-tailed deer *(Odocoileus virginianus)* and raccoon *(Procyon lotor)*. We report here that neutralizing antibodies against Bourbon virus were detected in white-tailed deer in North Carolina, suggesting that the virus is present in the state. We screened 32 white-tailed deer for the presence of Bourbon virus-specific neutralizing antibodies. Of 20 plasma samples that reacted with the virus, 18 were confirmed with neutralizing antibody titers ranging from 10 to ≥ 320 for a seroprevalence rate of 56% (95% confidence interval 39%–72%). The seropositive samples were from deer killed during the 2014 hunting season from Stanly and New Hanover counties.

The incidence of Bourbon virus infection in humans in North Carolina is unknown. However, given the abundance of the lone star tick in the state, and the notable proportion of deer with evidence of infection, human infections have likely gone unnoticed or possibly misdiagnosed. Human infection with Bourbon virus results in a nonspecific viral syndrome that includes fever, nausea, diarrhea, myalgia (muscle pain), arthralgia (joint pain), leucopenia (low white blood cell count), and thrombocytopenia (low blood platelet count). The illness resembles that caused by bacterial infections such as rickettsioses, ehrlichiosis, and anaplasmosis, but is nonresponsive to antibiotic therapy. It is also similar to the disease syndrome caused by Heartland virus, which was detected indirectly in's a serosurvey of these same white-tailed deer and directly from an ill patient in North Carolina. Health care providers should consider Bourbon and Heartland virus testing in patients presenting with an acute febrile illness with either leukopenia or thrombocytopenia not explained by another condition, or who were suspected to have a bacterial disease but did not improve following appropriate treatment (e.g., doxycycline). Testing can be obtained by sending acute and convalescent serum samples to the state public health laboratory, which can arrange for testing at the Centers for Disease Control and Prevention Arbovirus Diagnostic Laboratory in Fort Collins, Colorado.

The natural history of Bourbon virus is not fully understood. However, the pattern of human cases occurring in May and June suggests that risk to humans is largely based on transmission from the adult stages of the lone star tick. Adult lone star ticks typically feed on larger animals during spring and early summer and use vertebrate blood to nourish several thousand eggs. These eggs are laid on vegetation and when heat and humidity reach acceptable levels in July and August, they hatch into miniscule six-legged larvae. The almost invisible larvae feed on small and large mammals in late summer before transforming into eight-legged nymphs the size of a pinhead, just a few millimeters in diameter. Host-seeking nymphs are found throughout the year (except for the coldest months of winter, when they are inactive). Nymphs morph into adults shortly after feeding on mammalian blood. viruses are typically transmitted transstadially within the tick, but not transovarially (from the tick to its offspring). Therefore, it is expected that a larva feeding on an infectious host may become infected and subsequently remain infected as a nymph and an adult but fail to infect its offspring.

Because the virus is likely transmitted by infected ticks, prevention depends on using insect repellents, wearing long sleeves and pants, avoiding bushy and wooded areas, and performing tick checks after spending time outdoors. Future research is needed to assess geographic distribution of Bourbon virus infection risk and to understand the clinical spectrum of disease, including determination of whether asymptomatic infections can occur. Komar et al. North Carolina Medical Journal May 2020, 81 (3) 214-215; DOI: https://doi.org/10.18043/ncm.81.3.214. (This is the entire text. References available at the link.)

The Elusive Understanding of Lyme Disease in Non-Endemic Geographic Areas: An Exploratory Survey of Patients with Chronic Symptoms in Texas

This study was designed to determine the quality of life, diagnostic, and illness-related experiences of patients who self-report a diagnosis with Lyme disease (LD) and/or who are experiencing chronic illness in Texas, a state considered non-endemic for illness. This exploratory study found that self-reported LD respondents have multisystem health problems that result in very poor quality of life. Lyme disease respondents experience multiple and severe symptoms, particularly flu-like illness, extreme fatigue, back and neck pain, and anxiety and depression. These symptoms were present at similar levels among all LD respondents, whether their diagnosis was clinical or serological. For all LD respondents, this study points to quality of life experiences that are powerfully negative.

