Spatiotemporal pattern formation in a prey-predator model with generalist predator

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Abstract

Generalist predators exploit multiple food sources and it is economical for them to reduce predation pressure on a particular prey species when their density level becomes comparatively less. As a result, a prey-predator system tends to become more stable in the presence of a generalist predator. In this article, we investigate the roles of both the diffusion and nonlocal prey consumption in shaping the population distributions for interacting generalist predator and its focal prey species. In this regard, we first derive the conditions associated with Turing instability through linear analysis. Then, we perform a weakly nonlinear analysis and derive a cubic Stuart-Landau equation governing amplitude of the resulting patterns near Turing bifurcation boundary. Further, we present a wide variety of numerical simulations to corroborate our analytical findings as well as to illustrate some other complex spatiotemporal dynamics. Interestingly, our study reveals the existence of traveling wave solutions connecting two spatially homogeneous coexistence steady states in Turing domain under the influence of temporal bistability phenomenon. Also, our investigation shows that nonlocal prey consumption acts as a stabilizing force for the system dynamics.

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