Natural Resources and
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Biological Survey of Pleasant Grove Spring, Logan County, Kentucky

Kentucky Division of Water, Water Quality Branch, Nonpoint Source Section

Introduction

A biological evaluation of Pleasant Grove Spring (Figure 1) was conducted on April 20, 1994 as a supplement to Kentucky Geological Survey (KGS) monitoring efforts funded by Section 319(h). This evaluation was conducted by Division of Water biologists Bill Sampson and Lajuanda Maybriar, and Tom Karsner (Division of Conservation Water Quality Specialist) in an effort to help establish water quality conditions prior to the implementation of best management practices. At the time of sampling, water levels were elevated 2 to 2.5 feet above normal because of a recent rain-event. The stream was fairly turbid (14.5 NTU), and sediment deposition was observed both on the stream bank and substrate. Field water chemistry measurements are provided in Table 1.

Figure 1. Location of Monitoring Site

Table 1. Field Physicochemical Measurements	
Dissolved Oxygen (mg/L)	7.5
pH (S.U.)	6.7
Turbidity (NTU)	14.5
Specific Conductance (umhos)	347
Water Temperature (^{o}C)	14.6

Methods

Fish and macroinvertebrate data were collected in the vicinity of one of the existing KGS monitoring stations, roughly 2.0 miles upstream of Pleasant Grove Spring's confluence with Red River, in Logan County. Efforts were made to sample riffle, run, and pool areas equally. However, locating riffle habitat was made more difficult because of the high water level.

Fishes were collected by seining for one hour, and the specimens were preserved in a ten percent formalin solution. Three ten-foot, one-minute traveling kicknet repetitions were performed for collecting macroinvertebrates (Hornig and Pollard 1978). Selective sampling was also conducted for macroinvertebrates to ensure that all habitats present were included. Macroinvertebrate specimens were picked (separated from sediment, debris, etc.) in the field, and preserved in a seventy percent ethanol solution.

Results and Discussion

Karr's (1981) Index of Biotic Integrity (IBI) was used to evaluate the Pleasant Grove Spring fish data. The IBI is comprised of twelve equally weighted metrics that can be grouped into three general categories: species richness and composition; trophic composition; and fish abundance and condition. Each metric is assigned a 5, 3, or 1 value depending upon whether the obtained value strongly approximates the expected value (5), somewhat approximates the expected value (3), or does not approximate the expected value (1). Refer to Table 2.

Table 2. Fish and Macroinvertebrate Metrics	
IBI	26
Taxa Richness	23
Total Number of Individuals	245
EPT	9
HBI	6.32
MBI	2.67

The twelve individual metric values are summed to provide an IBI score, which will range between 12 to 60 (or no fish). A classification based on IBI scores is then assigned to describe the quality of the fish community at a given location. An IBI score of 26, which yields a classification of poor to very poor, was derived for the April 20, 1994 Pleasant Grove Spring fish data. (Note: the top carnivore metric could be misleading in this case. The percentage of top carnivores (8%) was elevated due to the small sample size collected. Therefore, a value of 3 was assigned for this metric instead of 5.)

Three metrics were used to evaluate the macroinvertebrate community (Table 2). These metrics included taxa richness, the Ephemeroptera-Plecoptera-Trichoptera (EPT) Index, and the Hilsenhoff Biotic Index (HBI). Values derived from these metrics were summed

and averaged to produce the Macroinvertebrate Bioassessment Index (MBI), which is an index used to assess the biotic integrity of the aquatic macroinvertebrate community.

Taxa richness refers to the total number of distinct taxa present in a sample (Karr 1981). In general, the greater the taxa richness the better the water quality, habitat diversity and/or habitat suitability. The total number of taxa for the Pleasant Grove Spring sample was 23, which indicates fair conditions for the Interior Plateau physiographic region (KDOW unpublished data).

The EPT Index is derived by enumerating the total number of taxa within the generally pollution-sensitive insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). A high EPT Index value will usually indicate good water quality, habitat diversity, and/or habitat suitability. The EPT Index value for the Pleasant Grove Spring sample was 7 which is considered fair to good for the Interior Plateau physiographic region (KDOW unpublished data).

The Hilsenhoff Biotic Index (HBI) is intended to characterize the overall pollution tolerance of a benthic macroinvertebrate community (Lenat 1988, 1993). A pollution tolerance value (a_i) is assigned to each taxon within a sample. The total number of individuals within each taxon, up to 25, is multiplied by the tolerance value for that taxon (Lenat 1993). All products are then summed and divided by the total number of individuals to derive the HBI value.

HBI values can range from 0 to 1.0, and HBI interpretations are adjusted by ecoregion. Higher HBI values indicate poor water quality and lower values indicate good water quality. The HBI for Pleasant Grove Spring was 6.32. Based upon benthic macroinvertebrate data throughout the Piedmont/Coastal ecoregion, this would reflect fair to good water quality conditions (KDOW unpublished data).

The MBI is calculated by assigning a value of 1 to 5 for each metric. These values are then averaged to derive an overall value. For the Pleasant Grove Spring data, taxa richness yielded a value of 2, EPT Index yielded a value of 3, and HBI yielded a value of 3. The MBI for this station was 2.67 which is an indication of fair conditions with respect to the overall biotic integrity of the macroinvertebrate community.

Based upon the biological data, particularly the fish data, Pleasant Grove Spring appears to be somewhat degraded, although the occurrence of several relatively pollution sensitive insect species brought taxa richness, EPT, and HBI values to moderate levels. For the most part, these pollution sensitive species were collected in low numbers. Impacts to the aquatic community (which is a reflection of water quality conditions) can largely be attributed to the several inches of sediment covering the stream bottom. Sediment deposition can smother benthic macroinvertebrates, as well as, interrupt the food chain and life cycle of fishes. Less obvious pollutants could possibly by contributing to the problem also.

It would be useful to repeat this data collection effort prior to BMP implementation to determine if sedimentation, or other impacts, are an ongoing influence or infrequent occurrence. Moreover, post-BMP data should be collected to assist in evaluating BMP effectiveness.

Literature Cited

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