Title: Qualitative Analysis of some Ecological and Eco-epidemiological Systems

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Abstract

Predator-prey interaction is a complex process in nature. We study this process in this thesis through mathematical models available in ecology and eco-epidemiology in integer-order as well as fractional order system. We have found some results in each chapter that are very interesting in the field of ecology and eco-epidemiology. Throughout the thesis we have considered predator is specialist in nature.

A predator-prey-pathogen model has been considered in Chapter 2, where predator influences the transmission rate of infection in its prey. We have seen that the predator density dependent transmission rate can causes oscillation in our system. We also have noticed that the system is impermanent if the death rate of predator crosses a certain threshold value. Generally most of ecological populations are suffer from different kind of infectious diseases. Due to disease in prey population they are very weak and they can be easily vulnerable to the predator. However there may be a risk factor for predator to consume the infected prey. Naturally the prey population can protect themselves in various ways to avoid being killed by their predators whether they are infected or not. In Chapter 3 we have focused on these two issues and we have seen that prey refuge has a major impact on each population.

Chapter 4, is based on a simple eco-epidemic model where the prey population is infected by chronic wasting disease (CWD). This is a prion disease of mule deer, white-tailed deer, elk, and moose and this disease belongs to the family of transmissible spongiform encephalopathy (TSEs). As this is a fatal disease so to eradicate this disease no vaccination is still available thus we have introduced predator population who only consume the infected population to control the disease. A fractional-order eco-epidemic model of chronic wasting disease is investigated in Chapter 5. We have seen that there is a possibility of Hopf bifurcation when the fractional order derivative crosses a certain critical value.

In Chapter 6, we have discussed a Leslie-Gower predator prey refuge system in presence of a competitor for prey population. Generally this Leslie-Gower type model exhibits stable behaviour with or without refuge but in presence of a competitor the system dynamics of the model may be changed. In this analysis we have thoroughly investigated local bifurcation analysis around the equilibria. The novelty of this chapter is the occurrence of transcritical bifurcation but no Hopf-bifurcation around the equilibria.

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