# Using Geospatial Analysis to Describe the Association between Active Tick Surveillance Data and Clinical Cases of Anaplasmosis

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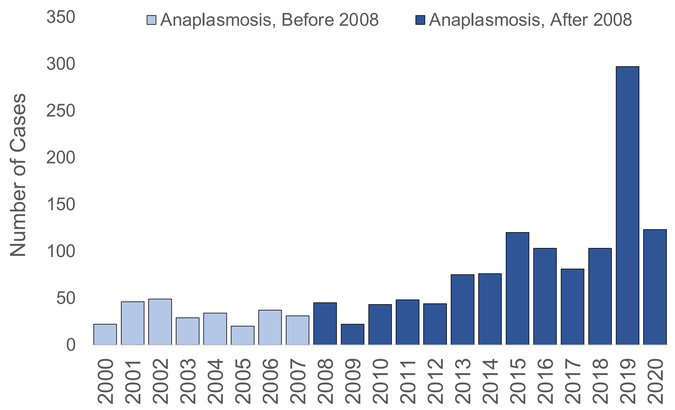
## HISTORY OF ANAPLASMOSIS IN CONNECTICUT

- Anaplasmosis is a disease caused by the bacterium *Anaplasma phagocytophilum*
- Spread by *Ixodes scapularis,* also known as deer tick or black-legged tick
- Main bacterium reservoirs in the United States are white-footed mice or white-tailed deer
- Most frequently seen in Northeastern states
- Established as a nationally notifiable disease by the U.S. Centers for Disease Control and Prevention (CDC) in 1999; case surveillance definition established by the CDC in 2008
- Cases have steadily increased in Connecticut since being established as a state-wide reportable disease in 2008 with a peak of 297 reported cases in 2019 (CTDPH, 2020)




## ACTIVE TICK SURVEILLANCE PROGRAM (ATSP)

- Established by the Connecticut Agricultural Experiment Station (CAES) in 2019 (CAES, 2021)
- Ticks are collected directly from the environment using dragging techniques where a piece of 1 $m^2$ cloth is used to drag 750 $m^2$ at a site
- Dragging is conducted at 40 sites throughout the state (5 sites in each of the 8 counties)
- Ticks are identified by species and life stage then tested for pathogens using organism-specific PCR

## STUDY DESIGN AND METHODS

**Clinical Case Collection**

- Human anaplasmosis case data was obtained from the Connecticut Department of Public Health (CT DPH) for 2019 and 2020
- Study population included all positive cases (both children and adults)
- State population estimates were also obtained from the CT DPH

**Active Surveillance Data for Ticks**

- Tick data was obtained from the CAES for 2019-2020 and included information such as county, tick life stage, and ticks tested/positive for disease

**Data Analysis**

- Human incidence rate (IR) calculated per 100,000 using case numbers and population estimates
- Tick data analyzed using SAS version 9.4 to create summary tables and acarological risk index (ARI) was calculated to understand the risk to humans (Nicholson and Foster, 2021)

$$\text{ARI} = \left[\frac{n\ ticks\ collected}{total\ area\ dragged}\ x\ 100\right]\ x\ \left[\frac{n\ positive\ ticks}{n\ ticks\ tested}\right]$$

- Spearman rank correlations calculated using SAS to determine the magnitude between IR and ARI by year and county
- ArcGIS mapping to present IR and ARI by year and county

## OBJECTIVES

- Objective 1: Understand how the anaplasma infection prevalence in ticks may geographically correlate to human anaplasmosis cases in Connecticut
- Objective 2: Identify the spatiotemporal patterns of the increase in clinical cases of anaplasmosis in Connecticut

## RESULTS

*Table 1: Human incidence per 100,000 by county in 2019*

| County | # of Cases | Total Population | IR |
|---|---|---|---|
| **Fairfield** | 130 | 943,332 | 13.78 |
| **Hartford** | 5 | 891,720 | 0.56 |
| **Litchfield** | 99 | 180,333 | 54.90 |
| **Middlesex** | 1 | 162,436 | 0.62 |
| **New Haven** | 42 | 854,757 | 4.91 |
| **New London** | 7 | 265,206 | 2.64 |
| **Tolland** | 3 | 150,721 | 1.99 |
| **Windham** | 6 | 116,782 | 5.14 |

*Table 2: Human incidence per 100,000 by county in 2020*

| County | # of Cases | Total Population | IR |
|---|---|---|---|
| **Fairfield** | 40 | 957,050 | 4.18 |
| **Hartford** | 2 | 898,682 | 0.22 |
| **Litchfield** | 29 | 184,938 | 15.68 |
| **Middlesex** | 1 | 164,063 | 0.61 |
| **New Haven** | 20 | 864,094 | 2.31 |
| **New London** | 23 | 268,450 | 8.57 |
| **Tolland** | 2 | 149,767 | 1.34 |
| **Windham** | 6 | 116,404 | 5.15 |

