IOSR Journal of Nursing and Health Science (IOSR-JNHS)
e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 6, Issue 6 Ver. VI. (Nov.- Dec .2017), PP 45-48
www.iosrjournals.org

A Retrospective Analysis Of The Contribution of Soil Type To The Diversity And Distribution Of Mites And Adult *Ixodes scapularis* Say Using The ProVector Collector Bioagent Transport And Environmental Modeling System

Thomas M. Kollars, Jr.
Health Sciences, Liberty University, Lynchburg, VA
tkollars@libety.edu
Corresponding Author: Thomas M. Kollars, Jr.

Abstract: *A survey for adult Ixodes scapularis Say and mites was conducted in October at Tobyhanna Army Depot (TYAD) located in northeastern Pennsylvania, USA. Acarines were collected using ProVector® Collector traps and cloth drag. Menhinick's index and analysis of variance were used to compare mite diversity among soil types. Dragging for adult I. scapularis was conducted throughout TYAD, representing 96% of soil types. Forty individuals from 7 groups of acarines were collected representing Collohmanniadae, Ixodidae, Johnstonianidae, Oribatululoidea, Tetranychidae, Trombiculidae, and Trombidiidae. The Bioagent Transport and Environmental Modeling System was used to compare the presence and abundance of mites, chiggers and adult I. scapularis in relationship to soil maps. There was a significant correlation between number of mites collected and soil type; although, additional trapping of mites on other soil types is necessary to further clarify the relationship. Based on the soil map, a high population of I. scapularis would not be expected at TYAD since sandy soils represented only 1% of the area; extensive dragging confirmed this, with only two adults captured. This work illustrates that readily available GIS data layers can be of significant value in the planning and execution of acarine population surveys.*

Key Words: *Acari, Ixodidae, Collohmanniadae, Johnstonianidae, Oribatululoidea Tetranychidae, Trombiculidae, Trombidiidae, Ixodes, chiggers, Lyme disease*

Date of Submission: 30-11-2017 Date of acceptance: 09-12-2017

I. Introduction

The Acari, mites and ticks, have colonized virtually every environment. They may be found in soil, caves, hot springs, ocean floors, arctic and desert habitats (Krantz, 1978) and as internal or external parasites. The geographic distribution of an acarine species is dependent upon its habitat requirements. A survey of Tobyhanna Army Depot (TYAD), located in northeastern Pennsylvania USA, was conducted to identify the abundance and distribution of adult *Ixodes scapularis* Say, chiggers and identify acarine diversity. Although habitats looked suitable for adult *I. scapularis*, few were captured despite extensive dragging and trapping. Because of the low capture number of *I. scapularis*, a retrospective analysis of soil type and the distribution of acarines was conducted. Predictive models based on soil type were developed using geographic information systems (GIS) that may be useful in assisting acarologists and vector biologists surveying for mites and *I. scapularis*.

II. Materials And Methods

Two methods of collecting arthropods were used. Thirty-six 100m tick drags, consisting of pulling a $1m^2$ cloth and checking each 10m, were conducted throughout TYAD during October. Drags were conducted from 0900 – 1700. Ten ProVector Collector™ traps, were used in an attempt to collect ticks and mites. The ProVector Collector uses chemical attractants and a glue board attached to a black plate and has been used to capture *I. scapularis, Amblyomma americanum* (L.) and mites. Tick drags were conducted on 12 of 17 soil types (Table 1), representing 91% of the soil area of TYAD (U.S. Army Corps of Engineers, Waterways Experiment Station, Mississippi 1996). ProVector Collector traps were placed in three areas for 3 trap nights, in what appeared to be ideal adult *I. scapularis* habitat based on ectonal and vegetative structure. These 3 areas represented 3 soil types. Dragging was conducted over the trap sites on the last day of the survey to collect ticks not captured by the trap. Mites were identified to superfamily, family or genus using a microscope.All collection sites were georeferenced within the 3 to 6 meters. An adaptation of Menhinick's Index (MI) (Whittaker, 1977) was used for measurement of mite diversity captured using the ProVector Collector. The mean MI of acarines (*sans I. scapularis*) inhabiting the three soil types were compared by analysis of variance

(ANOVA) using Statistica (Statsoft, Tulsa, Oklahoma). Soil maps were obtained from the Environmental Management Division, TYAD, Pennsylvania. ArcMAP and the Bioagent Transport and Environmental Modeling System (BioTEMS) were used to display and predict areas where *I. scapularis,* chiggers and where the highest mite diversity might occur.

