IMPACT OF FEAR IN A TRI-TROPHIC FOOD CHAIN MODEL INCORPORATING PREY REFUGE

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A tritrophic food chain model is proposed in this work where consumer (or, predator) hunt for prey species (or, source) with Holling type-III functional response and the functional response between consumer and predator (or, top-predator) follows Beddington-DeAngelis response. It is assumed that the birth rate of the prey population is affected and in fact, is reduced due to the fear of predation. Incorporation of prey refuge term implies that only a fraction of prey is available to the consumer for consumption. Positivity and boundedness of the system guarantee that the proposed model is biologically well-posed. Analytical results show that there are some parametric restrictions under which the system is permanent. By Routh-Hurwitz criterion, the local stability conditions of the equilibrium points have been analyzed and on the other hand, Lyapunov LaSalle theorem proves that the locally stable equilibrium points are globally stable under some parametric restrictions. Also , Matlab supports the analytical findings with the help of diagrams. The occurrence of one dimensional as well as two-dimensional bifurcations have been shown and conditions for the existence of a limit cycle in the system through Hopf bifurcation also have been stated. The numerical figures depict that the prey refuge has both stabilizing and destabilizing effect on the system. Both the analytical and numerical results suggest that a minimum amount of fear is needed to make the system steady.

References

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