Practitioners and disease surveillance experts may consider LD when multisystem symptoms are severe, other etiologies are ruled out, and quality of life is threatened. Maxwell SP. Journal of Patient Experience:1-6 2020.

◘◘ National Section ◘◘

25% of black legged tick nymphs were positive for the Lyme disease bacteria in this Pennsylvania area

A 4-Yr Survey of the Range of Ticks and Pathogens in the Lehigh Valley Region of Eastern Pennsylvania

Questing ticks were surveyed by dragging in forested habitats within the Lehigh Valley region of eastern Pennsylvania for four consecutive summers (2015–2018). A high level of inter-annual variation was found in the density of blacklegged tick nymphs, *Ixodes scapularis* Say, with a high density of host-seeking nymphs (DON) in summer 2015 and 2017 and a relatively low DON in summer 2016 and 2018. Very few American dog ticks (*Dermacentor variabilis* Say) and *Ixodes cookei* Packard were collected. Lone star ticks (*Amblyomma americanum* L.) and longhorned ticks (*Haemaphysalis longicornis* Neumann) were not represented among the 6,398 ticks collected.

For pathogen surveillance, DNA samples from 1,721 *I. scapularis* nymphs were prepared from specimens collected in summers 2015–2017 and screened using qPCR, high resolution melting analysis, and DNA sequencing when necessary.

The overall 3-yr nymphal infection prevalence of *Borrelia burgdorferi* was 24.8%, *Borrelia miyamotoi* was 0.3%, *Anaplasma phagocytophilum* variant-ha was 0.8%, and *Babesia microti* was 2.8%. Prevalence of coinfection with *B. burgdorferi* and *B. microti* as well as *B. burgdorferi* and *A. phagocytophilum* variant-ha were significantly higher than would be expected by independent infection. *B. burgdorferi* nymphal infection prevalence is similar to what other studies have found in the Hudson Valley region of New York, but levels of *B. microti* and *A. phagocytophilum* variant-ha nymphal infection prevalence are relatively lower. This study reinforces the urgent need for continued tick and pathogen surveillance in the Lehigh Valley region. Edwards MJ, et al. *Journal of Medical Entomology*, Volume 56, 1122–1134, https://www.lvhn.org/conditions/lyme-disease.

CDC study on hospital cost of Lyme disease for the 2,823 cases identified extrapolated to US population- ~$26,000,000 annually

Epidemiology and cost of Lyme disease-related hospitalizations among patients with employer-sponsored health insurance—United States, 2005–2014

An estimated 300,000 cases of Lyme disease occur in the United States annually. Disseminated Lyme disease may result in carditis, arthritis, facial palsy or meningitis, sometimes requiring hospitalization. We describe the epidemiology and cost of Lyme disease-related hospitalizations…

Of 20,983,165 admission records contained in the inpatient databases during the study period, 2,823 (0.01%) met inclusion criteria for Lyme disease-related hospitalizations. Over half of the identified records contained an ICD-9-CM code for meningitis (*n* = 614), carditis (*n* = 429), facial palsy (*n* = 400) or arthritis (*n* = 377). Nearly 60% of hospitalized patients were male.
The median cost per Lyme disease-related hospitalization was $11,688… Based on extrapolation to the U.S. population, we estimate that 2,196 Lyme disease-related hospitalizations in persons under 65 years of age occur annually with an estimated annual cost of $25,826,237. Lyme disease is usually treated in an outpatient setting; however, some patients with Lyme disease require hospitalization, underscoring the need for effective prevention methods to mitigate these serious cases. Information from this analysis can aid economic evaluations of interventions that prevent infection and advances in disease detection. Schwartz AR.et al. Zoonoses and Public Health, doi.org/10.1111/zph.12699.

