Public Tick IPM Working Group
June 12th, 2019
Please send additions, omissions or other corrections to wfulwider@ipminstitute.org

The Working Group meets via conference call on the second Wednesday of each month at 1:00PM CT (2:00PM EST). The following notes are for June 12th, 2019

Roll
1. Brian Leydet, SUNY-ESF
2. Tim Fox, Madison Area Lyme Disease Network
3. Jennifer Gruener, Warren County Mosquito Control District
4. Brian Snyder, Pike County
5. Gloria Kim, Limiting Lyme
6. Scott Larson, University of Wisconsin
7. Joellen Lampman, Cornell Extension
8. Larry Scrapper, Cherokee Nation
9. Amy Prunuske, University of Wisconsin
10. Chris Stelzig, ESA
11. Will Fulwider, IPM Institute

Agenda
1. Brian Leydet will present on the work of his lab at SUNY-ESF on tick invasion and Bb virulence
2. Announcements & updates from working group members

A recording of this call and presentation is available by visiting this link:
https://global.gotomeeting.com/play/recording/1ad06c450c06e65184e7d50bb267d0c035792f2f1a6fc00dd95add67440a6a73

Dr. Ledydet, Ticks and Tick-borne diseases, bfleydet@esf.edu

Dr. Leydet is a vector-borne disease biologist at the Leydet Lab at the State University of New York, College of Environmental Science and Forestry. He completed his doctoral work at LSU's School of Veterinary Medicine, where he studied tick-borne diseases in understudied areas and the pathogenic potential of Borrelia bissetti. His postdoctoral studies were conducted at both the Trudeau Institute in Saranac Lake NY and Southern Research in Birmingham AL. Additionally, he holds a Master of Public Health and has experience as an EMT-Paramedic. Brian is interested in understanding underlying factors that drive vector-borne disease enzootic cycles and will be presenting today on the work of his lab.

Tick and tick-borne diseases introduction
1. Bacteria that causes Lyme disease
   a. Spirochete
   b. Highly motile
   c. Borrelia burgdorferi sensu lato species complex
      i. To date there are 21 species, 8 in the US
ii. 5 confirmed human pathogenic species with *B. burgdorferi* sensu stricto being the primary cause of disease in N. America

2. Main vector for Lyme disease and other diseases in N. America is *Ixodes scapularis*
   a. 3 free living stages
   b. Hematophagous
      i. Must pick up *Borrelia* infection through bloodmeal
   c. Five additional ticks that can transmit the pathogen
      i. *I. scapularis* eggs are laid in the early spring, larvae emerge and are active in July-September, they take a bloodmeal and overwinter molt into nymphs, which emerge in the spring and can transmit Lyme disease, and after a bloodmeal, they molt into adults
   d. Full cycle takes two years

3. Large increases in the number of cases of Lyme disease across the US

4. Human infection manifests itself as Erythema migrans rash, which is not always the typical bullseye
   a. Early infection can result in arthralgia, neurological issues such as Bell's palsy and cardias issues such as heart block
   b. If left untreated can result in arthritis or neurological problems
   c. Antibiotic-refractory Lyme/PTLDS/Chronic Lyme
      i. Occurring in 10-20% of patients after treatment

5. Patient takes bit on skin, pathogen transmitted through the bloodstream

6. In the US, regional variations of spirochete species and likely to find more species with continued investigation

7. Increase in disease because of the spread of tick

**Tick invasion and disease spread**

8. From 1998-2017, in New York state, high numbers of Lyme disease cases downstate
   a. High number downstate, but steady number of cases
   b. Increasing number of cases elsewhere

9. Spread of *I. scapularis* into the Adirondack park, which was formerly considered inhospitable to the tick
   a. 2-year period of sampling, animal tracking and flagging
   b. 2-year period: 51 miles of area, 386 small mammals captured, and 2000 ticks found
   c. Working northward, found a decrease in tick density
      i. Albany had the highest density
      ii. Areas in the Champlain valley, lower numbers
      iii. Moved into the park from the valley, decrease in number

