Assessing the Vulnerability of Stream Communities and the Consistency and Use of Biotic Indices in Least-Disturbed Streams

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Abstract

The need in freshwater conservation is to understand the current status of aquatic biota so that we can recognize when degradation or changes occur. Because stream habitats and communities are dynamic, it is important to understand the natural variability through time and space so that departures may be used to make inferences on stability or instability. Additionally, attempting to predict aquatic communities that are more likely to experience a change in diversity, abundance, and function from anthropogenic impacts may help to prioritize locations for management action. Finally, assessing the consistency of various biotic indices (quantitative tools used to convey lotic ecosystem health) will aid in conveying a more holistic depiction of stream condition and to prioritize locations and biota for management action. To address each of the aforementioned data gaps, we used fish and aquatic invertebrate community data collected from 1988 to 2013 from 88 sites within seven National Park Service (NPS) units represented within the Heartland Inventory and Monitoring Network. The fish community (Index of Biotic Integrity) at each of the seven NPS units was less temporally variable than spatially variable. This relationship was not found with aquatic invertebrate community (Hilsenhoff Biotic Index) in that only three of the seven NPS units were less temporally variable than spatially variable.

Aquatic invertebrate communities at each NPS unit were most vulnerable to an altered flow regime (mean among parks: 81% ± 6% of the community vulnerable) while the fish community was most vulnerable to in-stream physical habitat alteration (mean among parks: 53% ± 15% of the community vulnerable). Generally, relationships among biotic indices were highly variable (ρ = -0.02 to 0.87) and uncorrelated (12 of 15 pairwise comparisons) and biotic indices that were correlated differed by river system. Within faunal group indices were more related within the Buffalo National River (ρ = -0.28 to 0.87) while richness indices were more related within the Ozark National Scenic Riverways (ρ = 0.60 to 0.81). Implementing these components into monitoring programs may lead to a more thorough understanding of lotic ecosystems, their aquatic biota, and their integrity status now and into the future.