



Tick-Borne Infections Council
of North Carolina, Inc.

NEWSLETTER 2017, Volume 1



Quote of the season: “Ticks from a laboratory colony are genetically distinct from wild populations, underscoring the need to account for natural variation when conducting transmission or immunological studies, many of which utilize laboratory-reared ticks.”
Monzpn et al. Genome Biol Evol (2016)doi: 10.1093/gbe/evw080First published online: April 13, 2016

Highlights...

New state entomologist

Lyme disease bacteria in ticks on the Outer Banks

Children are still dying from RMSF in NC

Tick testing- Does it make sense?

Red meat allergy (alpha gal)- two reports

Scroll down to see these features and more!

State Vector-Borne Disease Working Group 2016 Meeting Schedule

January 27, 2017

May 5, 2017

July 21, 2017

October 20, 2017 (Check with us before going to confirm date as they occasionally change.)

Location:

Office of the Chief Medical Examiner Photo ID required.

4312 District Drive

Raleigh, NC 27607

News About the New State Entomologist- September 2016

From: **Carl Williams, DVM, DACVPM**

State Public Health Veterinarian, Division of Public Health, Communicable Disease Branch

North Carolina Department of Health and Human Services

“Michael Doyle has joined us as the state public health entomologist to help NC address mosquitoes, ticks and other arthropod vectors of disease-causing agents with the goal of reducing transmission of vector-borne diseases through public education and outreach and targeted evidenced based interventions. Michael is coming to NC after having served five years as the executive director of the Florida Keys Mosquito Control District. Prior to that he worked as an entomologist for the Centers for Disease Control and Prevention in Ft. Collins Colorado and Colorado Mosquito Control. Michael received his Master’s degree in entomology from the Colorado State University and his Bachelor’s degree from Albion College. He is a recognized expert in many areas including mosquito surveillance and abatement.”

Mr. Doyle will be working in the Cooper Memorial Health in room 3061.

The Letters to Medical Providers from the State Department of Public Health on Lyme Disease and Rickettsial Diseases can be seen on our website at <http://tic-nc.org/publications/>

Reportable Tick-borne Diseases – Case Numbers

| Disease | Total cases by year of report 2013 Final | Total cases by year of report 2014 Preliminary | 2015 Final |
|---------------|--|---|------------------------|
| | Confirmed + Probable (Confirmed/Probable/Suspected) | Confirmed + Probable (Confirmed/Probable/Suspected)* | (Probable/Confirmed)** |
| Lyme disease | 180 (39/141/89) | 170 (27/143/86) | 192/38 |
| Rickettsioses | 426 (11/415/193) | 496 (10/486/278) | 454/5 |
| Ehrlichioses | 78 (24/54/22) | 73 (11/62/31) | 58/16 |
| Anaplasmoses | 15 (1/14/14) | 12 (0/12/12) | 15/4 |

*This is the year of report, not year of illness onset

** Illness onset may be prior to 1/1/16

Note: Six counties now have 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 are now declared endemic for Lyme disease: Wake, Guilford, Haywood, Alleghany, Buncombe, and Wilkes)**

Counties with one case of locally acquired Lyme disease: Cleveland (2008), Wilson (2009), Pitt (2009), Carteret (2009), Gates (2011), Perquimans (2011), Rowan (2013), Union (2013), Caldwell (2013), Franklin (2014), Stanley (2014), Duplin (2014).

| |
|--|
| <p>TIC-NC Talks and Materials Distributed</p> <p>Brochures: South Carolina Mosquito Control Association One Medicine Symposium</p> <p>Talks: South Carolina Mosquito Control Association NC Mosquito and Vector Control Association</p> |
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CDC: Lyme disease (*Borrelia burgdorferi*) 2011 Case Definition

“This surveillance case definition was developed for national reporting of Lyme disease; **it is not intended to be used in clinical diagnosis.**” The entire definition is at:

www.cdc.gov/nndss/conditions/lyme-disease/case-definition/2011/ It is confusing because the CDC teaches that the definition should be used for diagnosis.

A new definition takes effect in 2017. Further details on this will be in the next newsletter.

How Counties Investigate Communicable Disease Reports They Receive (Labs and Providers): Report from the State

“Each county/district has a communicable disease nurse. The responsibility for investigation is through each health director and is normally delegated to the communicable disease nurse. Depending on the type of investigation, the state CD Branch can assist and provide consultation. With this said, each county develops their own policy related to communicable disease investigation. We have validated that all counties have developed such policies. We did provide templates for those counties who did not have polices and placed those templates on the NC Communicable Disease Manual. Some counties chose to adopt the templates as their own and some did not.

