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Spatio-temporal dynamics of an ecological model with Cosner's functional response and prey taxis in networked vs. non-networked environments

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Recent ecological research has concentrated on mathematical modeling and the analysis of the spatial-temporal distribution of populations in interacting species. In this study, we aim to understand the spatiotemporal dynamics influenced by the prey taxis coefficient in an environment where generalist predators generate fear and cause carryover effects, leading both prey and predator populations to form clusters [1].

After validating the analytical conditions, the proposed model demonstrates a finite-time blow-up that depends on the initial data. This phenomenon has been numerically validated for predator species [2].

Additionally, we extend the spatial model to a discrete environment. Stability analysis has been conducted for the non-spatial model, spatial models on networks, and continuous media [3].

This work investigates the emergence of spatial patterns in both networked and non-networked environments, specifically comparing the formation of Turing patterns in network frameworks to those in continuous media while considering various network topologies [4].

The combined effects of diffusion coefficients, network structures, and the prey taxis coefficient are shown to affect the Turing patterns. Distinct parameter sets result in the gradual formation of different patterns, such as spots and stripes. Our simulations illustrate the impact of various network configurations, including Lattice (LA), Barabási-Albert (BA), and Watts-Strogatz (WS) networks, on node density distribution and the time required for patterns to stabilize [5].

We also demonstrate how internal network dynamics influence species distribution in their environments. These findings provide valuable new insights into the complex dynamics of prey-predator interactions in ecological systems.

Keywords: generalist prey-predator model, reaction-diffusion model, network environment, prey-taxis, finite time blow up

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