Macroinvertebrate community changes in streams of three watersheds of north Alabama

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Abstract

Benthic macroinvertebrate communities are commonly used as biological indicators for long term water quality studies. Biological assessments in the Wheeler Lake Basin in north Alabama have been conducted since 2006. The Flint River, Indian Creek, and Flint Creek watersheds were sampled seasonally in 2007 and 2008 along 3 reaches. Sampling methods were modified from the EPA (1996) Rapid Bioassessment Protocols using leaf packs, kick, surber, and dip nets to collect benthic macroinvertebrates from multiple habitats. Biological indices used to determine the community composition and structure included % EPT abundance and richness, total taxa richness, and community diversity. Taxa presence and absence data was analyzed for all three years to find any changes have occurred. Comparisons of community abundance and richness were also analyzed for all three years. Preliminary results indicated that stream water quality parameters such as dissolved oxygen, turbidity, water temperature, and pH did not significantly change over time. Other habitat characteristics, and land use data were also examined for each watershed.

Introduction

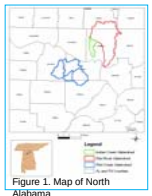
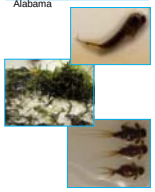


Figure 1. Map of North Alabama



Flint River, Indian Creek, and Flint Creek are major tributaries to the Tennessee River which supplies drinking water and provides recreation areas for North Alabama residents. Rapidly growing communities in North Alabama are straining current water resources. Most tributaries in these watersheds are impacted from sediment and chemical runoff. The public is increasingly concerned about their local water resources and its overall quality.

Benthic macroinvertebrates vary in their sensitivity and tolerance of pollutants occurring in surface water. These organisms respond to long term impairments of stream water. Unlike chemical water parameters which are reflective of water condition at time of sampling, population levels of aquatic fauna respond to long term effects due to their stabilized water environment.

Thus, as bioindicators, aquatic insects are excellent and reliable determinants of stream health. Members of the orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) are mostly intolerant of pollutants; their relative abundance indicates good water quality. The biological index of Ephemeroptera -Plecoptera - Trichoptera also known as EPT, calculates the taxa richness of a sampling site. Midge flies and Black flies (both are in the order Diptera)are tolerant of pollution; their occurrence in high numbers is indicative of organic water impairment.

Methods & Materials

Study Watersheds – Flint River, Indian Creek and Flint Creek

Three sampling sites, each 100 m long reach, were selected for Flint River and the Indian Creek watersheds. For ***Flint River***, the sites were on Hwy 72, Buddy Williams Road, and at 3 Forks. For ***Indian Creek***, Old Madison Pike, Farrow Road, and Providence Main were chosen. Lacon, AL, and the Bankhead National Forest are the two selected sites for ***Flint Creek***. A third site in Neel, AL, was chosen in 2006 within Flint Creek, but was eliminated because of intermittent flow and its small channel size.

Methods

Each site per watershed was sampled monthly. Sampling was based on EPA Rapid assessment Protocol's (RBP's) multi-habitat methods (USEPA 2006). Macroinvertebrates were collected from a variety of microhabitats using different techniques.

Surber Net Each site per watershed was divided into 3 sections with riffles along the length of the stream from which three samples were collected. Each sample was a composite of three sub samples obtained by rubbing substrate for 1 minute to dislodge the macroinvertebrates.

Kick Net Three riffles were sampled with a 1 m kick net. The substrate was disturbed approximately 3 meters upstream of the net.

Dip Net Both sides of the stream bank were sampled for aquatic insects using 10 jabs of dip net along the stream within the sampling site. Samples were combined for collections on each side of the stream.

Leaf Pack Leaf packs were collected from each half of the stream into a composite sample

hately 1000 mL of leaf material by volume).

Other Sampling Parameters

The general geophysical characteristics of the collection sites were noted canopy cover (%), riparian vegetation, stream disturbances, etc. Field parameters recorded includes: stream depth (cm), water temperature (°C), pH, turbidity (FAU), total dissolved solids (ppm) and dissolved oxygen (mg/L). All specimens were initially placed in 75% ethyl alcohol brought back to the laboratory, sorted, identified to family, and preserved in 90% ethanol.

