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Data Article

Quantity of questing black-legged ticks and associated micro-scale environmental data collected from four Suburban Parks near New York City

Shipeng Sun[a,d,*], Chong Di[b], Li Li[c,d], Brian Sulkow[c], Weigang Qiu[c,d]

[a] Department of Geography and Environmental Science, Hunter College, 695 Park Ave, New York, NY 10065, United States of America
[b] Department of Civil and Environmental Engineering, Rutgers University, 500 Bartholomew Rd, Piscataway, NJ 08854, United States of America
[c] Department of Biological Sciences, Hunter College, 695 Park Ave, New York, NY 10065, United States of America
[d] Graduate Center, The City University of New York, 365 5th Ave, New York, NY 10016, United States of America

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ABSTRACT

During 2017 and 2018, we collected the quantity of questing black-legged ticks (*Ixodes scapularis*), also known as deer ticks, in 124 sampling sites of 5m by 5m in four state parks—Caumsett State Historic Park, Connetquot River State Park, Rockefeller State Park, and Fire Island National Seashore—around New York City. The black-legged tick is the primary vector for the spirochete *Borrelia burgdorferi*, the pathogen of Lyme disease, in Northeastern United States. Using the flagging method, we collected and counted the numbers of adult and nymphal black-legged ticks at each stie. Along with these quantities, we also recorded the geographic coordinates, ambient temperature, and relative humidity at the sampling sites. Using high-resolution aerial imagery and LiDAR data, we further derived land cover composition, ecotone boundary length, normalized difference vegetation index (NDVI), elevation, solar radiation, and other environmental factors. The data could be used to conduct longitudinal analysis at the same sampling sites as well as comparison with other sites.

* Corresponding author.
E-mail address: shipeng.sun@hunter.cuny.edu (S. Sun).
Social media: @sunsp (S. Sun)

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Ecologists and environmental scientists can use the data for spatiotemporal and statistical analyses of tick ecology at the local scale.

Specifications Table

Subject	Environmental Science
Specific subject area	Ecology, tick ecology, geospatial analysis of environment and climate factors
Data format	Raw, Analyzed
Type of data	Table, Aerial Imagery, LiDAR
Data collection	Data were acquired from fieldwork and geospatial analysis. 5m x 5m sampling sites were randomly selected with consideration of accessibility in four state parks around New York City. We used fabric flags (0.75m x 1m) on poles (1m) to collect adult and nymphal black-legged ticks in the sampling sites. Ticks were collected with multiple flag sweepings. Only adult and nymphal black-legged ticks were identified and counted. A handheld Garmin GPSMAP 64x was used to record coordinates of the sites. An Extech 45158 Anemometer & Humidity Meter was used to measure the temperature and humidity. The aerial photos from the National Agriculture Image Program and LiDAR data from the State of New York were processed to derive micro-scale environmental factors at the sampling sites.
Data source location	Four state parks around New York City. The geographic coordinates in WGS 1984 spatial reference system are displayed in (longitude, latitude). Caumsett State Historic Park Preserve, (−73.471°, 40.920°) Connetquot River State Park Preserve, (−73.154°, 40.764°) Rockefeller State Park Preserve, (−73.841°, 41.110°), Fire Island National Seashore, (−73.208°, 40.636°)
Data accessibility	Repository name: Mendeley Data Data identification number: 10.17632/d24yyp96dc.2 Direct URL to data: https://data.mendeley.com/datasets/d24yyp96dc/2
Related research article	Chong, D., B. Sulkow, W. Qiu, S. Sun. (2023) Effects of Micro-Scale Environmental Factors on the Quantity of Questing Black-Legged Ticks in Suburban New York. Applied Sciences 13(20):11587. https://doi.org/10.3390/app132011587

1. Value of the Data

- The data provide a detailed, local delineation of the numbers of questing black-legged ticks as well as the associated environmental factors at a micro geographic scale in four state parks around New York City.
- The data benefit ecologists, environmental scientists, environmental health researchers, and statisticians who could utilize the data to gain further insights on how local-scale natural environments impact the questing activities of black-legged ticks.
- The association between the number of black-legged ticks and land cover and vegetation types in the data can help park and land managers develop vegetation management plans to reduce the density of black-legged ticks.
- The micro-scale spatiotemporal patterns revealed by the data and the contributing factors to ticks' questing activities provide useful information for park visitors to mitigate the risk of contracting black-legged ticks and Lyme disease.

