Geophysical Research Abstracts
Vol. 14, EGU2012-3229, 2012
EGU General Assembly 2012

Riparian seed dispersal: transport and depositional processes

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Riparian tree population dynamics are linked to the physical processes controlled by the hydrogeomorphic setting. In particular, fluvial seed dispersal is influenced by a combination of factors including the hydrology, fluvial geomorphology, and seed dispersal traits. This study examines the influence of stream flow patterns on the transportation and deposition of buoyant seeds by applying a one dimensional transport model. Conceptually, the model separates the stream into two components: the main channel and transient storage /deposition zones. The hydrologic processes are governed by an advection-dispersion equation and numerically solved using the Crank-Nicolson method. Additional terms in the equation allow for model variation in the flow regime (lateral inflow and outflow) and the incorporation of a transient storage/deposition component where seeds may be detained. The model parameters are based on a bedrock-gravel bed river with pool-riffle morphology where we conducted field experimentation in Coastal Northern California. The riparian zone of the study reach is inhabited by White Alder (Alnus rhombifolia) which disperses buoyant seeds in late winter/early spring coinciding with the latter part of the wet, Mediterranean climate. Artificial seeds with similar characteristic traits of buoyancy, density and Bond Number to White Alder seeds were used to quantify transport times and identify storage areas. The model output captures a greater number of seeds during a receding hydrograph due to the increase in transient storage. Typically, this is found in shallow stream margins where the flow is divergent such as areas with back-eddies. In the field, this is associated with the ends of gravel bars or riffles where flow expansion causes secondary flows. The results demonstrate the importance of transient storage for seed transport and depositional processes and emphasize the need for improved measurement techniques, in lieu of empirical coefficients, to advance the mechanistic understanding of the complex hydraulic processes.