RIT

Long term data required to establish trajectories of populations in Lyme disease transmitting deer ticks (*Ixodes scapularis)*

Ph.D. B.S. Research Initiative for Scientific Enhancement
R·I·T National Technical Institute for the Deaf

Rowan Christie[1], Christine A. Bahlai[2], Julia Perrone[2], Kaitlin Stack Whitney[1,3]

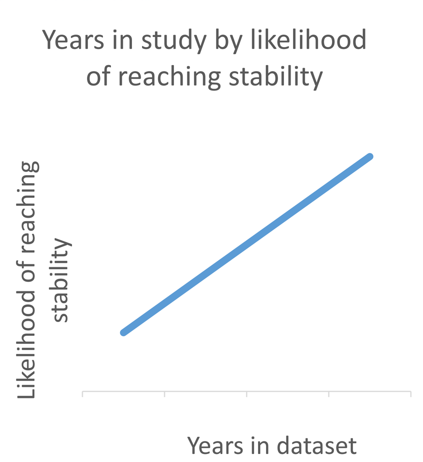
Introduction

Ixodes scapularis, the deer tick, is a primary vector of Lyme disease, a critical public health concern

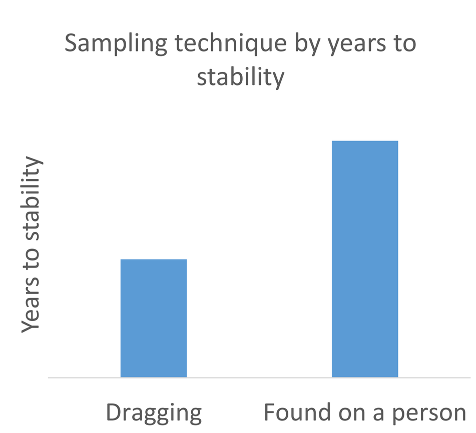
Yet many biology studies are only a few years long, potentially resulting in misleading inferences when projected into the future

Objective: **how do sampling method, geographic scope, life stage, and study length affect patterns inferred in long-term deer tick datasets?**

Hypotheses:



(H1)



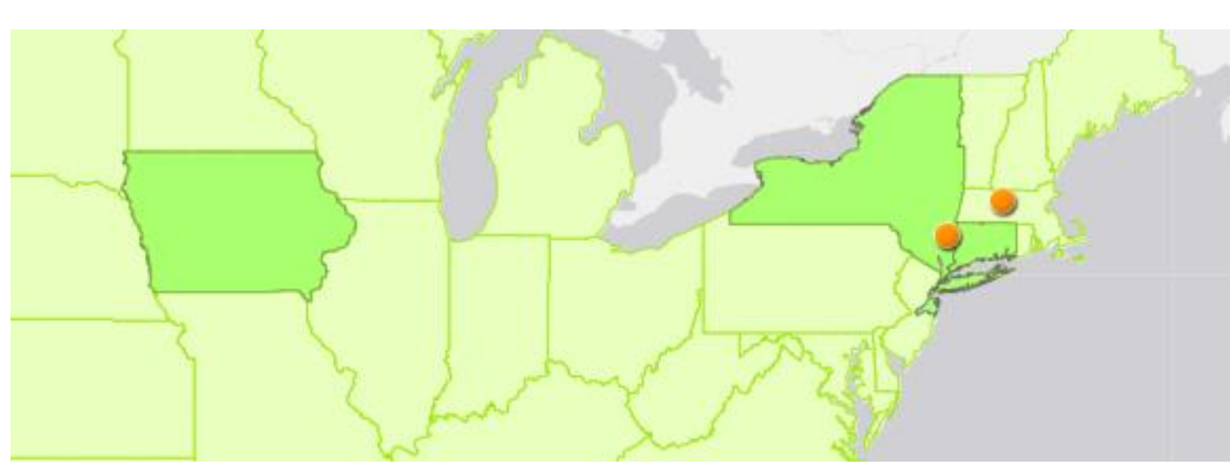
(H2)

