**PROJECT TITLE:** Understanding Environmental Factors that Impact Minnesota Tick Populations

**I. PROJECT STATEMENT**

Minnesota is at the forefront of a nationwide tick invasion. Over the past 20 years, ticks have expanded their geographic range and are found in places they hadn’t been previously seen. As a consequence, tick-borne disease is on the rise. Prevention of tick-borne illnesses is a priority of most health agencies, but we struggle to understand what causes variation in tick populations by year, state, or even across counties. Cold winters, regional droughts, heavy rainfalls, or persistent heat are likely to impact tick numbers and subsequent disease risk; however, the exact relationship is poorly understood. We propose to investigate the environmental factors that impact numbers of ticks in Minnesota by taking advantage of robust tick and weather data collected by the state of Minnesota. Our findings will elucidate the link between weather and ticks, and inform both insect-control strategies and public awareness campaigns to reduce the spread of tick-borne illnesses.

Ticks are tiny arachnids inhabiting wooded or brushy environments, which will bite and feed on human blood. Some ticks are known to spread harmful disease, including Lyme disease, babesiosis, and ehrlichiosis. While common symptoms often include rashes, fever, and fatigue, untreated tick-borne disease can spread to the joints, heart, and nervous system. Tick-borne disease is a major problem in Minnesota. In 2016, the Minnesota Department of Health (MDH) reported 39 Lyme disease cases per 100,000 people and this number has increased by 250% over the past 20 years. However, these numbers are considered to be low estimates of the true burden. Considering that Minnesota had 8 million state park visitors, nearly 1 million overnight campers, and a half million deer hunters in 2012, we have a significant population at-risk for tick exposure.

Our long-term goal is to reduce tick-borne disease and inform tick control strategies for the state of Minnesota through improved understanding of the tick and environment relationship. Our overall project objectives are to:

* Characterize historical weather conditions in Minnesota, including drought, heat, cold, and precipitation
* Identify the weather conditions that lead to changing tick populations
* Provide data to inform public awareness campaigns and disease reduction strategies when ideal tick conditions are forecasted

The rationale for this project is to inform decision making and protect Minnesotans from tick-borne disease. It seeks to benefit people that utilize parks and open spaces, advise insect control policies, and decrease the spread of Lyme disease. The project will involve a collaborative effort between University of Minnesota School of Public Health, Metropolitan Mosquito Control District, and Minnesota Department of Health. Led by Dr. Jesse Berman, we will characterize weather events across the state (1991 to 2016). Using statistical modeling, we will investigate how weather conditions influence historical tick abundance from 100 sites across the 7-county metro area for 26 years. Working with MDH, we will refine our understanding of environmental conditions leading to greater tick exposure risk, and prepare summaries to communicate with the public and control agencies.

**II. PROJECT ACTIVITY - UNDERSTANDING THE ENVIRONMENTAL FACTORS THAT IMPACT TICK POPULATIONS IN MINNESOTA**

**Outcome 1.** *Characterize historical Minnesota weather, including drought, heat, cold, and precipitation*

Using weather station and online climate data, we will identify drought, daily temperature, precipitation, snowfall, and other meteorological measures at hundreds of monitors across the state of Minnesota (1991-2016). Using spatial analysis, weather conditions will be classified into ‘events,’ such as drought or heatwave, that are important for tick populations. We will map conditions of event occurrences in Minnesota to create a visual picture of weather across both space and time. **ENRTF BUDGET: $ 79,828**

**Outcome 2:** *Determine weather conditions associated with changes in tick abundance*

Using a Geographic Information System (GIS), we will combine weather events with pre-existing tick data collected by the Metropolitan Mosquito Control District across 100 sample sites covering 26 years. Additional environmental characteristics of the sample sites will be incorporated, including the surrounding land types, proximity to parks, geography, and community characteristics. Using statistical modeling, we will quantitatively assess the relationship between weather and tick abundance, to determine how environmental conditions influence tick populations. **ENRTF BUDGET: $ 68,934**

**Outcome 3:** *Identify “ideal” conditions for ticks, and prepare summaries to communicate risks to the public*

We will use the findings from Activity 2 to discover how weather and environment lead to changes in tick abundance. This knowledge can be used for identification of early tick risks. We will work with the Minnesota Department of Health to prepare effective communication tools for both outdoor recreationalists and insect-control planners. This information will be used in tick management strategy, such as early warning systems and behavioral education to reduce harmful disease.

**ENRTF BUDGET: $ 50,769**

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| **Outcome** | **Completion Date** |
| *1. Characterize and map weather events in Minnesota across 26 years* | *April 30, 2020* |
| *2. Determine the relationship between weather conditions and tick-populations* | *December 31, 2020* |
| *3. Prepare communication tools for the public and insect-control planners* | *June 30, 2021* |

**III. PROJECT PARTNERS AND COLLABORATORS:**

**A. Partners receiving ENRTF funding**

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| --- | --- | --- | --- |
| **Name** | **Title** | **Affiliation** | **Role** |
| Dr. Jesse Berman | Assistant Professor | University of Minnesota  | Principal Investigator |
| Dr. Jon Oliver | Assistant Professor | University of Minnesota  | Co-Principal Investigator |

**B. Partners NOT receiving ENRTF funding**

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| **Name** | **Title** | **Affiliation** | **Role** |
| David Neitzel | VBD Unit Head | MN Dept. of Health | Collaborator |
| Kirk Johnson | Vector Entomologist | Metropolitan Mosquito Control District | Collaborator |

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

The project will enhance our understanding of environmental conditions that lead to increased tick populations where people live, work, and play. The results will inform surveillance and control activities of the Department of Health and Metropolitan Mosquito Control Department. It will provide information to reduce tick and disease exposure for Minnesota residents. We will disseminate our findings through the Department of Health website and through UMN Extension. Results from Outcomes 2 and 3 will also be presented at public health conferences and published in scientific journals, where they can be useful for other Midwest states looking to inform tick disease strategies.

**V. TIME LINE REQUIREMENTS:**

The proposed will require 24 months to complete. The first 10-months will be devoted to acquiring, cleaning, mapping, and characterizing 26 years of weather events in Minnesota. The next 8-months will statistically model associations between tick populations and weather. The last 6-months will be devoted to analyzing environmental conditions leading to increased tick-risk and preparing public communication messaging.

**VI. SEE ADDITIONAL PROPOSAL COMPONENTS: A) Proposal Budget Spreadsheet, B) Visual Component, F) Project Manager Qualifications and Organization Description**