Graduate Seminar

Speaker

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Time Delayed Models in Population Biology and Epidemiology

Abstract:

In this talk, I will introduce our recent research on the dynamics of time-delayed mathematical models in ecology and epidemiology. Throughout five different projects, we have developed dynamical models and then used various methods to study their qualitative features including existence and uniqueness of solutions, boundedness, steady states, persistence, local and global stability. (i) Ecological models: First, we studied a single species-fish with three stages and two harvesting strategies depending on the size and maturity. Then we developed a model for the growth of sea lice with three stages such that the development age for non-infectious larvae to spread into infectious larvae relates to the size of adult population size. In an ongoing work, we are exploring a biological control of sea lice using one of the predators, "cleaner fish", by proposing a model with predator-prey interaction at the adult level of sea lice. (ii) Epidemiological models: During the outbreak of Ebola, we proposed a model that incorporates both the transmission of infection between the living humans and from the infected corpses to the living individuals, with a constant latent period. We found that the long latent period or low transmission rate from infectious corpses may reduce the spread of Ebola. Later we considered the influence of seasonal fluctuations on disease transmission and developed a periodic infectious disease model where asymptomatic carriers are potential sources for disease transmission. We considered a general nonlinear incidence rate function with the asymptomatic carriage and latent periods. We implemented a case study regarding the meningococcal meningitis disease transmission in Dori, Burkina Faso. Our numerical simulation indicated an irregular pattern of epidemics varying in size and duration, which is consistent with the reported data in Burkina Faso from 1940 to 2014. All these works are supervised by Dr. Yuan.