The rickettsia lone star ticks carry (*Rickettsia amblyommatis*) appears to be making people symptomatic

New Jersey-Wide Survey of *Rickettsia* (Proteobacteria: Rickettsiaceae) in *Dermacentor variabilis* and *Amblyomma americanum* (Acari: Ixodida: Ixodidae)

For the last decade, the New Jersey (NJ) Department of Health has reported between 42 and 144 new cases each year of "spotted fever group rickettsiosis" (SFGR), a statistic that reflects uncertainty regarding which rickettsial agents (Proteobacteria: Rickettsiaceae: *Rickettsia*) are infecting NJ residents.

To identify the *Rickettsia* circulating in NJ ticks, we used a combination of conventional and qPCR approaches to screen 560 *Dermacentor variabilis* Say and 245 *Amblyomma americanum* L. obtained from a 1-day state-wide surveillance in May 2018 and an additional 394 *D. variabilis* collected across NJ in 2013–2018. We found zero *D. variabilis* infected with *Rickettsia rickettsii*, the agent of Rocky Mountain spotted fever and, on average, 1.3% infected with presumed nonpathogenic *Rickettsia montanensis*. We also found zero *A. americanum* infected with *R. rickettsii*, and 20% infected with *Rickettsia amblyommatis*, a prevalence somewhat lower than in more southern states.

Overall, we conclude that it is unlikely that *R. rickettsii* vectored by *D. variabilis* is a primary cause of SFGR cases in NJ and discuss our findings in the context of known facts and current limitations. We conclude that understanding the causes of SFGR east of the Mississippi will require collaboration among medical doctors, public health authorities, and medical entomologists to follow up presumptive human cases of SFGR with detailed histories of exposure, species-specific molecular assays, and active surveillance of putative vectors and the pathogens they may carry. Occi J, et al. The American Journal of Tropical Medicine and Hygiene, doi.org/10.4269/ajtmh.20-0145.

Strain-specific joint invasion and colonization by Lyme disease spirochetes is promoted by outer surface protein C

Infection by different Lyme disease bacteria is associated with different manifestations, such as cardiac, neurologic, or, in the case of *B. burgdorferi*, the major cause of Lyme disease in the U.S., joint disease. The basis for these differences is unknown, but likely involve strain-specific interactions with host components in the target tissue. The sequence of the outer surface lipoprotein OspC varies with the strains, and we found that this variation influences the spectrum of host extracellular matrix components recognized.
Infection of mice with strains that are identical except for *ospC* revealed that OspC variants that differ in binding spectrum promote infection of different tissues. A strain producing OspC invaded and colonized the joint in living animals, but an altered OspC protein incapable of binding tissue components did not. Thus, tissue-binding by OspC is critical for infection and joint invasion, and OspC variation directly influences tissue tropism.

- We conclude that OspC functions as an ECM-binding adhesin that is required for joint invasion, and that variation in OspC sequence contributes to strain-specific differences in tissue tropism displayed among Lyme disease spirochetes. Lin Y, et al. PLoS Pathogens, doi.org/10.1371/journal.ppat.1008516.

Tick and Tick-borne Pathogen Surveillance as a Public Health Tool in the United States

In recent decades, tick-borne disease (TBD) cases and established populations of medically important ticks have been reported over expanding geographic areas, and an increasing number of tick-borne bacteria, viruses, and protozoans have been recognized as human pathogens, collectively contributing to an increasing burden of TBDs in the United States.

The prevention and diagnosis of TBDs depend greatly on an accurate understanding by the public and healthcare providers of when and where persons are at risk for exposure to human-biting ticks and to the pathogens these ticks transmit. However, national maps showing the distributions of medically important ticks and the presence or prevalence of tick-borne pathogens are often incomplete, outdated, or lacking entirely. Similar deficiencies exist regarding geographic variability in host-seeking tick abundance. Efforts to accurately depict acarological risk are hampered by lack of systematic and routine surveillance for medically important ticks and their associated human pathogens.