Most physicians when they report use only the Part 1 form and then the CD nurses collect additional information. Nurses are trained to ask open-ended questions. Travel questions are open ended. Did you travel? Or did you travel within the past 30 days from onset of the EM rash. I have seen travel recorded for out of the country in NCEDSS (North Carolina Electronic Disease Surveillance System).”

You can see the templates by clicking into the link on the CD Manual:

<http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/toc.html>

The specific section of the manual that lists the templates is as follows:

<http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/sample.html>

Information from Jodi Reber, RN, Communicable Disease Nurse Consultant, Division of Public Health, Communicable Disease Branch, North Carolina Department of Health and Human Services, fall 2016

»» TIC-NC Activities »»

TIC-NC is helping with a survey on experience with ticks and tick-borne diseases conducted by the Chatham County Health Department among the persons involved with the local community college population. We view this as a pilot study and hope it will lead to a larger one as there are no good epidemiological data in this region on the burden of tick-borne diseases and other associated issues. The results will be available in late spring. We hope to publish the findings.

Plans for several presentations are underway in local schools and communities.

A letter to our approximately 500 members will be mailed soon. The purpose is to report on our activities from 2012 to 2016, to ask for donations, and to update our database of addresses and emails.

The Lyme disease bacteria, *B. burgdorferi* sensu stricto, is endemic in questing Blacklegged and mammalian tick hosts on the NC Outer Banks

Stable Transmission of *Borrelia burgdorferi* Sensu Stricto on the Outer Banks of North Carolina

The spirochaete (*Borrelia burgdorferi*) associated with Lyme disease was detected in questing ticks and rodents during a period of 18 years, 1991–2009, at five locations on the Outer Banks of North Carolina. The black-legged tick (*Ixodes scapularis*) was collected at varied intervals between 1991 and 2009 and examined for *B. burgdorferi*. The white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*) marsh rice rat (*Oryzomys palustris*), marsh rabbit (*Sylvilagus palustris*), eastern cottontail (*Sylvilagus floridanus*) and six-lined racerunner (*Cnemidophorus sexlineatus*) were live-trapped, and their tissues cultured to isolate spirochaetes.

Borrelia burgdorferi isolates were obtained from questing adult *I. scapularis* and engorged *I. scapularis* removed from *P. leucopus*, *O. palustris* and *S. floridanus*. The prevalence of *B. burgdorferi* infection was variable at different times and sites ranging from 7 to 14% of examined questing *I. scapularis*. Mitochondrial (16S) rRNA gene phylogenetic analysis from 65 adult *I. scapularis* identified 12 haplotypes in two major clades. Nine haplotypes were associated with northern/Midwestern *I. scapularis* populations and three with southern *I. scapularis* populations. Sixteen isolates obtained from tick hosts in 2005 were confirmed to be *B. burgdorferi* by amplifying and sequencing of 16S rRNA and 5S-23S intergenic spacer fragments. The sequences had 98–99% identity to *B. burgdorferi* sensu stricto strains B31, JD1 and M11p.

Taken together, these studies indicate that *B. burgdorferi* sensu stricto is endemic in questing *I. scapularis* and mammalian tick hosts on the Outer Banks of North Carolina. Apperson et al. *Zoonoses and Public Health*, online 2016 Dec 14. <http://doi.org/10.1111/zph.12302>

Children Are Still Dying from RMSF—A Study from Winston-Salem

Retrospective Study of Rocky Mountain Spotted Fever in Children

Rocky Mountain spotted fever (RMSF), a lethal tick-borne illness, is prevalent in the south central United States. Children younger than 10 years old have the greatest risk of fatal outcome from RMSF. A retrospective review was performed of inpatient dermatology consultations at a tertiary care center in North Carolina from 2001 to 2011.

A total of 3,912 consultations were conducted in the dermatology service over 10 years. Six patients with RMSF, ranging in age from 22 months to 10 years (mean 5.1 years), were evaluated during April, May, and June. All preconsultation diagnoses included RMSF in the differential diagnosis. All patients underwent skin biopsies, and a culture was obtained in one case. Fifty percent of patients died within 4 days of hospitalization.

