Mapping Stream Habitat Heterogeneity Using a Flexible Neighborhood Analysis Algorithm

Keith D. Olson[1]
Department of Forest, Rangeland, and Watershed Stewardship, Colorado State University, Fort Collins

Christopher O. Cuhaciyan
Department of Civil Engineering, Colorado State University, Fort Collins

Brian P. Bledsoe
Department of Civil Engineering, Colorado State University, Fort Collins

Abstract. Instream habitat results from interactions between hydrologic regimes, geomorphic characteristics, and other watershed processes. Fishes respond to the diversity, redundancy, and connectivity of refugia and foraging and rearing areas in drainage networks. We present an approach for mapping aquatic habitat heterogeneity at the drainage network scale using geospatial data. A flexible neighborhood analysis algorithm, the focus of this study, was developed in Visual Basic for the computation of statistics within a given stream segment length. This algorithm is distinct in that, unlike most neighborhood functions, it constructs unique neighborhoods according to the geometry of the stream network at distances measured along the stream. The result is a function that calculates heterogeneity (e.g. relatively high variance or counts) in a topological network. Local channel geomorphic form was characterized using 10-m digital elevation models (DEM) to demonstrate the value of such an approach in two watersheds in the Pacific Northwest. Valley entrenchment, hillslope connectivity, stream power ($SA^{0.4}$), and significant tributaries were calculated using previously developed Arc Macro Language and C++ models. The standard deviations or counts of these variables were computed within varying network distances and mapped onto the drainage network to reveal regions with high habitat heterogeneity. The ability to map aquatic habitat heterogeneity on a network scale may further explain patterns of biological variation and facilitate understanding of linkages between biotic, hydrologic, and geomorphic drivers. Such models have the potential to aid in identifying biological hotspots and logical network locations having the greatest habitat potential for guiding stream rehabilitation and protection projects.

[1] MS Student, Geospatial Science
Forest, Rangeland, and Watershed Stewardship Department
Colorado State University
Fort Collins, CO 80523-1472
Tel: (970) 491-8288
e-mail: keitho@cnr.colostate.edu