Atelier
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Workshop
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Modeling spatially-explicit ecological dynamics in streams and rivers

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I will review recent research on mathematical models of populations that disperse in media with net unidirectional flow and their application to aquatic ecosystem management. Examples include drifting invertebrates in rivers and streams and marine organisms whose larvae are dispersed in local longshore currents. I will focus on theory relating to three issues: biotic responses to abiotic forcing, system stability, and conditions for population persistence. For all issues, I will identify key length scales that impact qualitative dynamics. Spatial heterogeneity introduces a number of scenarios where population persistence involves source-sink dynamics. Interpretation of many aspects of steady state and transient responses to environmental forcing involves the "response length", a measure of the distance over which the impact of a point-source disturbance is felt. Other lengths scales emerge when the system is unstable. Demographic and dispersal characteristics of organisms in finite systems determine the "critical domain size", i.e. the minimum system size for population viability. The recent advances have implications for future theoretical, experimental and field work, along with policy development in the areas of conservation biology and environmental assessments. I will cover recent results for two emerging issues: application of metric graphs to river networks, and integration of hydrology with population dynamics. I will conclude by describing extensions of these ideas to river network modeling, including suggested models for gene flow, populations with in- and out-of-network movement modes, and metacommunity dynamics.

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