Methods

Data Collection

We compiled 286 public datasets that recorded tick density or count for 9+ years

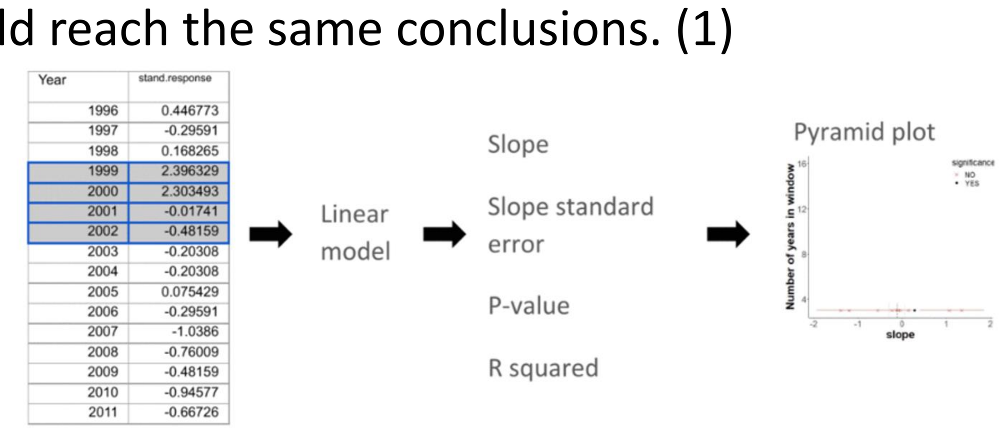
Datasets varied in geographic scope, sampling techniques, study length, and life stage of tick sampled



Green areas are states and counties; and orange dots represent the state forests included in the study.

Bad Breakup Algorithm

This algorithm splits long-term datasets into different lengths to examine whether the truncated datasets would reach the same conclusions. (1)



Results

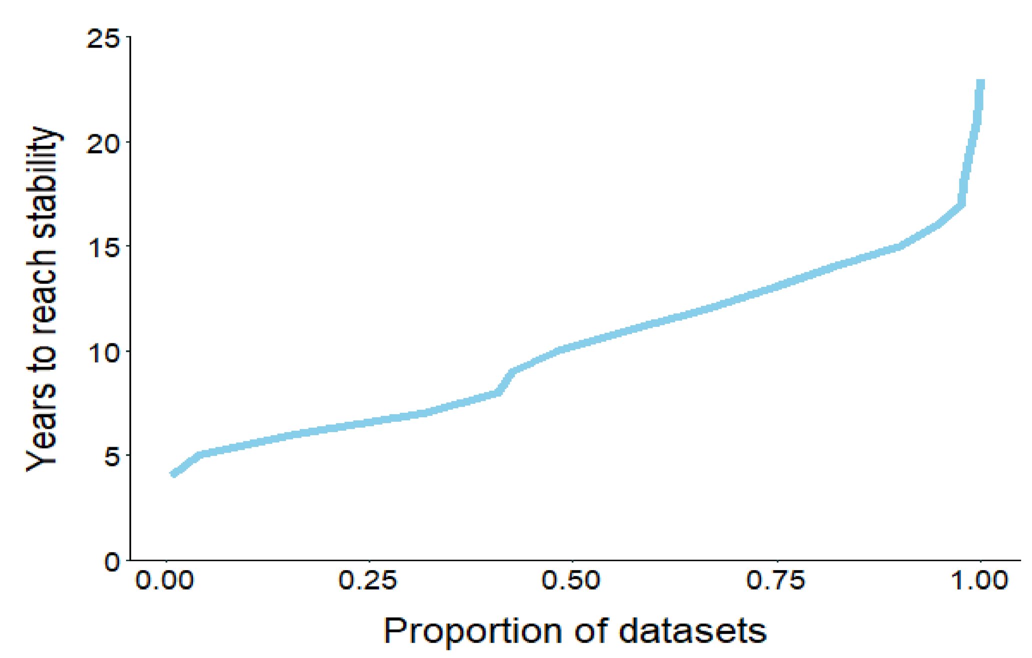


Figure 1: The fraction of datasets that take *y* years to reach stability. All of the datasets (n = 289) reach stability by 24 years, and none of the datasets reach stability before 4 years.