Variables associated with mortality from RMSF are delayed diagnosis and initiation of antirickettsial therapy. Physicians should consider RMSF in children presenting with fever and rash during the

summer months. Dermatology consultation is useful in evaluating patients with suspicious clinical features of RMSF with skin findings. Tull et al. Pediatric Dermatology, Dec. 2016, DOI: 10.1111/pde.1305

Lyme disease bacteria not found in teaching forest in Florida, however, only a small number of ticks were tested

Borrelia burgdorferi DNA absent, multiple Rickettsia spp. DNA present in ticks collected from a teaching forest in North Central Florida

Tick-borne diseases are an emerging public health threat in the United States. In Florida, there has been public attention directed towards the possibility of locally acquired *Borrelia burgdorferi sensu stricto*, the causative agent of Lyme disease, in association with the lone star tick. The aim of this study was to determine the prevalence of ticks and the pathogens they carry and potentially transmit, such as *B. burgdorferi*, in a highly utilized teaching and research forest in North Central Florida. Ticks were collected by dragging and flagging methods over a four month period in early 2014, identified, and tested by PCR for multiple pathogens including *Anaplasma*, *Borrelia*, *Rickettsia*, and *Ehrlichia* species. During the study period the following ticks were collected: 2506 (96.5%) *Amblyomma americanum* L., 64 (2.5%) *Ixodes scapularis* Say, 19 (0.7%) *Dermacentor variabilis* Say, and 5 (0.2%) *Ixodes affinis* Neuman. Neither *Borrelia* spp. (0/846) nor *Anaplasma* spp. (0/69; *Ixodes* spp. only) were detected by PCR in any of the ticks tested. However, *Rickettsia* DNA was present in 53.7% (86/160), 62.5% (40/64), 60.0% (3/5) and 31.6% (6/19) of *A. americanum*, *I. scapularis*, *I. affinis* and *D. variabilis*, respectively. Furthermore, *E. chaffeensis* and *E. ewingii* DNA were detected in 1.3% and 4.4% of adult *A. americanum* specimens tested, respectively. Although receiving an *A. americanum* bite is likely in wooded areas in North Central Florida due to the abundance of this tick, the risk of contracting a tick-borne pathogen in this specific area during the spring season appears to be low. The potential for pathogen prevalence to be highly variable exists, even within a single geographical site and longitudinal studies are needed to assess how tick-borne pathogen prevalence is changing over time in North Central Florida. Saylor et al. Ticks and Tick-borne Diseases. 2016 Sep 24.

▣▣ National Section ▣▣

Tick Testing- Does It Make Sense?

Here at TIC-NC we occasionally get calls from people who have had a tick bite, who have correctly kept the tick, and want to get the tick tested for possible pathogens. While it is an individual decision, it is important to keep in mind that the tests are not perfect. And, they are expensive. If a tick is found positive for one or more pathogens, it does not prove that the pathogen was transmitted to the victim. Of course, the longer it is attached the more likely that that can happen. If the tests are negative, it does not prove with 100% assurance that no pathogen was transmitted. Second, there may be a pathogen that the companies are not testing for, is unknown, or has no test (for example, STARI). You can see in the table below that the testing labs posted by the University of Rhode Island are focused on pathogens in the Northeast.

Tick Testing Labs Capabilities



| | Lyme | Babesia | Anaplasma |
|---|------|---------|-----------|
| UMASS Laboratory of Medical Zoology info@tickreport.com http://www.tickreport.com | ✓ | ✓ | ✓ |
| Imugen, Inc. (781) 255-0770 Learn More | ✓ | ✓ | |
| Analytical Services, Inc. (ASI) (800) 723-4432 Learn More | ✓ | | |
| CT Pathology Laboratories (860) 450-1823 Learn More | ✓ | ✓ | ✓ |
| Connecticut Veterinary Medical Diagnostic Laboratory (860) 486-3738 Learn More | ✓ | ✓ | ✓ |
| TickChek LLC 562 Independence Road, East Stroudsburg, PA 18301 Toll free: 1-866-713-TICK Learn More | ✓ | ✓ | ✓ |

