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Global stability and Hopf bifurcation in a tick population model with delays

Abstract: Transmitted by ticks, Lyme disease is an emerging infectious disease that can cause severe problems for human health. The reproduction and development of ticks are closely related to the environmental factors, in particular, the daily temperature. We study a three-stage population model for ticks with three delays to reflect the impact of average daily temperature on the developmental stages. We define the basic reproduction number R^* of the tick population. The tick population is uniformly persistent if $\mathcal{R}^* > 1$. Besides if $1 < \mathcal{R}^* < e^2$, then the unique positive equilibrium point (L^*, N^*, A^*) is globally asymptotically stable. If $\mathcal{R}^* > e^2$, the positive equilibrium could lose stability through the occurrence of a Hopf bifurcation and the system shows oscillatory behaviors. Recently, we established the existence of global Hopf bifurcation using delays as bifurcation parameters. To illustrate our theoretical results, we present some global Hopf bifurcation diagrams as delays vary and some numerical solutions of the model. This is joint work with Prof. Zhu (York University) and Prof. Thieme (Arizona State University)