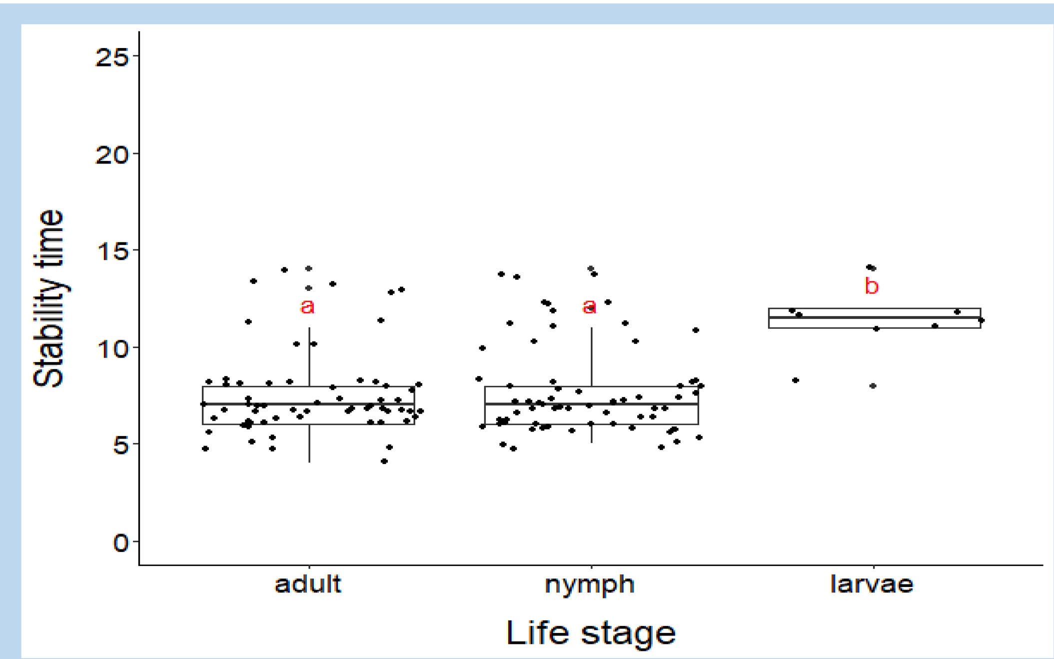


Figure 3A: Comparison of years to stability by life stage. Studies examining adults and nymphs reach stability significantly faster than studies examining larvae (adults and larvae, t = -5.9627, p-value = 0.0001328; nymphs and larvae, t = -5.5196, p-value = 0.0002109).