Pathogens in Ticks in NE Missouri

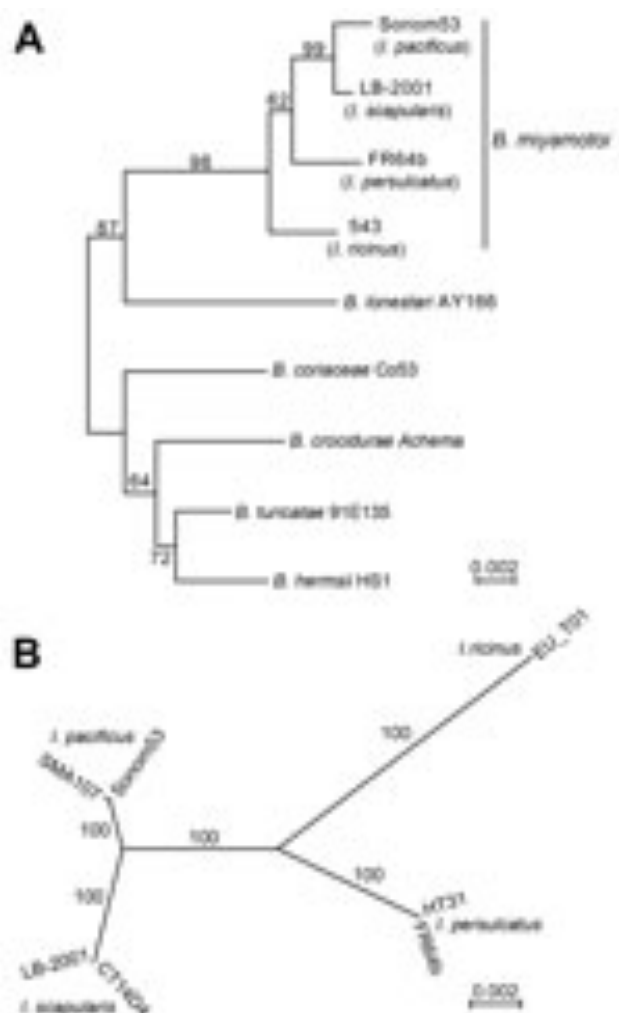
Detection of *Borrelia*, *Ehrlichia*, and *Rickettsia* spp. in ticks in northeast Missouri D.A. Hudman*, N.J. Sargentini A. T. Still University, 800 W. Jefferson St., Kirksville, MO 63501, United States *a r t i c l e i n f o* Article history: Received 29 February 2016 Received in revised form 18 April 2016 Accepted 19 April 2016 Available online 20 April 2016 Keywords: *Amblyomma americanum* *Dermacentor variabilis* Tick-borne agents Missouri *a b s t r a c t* We evaluated *Amblyomma americanum* (lone star tick) and *Dermacentor variabilis* (American dog tick) in northeast Missouri for the presence of *Borrelia*, *Ehrlichia*, and *Rickettsia* bacteria. We collected actively questing ticks from four sites

within Adair County, Missouri. A total of 15,162 ticks were collected, of which 13,980 were grouped in 308 pools (lone star ticks, 288 pools; American dog ticks, 20 pools) and tested for presence/absence of bacteria using polymerase chain reaction. Infection rates were calculated as the maximum likelihood estimation (MLE) with 95% confidence intervals (CI). Of the 308 pools tested, 229 (74.4%) were infected with bacteria and the overall MLE of the infection rate per 100 ticks was calculated as 2.9% (CI 2.661–3.21). Infection rates varied among life stages, 28.6% (CI 23.89–33.97) in adults, 7.0% (CI 5.10–9.86) in nymphs, and 1.0% (CI 0.75–1.20) in larvae. In the 116 adult lone star pools, infection rates were calculated for *Borrelia lonestari* (1.4%), *Borrelia* spp. (2.7%), *Ehrlichia chaffeensis* (6.1%), *Ehrlichia ewingii* (3.3%), *Rickettsia amblyommii* (18.3%), and *Rickettsia montanensis* (0.4%). Infection rates for the 52 nymphal lone star pools were calculated as *B. lonestari* (1.03%), *Borrelia* spp. (0.40%), *E. chaffeensis* (2.02%), *E. ewingii* (0.24%), and *R. amblyommii* (2.70%). In the 20 adult American dog tick pools, infection rates were determined as *E. chaffeensis* (9.47%), *E. ewingii* (5.47%), and *R. montanensis* (8.06%). Eight *Borrelia* samples were sequenced with five 99–100% identical to *B. burgdorferi* (s.l.) and three 99% identical to *B. lonestari*. Eight samples were sequenced for *E. chaffeensis* (all 99–100% identical) and one sample was sequenced for *E. ewingii* (99% identical). Seven samples were sequenced for *Rickettsia* and three were 99% identical to *R. montanensis* and four were 100% identical to *R. amblyommii*. This study demonstrates *B. lonestari*, *E. chaffeensis*, *E. ewingii*, *R. amblyommii*, and *R. montanensis* in northeast Missouri ticks for the first time. Understanding the presence and epidemiology of these causative (*E. chaffeensis* and *E. ewingii*) and suspected (*B. lonestari* and *R. amblyommii*) agents in Missouri should increase awareness of potential tick-borne disease in the medical community. © 2016

