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The Impact of Climate Warming on the Establishment of Lyme Disease Tick Vector Ixodes Scapularis

A stage-structured periodic deterministic model is formulated to assess the climate warming impact on the tick (Ixodes scapularis) population at Long Point, Ontario, Canada. The model is parametrized by using Fourier analysis, and the tick development and questing activity data are complied from the laboratory and field experiments conducted in Canada. These validated estimations provide the basis for our study using the deterministic model with periodic coefficients to describe the influence of climate warming on the Lyme disease establishment in the considered region. The basic reproduction number for the tick population is derived and this number serves as a threshold parameter for tick invasion: the tick is doomed to extinction when this number is less than unity; and the tick can successfully invade into the study region and may stabilize at a positive seasonal equilibrium state when this number is greater than one. Both temperatures and host densities influence the value of the basic reproduction number, thereby influencing the risk of tick establishment in a habitat, specifically, climate warming promotes tick survival in favorable habitats and affiliates tick invasion to previously non-endemic areas. This is joint work with Xiaotian Wu, Venkata R. Duvvuri, Nicholas H. Ogden and Jianhong Wu.