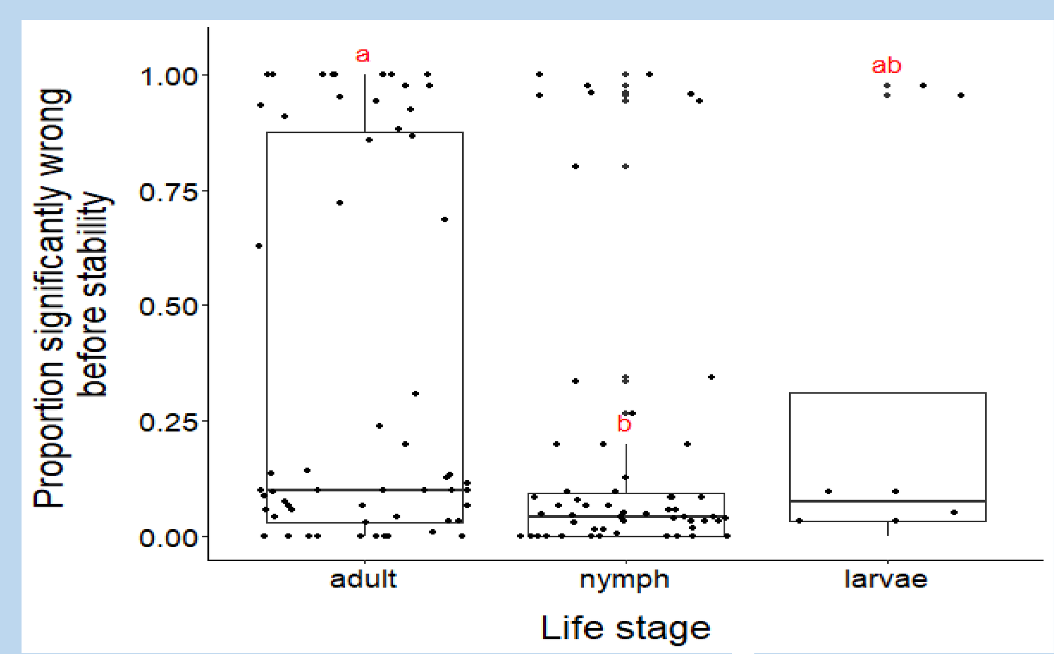


Figure 3B: Comparison of proportion significantly wrong before stability by life stage. Studies examining adults have a significantly greater proportion significantly wrong before stability compared to studies examining nymphs (t = 2.8993, p-value = 0.00449).

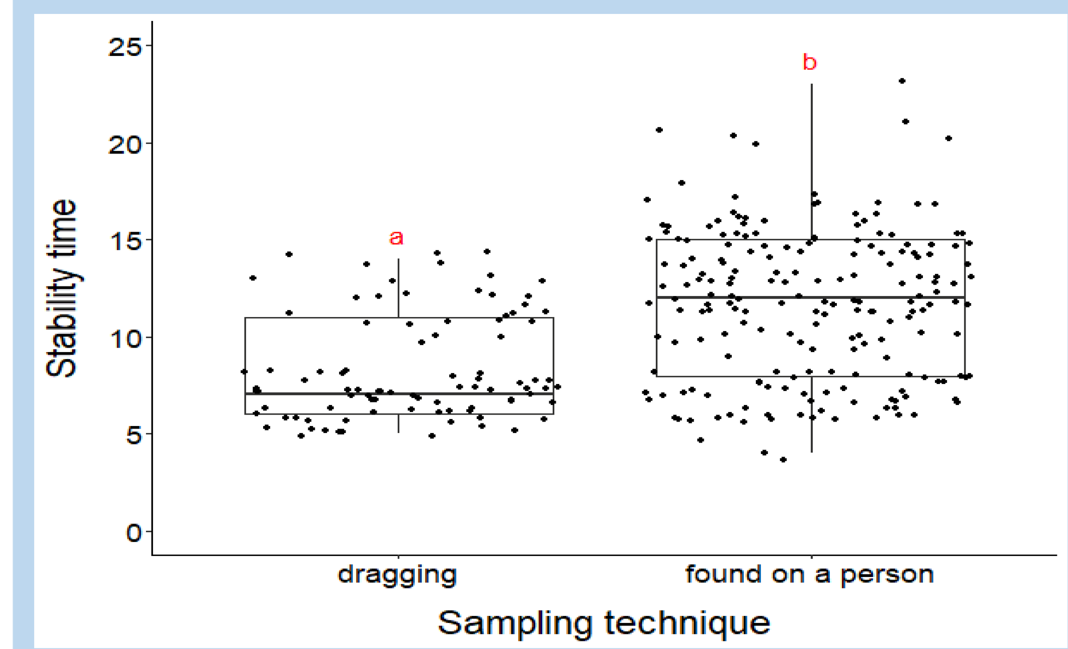


Figure 2A: Comparison of years to stability by sampling technique. Data produced by dragging reaches stability significantly faster (t = -8.5346, p-value = 1.724e-15).