2. Background

The objective of this dataset is to depict the spatiotemporal variations of the quantity of questing black-legged ticks and their relations to regulatory environmental and climate factors at micro geographic scales in four state parks around New York City [1]. Existing studies on tick ecology are mostly in controlled or semi-controlled lab settings or in the natural environments at macro scales [2,3]. Researchers have examined how ticks respond to temperature and humidity within controlled environments and to land cover and vegetation types in semi-controlled or natural settings [4]. Although these studies have found robust correlations between environmental variables and tick dynamics at macro spatiotemporal scales, it is unclear if they still hold at local scales with substantial variations over time and space. From the perspective of environmental health, studying how micro-scale environmental factors influence black-legged ticks' questing activities is critical to understanding the spatiotemporal patterns of Lyme disease risks in small local areas [5]. While our research article presents the analysis results from the dataset, the dataset itself offers specific details about the small local patches in the parks where we collected the black-legged ticks, the original counts of adult and nymphal questing ticks at each patch, and the key environmental factors with high spatial and temporal resolutions [6].

3. Data description

The data are released in three folders: data, NAIP, and LiDAR (Fig. 1). The data folder contains a CSV file and an R markdown file. The CSV file has the field data and the associated environmental and climate data. The R file contains the code for data processing, visualization, and statistical analysis. The NAIP imagery folder includes the one-meter resolution aerial photos from the national agriculture imagery program. Our data were acquired from the "*Earth Explorer*" website at https://earthexplorer.usgs.gov. While the site provides more recent data, we used the

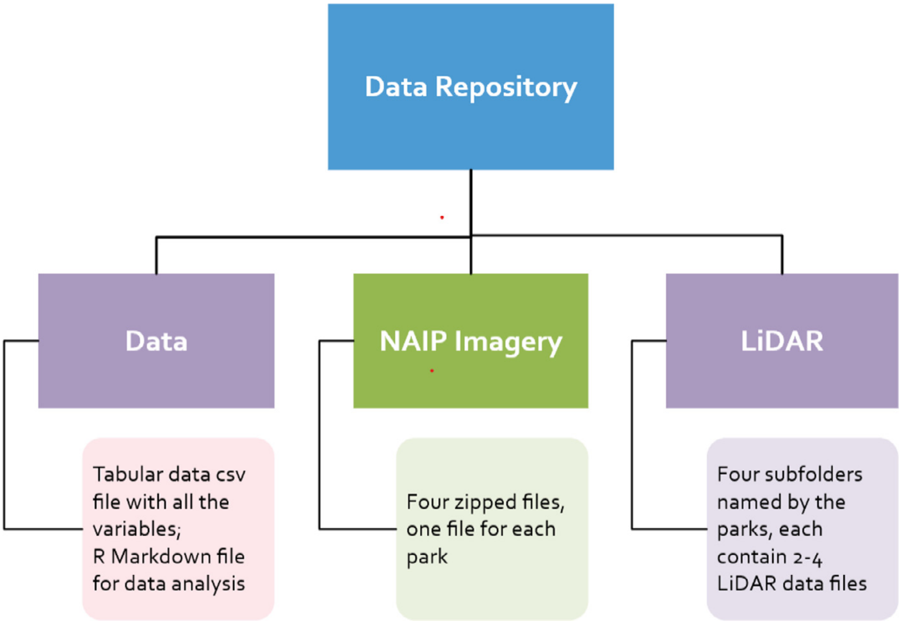

Fig. 1. Data File Organization.

2017 imagery to match the tick sampling times. The LiDAR folder saves the original point cloud data around the sampling sites in the four parks. We separate those files into four folders, with one folder for each park. All the LiDAR data were downloaded from the "*Discover GIS Data NY*" website at https://orthos.dhses.ny.gov.

The raw data file contains the data from our field work and from geospatial analysis of the LiDAR and NAIP imagery. The variables in the data include information about the sampling sites, the numbers of black-legged ticks and nymphs, the environmental factors, and climate factors (Table 1).

Table 1
Variables in the CSV file.