Unique Strain of *Borrelia miyamotoi* in *Ixodes pacificus* Ticks, California, USA

Borrelia miyamotoi causes a recently recognized tickborne zoonosis in Eurasia and North America (1). The species has been detected in *Ixodes persulcatus* ticks in Asia and Russia, *I. ricinus* ticks in Europe, and *I. scapularis* and *I. pacificus* ticks in North America. In most of these regions, *B. miyamotoi* is sympatric with Lyme disease agents, such as *B. burgdorferi*, and both pathogens are transmitted locally by the same species of *Ixodes* ticks. *B. miyamotoi* generally is less prevalent than *B. burgdorferi* in nymphs and adults in North America (2), except in California, where the prevalences of the 2 species in populations of nymphal and adult *I. pacificus* ticks are similar...

We determined a rooted neighbor-joining phylogram of 16S ribosomal RNA gene sequences of *B. miyamotoi* from different *Ixodes* species and that of *Amblyomma americanum* tickborne *B. lonestari* (Figure, panel A)... In conclusion, we identified differences in several genetic loci between *B. miyamotoi* in *I. pacificus* ticks and



organism strains associated with other *Ixodes* species. However, we found a close phylogenetic relationship between organisms from the far-western and the northeastern United States.

Cook VJ, et al. Unique strain of *Borrelia miyamotoi* in *Ixodes pacificus* ticks, California, USA [letter]. Emerg Infect Dis. 2016 Dec <http://dx.doi.org/10.3201/eid2212.152046>

Red meat allergy (alpha gal) case from New Hampshire

A Case of Unexplained Shock Following Steak Consumption

INTRODUCTION: Delayed anaphylaxis following red meat consumption is a novel phenomenon in the Southwestern United States. This presentation will illustrate a case of IgE mediated activity against the galactose- α -1,3-galactose (alpha-gal) epitope. This carbohydrate determinant is common in humans and isotype switching to alpha-gal IgE occurs following ectoparasite exposure. First described in 2009, early case reports led to identification of the *Amblyomma americanum*, or lone star tick, as the sensitizing exposure. We present the first reported case of anaphylaxis in New Hampshire from red meat consumption following alpha-gal sensitization.

CASE PRESENTATION: Our patient is a 69-year-old male who presented with an anaphylactic reaction. He has no known allergies or co-morbidities. A history revealed consumption of steak 6 hours before symptom onset of generalized urticaria, angioedema and dyspnea. Treatment included anti-histamines, steroids, and epinephrine. It was later divulged he sustained a tick bite 5 weeks prior to this admission. Further work-up identified a total IgE of 129 kU/L and an elevated alpha-gal IgE of 10 kU/L (normal ≤ 0.34 kU/L). His history and serologic testing allowed us to confirm a diagnosis of delayed anaphylaxis due to a red meat allergy. He made a full recovery, and received follow-up in our Allergy clinic and counseling on red meat avoidance.

DISCUSSION: IgE sensitization to the oligosaccharide alpha-gal following exposure to the lone star tick is described largely in the southeastern United States. After red meat ingestion, a delayed anaphylactic reaction may occur. The diagnosis should be suspected when caring for the patient with anaphylaxis of unclear etiology, and is confirmed using an IgE specific immunoassay.

Treatment in the acute setting is supportive, and long term care includes avoidance of mammalian meats and prevention of further tick exposure.

CONCLUSIONS: This case demonstrates a vector-associated sensitivity leading to delayed anaphylaxis following consumption of mammalian meat. It is the first documented occurrence in our state, supporting the described geographic spread of the lone star tick. Practitioners should maintain this condition on their differential as it becomes increasingly recognized in non-endemic regions. Backer and Carroll. *Chest*. 2016;150(4_S):1139A. doi:10.1016/j.chest.2016.08.1249

New PCR method found average of 2200 Lyme disease spirochetes per nymphal Ixodes scapularis tick in Texas

Validation of droplet digital PCR for the detection and absolute quantification of Borrelia DNA in Ixodes scapularis ticks