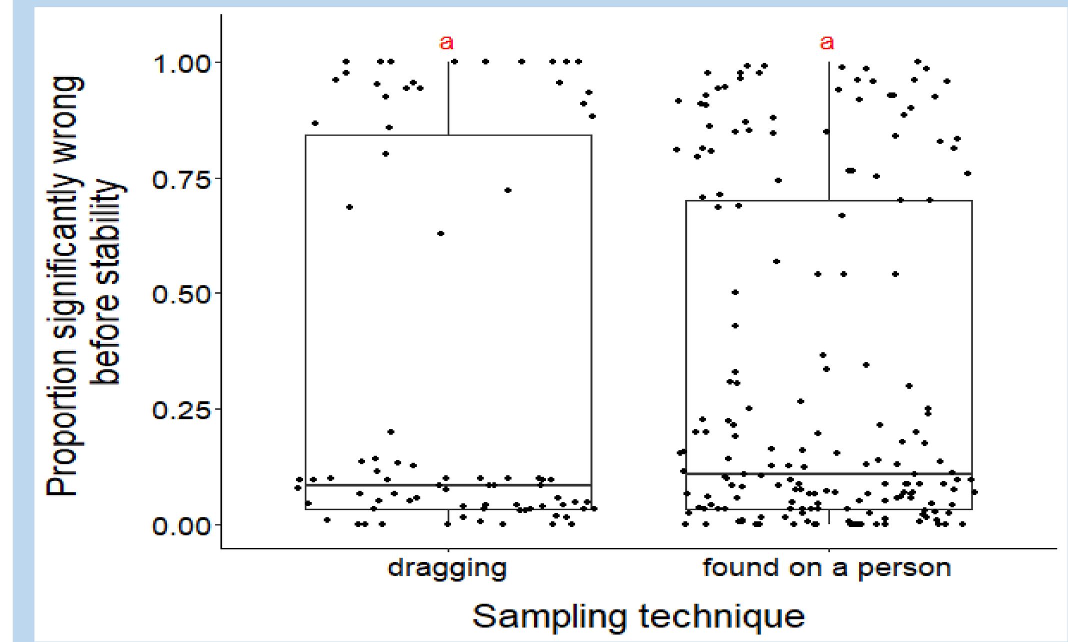


Figure 2B: Comparison of proportion significantly wrong before stability by sampling techniques. The difference between datasets produced by different sampling techniques is insignificant (t = 0.083576, p-value = 0.9335).

