

CAUSES AND CONSEQUENCES OF CLOGGING IN EFFLUENT-DOMINATED WATERWAYS

Natalie Case*, Julie Stromberg

ABSTRACT: There is evidence of reduced infiltration of surface water in waterways that receive steady inputs of treated wastewater, such as the Santa Cruz River in southern Arizona. Reduced infiltration can be a result of biotic and/or abiotic processes, but the end result is reduced exchange of water through interstitial spaces in the sediments. This disruption of hydrologic connectivity, or clogging, can reduce survivorship of riparian vegetation, reduce local recharge of groundwater, and induce surface flow where it is not desired. Little is known about the identity of clogging layers in waterways and the environmental factors that regulate them, but the steady flow of nutrient-enriched waters that occur in effluent-dominated waterways may promote microbial growth and clogging. A natural field experiment was conducted along an effluent-dominated river and a nearby control river to investigate the spatial distribution, identity, and environmental controls of clogging in semiarid streams. A series of sites at varying distances from municipal effluent discharge points on the Santa Cruz (near Nogales and Tucson, Arizona) and in non-effluent control reaches of the San Pedro were established and data were collected over one year to capture seasonal changes and flood cycles. At each site, streambed infiltration rates were quantified by measuring hydraulic conductivity with multi-depth piezometers. Sediment samples were analyzed for physical (particle size), chemical (DO, pH, ORP, organic carbon, ammonium and other nutrients) and biological (bacterial counts and carbon utilization) parameters. Results indicate that hydraulic conductivity of river sediments was reduced in areas where fine sediment textures made up at least 20% of the sediments. Reduced hydraulic conductivity was also associated with locations of higher bacterial numbers. Bacteria were found to be more abundant in fine sediments and in areas with higher levels of organic carbon and ammonia. Water quality and infiltration rates were found to be much lower at the Tucson outfall, signifying policy implications for the management of treated municipal wastewater. Understanding the dynamics of clogging is imperative for management of the valued riparian corridors that have developed along the effluent-dominated Santa Cruz River and in maintaining groundwater recharge.

* Graduate Student, Arizona State University, Mesa, AZ 85210 USA, Phone: 480-965-3167, Email: ncase@asu.edu