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Modelling habitat loss with partial differential equations: the effects of habitat fragmentation on survival and abundance

It is well known that habitat loss is one of the major contributing factors to the decline of biodiversity worldwide. Partial differential equations offer one method to study the effects of habitat loss in a spatially explicit setting. Often, we identify three primary forms of habitat loss: degradation, destruction, and fragmentation. In this talk, I will briefly introduce two related competition diffusion systems subject to either habitat degradation or destruction. With these models as motivation, we shift our focus to the effects of habitat fragmentation through a careful study of the effect of habitat arrangement in two spatial dimensions. On one hand, we may consider the effect of fragmentation through survival of the population. This perspective allows one to define a quantitative measure of fragmentation. It is then possible to compare differing habitat arrangements of fixed volume. On the other hand, we may consider the effect of fragmentation through population abundance at the steady state. While this perspective does not lend itself to defining a measure of fragmentation, it does provide an interesting compliment to the first perspective. These mathematical insights in turn provide some interesting biological insights to the problem of fragmentation, and in fact highlight some key areas where confusion in the ecological literature may materialize.