In this review, we: 1) outline the public health importance of tick surveillance; 2) identify gaps in knowledge regarding the distributions and abundance of medically important ticks in the United States and the presence and prevalence of their associated pathogens; 3) describe key objectives for tick surveillance and review methods appropriate for addressing those goals; and 4) assess current capacity and barriers to implementation and sustainability of tick surveillance programs. Eisen and Paddock, Journal of Medical Entomology, XX(X), 2020, 1–13 https://academic.oup.com/jme/advance-article/doi/10.1093/jme/tjaa087/5841916. Entire article free of charge.

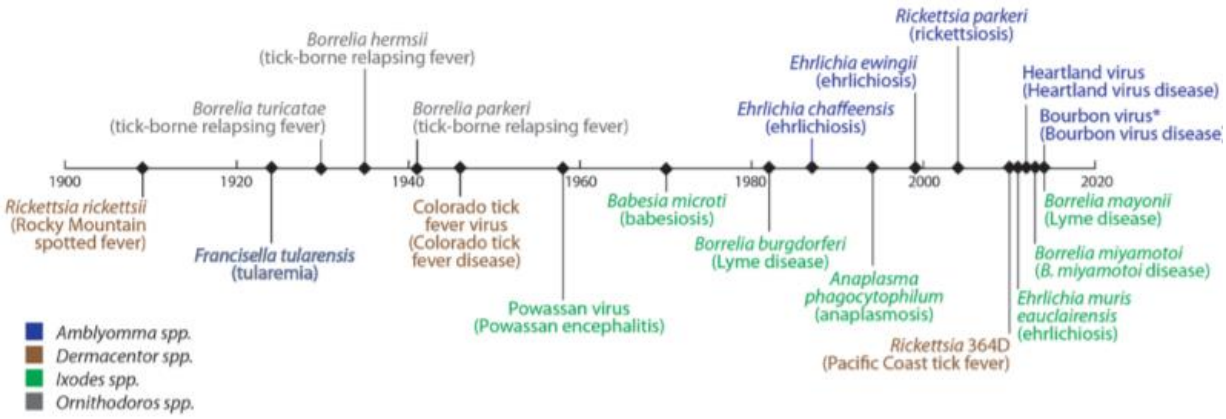


Fig. 1. Discovery of tickborne pathogens as causes of human disease in the United States, 1900 to present.

After decades of suburban deer research and management in the eastern United States: where do we go from here?

State wildlife agencies have regulatory authority and oversight over deer (Cervidae) management in the United States. However, increased urban sprawl and overabundant deer populations have created increased human–deer conflicts. Because of the growing controversy surrounding the use of traditional management practices such as regulated hunting in suburban areas in the eastern United States, managers are now using specialized tools and management approaches to reduce deer conflicts in urban areas. However, this has created new challenges as they try to meet the desires of diverse stakeholder groups. Although deer management programs in urban areas differ somewhat in every state, effective management options remain limited.

Essentially the same management tools that were used for 3 decades have not changed, even with substantial investments in deer research. Despite public support for deer fertility control, it is still largely experimental and expensive. Immunocontraceptive vaccines are seldom used because of the cost and difficulty of retreating free-ranging deer. Surgical sterilization of deer has shown promise, but the scale of application remains limited by cost and the number of deer that need to be handled. Lethal deer removal remains the only method that has consistently reduced deer numbers in an acceptable time frame at multiple scales. Even in areas where urban deer numbers have been substantially reduced using lethal methods, the resulting effects on deer populations and human–deer conflicts have been poorly documented.

