

Role of Additional Food Resources in an Ecosystem with Two Discrete Delays

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Abstract : This study proposes a three dimensional prey-predator model with additional food, provided to predator individuals, including gestation delay in predators and delay in supplying the additional food to predators. It is assumed that the interaction between prey and predator is followed by Holling type-II functional response. We discussed the steady states and their local and global asymptotic behavior for the non-delayed system. Hopf-bifurcation phenomenon with respect to different parameters has also been studied. We obtained a range of predator's tendency factor on provided additional food, in which the periodic solutions occur in the system. We have shown that oscillations can be controlled from the system by increasing the tendency factor. Moreover, the existence of periodic solutions via Hopf-bifurcation is shown with respect to both the delays. Our analysis shows that both delays play an important role in governing the dynamics of the system. It changes the stability behavior into instability behavior. The direction and stability of Hopf-bifurcation are also investigated through the normal form theory and the center manifold theorem. Lastly, some numerical simulations and graphical illustrations have been carried out to validate our analytical findings.

Keywords : additional food, gestation delay, Hopf-bifurcation, prey-predator

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