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Deterministic Chaos vs. Stochastic Oscillation in an Eco-epidemic Model

Eco-epidemiological models of prey-predator interaction in presence of disease affecting either or both the species have received significant attention from various researchers. Some recent investigation reveals chaotic dynamics for certain range of parameter values. Unusual disease related death or higher growth rate of susceptible species or sudden outbreak of the disease or high rate of infection are possible explanation behind the chaotic dynamics. Most of these modeling approaches neglected the demographic stochasticity as well as environmental stochasticity. Main objective of the presentation is to construct the stochastic eco-epidemic model based upon the existing deterministic model and study the dynamics for a wide range of parameter values. The dynamics of the stochastic model is investigated for two types of parameter values, first set correspond to stationary or periodic scenario and second set correspond to chaotic oscillation for the deterministic model. It is interesting to note that the evolution of either species is not chaotic within stochastic setup rather they exhibit non-equilibrium fluctuation around some average values for both types of parameter values. Chance of extinction and expected time to extinction is also studied with the help of exhaustive numerical simulations.