SUMMARY We evaluated the QX200 Droplet Digital PCR (ddPCR™, Bio-Rad) system and protocols for the detection of the tickborne pathogens *Borrelia burgdorferi* and *Borrelia miyamotoi* in *Ixodes scapularis* nymphs and adults collected from North Truro, Massachusetts. Preliminary screening by nested PCR determined positive infection levels of 60% for *B. burgdorferi* in these ticks. To investigate the utility of ddPCR as a screening tool and to calculate the absolute number of bacterial genome copies in an infected tick, we adapted previously reported TaqMan®-based qPCR assays for

ddPCR. ddPCR proved to be a reliable means for detection and absolute quantification of control bacterial DNA with precision as low as ten spirochetes in an individual sample. Application of this method revealed the average carriage level of *B. burgdorferi* in infected *I. scapularis* nymphs to be 2291 spirochetes per nymph (range: 230–5268 spirochetes) and 51 179 spirochetes on average in infected adults (range: 5647–115 797). No ticks naturally infected with *B. miyamotoi* were detected. The ddPCR protocols were at least as sensitive to conventional qPCR assays but required fewer overall reactions and are potentially less subject to inhibition. Moreover, the approach can provide insight on carriage levels of parasites within vectors. King et al. *Parasitology*. 2016 Nov 3:1-9. [DOI:10.1017/S0031182016001864]

New *Borrelia* disease examined in a mouse model

Duration of *Borrelia mayonii* infectivity in an experimental mouse model for feeding *Ixodes scapularis* larvae

A novel species within the *Borrelia burgdorferi* sensu lato complex, *Borrelia mayonii*, was recently described and found to be associated with Lyme borreliosis in the Upper Midwest of the United States. The blacklegged tick, *Ixodes scapularis*, is naturally infected with *B. mayonii* in the Upper Midwest and has been experimentally demonstrated to serve as a vector for this spirochete. Natural vertebrate reservoirs for *B. mayonii* remain unknown. In this study, we demonstrate that an experimental spirochete host, the CD-1 strain outbred white mouse, can maintain active infection with *B. mayonii* for up to 1 year: infected mice consistently yielded ear biopsies containing motile spirochetes from 29 to 375 days after they were first infected via tick bite. Infection rates in resultant nymphal ticks varied greatly both over time for larvae fed on the same individual mouse at different time points after infection (2–42%) and for larvae fed on different mice at a given time point up to 8 months after infection (0–48%). Infection rates were lower in nymphs fed as larvae on mice 10–12 months after infection (2–3% for 5 mice and 9.8% for 1 mouse). In addition to ear biopsies, *B. mayonii* was detected from bladder, heart, and spinal cord of infected mice when they were sacrificed 163–375 days after initial infection via tick bite. Examination of blood from mice determined to be infected with *B. mayonii* by ear biopsy did not produce evidence of *B. mayonii* DNA in blood taken 8–375 days after the mice were first infected via tick bite. Dolan, et al. *Ticks Tick-borne Dis.* (2016) <http://dx.doi.org/10.1016/j.ttbdis.2016.11.002>

Lyme disease and other tick-borne illness increases when the natural diversity of birds and mammals is reduced

Do Species Matter?

An increasing body of scientific work suggests that a diverse world—what biologists call high biodiversity—is a healthier world. Working at the Cary Institute in Millbrook, NY, Rick Ostfeld has shown that the prevalence of Lyme disease and other tick-borne illness is more widespread in areas where the natural diversity of birds and mammals has been reduced by suburbanization. We should expect the same for the prevalence of the Zika virus, carried by mosquitoes. Entire article at: <http://www.themillbrookindependent.com/content/do-species-matter>, Citizen Scientist by Bill Schlesinger, Tue Sep 20th, 2016

Alpha gal, the red meat allergy associated with certain ticks is worldwide Tick-induced mammalian meat allergy – worldwide

People living in tick-endemic areas around the world are being warned of an increasingly prevalent, potentially life-threatening side effect to being bitten: developing a severe allergy to meat. Sufferers of "tick-induced mammalian meat allergy" will experience a delayed reaction of between 2 and 10 hours after eating red meat. Almost invariably, they are found to have been bitten by a tick – sometimes as much as 6 months before...

Cases of the emergent allergy have been reported in Europe, Asia, Central America, and Africa, but it is most prevalent -- and on the rise -- in parts of Australia and the United States where ticks are endemic and host populations are booming. Bandicoots and other small native mammals are flourishing along the east coast where the Australian paralytic tick is endemic. The lone star tick is widespread throughout the US, but meat allergies have been reported in the south eastern states, home to growing herds of white-tailed deer. Source: The Guardian For entire article: <https://www.theguardian.com/society/2016/oct/07/tick-bites-that-trigger-severe-meat-allergy-on-rise-around-the-world>

“Swiss Agent,” now called *Rickettsia helvetica* first considered as the Lyme disease agent by It’s discoverer, Willie Burgdorfer & more

Newly discovered documents suggest some Lyme disease patients were infected with another tick-borne bacteria in the late 1970s called the "Swiss Agent."