In highly fragmented, developed landscapes, removing enough deer to demonstrate impact reduction has been a difficult and expensive process. It usually takes multiple approaches across several years to achieve desired results. Thus, the lack of long-term planning and sufficient budgets needed to sustain management efforts may impede overall program success and sustainability. Herein, I review the lessons learned from multiple deer research and management efforts from suburban areas in the eastern United States and highlight potential directions for future urban deer management programs. Curtis PD, Human–Wildlife Interactions 14(1):111–128, Spring 2020 • digitalcommons.usu.edu/hwi. Entire article free of charge. **https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1627&context=hwi**

Lone star ticks, American dog tick, and several other ticks familiar in the lower 48 states have recently been found in Alaska not related to travel

Establishing a baseline for tick surveillance in Alaska: Tick collection records from 1909-2019

The expanding geographic ranges of tick species that are known pathogen vectors can have implications for human, domestic animal, and wildlife health. Although Alaska is home to several hard tick species, it has historically been outside of the range of the most common medically important ticks in the contiguous United States and western Canada. To assess the status of tick species establishment in the state and to provide a baseline for tracking future change in the distribution of ticks, we reviewed and compiled historical tick records and summarized recent tick occurrence records collected through the development of the Alaska Submit-A-Tick Program and through tick drag sampling at sentinel sites in southcentral Alaska.

Between 1909-2019, there were 1,190 tick records representing 4,588 individual ticks across 15 species in Alaska. The majority of ticks were species historically found in Alaska: *Haemaphysalis leporispalustris*, *Ixodes angustus*, *Ixodes auritulus*, *Ixodes howelli*, *Ixodes signatus*, and *Ixodes uriae*. Over half of all tick records in the state were collected in the last 10 yr. During this time, the number of tick records and the number of tick species recorded in Alaska each year has increased substantially. Between 2010-2019, there were 611 tick records representing 1,921 individual ticks. The most common hosts for reported ticks were domestic animals (n = 343, 56%) followed by small wild mammals (n = 147, 24%), humans (n = 49, 8%), and wild birds (n = 31, 5%). Less than 5% of records (n = 25) were of unattached ticks found in the environment.

Since 2007, non-native tick species have been documented in the state every year, including *Amblyomma americanum*, *Dermacentor andersoni*, *Dermacentor occidentalis*, *Dermacentor variabilis*, *Ixodes pacificus*, *Ixodes ricinus*, *Ixodes scapularis*, *Ixodes texanus*, and *Rhipicephalus sanguineus* sensu lato (s.l.). Almost half of the records (n = 68, 48%) of non-native tick species from 2010-2019 represented ticks found on a host (usually a dog or a human) that had traveled outside of Alaska in the two weeks prior to collection. However, *A. americanum*, *D. variabilis*, *I. pacificus*, *I. texanus*, and *R. sanguineus* s.l. have been found on humans and domestic animals in Alaska without reported recent travel. In particular, there is evidence to suggest that there is local establishment of *R. sanguineus* s.l. in Alaska. A tick species historically found in the state, *I. angustus* was frequently found on human and dogs, suggesting a potential role as a bridge vector of pathogens. Given the inconsistency of tick monitoring in Alaska over the past century, it is difficult to draw many conclusions from temporal trends in the data. Continued monitoring through the Alaska Submit-A-Tick Program will allow a more accurate assessment of the changing risk of ticks and diseases in the state and provide information for setting clinical and public health guidelines for disease prevention.

Hahn MB.et al. Ticks and Diseases**,** doi.org/10.1016/j.ttbdis.2020.

https://www.adfg.alaska.gov/index.cfm?adfg=wildlifenews.view_article&articles_id=557

Benefits and Drawbacks of Citizen Science to Complement Traditional Data Gathering Approaches for Medically Important Hard Ticks (Acari: Ixodidae) in the United States

Tick-borne diseases are increasing in North America. Knowledge of which tick species and associated human pathogens are present locally can inform the public and medical community about the acarological risk for tick bites and infections.

… Citizen science is particularly useful to generate information on human–tick encounters and may also contribute to geographical tick records to help define species distributions across large areas. Previous citizen science projects have utilized three distinct tick record data gathering methods including submission of:

1) physical tick specimens for identification by professional entomologists
2) digital images of ticks for identification by professional entomologists
3) data where the tick species and life stage were identified by the citizen scientist.

