Models of crowding effect on phytoplankton competition for nitrogen

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We consider a chemostat model of phytoplankton competing for nitrogen taking into account effects of both intra- and interspecific crowding. Crowding can be modeled as an additive density-dependent mortality rate. Crowding effects may be classified into intra- and interspecific crowding depending on whether the additional mortality is caused by the same or alternate species. We analyze the existence and local and global stability of single species and coexistence equilibria using the linearization and stability method of Lyapunov. A numerical example illustrating that the crowding effects may lead to the bistable coexistence of two phytoplankton species. We demonstrate that the crowding affects the outcome of exploitative competition for a single resource and promote coexistence. This work was published in \cite{1}. To consider of the spatial homogeneity, lattice dynamical systems are proposed here. The lattice dynamical systems can be viewed as a model for patchy environment. In this study, each patch consist of the identical chemostat model with crowding effect. To connect patches together, we let the washout of each patch feed into the next one. The global stability of positive equilibrium is performed and the numerical simulation of such a model suggests the existence of traveling wave solution connecting two equilibria. Such traveling wave solutions allow us to understand how the population propagate in space. The existence of traveling wave solutions was analyzed by utilizing the connection between the existence of a traveling wave solution and the existence of a heteroclinic solution for its corresponding delayed ordinary differential equation.

\textsuperscript{*}Mini-Symposium: contributed talk
References