Variable	Explanation	Note
Pid	Park ID	Coded integer: 1 = Caumsett; 2 = Connetquot River 3 = Rockefeller; 4 = Fire Island
Sid	Sampling site ID	Coded string: Park Abbreviation + Site Number
date	Collection Date	MM/DD/YYYY
season	Season of the collection date	1 = Spring, 0 = Fall
lat	Latitude of geographic location	Decimal degrees (WGS 1984)
lon	Longitude of geographic location	"
temp	Temperature	Degree in Fahrenheit
rh	Relative Humidity	Ratio value
elv	Elevation	Bare-earth elevation (meter) derived from LiDAR data
solar	Area Incoming Solar Radiation	Insolation (WH/m^2, watt hour per square meter) at the sampling site. Calculated from elevation using spatial analysis.
ndvi	Normalized Difference Vegetation Index (NDVI)	Ratio value, calculated from NAIP images
mixed_hardwood	Proportion of hardwood vegetation land cover	Ratio value, derived from classified land cover map using NAIP images.
pine_forest	Proportion of pine forest	"
drawf_shrub	Proportion of shrub	"
grassland	Proportion of grassland	"
residential	Proportion of residential land cover, including roads and trails	"
sand	Proportion of sand near beaches	"
ecotone	total length of the boundaries between different land cover types.	The ecotone length (meter). Calculated using spatial analysis approach.
t_adult	The number of adult black-legged ticks	Counted from ticks collected in the field using flagging method. Only black-legged ticks included.
t_nymph	The number of nymphs of black-legged ticks	"

4. Experimental design, materials and methods

The black-legged ticks' questing activity data are products of combined field works and laboratory analyses. First, our study sites are four state parks in Westchester and Long Island, New York—Caumsett State Historic Park Preserve (CSP), Connetquot River State Park Preserve (CRSP), Rockefeller Park Preserve (RPP) and Fire Island National Seashore (FINS) (Fig. 2). They were chosen for their representativeness of the typical suburban environments and the well-documented presence of black-legged ticks [7–9]. In addition, they are close to densely populated urban areas and are popular destinations for local visitors during questing seasons of ticks.

Second, during the spring and fall of 2017, as well as the spring and early summer of 2018, we visited these four state parks on nine separate days to collect black-legged ticks (Fig. 3). Whenever possible, we selected dates with no rain in the forecast, but within a few days of

