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Front propagation in predator-prey type reaction-diffusion systems

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In this talk I will discuss the spreading properties of solutions of a certain class of predator-prey type reaction-diffusion systems. Here, by a spreading property, we mean the way the solution front propagates to infinity when starting from compactly supported initial data. There is extensive literature on front propagation in various reaction-diffusion equations, but, as far as front spreading (from compactly supported initial data) is concerned, few rigorous results are known for systems for which the comparison principle does not hold, such as our predator-prey systems. Among other things we show that both the prey and the predator spread to infinity with definite spreading speeds, which could be different between the two species. This means that two separate fronts may appear, and they divide the space into three regions; the leading edge, the intermediate zone and the final zone. The final zone is where the two species are both uniformly positive and interact with each other most intensively. If the corresponding ODE system has a special type of Lyapunov function and if the diffusion coefficients of the two species are equal, then the solution in the final zone converges uniformly to a spatially homogeneous positive steady-state as time goes to infinity. However, in a more general situation, the dynamics in the final zone is largely unknown. If I have time, I will also mention briefly the extension of the above work to the following two cases:

(1) spreading in spatially periodic environments;

(2) spreading in the hyperbolic space.

Most of this talk is based on the joint work with Arnaud Ducrot and Thomas Giletti.