“The tick hunter was hopeful he had found the cause of the disabling illness, recently named Lyme disease, that was spreading anxiety through leafy communities east of New York City. At a government lab in Montana, Willy Burgdorfer typed a letter to a colleague, reporting that blood from Lyme patients showed “very strong reactions” on a test for an obscure, tick-borne bacterium. He called it the “Swiss Agent.”

But further studies raised doubts about whether he had the right culprit, and 18 months later, in 1981, Burgdorfer instead pinned Lyme on another microbe. The Swiss Agent test results were forgotten.

Now STAT has obtained those documents, including some discovered in boxes of Burgdorfer’s personal papers found in his garage after his death in 2014. The papers — including letters to collaborators, lab records, and blood test results — indicate that the Swiss Agent was infecting people in Connecticut and Long Island in the late 1970s.” Entire article: <https://www.statnews.com/2016/10/12/swiss-agent-lyme-disease-mystery/>

Lyme disease ticks and proportion infected has greatly increased

Analysis of the human population bitten by *Ixodes scapularis* ticks in Québec, Canada: increasing risk of Lyme disease

Ixodes scapularis, the main vector of *Borrelia burgdorferi*, the spirochetal agent of Lyme disease, is expanding its range in southern Canada and bringing risk to the public from Lyme disease. Ticks were collected from 2008-2014 in a passive surveillance program conducted by the Laboratoire de santé publique du Québec (LSPQ), and tested by PCR for *B. burgdorferi* at the National Microbiology Laboratory. The number of ticks submitted each year more than quadrupled during the study period (from 174 in 2008 to 962 in 2014), increases in the geographic range and geographic uniformity of submissions amongst municipalities were observed, and infection prevalence in the ticks (mostly adult females) submitted rose from 5.9% in 2008 to 18.1% in 2014. These data are consistent with outcomes from active surveillance for blacklegged ticks. More men (54.4%) than women (45.6%) were bitten by *I. scapularis* ticks and the frequency of tick submission was highest in children under 15 years of age and in the adults 50-70 years old. These findings demonstrate the utility of conducting passive tick surveillance using humans and provides information on risk groups (i.e., males, children under 15, adults older than 50, and those living in the more southern parts of the province) to which information on personal protection and tick-bite prevention should be most strongly targeted.

Gasm S, et al. Ticks and Tick-borne Diseases <http://dx.doi.org/10.1016/j.ttbdis.2016.09.006>

Seroconversion to *Rickettsia* spp. more common than Lyme disease in certain areas of Sweden

Spotted Fever Rickettsioses in Sweden: Aspects of Epidemiology, Clinical Manifestations and Co-infections

The spotted fever group rickettsiae are emerging diseases. They cause damage in their hosts by invading the endothelium in small to medium-sized blood vessels, which results in vasculitis that can cause clinical manifestations from most organs.

The present thesis describes the prevalence of *Rickettsia helvetica* in ticks, the incidence of rickettsial infection based on seroreactivity and seroconversion in humans and their symptoms, from different parts of Sweden and the Åland Islands in Finland. This was accomplished through serological analysis of both retrospective and prospective serum samples from confirmed and suspected tick-bitten individuals compared to individuals with no knowledge of tick exposure (blood donors). In comparison with *Borrelia* spp., seroconversion to *Rickettsia* spp. was more common in the areas we investigated, indicating that rickettsiosis is a common tick-borne infection in Sweden and most likely underdiagnosed.

The present thesis shows that *Rickettsia* spp. are common in ticks and do infect humans. Rickettsial infection should be considered in both non-specific or specific symptoms after a tick bite. It was also shown in the thesis that flea-borne rickettsiosis (*R. felis*) occurs in Sweden and may cause invasive infections. Lindblom, A, Uppsala University, 2016 (English) Doctoral thesis, 2016, 64 p.

