



Effect of Fear on an Epidemic Model with Gestation Delay and Disease in Predator Population

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Abstract

Recent research shows that predators not only kill their prey directly, but they also make them fearful, which reduces the rate at which prey species procreate. We present a three-dimensional model of prey-predator with fear in prey along with diseases that affect predators as well as time lag brought on by the population of predators gestating. The boundedness and positive invariance of the suggested system's solutions have been clarified. We evaluate the equilibrium points and the existence of equilibria have been explained. Additionally, the local stability of each potential equilibrium points is investigated. Fear can stabilise the predator-prey system, according to our mathematical calculations. The system's Hopf bifurcation has been studied in relation to a number of factors. Moreover, Hopf bifurcation is used to show that time delay has periodic solutions and that time delay is crucial for controlling the system dynamics. To further illustrate the influence that fear may have on the delayed prey-predator model, we looked at connection between fear effects and other characteristics using numerical simulations. To determine the direction of the Hopf bifurcation and the stability of the bifurcating periodic solution, explicit formulations based on the normal form theory and the center manifold theorem are provided. The outcome of the theoretical investigation is ultimately validated through numerical simulation.

Keywords Fear effect · Prey-predator · Hopf bifurcation · Gestation · Time delay · Stability · Bifurcation analysis · Numerical simulations

Introduction

In ecological science, dynamical connection between prey and predator is a key subject because of their significance and universal existence. Numerous mathematical models between prey-predator have been thoroughly studied from various angles by several researchers over the last few decades. By the end of the 18th century, Malthus [1] proposed

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