Elucidating an invasion of blacklegged ticks and zoonotic pathogens in real-time in Michigan: field and molecular perspectives

SARAH A. HAMER[1], GRAHAM J. HICKLING[2], EDWARD D. WALKER[3], and JEAN I. TSAO[1,4]

[1]Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI USA. [2]Department of Forestry, Wildlife, and Fisheries, University of Tennessee-Knoxville, Knoxville, TN USA. [3]Department of Microbiology and Molecular Genetics, Michigan State University, East Lansing, MI USA. [4]Department of Large Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI USA.

Our ability to detect and manage invasions of zoonotic pathogens is often hindered by unknown mechanisms of invasion, insensitive surveillance measures, and the complex ecology of these disease systems. Within the past decade, field populations of *Ixodes scapularis* (blacklegged ticks) were detected for the first time in southwestern Lower Michigan. Established ticks are accompanied by an increased risk of *I. scapularis*-borne diseases to humans and canines, including Lyme disease, which was previously restricted to endemic areas in the Northeast and upper Midwestern United States. Since the summer of 2004, we have been investigating this invasion in real-time, using complementary field and diagnostic approaches to test hypotheses about mechanisms of tick and pathogen invasion. Repeated sampling of ticks, tissue, and blood from wildlife and companion animals at various state parks allowed us to establish gradients of invasion that are dynamic over space and time as tick infestation rates increase and the previously-naïve animal community is exposed to the invading pathogen. The invasion is proceeding more rapidly in a northward direction along Michigan's west coast dune forests as compared to the movement inland. Additionally, we have evidence to support a cryptic maintenance of the Lyme disease pathogen between birds and a bird/rabbit-specialist tick species at a focal site outside the detected invasion zone of *I. scapularis.* While molecular characterization of this bird tick-associated pathogen is ongoing, we predict that invading *I. scapularis* will bridge this pathogen to humans and canines. Through continued monitoring of the process of invasion of this disease system, we aim to determine the rate and mechanisms of invasion. Our findings emphasize the need for heightened awareness among human and veterinary health professionals for tick-borne disease throughout Michigan.