10. There is thought that there are more pathogenic strains of Lyme disease
    a. Genotyping of the captured ticks through use of Outer Surface Protein C (*ospC*)
    b. Tests from four sites

11. Different genotypes of *Borrelia* have been associated with:
    a. More severe human disease
    b. Higher transmission efficiencies in small mammals
    c. Different dissemination rates in murine models

12. Data shows 70% of animals had a multiple *ospC* genotype infections
    a. Average of 3.8
    b. Range of 2-7

13. Comparing the Adirondack sites with the sites around Albany where the ticks have been historically endemic
    a. Albany sites: ticks and small mammals had higher rates of infection
    b. Adirondack sites: ticks had higher rates of the human invasive strains in ticks (42% vs. 18% in the Albany sites)
i. But, in the small mammals, the human invasive strains at the Albany sites (73%) outnumbered the Adirondack sites (46%)

**Tick Rich vs. Tick Poor**

14. Differences in tick densities (tick rich vs. tick poor) and how that influences virulence infection or genotype differences
   - a. Student flagged 15 square miles from May-October and collected 1003 ticks
   - b. Tick rich site: 82 ticks/1000 m$^2$
   - c. Tick poor site: 0.3 ticks/1000 m$^2$
   - d. Highest number of ticks captured in June for both sites
   - e. 312 captures of 214 individuals
   - f. 66% Peromyscus mice, 15% chipmunks, 7% vole, 7% shrew
     - i. Did not think that ticks were feeding differently in these environments
   - g. Collected 991 ticks off animals, but only 35 from the tick poor site
   - h. Infestation levels were near 100% for the tick rich site, but below 10% in the tick poor site
   - i. Infection rates for the tick poor sites were much higher than they estimated (45% for chipmunks vs. 64% for the tick rich site chipmunks) considering the low number of ticks found
   - j. *Borrelia* infection rates of tick between the tick poor (72%) and tick rich sites (63%)
   - k. Waiting on the genotyping data

15. Study of human development effect's on ground foraging birds, tick infestation rates, and Bb infection prevalence
   - a. Collected birds (n=471) from sites (n=29) ranging in degree of development and 1,205 tick collected
     - i. 50.1% tick infested, 10.8% infected with Lyme, but probably more because not catching it at all points of the year, 79.3% of sites with infested birds

**Currently ongoing work with no data**

16. Landscape management and Lyme disease
   - a. Based on the idea that different small mammal species have a different ability to harbor ticks and human invasive strains
     - i. Presence of certain animals like coyotes that influence the risk of tick-borne disease poses to human
   - b. Currently studying an area with a deer park with two resident deer
     - i. A comparative study of hardwood forest and ash forest with thick understory within the area
       - I. Forests have different resident species, which have different tendencies to carry tick-borne disease
       - II. Currently tracking to see how these sites can be managed and the distribution of genotypes

17. Novel anti-tick compounds
   - a. Colleague found that Darwin finches self-medicate against parasites
   - b. Started thinking about tick behavior
     - i. High throughput anti-tick compound bioassays
     - ii. High numbers of *I. scapularis* in the southern US, but low levels of Lyme disease
     - iii. What compounds can keep ticks on the ground to mitigate infestation?

**Questions**

- c. Were ticks that were captured from birds tested for pathogens rather than relying on the blood?
  - i. Did not get to it, but do plan on testing this
- d. Will presentation be online?
i. Yes, presentation will be online along with a recording of the presentation

e. Any speculation on why newly invaded sites would have higher rates of human invasive strains in ticks?
   i. Human invasive strains may infect animals longer than the non-invasive strain and be more likely to be picked up in a low-density tick environment
   ii. Differences in dissemination and pathogenesis in mouse models
      l. Do not know if happening in nature

These notes are for a Working Group call on June 12th, 2019. Future calls will continue to fall on the second Wednesday of each month at 1 PM Central time.

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