Numerical Study of Pest Population Size at Various Diffusion Rates

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Abstract

Estimation of the population size from spatially discrete sampling data is a routing task of ecological monitoring. This task may however become quite challenging in case the spatial data are sparse. The latter often happens in nationwide pest monitoring programs where the number of samples per field or area can be reduced, due to resource limitation and other reasons, to just a few. In this rather typical situation, the standard approaches become unreliable. Here we develop an alternative approach to obtain an estimate of the population size from sparse spatial data by considering numerical integration of the population density over a coarse grid. We first show that the species diffusivity is a controlling parameter that directly affects the complexity of the density distribution. We then obtain the conditions on the grid step size (i.e. the distance between two neighboring samples) allowing for the integration with a given accuracy at different diffusion rates. We consider how the accuracy of the population size estimate may change if the sampling positions are spaced non-uniformly. Finally, we discuss the implications of our findings for pest monitoring and control.