EMERGING DIVERSITY AND COMPETITION SUCCESS IN DISPERSAL-STRUCTURED POPULATIONS

David Navidad Maeso[1,2], Marco Patriarca[1], and Els Heinsalu[1]

[1]*National Institute of Chemical Physics and Biophysics, Rävala pst 10, 10143 Tallinn, Estonia*
[2]*University of Tallinn, Narva mnt 25, 101120 Tallinn, Estonia*
e-mail: dnavidad@tlu.ee

Interacting particle systems can be used to study various problems in fields as diverse as condensed matter physics, chemical kinetics, population biology (individual based models), or sociology (agent based models). Insect swarms, bacterial patterns or bird flock are just a few examples of organism aggregates in real systems. An attempt to reproduce particle aggregation in the context of population dynamics (with emphasis on plankton patchiness) was made within a Brownian bug model [1]. It consists of an ensemble of individuals that die or reproduce at given rates and move in space. However, the model did not allow for interactions occurring in real system. In more realistic models [2] biological interactions are introduced by assuming birth and death rates to be functions of the number of neighbors within a given distance of each bug. A salient property of that model is the formation of spatially periodic clustering of bugs. In the present work, aimed to study the problem of natural selection, we develop an extended version of the finite-range interacting Brownian bug model. Namely, we study the dynamics of dispersal-structured populations, assuming that individuals are characterized by different diffusion coefficients. We observe that the initial distribution of the diffusion coefficients and the temporal fluctuations determine the diffusion coefficients leading to the competition success as well as the final diversity of the system at finite time (the number of different diffusion coefficients present in the system). The pattern formation is associated to the competition success of the slower diffusing individuals. The diversity diminishes by increasing the temporal fluctuations that give the competition advantage to the faster diffusing individuals. Temporal fluctuations are also shown to control the level of patchiness in the system.

References

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