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DELAY INDUCED MULTIPLE STABILITY SWITCH AND CHAOS IN A PREDATOR-PREY MODEL WITH FEAR EFFECT

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We propose a delayed predator-prey model with fear in the prey population. We consider that the growth rate of the prey population is suppressed due to the fear of predators. It is also considered that there is a time lag between the time of perceiving predator signals through chemical and/or vocal cues and the changes in life-history and behavioral responses in the prey population. We study boundedness, persistence, local and global behaviour of the delayed system. Moreover, the Hopf-bifurcation analysis around the interior equilibrium with respect to the delay parameter is established. The stability and direction of Hopf-bifurcation are also studied. It is observed that fear induce delay has both stabilizing and destabilizing effects depending on the magnitude of the delay parameter. We observe that for the gradual increase of the magnitude of delay, the system dynamics switches multiple times between stable focus and limit cycle oscillations. However, for a higher value of the delay parameter, the system ultimately enters into the chaotic regime. The delay system also exhibits node-cycle bi-stability behavior between the interior equilibrium point and stable limit cycle. Numerical simulations are also performed to validate analytical findings.

References

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