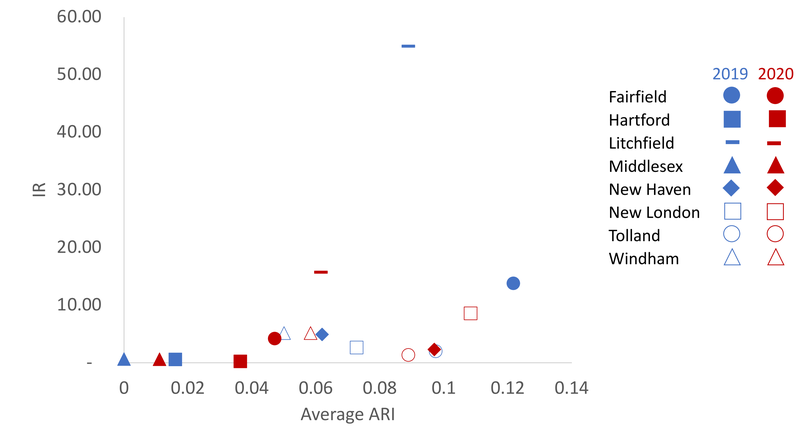
*Table 3: Spearman Rank Correlation between IR and ARI.*

| Year | Mean IR (SD) | Mean ARI (SD) | Spearman Correlation | P Value |
|---|---|---|---|---|
| **2019** | 10.57 (18.41) | 0.064 (0.041) | 0.5952 | 0.1195 |
| **2020** | 4.76 (5.21) | 0.064 (0.033) | 0.5476 | 0.1600 |
| **2019-2020 (Combined)** | 7.66 (13.41) | 0.064 (0.036) | 0.5430 | 0.0297 |

## DISCUSSION

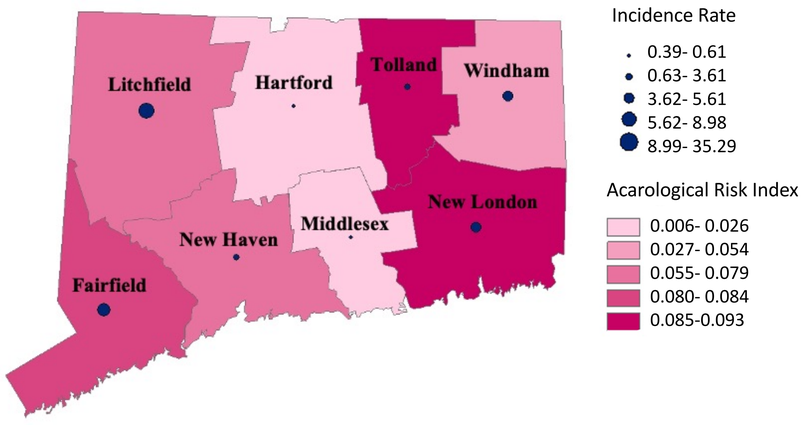
- Area with the greatest increase in both ARI and IR in Connecticut from 2019-2020: New London County
- Other notable areas with high IR and ARI: Litchfield County and Fairfield County
- A positive correlation between IR and ARI exists when combining 2019 with 2020 data, which indicates that the ATSP is an effective public health tool in understanding tick-borne diseases
- Future efforts should be made to approach surveillance at a more local level such as towns or popular parks so that more targeted pest management approaches can be implemented
- **Limitations**:
  - Limited time for data collection (2 years) – trends by season or year may not appear over this length of time
  - Human anaplasmosis data is also limited to individuals who were tested for infection → individuals who were asymptomatic or presented mild symptoms may not have been tested for anaplasmosis so some cases may not be included in this analysis

## RESULTS – CHANGES BY COUNTY




Notable County Trends from 2019 to 2020

- Litchfield: 71% ↓ in IR, 30% ↓ in ARI
- Fairfield: 70% ↓ in IR, 160% ↓ in ARI
- New London: 225% ↑ in IR, 48% ↑ in ARI

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## CITATIONS

- CAES. (2021). Active Tick Surveillance— Connecticut, 2019-2020. Retrieved 1/27/2022, from https://www.cga.ct.gov/app/related/20210315_2021%20 Conservation%20and%20Development%20Subcommittee%20Work%20Session%20Documents/AES_CT%20Tick%20Surveillance%20Summary%202019-2020.pdf
- CTDPH. (2020). Anaplasmosis. https://portal.ct.gov/DPH/Epidemiology-and-Emerging-Infections/Anaplasmosis
- Nicholson, W., & Foster, E. (2021). *Tick Surveillance as a Public Health Tool*. CDC Retrieved from https://www.cdc.gov/ticks/pdfs/Tick_Surveillance_NECOE _Bootcamp_2021-508.pdf