We explore the benefits and drawbacks of citizen science, relative to the traditional scientific approach, to generate data on tick records, with special emphasis on data quality for species identification and tick encounter locations. We recognize the value of citizen science to tick research but caution that the generated information must be interpreted cautiously with data quality limitations firmly in mind to avoid misleading conclusions. Eisen and Eisen. *Journal of Medical Entomology*, doi.org/10.1093/jme/tjaa165.

Stemming the Rising Tide of Human-Biting Ticks and Tick-borne Diseases, United States

Discouraging but at least the topic is getting recognition

To the Editor: We agree with Eisen (*1*) that …
Last, we caution that managing ticks in residential situations (as opposed to high-risk public open spaces and trails) is fraught with technical and public relations challenges, legal issues, and likely insurmountable funding demands (*4*,*5*). The complex array of environmental and social factors contributing to the increase in tick-borne disease cases (e.g., forest management practices, climate change, land use, and an aging population) is frankly beyond the scope of any individual VCA to address without higher-level (state and federal) coordination.
A proactive approach with higher-level coordination will help manage tick-borne disease. To give VCAs the best chance to combat tick-borne disease, they must be adequately and sustainably funded to manage mosquitoes and ticks, even during years of fiscal challenge. Egizi & Jordan, Emerging Infectious Diseases, https://whttps://wwwnc.cdc.gov/eid/article/26/10/20-1271_articlewwnc.cdc.gov/eid/article/26/10/20-1271_article. Entire letter free of charge.

Discouraging finding: the European blacklegged tick was found out to 5800 feet in this study, plus prevalence of pathogens

Ticks climb the mountains: Ixodid tick infestation and infection by pathogens in the Western Alps

In mountain areas of northwestern Italy, ticks were rarely collected in the past. In recent years, a marked increase in tick abundance has been observed in several Alpine valleys, together with more frequent reports of Lyme borreliosis. We then carried out a four-year study to assess the distribution and abundance of ticks and transmitted pathogens and determine their altitudinal limit in a natural park area in Piedmont region.

Ixodes ricinus and *Dermacentor marginatus* were collected from both the vegetation and hunted wild ungulates. Tick abundance was significantly associated with altitude, habitat type and signs of animal presence, roe deer's in particular. *Ixodes ricinus* prevailed in distribution and abundance and, although their numbers decreased with increasing altitude, we recorded the presence of all active life stages of up to around 1700 m a.s.l., with conifers as the second most infested habitat after deciduous woods.

Molecular analyses demonstrated the infection of questing *I. ricinus* nymphs with *B. burgdorferi* sensu lato (15.5 %), *Rickettsia helvetica* and *R. monacensis* (20.7 %), *Anaplasma phagocytophilum* (1.9 %), *Borrelia miyamotoi* (0.5 %) and *Neoehrlichia mikurensis* (0.5 %). One third of the questing *D. marginatus* were infected with *R. slovaca.* We observed a spatial aggregation of study sites infested by *B. burgdorferi* s.l. infected ticks below 1400 m. *Borrelia*-infected nymphs prevailed in open areas, while SFG rickettsiae prevalence was higher in coniferous and deciduous woods.

Interestingly, prevalence of SFG rickettsiae in ticks doubled above 1400 m, and *R. helvetica* was the only pathogen detected above 1800 m a.s.l. Tick infestation on hunted wild ungulates indicated the persistence of tick activity during winter months and, when compared to past studies, confirmed the recent spread of *I. ricinus* in the area.

Our study provides new insights into the population dynamics of ticks in the Alps and confirms a further expansion of ticks to higher altitudes in Europe. We underline the importance of adopting a multidisciplinary approach in order to develop effective strategies for the surveillance of diseases, and inform the public about the hazard posed by ticks, especially in recently invaded areas. Garcia-Vozmediano A, Ticks and Diseases, Volume 11, Issue 5, 2020. doi.org/10.1016/j.ttbdis.2020.101489.

