

# Effects of fear in a fractional-order predator-prey system with predator density-dependent prey mortality.

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## Abstract

In this work, we have formulated a fractional-order predator-prey system with fear effect, where the death rate of the prey population is predator density-dependent. Generally, most of the ecological study considers the direct killing of prey in a predator's presence, but they ignore the effect of predators' presence on prey. Some experimental studies confirmed that fear affects the reproduction rate of the prey population, but a few studies are there, which conclude that fear also affects the death rate of the prey population. Thus our main aim in this work is to investigate the influence of the fear effect produced by a predator on the reproduction rate and death rate of the prey population. We first prove the existence, uniqueness, non-negativity, and boundedness of the considered model solutions. After that, we show a detailed analysis of different equilibria and their stability criteria based on some conditions where we specifically investigated the global stability of the interior equilibrium point. Besides that, the existence of Hopf bifurcation and the persistence of the system is derived. We also observed how fractional-order derivative also has an impact on our proposed system. Finally, some numerical simulation is performed to validate our findings.