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One equation helps solve three paradoxes in the spatial ecology of predators and prey

In this talk I will illustrate the rich interplay that is now emerging between mathematics and spatial ecology. I will start by introducing three paradoxes in the spatial ecology of predators and prey (1) Buffer Zone Paradox: Why do wolves maintain stable buffer zones for prey, even though they may be only saving prey for the neighboring packs? (2) Road Use Paradox: Why are wolves attracted to roads and related linear features, even though that can mean higher chances of dying? (3) Path Less Travelled Paradox: Why do wolves preferentially travel to places they haven't been recently, even if it means fewer prey? To help solve these paradoxes, I will start with the Fokker-Planck equation, which describes the probability density function for an individual undergoing a random walk. I will then employ a mixture of mathematical approaches including nonlinear advection-diffusion, differential games, first passage time theory and stochastic processes. All of the resulting models will be fit to data before drawing scientific conclusions.