III. Results And Disussion

Forty individuals from 7 groups of acarines were collected representing Collohmanniadae, Ixodidae, Johnstonianidae, Oribatululoidea, Tetranychidae, Trombiculidae, Trombidiidae. Soil definitions of TYAD are given in Table 1. Chippewa and Norwich extremely stony soils; 0-8% slopes (CNB) had a significantly higher mean, $P<0.05$, MI (mean=1.3, sd=0.19) than the MI of Oquaga-Lackawanna channery loams; 0-8% slopes (OXB) (mean=0.50, sd=0.71). The mean MI of Morris, extremely stony silt loam; 0-8% slopes (MOB) (mean=1.0, sd=0.26) was not significantly different than either CNB or OXB. Chiggers (Trombiculidae) were found on CNB and MOB soil types. One male and one female *I. scapularis*, the primary vector of Borreliosis in the eastern U.S., were collected on consecutive days from one site by drag on CNB. No ticks were collected by dragging over trap sites.Soil types have been correlated with acarine diversity and distribution. Diversity of orobatid mites has been shown to vary in soils under different conifer species (Berch et al. 2001); Douglas-fir plots had similar patterns of diversity, whereas, Sitka spruce, red cedar, and hemlock showed no clear patterns. Various groups of mites may be collected from habitats having little complexity. For example, in a one-year study of city pavements in Prague, 136 individual mites were collected; some were allergogenic mites while most were food store mites (Samsinak and Vobrazkova, 1985).The abundance of *I. scapularis* has often been shown to be associated with habitat, including soil type. In the north central United States, *I. scapularis* populations were associated with dry to mesic deciduous forests and alfisol-type soils of loam-sand textures. Absence was associated with wet mesic forests with acidic soils of low fertility and a clay soil texture (Guerra et al. 2003). In Maryland, *I. scapularis* abundance was positively correlated with well-drained, sandy soils having low water tables (Glass et al. 1994). In mid-Atlantic states, the abundance of *I. scapularis* was correlated with sandy soil and channery soil, and gravel using digital soil series. However, when using lower resolution soil data, the correlation between some soil types and tick abundance changed between years (Bunnell et al. 2003).

In the present study, preliminary findings on 3 of 17 soil types indicate that acarine diversity is highest in CNB soil type, with dominant tree species consisting of eastern white pine and white spruce, followed by soil type MOB with European larch, eastern white pine, Norway spruce and white pine (Figure 1). The lowest diversity of mites was found in OXC soil type with eastern white pine, red pine, European larch, and Norway spruce. Chigger populations had the same pattern as total mite diversity, CNB>MOB>OXC (Figure 2). Only two adult *I. scapularis* were collected during the 4 days, although drags were conducted on 91% of the soil types. They were found only on CNB soil type, which represented 9% of the total area.The habitat at TYAD does not appear to be appropriate for high abundance of this species based upon previous studies indicating sandy soils as important for high densities. Sandy soils represent approximately 1% of the total area of Tobyhanna Army Depot and sites in Figure 3 should be periodically sampled for *I. scapularis* surveillance. Data layers for GIS are readily available and can be easily incorporated into Arcview or other GIS computer software. Although the vegetation and habitat seemed appropriate, a retrospective analysis of soil types helps to explain why there was a paucity of adult *I. scapularis* present at TYAD. This work illustrates that readily available GIS data layers can be of significant value in the planning and execution of acarine field surveys designed to identify the spatial distribution and diversity of Acari.

Acknowledgement

Gratitude is expressed to Karl Neidhardt and Brian Zeichner for their assistance on this project. This work was supported by funds from the U.S. Army Center for Health Promotion and Preventive Medicine. We would like to acknowledge the help of Ms. Shannon Lowe, GIS Branch, USACHPPM and the Environmental Management Division, Tobyhanna Army Depot for technical and map support. The views of the authors do not purport to represent the position of the Department of the Army or the Department of Defense. Statement of conflict of interest: Prof Thomas Kollars is the inventor of the ProVector.

References

[1]. Berch, S. M., B. Baumbrough, J. Battigelli, P. Kroeger, N. Strub, and L. de Montigny. 2001. Preliminary assessment of selected communities of soil organisms under different conifer species. B.C. Min. For., Res. Br., Victoria, BC. Research Repor 20. 35pp.
[2]. Bunnell, J. E., S. D. Price, A. Das, T. M. Shields, and G. E. Glass. Geographic
[3]. information systems and spatial analysis of adult Ixodes scapularis (Acari:
[4]. Ixodidae) in the middle Atlantic region of the U.S.A. J. Med. Entomol. 40: 570-576.
[5]. Glass, G. E., B. S. Schwartz, J. M. Morgan III, D. Johnson, P. M. Noy, and E. Israel.
[6]. 1994. Environmental risk factors for Lyme disease identified with geographic information systems. 85: 944-948.
[7]. Guerra, M., E. Walker, C. Jones, S. Paskewitz, M. R. Cortinas, A. Stancil, L. Beck, M. Bobo, and U. Kitron. 2003. Predicting the risk of Lyme disease: habitat suitability for *Ixodes scapularis* in the north central United States. Em. Inf. Dis. 8: 289-297.

