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Stabilization of a prey-predator system via targeted control in space and across populations

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This work addresses the challenge of eradicating an invasive predator population in an environment that varies seasonally – a topic of increasing relevance in ecological management and conservation biology. The problem is approached through a general prey-predator framework that incorporates nonlocal reaction terms, local diffusion and time-periodic coefficients, allowing us to capture the complex dynamics of such systems.

Our research emphasizes the effectiveness of selective control strategies – applied either directly to the predator population or indirectly through their prey – in achieving long-term eradication. We establish criteria for successful eradication, formulated in terms of the sign of the principal eigenvalue of a non-self-adjoint parabolic operator. As part of our analysis, we also compare the efficiency and feasibility of different types of controls.

These findings contribute to a deeper understanding of species management in dynamic reaction-diffusion ecosystems and provide a foundation for developing more refined, ecologically informed intervention strategies in future work.

Keywords: zero-stabilization, prey-predator system, reaction-diffusion system, regional control

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