Impact of Asymmetric Movement on the Spatial Spread of an Infectious Disease

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Spatial heterogeneity and rates of movement can have a large impact in the dynamics of an infectious disease. In this talk, we present an n-patch model, incorporating both spatial heterogeneity and directed movement between populations. We allow some individuals to gain host immunity after recovery from infection, but additionally allow some individuals to obtain no immunity after infection. We assume an arbitrary nonlinear incidence function, and disease-induced death rates. New global stability results are established utilizing a graph-theoretic approach and Lyapunov functions. Approximations for both the disease-free equilibrium and basic reproduction number are determined as the diffusion of human individuals are faster than the disease dynamics. Numerical simulations confirm validity of these approximations, and also give rise to new dynamics regarding the dependence of the reproduction number to the diffusion of susceptible individuals.

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