[8]. Krantz, G. W. 1986. A manual of Acarology, 2nd Ed. Oregon State University Book Stores, Inc. Corvallis, Oregon, USA. 509pp.
[9]. Samsinak, K. and E. Vobrazkova. 1985. Mites from the city pavement. Zentralbl. Bakteriol. Mikrobiol. Hyg. 181: 132-138.
[10]. Whittaker, R. H. 1977. Evolution and measurement of species diversity. Taxon., 21:
a. 213-251.
b.

Figure 1. Predicted Diversity of Mites using Menhinick's Index (MI) at Tobyhanna Army Depot Based on Soil Map Profile

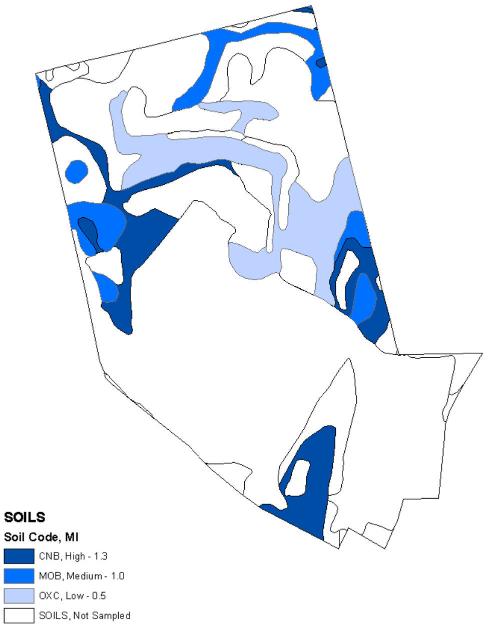


Figure 2. Predicted Chigger Rate using Analysis of Variance at Tobyhanna Army Depot Based on Soil Map Profile

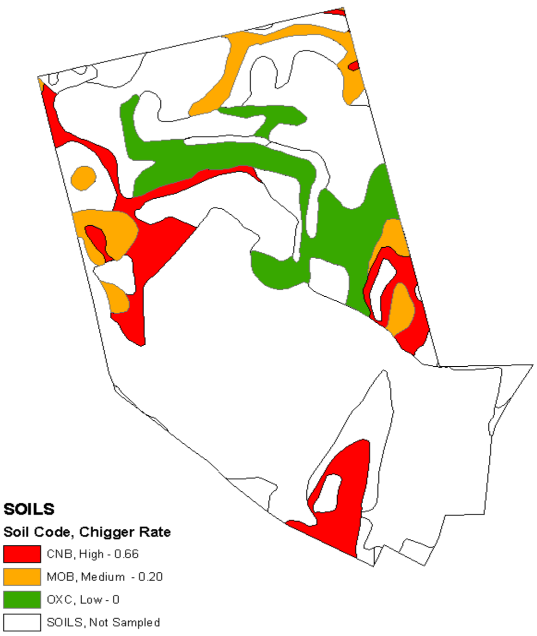
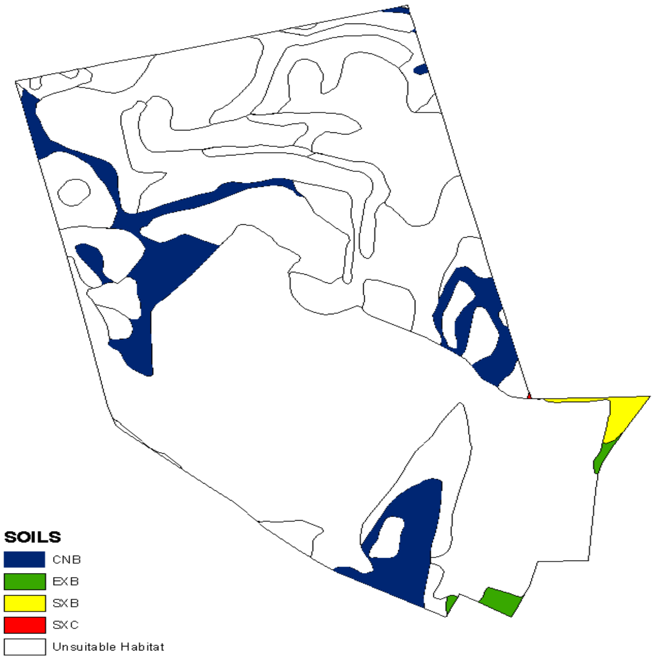


Figure 3. Recommended Surveillance Areas for *Ixodes scapularis* at Tobyhanna Army Depot Based on Soil Map Profile



Thomas M. Kollars "A Retrospective Analysis Of The Contribution of Soil Type To The Diversity And Distribution Of Mites And Adult IxodesScapularis Say Using The Bioagent TransportAndEnvironmental Modeling System." IOSR Journal of Nursing and Health Science (IOSR-JNHS) , vol. 6, no.6 , 2017, pp. 45-48.