

# Quantifying the relationship between fat content and *Rickettsia sp.* bacterial prevalence in the American dog tick (*Dermacentor variabilis* (Say.))



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## Introduction

### Host: *Dermacentor variabilis*

- *Dermacentor variabilis*, commonly referred to as the American dog tick, is a hard bodied tick largely distributed across North America
- American dog ticks feed on a variety of small and large mammals, including mice, dogs, deer, and humans (Sonenshine 2018)



Figure 1. Adult Male (Left) and Female (right) *Dermacentor variabilis* ticks

- Vector for several disease pathogens, the most notable being *Rickettsia rickettsii* (Sonenshine & Roe 2013)

### Pathogen of Interest: *Rickettsia rickettsii*

- Intracellular gram-negative bacteria
- Causative agent of Rocky Mountain Spotted Fever (RMSF)
- Treated with antibiotics such as doxycycline (Thorner et al. 1998)

### Related Research: Tick Fat Bodies (Herrmann et al. 2013)

- Ticks convert energy from blood meals into fat to act as an energy reserve between blood meals
- Hard bodied ticks from the same family of *D. variabilis* have shown increased fat content when infected by bacterial pathogens
- *Ixodes ricinus*, a hard bodied tick distributed across Europe, had increased fat content when infected with *Borrelia Burgdorferi*.

## Significance

- *D. variabilis* poses risk due to potential of *Rickettsia* infected ticks that have increased energy
- Potential Northern range expansion of over 50% in 2050 (Minigan et al. 2018)

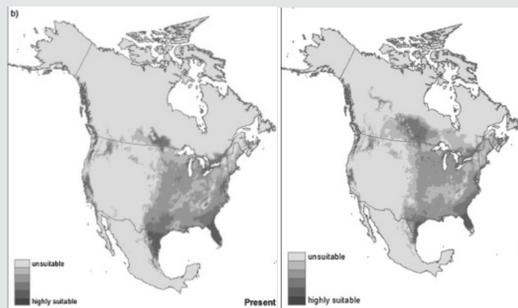


Figure 2. Current (Left) and 2050 potential (Right) range of *Dermacentor variabilis* ticks

## Aim of Study & Hypothesis

- This study seeks to determine if *Dermacentor variabilis* ticks that are infected with *Rickettsia rickettsii* exhibit the same correlation with respect to fat content and bacterial prevalence as seen in *Ixodes ricinus* ticks infected by *Borrelia Burgdorferi*.
- **I hypothesize that infected *Dermacentor variabilis* ticks will show the same correlation seen by Herrmann et al. in 2013.**

## Methods



Figure 3. *D. variabilis* sample locations across Nova Scotia

- 83 *D. variabilis* ticks, 50 males and 33 females were collected in Nova Scotia in June and July of 2025

- The "Flag & Drag" technique involves using a 1m x 1m fabric flag and brushing it across leaf litter to catch questing ticks



Figure 4. Tick lab volunteer demonstrating "Flag & Drag" technique

### Tick Processing & Fat Extraction

- Ticks were cut in half along their sagittal plane; one half being used for fat extraction and the other for DNA extraction
- Fat extraction was done using 24-hour cycles of oven and chloroform baths over five days to determine fat-free dry mass

### DNA Extraction, PCR, Gel Electrophoresis

- Tick DNA was extracted via AquaGenomic solution
- Targeting 16SrRNA gene using primers (Tz15 & Tz16) with amplicon of 17kDa
- Gel electrophoresis 2% agarose gel ran at 100V for 1 hour

## References

- Herrmann C, Voordouw MJ, Gern L. 2013. *Ixodes ricinus* ticks infected with the causative agent of Lyme disease, *Borrelia burgdorferi sensu lato*, have Higher Energy Reserves. *International Journal for Parasitology* 43:477-483.
- Minigan JN, Hager HA, Peregrine AS, Newman JA. 2018. Current and potential future distribution of the American dog tick (*Dermacentor variabilis*, say) in North America. *Ticks and Tick-borne Diseases* 9:354-362.
- Sonenshine D. 2018. Range expansion of tick disease vectors in North America: Implications for spread of tick-borne disease. *International Journal of Environmental Research and Public Health* 15:478.
- Sonenshine DE, Roe RM. 2013. *Biology of Ticks* Volume 2. New York, New York: Oxford University Press, USA.
- Thorner AR, Walker DH, Petri, Jr. WA. 1998. Rocky Mountain Spotted Fever. *Clinical Infectious Diseases* 27:1353-1359.

## Results

### Preliminary results on scutal measurements and fat percentage

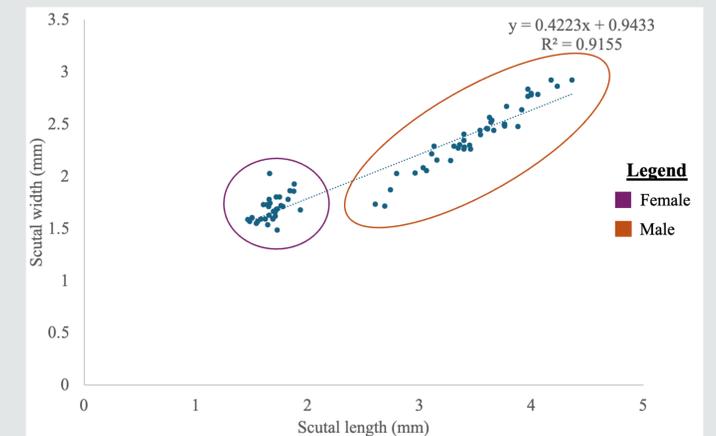


Figure 5. Male and female *D. variabilis* scutal length and width

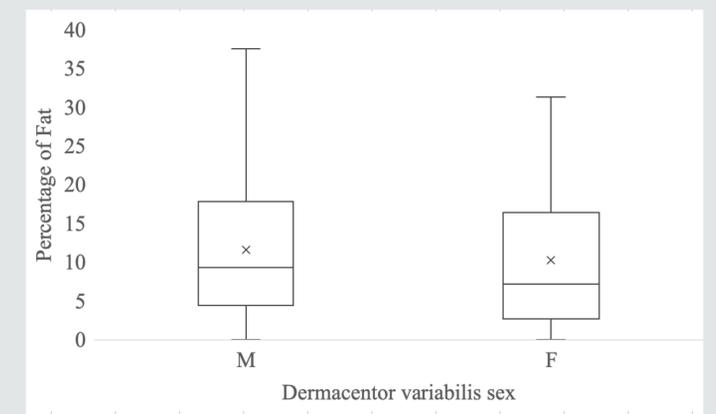


Figure 6. Male and female *D. variabilis* fat percentages

## Discussion & Future Initiatives

### Current Findings

- Correlation between tick sex and scutal size
- This correlation not continued when looking at fat content
- Significant variation when looking a fat percentage in both sexes
- Still awaiting DNA, PCR, gel electrophoresis results to determine bacterial prevalence

### Future Initiatives

- Due to inevitable range expansion, more research on *Dermacentor variabilis* is essential
- Connect weight, fat content, water content and scutal area

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