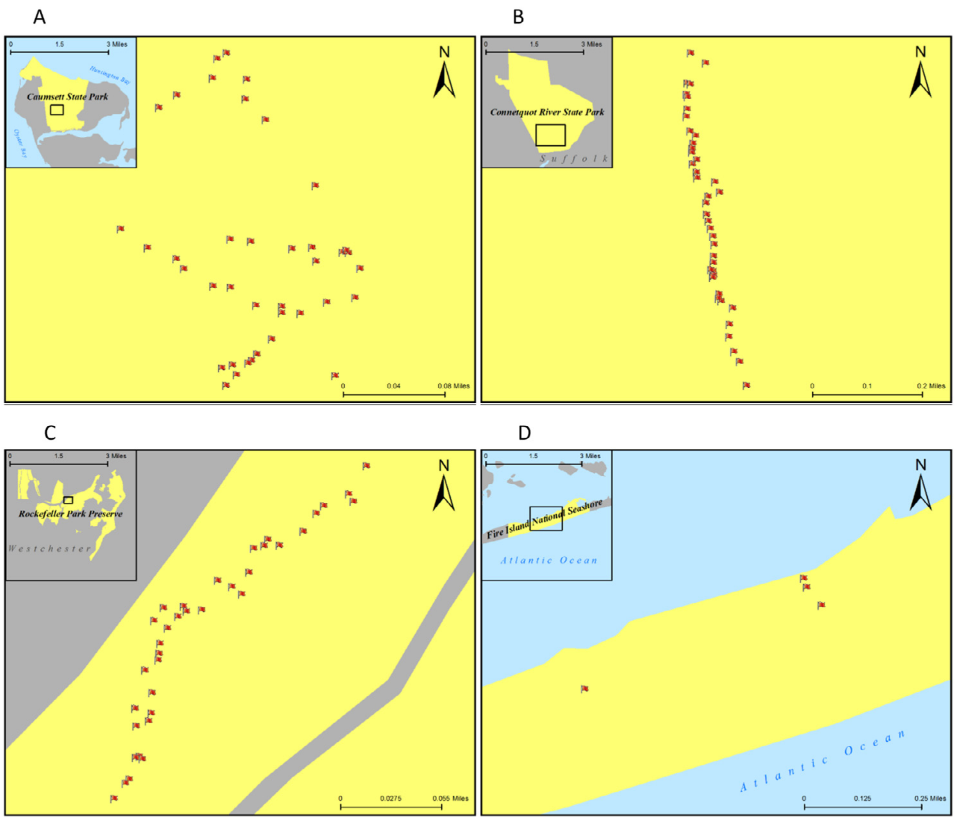

Fig. 2. Distribution of sampling sites (marked by flags) within the four state parks. A) Caumsett State Park, B) Connetquot River State Park, C) Rockefeller Park Preserve, and D) Fire Island National Seashore.

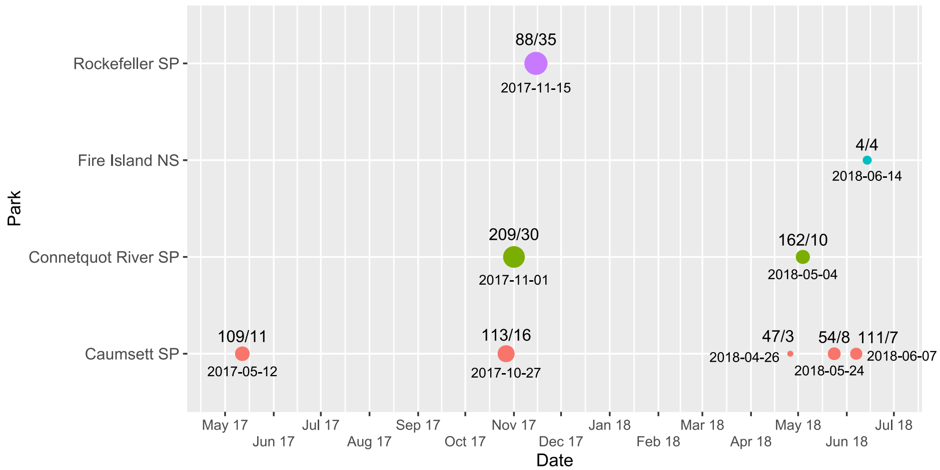

Fig. 3. Tick-collecting field trips. The numbers on the top of each circle are the quantity of collected ticks and the number of 5m x 5m sampling sites. The circle is proportional to the number of sampling sites for each field trip.

Fig. 4. Examining the flag for black-legged ticks and nymphs after sweeping it over the shrub (Credits: Chong Di, Weigang Qiu).

rain. This is because ticks prefer moist environments, but the flagging method that we used for tick collection is not effective in wet conditions. Each field work trip to one of the four parks lasted approximately 4 hours, roughly from 10:00 am to 2:00 pm on scheduled sampling dates. We randomly selected tick sampling sites in the park, primarily in the off-trail areas with vegetation land cover and safe to access (Fig. 2). Each tick-sampling site was measured 5m by 5m. The geographic coordinates and boundaries of all sites were recorded using a handheld Garmin GPSMAP 64x. At Caumsett State Historical Park, we collected 434 black-legged ticks on five days from 45 sampling sites; at Connetquot River State Park, it was 371 ticks from 40 sites on two days; we only conducted field work at Rockefeller State Park and Fire Island National Seashore for one day only, with 88 ticks from 35 sites and 4 ticks from 4 sites respectively.

At each 5 $\times$ 5 m sampling site, we used the flagging method to collect ticks. Two team members swept cloth flags ($\sim$ .75 $\times$ 1 m) attached to 1 m poles over ground cover, foliage, and fallen trees within the boundary of the site for ten minutes. After thoroughly sweeping the sampling site multiple times, team members identified all ticks and nymphs attached to the flags (Fig. 4). Only black-legged ticks and nymphs were collected and counted while other types like Lonestar ticks were ignored. On the site, the ambient temperature and relative humidity were measured at three random spots with an "Extech 45158 Anemometer & Humidity Meter" held approximately 40 cm above ground to match the average questing heights of black-legged ticks.

We further supplemented the field data with environmental variables derived from 1m-resolution LiDAR from the State of New York and aerial imagery from the NAIP (National Agriculture Imagery Program). Using ArcGIS, we generated elevation and solar insolation from LiDAR (Fig. 5). Solar insolation is the incoming solar radiation across an area and is generally considered a terrain variable, as the amount of solar energy received at the ground level is largely determined by terrain factors, including slope of the earth's surface and surrounding objects.

