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Population dynamics in river networks

Natural rivers connect to each other to form networks. The geometric structure of a river network can significantly influence spatial dynamics of populations in the system. We consider a process-oriented model to describe population dynamics in river networks of trees, establish the fundamental theories of the corresponding parabolic problems and elliptic problems, derive the persistence threshold by using the principal eigenvalue of the eigenvalue problem, and define the net reproductive rate to describe population persistence or extinction. By virtue of theoretical and numerical analyses, we investigate the effects of biotic and abiotic factors, especially the structure of the river network, the diffusion rate, and the flow velocity on population persistence in temporally constant or fluctuating environments.