Persistence, Permanence, and Global Stability in Biological Interaction Networks

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Complex interaction networks are present in all areas of biology, and manifest themselves at very different spatial and temporal scales. Persistence, permanence and global stability are emergent properties of complex networks, and play key roles in the dynamics of living systems. Mathematically, a dynamical system is called persistent if, for all positive solutions, no variable approaches zero. In addition, for a permanent system, all variables are uniformly bounded. We describe criteria for persistence and permanence of solutions, and for global convergence of solutions to an unique equilibrium, in a manner that is robust with respect to initial conditions and parameter values. We will also point out some connections to classical problems about general dynamical systems, such as the construction of invariant sets and Hilbert's 16th problem.

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