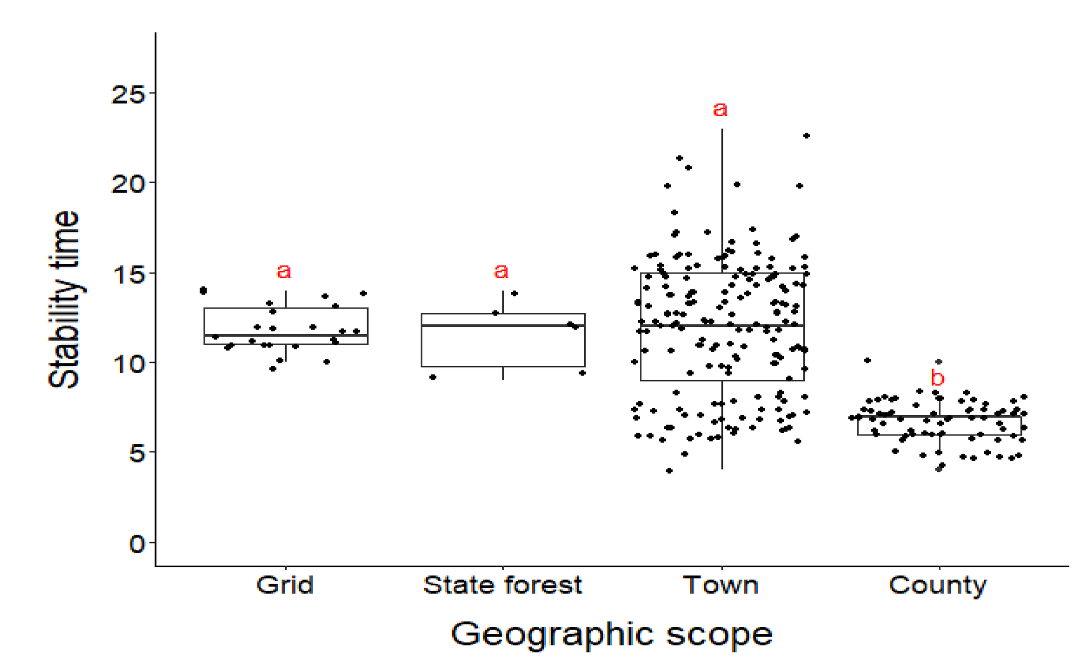
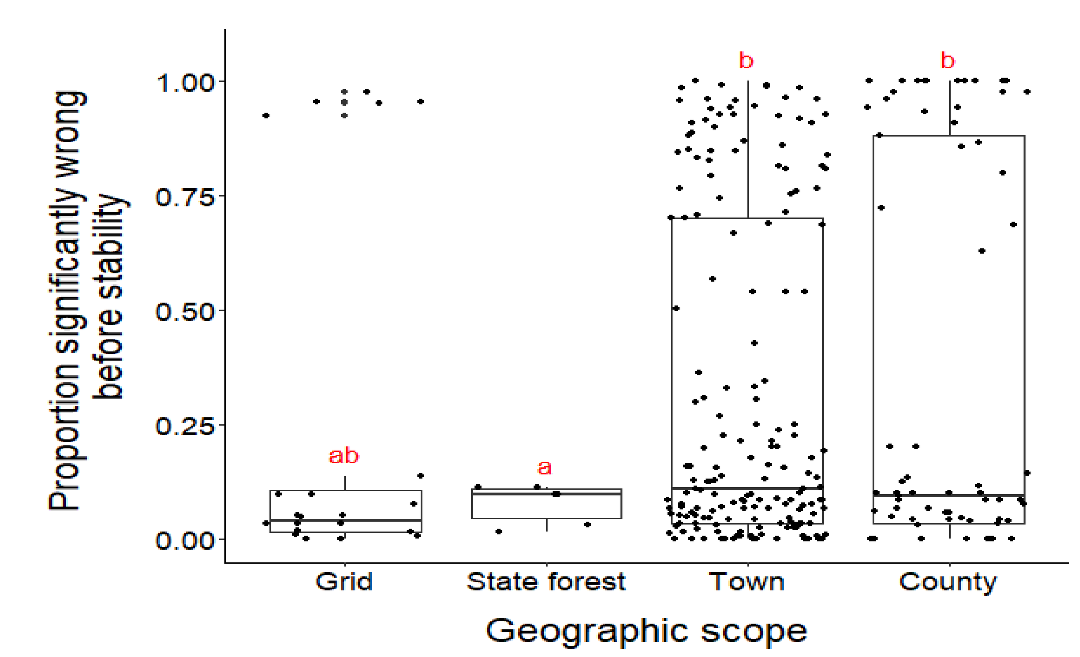


Figure 4A: Comparison of years to stability by geographic scope. County level studies reach stability significantly faster than town (t = -17.029, p-value < 2.2e-16), state forest (t = -5.5457, p-value = 0.002278), and grid level studies (t = -17.207, p-value < 2.2e-16).

Legend for all figures:

Dots represent the data points between stability time or proportion significantly wrong before stability and x factor. Letters show which pair of factors are significantly different - if factors share the same letter, they are not significantly different, but if not, then the factors are significantly different.

Figure 4B: Comparison of proportion significantly wrong before stability by geographic scope. State forest level studies have a significantly smaller proportion significantly wrong to stability than town and county level studies (state forest and county, t = 5.2409, p-value = 1.445e-06; state forest and town, t = 7.4221, p-value = 2.013e-09).



Discussion

Our main findings:

Longer study length is important for reaching stability

Results from deer tick studies with less than 5 years of study should be interpreted cautiously

Implications for future research:

Dragging is more likely to yield stable trends than public surveys. Researchers should consider using standardized sampling techniques (dragging, flagging) as opposed to opportunistic surveys

Studies that collect data on adult ticks are more likely to reach stability than nymphs or larvae. Studies that focus on nymphs and larvae only should be interpreted more cautiously

County level studies are more likely to reach stability than town, state forest, and grid level studies

Researchers should consider collecting data on county level scale rather than a smaller scale

Analyzing the impact of study parameters help researchers conduct studies that reach stable trends and avoid misleading results

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Author affiliations: 1 Thomas H Gosnell School of Life Sciences, Rochester Institute of Technology; 2 Department of Biological Sciences, Kent State University 3 Science, Technology & Society Department, College of Liberal Arts, Rochester Institute of Technology.

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