



Understanding Pennsylvania Tick Population and Tick-borne Disease Dynamics: A Retrospective Analysis of Archived Databases from 2008-2020



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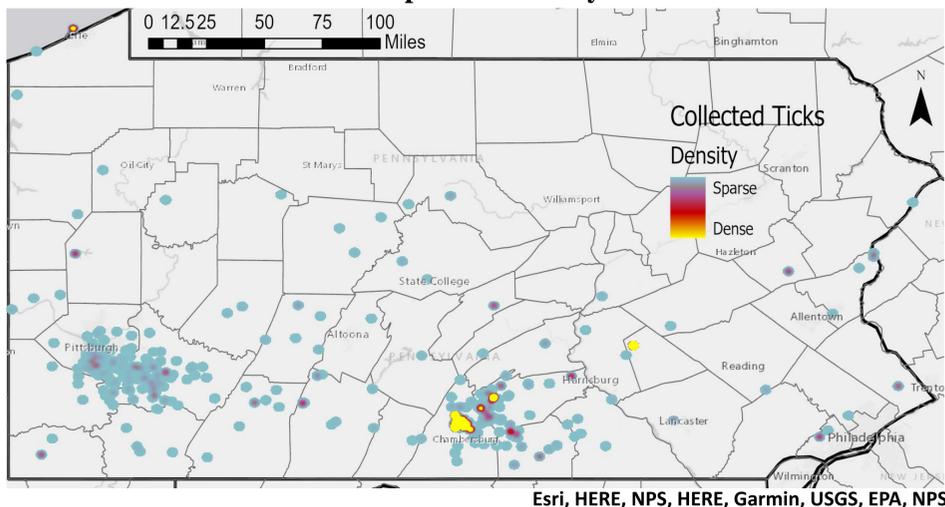
Introduction

Ticks have been widely studied for their importance in disease transmission. In Pennsylvania, four different ticks (associated with human diseases) are commonly encountered: (1) *Dermacentor variabilis* (Rocky Mountain Spotted Fever); (2) *Ixodes scapularis* (Lyme disease); (3) *Amblyomma americanum* (Ehrlichiosis); and (4) *I. cookei* (possible Powassan). In addition to the commonly occurring tick species, approximately 25 species have been identified in the state. *I. scapularis*, which was once primarily found in Central and Eastern PA, can now be found in all counties in PA. In recent years, PA has had the highest confirmed numbers of Lyme disease cases in the United States. The increasing abundance and prevalence of ticks known to vector human pathogens has prompted public health concerns and further research. Despite the devastating consequences, and potentially fatal outcomes of tick-borne diseases, the local/regional distribution of ticks in Pennsylvania is under-investigated with regards to changes in tick populations and tick-borne disease dynamics.

Methods

- Compiled individual databases from 2008-2020 into one master database
 - Date of collection, location, method of collection, species, sex, life stage, engorgement status, and molecular status
- Quantitative analysis and mapping (ArcGIS Pro version 2.7.3 (Esri, Redlands, CA)) used to conduct comparative analysis of changing geographical distributions, seasonal distribution, and tick life stage
- Tick-borne microbes (*Rickettsia*, *Ehrlichia*, *Anaplasma*, and *Borrelia*) were compared for ticks collected from 2008-2016.

Sample Site Density



- Further investigation will examine host association of tick species and the molecular status of ticks that are positive or negative for these pathogens from 2016-2020

Conclusions

- I. scapularis* and *D. variabilis* have been present in PA since 2008.
- A. americanum* and *Haemaphysalis* species are emerging species in the state.
- Rickettsia* and *B. burgdorferi* are most prevalent among the species of ticks tested.
- E. chaffeensis* and *A. phagocytophilum* are hypothesized to increase in prevalence.

Implications

- Application in the medical field: provide insight on tick-borne illness prevalence in PA
- Provide pertinent background information for future researchers and epidemiologists

Future Research

- Molecular testing of ticks from 2016-2020
- Further expanded surveying of ticks in Pennsylvania

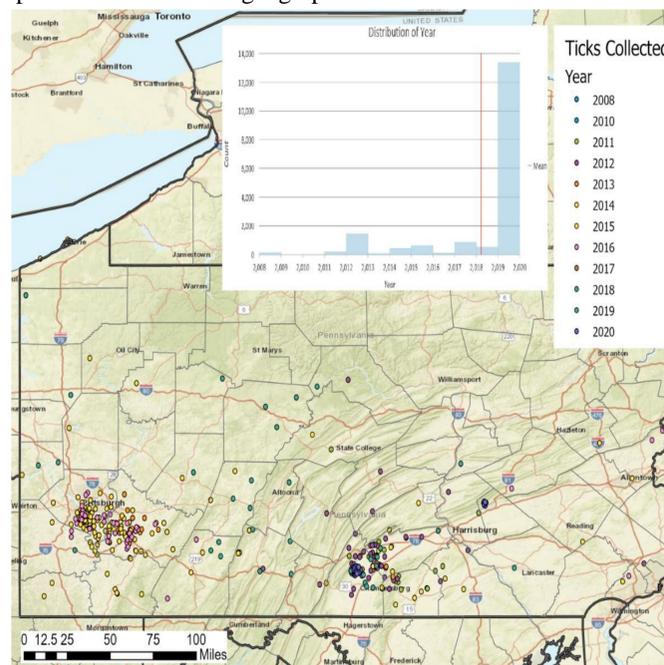
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Results

Total Ticks Collected by Year		
<u>2008</u>	<u>2013</u>	<u>2017</u>
131 ticks	72 ticks	875 ticks
<u>2010</u>	<u>2014</u>	<u>2018</u>
2 ticks	138 ticks	521 ticks
<u>2011</u>	<u>2015</u>	<u>2019</u>
188 ticks	633 ticks	6512 ticks
<u>2012</u>	<u>2016</u>	<u>2020</u>
1442 ticks	93 ticks	6855 ticks
<u>Total</u>		
17,507 ticks		

Table 1 and Figure 1. A total of 17,507 ticks were collected. Major collecting years included 2012 (n = 1,442), 2019 (n = 6,512), and 2020 (n = 6,855), with concentrations centered around western and central Pennsylvania, but a presence in statewide geographical distribution



Tick Species	Percentage of Total Ticks Collected
<i>I. scapularis</i>	6884/17,507 (39.32%)
<i>D. variabilis</i>	2119/17,507 (12.10%)
<i>A. americanum</i>	6868/17,507 (39.23%)
<i>Haemaphysalis spp.</i>	112/17,507 (0.64%)

Table 2. Major species collected included *Ixodes scapularis* (39.32%), *Amblyomma americanum* (39.23%), and *Dermacentor variabilis* (12.10%). Emergence of two previously rare/unknown ticks in Pennsylvania, *A. americanum* (2017) and *Haemaphysalis* (2015), with significant prevalence from 2018-2020.

Pennsylvania 2008-2020	
Pathogen	qPCR positive ticks
<i>Rickettsia</i>	169/793 (21.31%)
<i>B. burgdorferi</i>	108/852 (12.68%)
<i>E. chaffeensis</i>	59/802 (7.36%)
<i>A. phagocytophilum</i>	15/550 (2.73%)
<i>Borrelia spp.</i>	143/377 (37.93%)

Table 3. Molecular testing (qPCR) of ticks from 2008-2016 demonstrated *Rickettsia* (21.31%) and *Borrelia burgdorferi* (12.68%) as the most commonly detected tick-borne microbes.

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