Persistence, global stability, and global Hopf bifurcation in a staged tick population model with delays

Guihong Fan

Columbus State University

Abstract: Transmitted by ticks, Lyme disease is an emerging infectious disease which can cause severe problems for human health. The reproduction and development of ticks are closely related to the environmental factors, in particularly 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 tick population. The tick population is uniformly persistent if $\mathcal{R}^* > 1$. In addition 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 proved the existence of global Hopf bifurcation as bifurcation parameters vary. To illustrate our theoretical results, we present some global Hopf bifurcation diagrams as delays vary and some numerical solutions of the model.