Implementation of Cellular Automata for the Diffusion with Species Interaction

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Abstract

A discrete diffusion model was devised to represent spatio-temporal dynamics of populations based on Cellular Automata (CA). The model was constructed to represent the dispersal of invading insect species in interaction with its food and parasitoid species. In the model the multi-phases of reproduction, interaction with other species, and movement in short and large scales were considered on a spatio-temporal framework of CA. The survival of individuals and population growth were constrained by the amount of vegetation. The movement by the parasitoid for searching was allowed in the small scale while the long-distance movement was also represented in the CA model. The environmental effects such as wind, temperature and topography were also considered in the model. Through calculation, the amount of food and density distributions of prey and parasitoids were concurrently obtained through the spatial-diffusion process as time progressed. The simulation results were compared with field data for the dispersal of pine needle gall midge (PNGM), *Thecodiplosis japonensis*, a key pest of pine trees in Northeastern Asia including Korea and Japan. The model revealed the impacts of population interactions and key environmental factors in the dispersal of PNGM.

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