Demography and Dispersal: Two-Sex Models

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Scalar integrodifference equations (IDEs) [1] of the form

$$n(x, t+1) = \int_\Omega k(x, y)\, f(n(y, t))\, dy \qquad (1)$$

have become popular for modelling biological growth and dispersal processes. In these models, n is the local population density and $k(x, y)$ is a dispersal kernel that, roughly speaking, gives the probability that an organism at location y at time t disperses to location x at time $t+1$. IDE models have been used to calculate minimum viable habitat sizes [1], to investigate pattern formation [2], and to calculate the speed of ecological invasions in both constant [3], fluctuating [4], and spatially heterogeneous environments [5].

Scalar equations, however, cannot capture the fact that vital rates differ among individuals depending upon their age, size, or developmental stage. Recognizing this fact, Lui [6] and Neubert and Caswell [7] have generalized IDE models to include population stage structure. Their analyses have shown that this variability plays an important role in determining invasion speed. Vital rates and dispersal abilities can also differ significantly between individuals of different sexes [8], but the effects of sex-based differences on invasion speed have received little attention. In this talk, we will demonstrate how sex structure can be incorporated into IDE models and describe the effects of sex structure on invasion speed.

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