Developing Flow-Ecology Relationships in Southern California

Sarah R. Eberhart and Brian P. Bledsoe
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Development of flow-ecology relationships that relate changes in streamflow to the biological responses of streams is a vital component of bioassessment programs and watershed management efforts. With these relationships, watershed managers can predict the response of instream biota to the streamflow effects of land use changes. This study develops flow-ecology relationships for watersheds within and proximate to southern California as part of a larger effort to understand the effects of urbanization and other sources of hydromodification on stream biota. Streams in this region are predominately flashy and seasonal with many going dry for part or much of the year. Hence, the instream disturbance regime is a major determinant of biotic composition. Flow-ecology relationships typically relate statistics describing departures in stream discharge from some reference condition to biological condition. This approach has limitations because stream discharge is used as a surrogate for hydraulic and bed mobility conditions that are controlled by the geomorphic setting. In this study, we convert measured discharges to hydraulic descriptors including dimensionless shear stress and dimensionless specific stream power that are more direct indicators of instream disturbance. These hydraulic metrics are then related to the composition of benthic macroinvertebrates at each bioassessment site. To develop these hydraulic-ecology relationships, existing biological sampling data in southern California were tied to nearby USGS gages and channel geometry and substrate data collected at bioassessment sites were used to convert discharges to time series of hydraulic metrics. Statistical analysis of associations between macroinvertebrates and both discharge metrics and hydraulic metrics is used to assess whether metrics that provide a more complete description of the stream disturbance regime are better predictors of biotic composition. Such information is useful for identifying the level of physical detail required to detect biological responses to streamflow alteration in urbanizing watersheds.