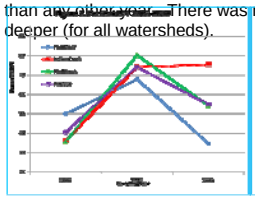
Statistical Analysis

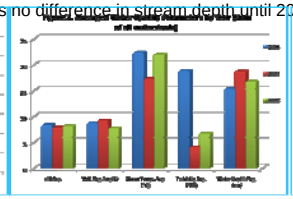
SAS was used to analyze data using ANOVA and Duncan's Multiple Range Test for multiple comparisons.

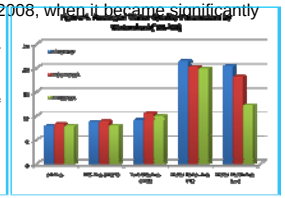
Results

Relative abundance of macroinvertebrates was not significantly different between sampling years 2006 though 2008. Relative abundance was significantly lower in the Flint Creek Watershed. The Flint River sampling location HWY 72 yielded the highest total abundance during the 2006-2008 sampling period. Kick and Surber nets produced the most abundant samples, Dip Nets the least. Taxa (family) richness was highest during 2007; lowest during 2006. The Flint River watershed averaged different families collected per site (X=10.8); Indian Creek (X=7.3) and Flint Creek (X=7.9) were statistically similar according to Duncan's MRT. Macroinvertebrate families collected during the Spring (April-June) were significantly different from those collected during late Fall (November/December). The EPT percentages increased significantly from 2006 to 2007; with significant declines in 2008 in the Flint River and Flint Creek watersheds (Figure 2).

Water Quality Parameters were generally varied between the three watersheds. Analysis between 2006 and 2008 show that all parameters (except for Water Depth) were uniform. (See Figures 3 & 4). Turbidity showed the most variance by year, watershed, and location. Late Winter (March) averaged the least turbid streams throughout the watersheds. May (Spring) and November (Fall) were the most turbid sampling times for all watersheds and locations. Dissolved Oxygen was significantly higher during 2007 than any other year. There was no difference in stream depth until 2008, when it became significantly deeper (for all watersheds).







Discussion

North Alabama endured mild to severe drought conditions beginning in 2006, peaking in 2007 and finally ending by late 2008. While the overall effects of this major drought upon the macroinvertebrate communities are unknown, we will continue sampling all three watersheds in the coming years. Unexpectedly, for 2007, the water depth measured in all three watersheds was on average, deeper than 2006 or 2008- despite the record drought. We believe this is due to the formation of deep pools in two sampling sites: Farrow Road (Indian Creek) and Bankhead NF (Flint Creek). By 2007, two trees in Indian Creek collapsed into the reach due to severe erosion along both sides of the bank. Similarly in the Bankhead NF, one tree fell into the creek

Figure 5. New Snag in West Flint Creek (Bankhead NF)

accumulated dumped trash that created new, deeper ponds within the reach (Figure 5

Both sampling sites at Flint Creek ran incredibly low in both in 2006 and 2008. During summer of 2007, these two tributaries of Flint Creek were almost dried up completely a few shallow ponds. Poor habitat structure and disrupted flows are probably the main contributions to Flint Creek's low rates of abundance and richness. Currently, we are unsure why the percent of Ephemeropterans, Plecopterans, and Trichopterans markedly increased in 2007 and then declined again in 2008. We hypothesize that either this is apart of a natural upswing of their population cycles or that these families may be more drought resilient and caught in larger numbers during 2007. Continued biosassessments are needed to validate either hypothesis.

Turbidity's variance is due to the amount of rainfall and the amount of sediment is the streams from the surrounding watershed. It is a top priority for several local organizations within north Alabama to reduce valuable topsoil losses in the increased sedimentation within its streams. During the Fall of 2008 we sampled for percent embeddedness and conducted preliminary pebble counts alongside our bioassessments in the Flint River watershed. We anticipate that further studies correlating

Literature Cited

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Acknowledgements

Many thanks go to Joe Gardiniski of NRCS and Dr. Tadesse for their contributions of watershed maps and GIS modeling of these watersheds. Heather Howell for her input and much needed assistance sampling.