A review of the reaction that follows antibiotic treatment in some infections including Lyme disease

The Jarisch–Herxheimer Reaction After Antibiotic Treatment of Spirochetal Infections: A Review of Recent Cases and Our Understanding of Pathogenesis

Within 24 hours after antibiotic treatment of the spirochetal infections syphilis, Lyme disease, leptospirosis, and relapsing fever (RF), patients experience shaking chills, a rise in temperature, and intensification of skin rashes known as the Jarisch–Herxheimer reaction (JHR) with symptoms resolving a few hours later. Case reports indicate that the JHR can also include uterine contractions in pregnancy, worsening liver and renal function, acute respiratory distress syndrome, myocardial injury, hypotension, meningitis, alterations in consciousness, seizures, and strokes. Experimental evidence indicates it is caused by nonendotoxin pyrogen and spirochetal lipoproteins. Mediation of the JHR in RF by the pro-inflammatory cytokines tumor necrosis factor (TNF), interleukin (IL)-6, and IL-8 has been proposed, consistent with measurements in patients' blood and inhibition by anti-TNF antibodies. Accelerated phagocytosis of spirochetes by polymorphonuclear (PMN) leukocytes before rise in cytokines is responsible for removal of organisms from the blood, suggesting an early inflammatory signal from PMNs. Rarely fatal, except in neonates and in pregnancy for African women whose babies showed high perinatal mortality because of low birth weight, the JHR can be regarded as an adverse effect of antibiotics, necessary for achieving a cure of spirochetal infections. Butler T. Online October 24, 2016 , doi:10.4269/ajtmh.16-0434Am J Trop Med Hyg 2016 16-0434.

About strains of *Borrelia burgdorferi* (in Europe)

Lyme borreliosis is the most common vector-borne disease in the Northern Hemisphere and is caused by spirochete bacteria that belong to the *Borrelia burgdorferi* sensu lato species complex. These tick-borne pathogens are transmitted among vertebrate hosts by hard ticks of the genus *Ixodes*. Each *Borrelia* species can be further subdivided into genetically distinct strains. Multiple-strain infections are common in both the vertebrate host and the tick vector and can result in competitive interactions. To date, few studies on multiple-strain vector-borne pathogens have investigated patterns of co-occurrence and abundance in the arthropod vector. We demonstrate that the abundance of a given strain in the tick vector is negatively affected by the presence of co-infecting strains. In addition, our study suggests that the spirochete abundance in the tick is an important life history trait that can explain why some strains are more common than others in nature. From: Multi-strain infections of the Lyme borreliosis pathogen in the tick vector. Applied and Environmental Microbiology doi:10.1128/AEM.02552-16

A phage (virus that attacks bacteria) that attacks *Borrelia burgdorferi* may be useful

Phage-mediated horizontal gene transfer of both prophage and heterologous DNA by ϕ BB-1, a bacteriophage of *Borrelia burgdorferi*.

Horizontal gene transfer (HGT) in *Borrelia burgdorferi*, the Lyme disease agent, is likely mediated by bacteriophage. Studies of the *B. burgdorferi* phage, ϕ BB-1, and its role in HGT have been hindered by the lack of an assay for readily characterizing phage-mediated DNA movement (transduction). Here we describe an in vitro assay in which a clone of *B. burgdorferi* strain CA-11.2A encoding kanamycin resistance on a ϕ BB-1 prophage is co-cultured with different clones encoding gentamicin resistance on a shuttle vector; transduction is monitored by enumerating colonies selected in the presence of both kanamycin and gentamicin. When both clones used in the assay were derived from CA-11.2A, the frequency of transduction was 1.23×10^{-6} transductants per cell, and could be increased fivefold by

exposing the phage-producing strain to 5% ethanol. Transduction also was demonstrated between the CA-11.2A clone and clones of both high-passage *B. burgdorferi* strain B31 and low-passage, virulent *B. burgdorferi* strain 297, although with lower transduction frequencies. The transductant in the 297 background produced phage capable of transducing another *B. burgdorferi* clone: this is the first experimental demonstration of transduction from a clone of a virulent strain. In addition to prophage DNA, small *E. coli*-derived shuttle vectors also were transduced between co-cultured *B. burgdorferi* strains, suggesting both a broad role for the phage in the HGT of heterologous DNA and a potential use of the phage as a molecular tool. These results enhance our understanding of phage-mediated transduction as a mechanism of HGT in the Lyme disease spirochetes. Furthermore, the reagents and techniques developed herein will facilitate future studies of phage-mediated HGT, especially within the tick vector and vertebrate host. Eggers et al. Pathog Dis. 2016 Nov 2. pii: ftw107.

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Insect Shield's EPA-registered technology converts clothing and gear into effective and convenient insect protection. The repellency is long-lasting and appropriate for use by the entire family with no restrictions for use.

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