Abstract

Lyme disease (LD) is the most common vector-borne disease in North America; it is transmitted to humans primarily by the nymphal stage of blacklegged ticks (Ixodes scapularis). In the eastern U.S., persistence of Lyme disease depends mostly on white-footed mice (Peromyscus leucopus) as they are common hosts for larval and nymphal blacklegged ticks and are highly competent reservoirs of the LD agent, Borrelia burgdorferi (Levi et al. 2012). We attempted to test 3 hypotheses: 1) that white-footed mouse densities are positively associated with Ixodes tick densities; 2) that white-tailed deer densities are only correlated with Ixodes tick population densities when deer densities are low and 3) that red fox densities are negatively associated with small mammal densities. We collected relevant data in BNL’s Pine Barrens ecosystem. We used live traps for small mammals (2048 trap nights), uniquely marked and removed ticks from captured mice, and collected ticks by flagging each site. Ticks were categorized by species and life stage. We used camera traps to monitor the abundance of other mammals such as deer and red fox. We found that there was a significant positive linear relationship between the density of mice and amount of nymphal Ixodes at each site. Therefore, if coyotes were to emerge in Long Island and prey on red foxes, it is expected that there would be an increase in the density of white-footed mice and in the amount of Ixodes ticks.

Introduction

Increasing medical cases in northeastern United States indicate that Lyme disease (LD) is the most common tick-borne disease in the country. LD is transmitted to humans primarily by the nymphal stage of blacklegged ticks (Ixodes scapularis), these ticks also feed on a wide variety of birds, mammals, and lizards. It is important to understand the dynamics of ecological systems that affect tick populations and the LD agent, Borrelia burgdorferi, if we are to reduce LD cases in humans. This research project involves testing Levi et al. (2012)’s hypotheses involving the relationships between coyotes, deer, red fox, small mammals, Ixodes ticks, and LD. We did this by measuring the abundance of white-footed mice, I. scapularis ticks, white-tailed deer, and red fox at four plots at BNL. In particular, we examined the relationship between the numbers of I. scapularis ticks at different life cycle stages found on white footed mice populations.

Hypotheses:

H1: White-footed mouse populations are positively associated with Ixodes tick population densities.
H2: White-tailed deer densities are only correlated with Ixodes tick population densities when deer densities are low.
H3: Red fox densities are negatively associated with small mammal densities.

Results

Analysis:

• Program MARK Version 8.1, robust design model was used for a parameter estimate of white-footed mice abundance at each site (Coonh and White 2006).
• Program DENSITY Version 5.0 was used to predict the size of white-footed mouse population within the surrounding hectare using the spatially explicit capture-recapture data collected (Efford 2012).
• Tick prevalence was assessed calculating the proportion of mice with at least one attached tick.

Discussion

• The population of ticks found from flagging may not reflect ticks found on small mammals in the area.
• Density of mice in one hectare has a significant positive linear relationship with amount of Ixodes nymphs.
• Increase in coyote population may have indirect positive relationship with Lyme disease rates.
• Future studies should try to obtain data on deer and red fox populations relationship with tick density.

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References