162. Modelling the effects of drought on predator-prey population dynamics

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Abstract

Drought has severe ecological effects and it's of paramount importance to broaden our knowledge on how it affects not only specific species but also multi-trophic interaction at large. In this study, a three-dimensional continuous predator-prey system that incorporates the concept of drought is proposed and analyzed. Focus have been on the impact of drought due to the challenges it presents to the predator prey populations ranging from resources variability to cascading effects in food webs. The model utilizes the logistic equation with both Holling type I and type II functional response to represent the dynamics of the system. Drought has been modelled as an exogenous driver influencing the prey's growth rate and the predators responds through changes in prey density. The existence, boundedness, and uniqueness of the model's solution are investigated. The feasibility and stability conditions of the fixed points within the system are examined by employment of linearization, eigenvalue method and Routh Hurwitz criterion. Numerical Simulation of the developed model was utilized to gain insights into the dynamics and behavior of the species population dynamics. A major observation deduced was that the healthy prey population decreased consequently increasing the predators' population. As drought intensified, the weakened prey population continuously increased accelerating the increase of the predators' species. Predator population increases since it consumes both gazelles though with different response. Due to the weak body condition of the gazelle, they become the favorite, but since predators spend most of their time in searching and handling then the weakened prey populations continues to increase rather than decrease despite being predators favorite. Prey population later declines due to intra specific competition and natural deaths. Without drought, it's seen that the prey population is regulated by the carrying capacity which in-turn takes care of the predators' population. Further research can be carried out to improve the model by incorporating factors such as migration, refuge, disease and inter- specific competition in order to depict the earth's natural phenomenon and look into working with experimental data for validation.

Keywords: *Drought, Routh-Hurwitz, Jacobian, Predator-Prey, Stability Analysis*