Mathematics behind stream population dynamics

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Human activities change the natural flow regimes in streams and rivers and this impacts ecosystems. In this talk I will mathematically investigate the impact of changes in water flow on biological populations. The approach I will take is to develop process-oriented advection-diffusion-reaction equations that couple hydraulic flow to population growth, and then to analyze the equations so as to assess the effect of impacts of water flow on population dynamics. The mathematical framework is based on new theory for the net reproductive rate R_0 as applied to advection-diffusion-reaction equations. I will then connect the theory to populations in rivers under various flow regimes.
This work lays the groundwork for connecting R_0 to more complex models of spatially structured and interacting populations, as well as more detailed habitat and hydrological data. This is achieved mathematically by extending the R_0 theory to noncompact operators and computationally through explicit numerical simulation of two dimensional depth-averaged models for river population dynamics.