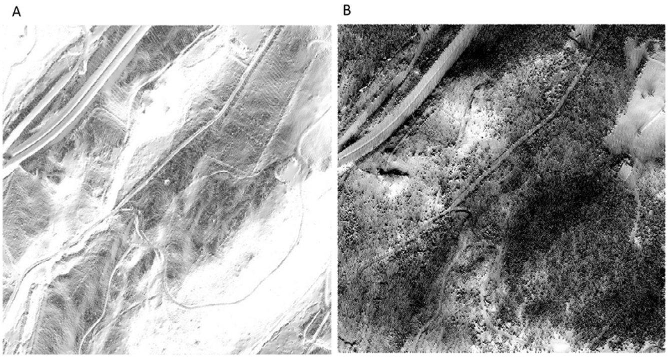

Fig. 5. Results of LiDAR data analysis. A) digital elevation, B) area solar radiation.

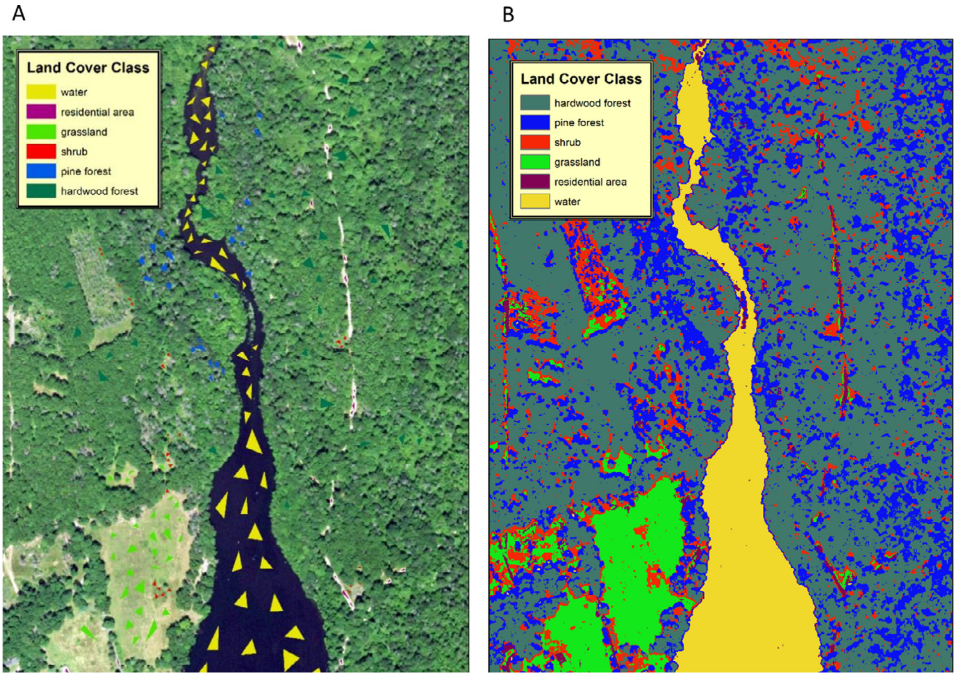

Fig. 6. Supervised land cover classification using NAIP imagery. A) Image and training samples (triangles), B) classed land cover map.

Using the supervised maximum likelihood image classification tool in ArcGIS, we derived land cover types of hardwood forest, pinewood forest, shrub, grassland, residential/pavement, and water (Fig. 6) with high accuracy (Table 2). These land cover classification data were used to generate the proportions of different vegetation or land use in each sampling site.

We also calculated the normalized difference vegetation index (NDVI) using band 1 (red) and band 4 (near infrared) in the NAIP imagery.

$$NDVI = \frac{Near\ Infrared - Red}{Near\ Infrared + Red} = \frac{Band_4 - Band_1}{Band_4 + Band_1}$$

Converting the data to vector format in ArcGIS, we were able to extract the total length of ecotone overlaying each sampling site using the Intersect tool with line being the output type.

Table 2
Land cover classification accuracy at the four parks.

