Asymptotic behavior and global existence of solutions to a two-species chemotaxis system with two chemicals

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Abstract

One of the mathematically challenging problems in the population dynamics is finding conditions under which all of the populations coexist. In this paper, we consider a nonlinear system of differential equations, a competitive parabolic-elliptic-parabolic-elliptic two-species chemotaxis system with two chemicals in a smooth bounded domain. By introducing global competitive/cooperative factors, we obtain, for different ranges of parameters, that any positive and bounded solution converges to a spatially homogeneous state. The proofs rely on the maximum principle for spatially homogeneous sub- and super-solutions. The existence and uniqueness of global classical solutions is proved under assumptions on the initial data and appropriate conditions on the parameters of the system. Such solution stabilizes to spatially homogeneous equilibria in the large time limit.