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AQUATIC MACROINVERTEBRATE DIVERSITY WITHIN AN URBANIZED GRADIENT

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Introduction

Urbanization leads to reduced ecosystem functioning and biological diversity of streams.1,2 However, catchment level effects may also be critical in understanding variation in this relationship.3 Rock Island and Moline, IL are experiencing substantial growth in population and impervious surfaces (Fig. 1), resulting in less natural infiltration and higher amounts of flow, debris, and pollutants in stormwater streams. Even low levels of development (upstream percent impervious surface levels of 5-10%) can eliminate or reduce many pollution intolerant macroinvertebrates. Aquatic invertebrate families are sensitive to water quality and can present a more integrative picture of overall water quality.

Research Questions:
1) How do macroinvertebrate communities vary across a gradient of urbanization?
2) How does observed variation relate to water quality?

Methods

• 11 watersheds were identified and mapped using GIS (Fig. 2).
• 30 access points to the watersheds were chosen based on access to the headwater, ravine, and confluence.
• Macroinvertebrates were collected at all sites4 (Fig. 2).
• 2013: samples were collected approximately once per month May–September.
• 2014: a standardized unit effort was established: 10 pool/10 riffle dip net samples and a fixed 30 minute effort.
• The Family Biotic Index (FBI=tolerance value x frequency) was calculated for each site5 (Fig. 3).

Results

The sites varied significantly from one another.
• The percent impervious of the surfaces around the sampling sites varied greatly, ranging from 25% to 60% impervious (Fig. 1 and 2).
• Nitrate: range: 0.35-25.66 mg/L; overall mean: 6.49 mg/L
• Ammonia: range: 0.00-0.60 mg/L; overall mean: 0.13 mg/L
• Total Dissolved Solids: range: 3.64-1715.0 ppm; overall mean: 661.66 ppm
• In general, headwater sites experienced higher nitrate and ammonia levels than Ravine sites, while TDS levels remained the same in both headwater and ravines for most watersheds.

Figure 1: percent impervious in sampled watersheds.

Discussion

Our findings provide insights into the integrity of the macroinvertebrate community within an urbanization gradient.
• No macroinvertebrates were collected in almost 20% of our sites despite extensive collecting effort (Fig. 2), suggesting severe impairment.
• Findings are consistent with those of other studies showing that high levels of urbanization can homogenize communities: Chironomidae dominate within urban settings while Ephemeroptera and Trichoptera, insect Orders that are highly sensitive to changing water conditions and poor water quality, were found in extremely low abundances.
• Measured water quality parameters and percent imperviousness do not drive observed patterns in FBI.
• The lack of observed impact may be due to watershed specific effects such as fine scale land use variation throughout the sampling area, as well as variation in water level and flow.

Figure 3: The average Family Biotic Index score for each sampling site.

References