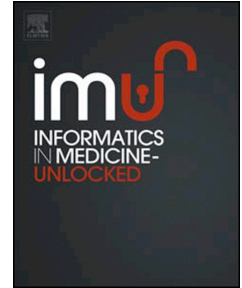


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Dynamics of a predator-prey model with stage-structure on both species and anti-predator behavior

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Abstract: In this paper, we have formulated and studied a stage-structure predator-prey model. Here, we consider stage-structure on both prey as well as predator population which means that the prey population is divided into two sub populations such as juvenile prey and adult prey, on the other hand, the predator population is also divided into two sub populations such as juvenile predator and adult predator. It is assumed that only adult predator have the ability to predation and they consume both juvenile prey as well as adult prey. Here, it is also considered that the growth rate of juvenile prey depends upon the adult prey population i.e., the juvenile prey has no reproduction capability. Also, Holling II and Holling IV response function have been used for the consumption of juvenile prey and adult prey by adult predator respectively. It is also considered two types of factors such as anti-predator behavior and group defense to formulate our proposed model. Mathematically, we have analyzed the positivity and boundedness of solutions, existence of equilibria, stability of the proposed system around these equilibrium points and Hopf bifurcation of interior equilibrium point. Finally, some numerical simulations have been presented to validate our theoretical results.

Keywords: Prey-predator model, Stage-structure, Group defense, Anti-predator behavior, Holling IV response function, Stability analysis.

1 Introduction

Predator-prey model is an essential tool in mathematical ecology and specifically for our understanding of interacting populations in the natural environment. Population biology [1,2,7] is a subset study within ecology that evaluates factors that affect populations. A population is defined as a group of the same species living in a similar geographical area. In recent time, focus on general factors or components [5,10,11,12] of a population that researchers focus on when evaluating populations. When a population biologist begins to evaluate a population of species, they use many tools to gather information. Mathematical formulas and models are constructed based on the experiments and observations and then used to make predictions. Basically, the researchers need to look at factors that affect the population.

In anti-predator defense mechanism [9 – 12,34], predator recognition is an important component because most of the defenses necessitate prey first recognizing danger i.e.,

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