Bartonella species in medically important mosquitoes, Central Europe

Here, we provide the first mass molecular screening of medically important mosquitoes for Bartonella species using multiple genetic markers. We examined a total of 72,115 mosquito specimens, morphologically attributed to Aedes vexans (61,050 individuals), Culex pipiens (10,484 individuals) and species of the Anopheles maculipennis complex (581 individuals) for Bartonella spp.

The initial screening yielded 63 Bartonella-positive A. vexans mosquitoes (mean prevalence 0.1%), 34 Bartonella-positive C. pipiens mosquitoes (mean prevalence 0.3%) and 158 Bartonella-positive A. maculipennis group mosquitoes (mean prevalence 27.2%). Several different Bartonella ITS sequences were recovered. This study highlights the need for molecular screening of mosquitoes, the most important vectors of arthropod-borne pathogens, for potential bacterial agents. Rudolf I et al. Parasitology Research, 2020. doi.org/10.1007/s00436-020-06732-1.

Significantly shorter transmission time for pathogens were demonstrated in laboratory experiments by interrupted blood feeding

Interrupted Blood Feeding in Ticks: Causes and Consequences

Ticks are obligate hematophagous arthropods and act as vectors for a great variety of pathogens, including viruses, bacteria, protozoa, and helminths. Some viruses, such as Powassan virus and encephalitis virus, are transmissible within 15–60 min after tick attachment. However, a minimum of 3–24 h of tick attachment is necessary to effectively transmit bacterial agents such as *Ehrlichia* spp., *Anaplasma* spp., and *Rickettsia* spp. to a new host. Longer transmission periods were reported for *Borrelia* spp. and protozoans such as *Babesia* spp., which require a minimum duration of 24–48 h of tick attachment for maturation and migration of the pathogen. Laboratory observations indicate that the probability of transmission of pathogens increases with the duration an infected tick is allowed to remain attached to the host.

However, the transmission time may be shortened when partially fed infected ticks detach from their initial host and reattach to a new host, on which they complete their engorgement. For example, early transmission of pathogens (e.g., *Rickettsia rickettsii*, *Borrelia burgdorferi*, and *Brucella canis*) and a significantly shorter transmission time were demonstrated in laboratory experiments by interrupted blood feeding. The relevance of such situations under field conditions remains poorly documented. In this review, we explore parameters of, and causes leading to, spontaneous interrupted feeding in nature, as well as the effects of this behavior on the minimum time required for transmission of pathogens. Tahir D, et al. *Microorganisms* **2020**, *8*, 910; doi:10.3390/microorganisms8060910.

Pathogens Manipulating Tick Behavior—Through a Glass, Darkly

Pathogens can manipulate the phenotypic traits of their hosts and vectors, maximizing their own fitness. Among the phenotypic traits that can be modified, manipulating vector behavior represents one of the most fascinating facets. How pathogens infection affects behavioral traits of key insect vectors has been extensively investigated…

This review focuses on current knowledge about the behavioral changes triggered by Anaplasma, Borrelia, Babesia, Bartonella, Rickettsia and encephalitis virus (TBEV) infection in tick vectors, analyzing their potential adaptive significance. As a general trend, being infected by Borrelia and TBEV boosts tick mobility (both questing and walking activity). Borrelia and Anaplasma infection magnifies Ixodes desiccation resistance, triggering physiological changes (Borrelia: higher fat reserves; Anaplasma: synthesis of heat shock proteins). Anaplasma infection also improves cold resistance in infected ticks through synthesis of an antifreeze glycoprotein. Being infected by Anaplasma, Borrelia and Babesia leads to increased tick survival. Borrelia, Babesia and Bartonella infection facilitates blood engorgement. In the last section, current challenges for future studies are outlined. Benelli, G. Pathogens **2020**, 9, 664; doi:10.3390/pathogens9080664.

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