Study Area	Overall Accuracy	Kappa Coefficient
Caumsett State Park (CSP)	89.88%	0.8385
Connetquot River State Park (CRSP)	92.79%	0.9029
Rockefeller Park Preserve (RPP)	97.08%	0.9118
Fire Island National Seashore (FINS)	85.71%	0.8092

The ecotone length essentially measures the length of edges between different vegetation land cover types [1].

Limitations

The dataset is small due to the difficulty and labour-intensiveness of conducting this time and weather sensitive field research. This may limit the statistical significance of relevant analyses. Additionally, despite following the same protocol, tick collectors may sweep flags differently, and variations among sampling sites may not be consistent, although systematic biases are not expected. Finally, the method of calculating solar radiation does not account for weather conditions of the dates when ticks were collected.

Data availability

Quantity of Questing Blacklegged Ticks and Micro-scale Environmental Factors in Four Suburban Parks near New York City (Original data) (Mendeley Data)

CRediT Author Statement

Shipeng Sun: Methodology, Investigation, Funding acquisition, Supervision, Data curation, Formal analysis, Validation, Writing – original draft; **Chong Di:** Conceptualization, Methodology, Investigation, Data curation, Writing – review & editing; **Li Li:** Methodology, Investigation; **Brian Sulkow:** Methodology, Investigation; **Weigang Qiu:** Conceptualization, Methodology, Investigation, Funding acquisition, Supervision, Writing – review & editing.

Ethics statement

Access to and the tick-collecting field works in the state parks were approved by the New York State Office of Parks, Recreation and Historic Preservation and the New York State Department of Environmental Conservation. No plants or animals were harmed during the field works.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] C. Di, B. Sulkow, W. Qiu, S. Sun, Effects of micro-scale environmental factors on the quantity of questing black-legged ticks in Suburban New York, Appl. Sci. 13 (20) (2023) 11587, doi:10.3390/app132011587.
[2] S. Li, S.O. Vanwambeke, A.M. Licoppe, N. Speybroeck, Impacts of deer management practices on the spatial dynamics of the tick Ixodes ricinus: a scenario analysis, Ecol. Model. 276 (2014) 1–13, doi:10.1016/j.ecolmodel.2013.12.023.
[3] A. Estrada-Peña, S. Cutler, A. Potkonjak, M. Vassier-Tussaut, W. Van Bortel, H. Zeller, N. Fernández-Ruiz, A.D. Mihalca, An updated meta-analysis of the distribution and prevalence of Borrelia burgdorferi s.l. in ticks in Europe, Int. J. Health Geographics 17 (1) (2018) 41, doi:10.1186/s12942-018-0163-7.
[4] D.C. Mathisson, S.M. Kross, M.I. Palmer, M.A. Diuk-Wasser, Effect of vegetation on the abundance of tick vectors in the Northeastern United States: a review of the literature, J. Med. Entomol. 58 (6) (2021) 2030–2037, doi:10.1093/jme/tjab098.
[5] H.S. Ginsberg, E.L. Rulison, J.L. Miller, G. Pang, I.M. Arsnoe, G.J. Hickling, N.H. Ogden, R.A. LeBrun, J.I. Tsao, Local abundance of Ixodes scapularis in forests: Effects of environmental moisture, vegetation characteristics, and host abundance, Ticks Tick-borne Dis. 11 (1) (2020) 101271, doi:10.1016/j.ttbdis.2019.101271.
[6] S. Sun, C. Di, [Dataset], Quantity of questing blacklegged ticks and micro-scale environmental factors in four Suburban Parks near New York City, Mendeley Data V2 (2023), doi:10.17632/d24yyp96dc.2.
[7] R.C. Falco, D. Fish, Potential for exposure to tick bites in recreational parks in a Lyme disease endemic area, Am. J. Public Health 79 (1) (1989) 12–15, doi:10.2105/ajph.79.1.12.
[8] D. Fish, R.C. Dowler, Host associations of ticks (Acari: Ixodidae) parasitizing medium-sized mammals in a Lyme disease endemic area of southern New York, J. Med. Entomol. 26 (3) (1989) 200–209, doi:10.1093/jmedent/26.3.200.
[9] J.L. Tomkins, J. Aungier, W. Hazel, L. Gilbert, Towards an evolutionary understanding of questing behaviour in the tick Ixodes ricinus, PLoS One 9 (10) (2014) e110028, doi:10.1371/journal.pone.0110028.