Abstract. This study shows that biological assessments of water quality status using biomass estimates of wet, dry, and ash-free dry weights and counts of individual organisms from a small, headwater stream in southwestern Ohio provide essentially similar results concerning the impact of a sewage treatment plant discharge. Of the indices of biotic status for the stream segment employed for data evaluation; Diversity Index (D), Community Diversity Index ($\delta$), Trophic Condition Index (TCI), and Empirical Biotic Index (EBI), the latter two provided evaluations most consistent with benchmark water chemistry and physics information concerning the trophic status of the stream. In addition, the percent composition of macroinvertebrate taxa by pollutional category; 'clean water', 'facultative', and 'pollution tolerant', as ascribed using TCI and EBI ranges for individual taxa collected in combination of Ekman grab, rock-filled basket sampler and drift net samples, proves adequate for interpretation of biotic status.

1. Introduction

In recent years, the need for rapid assessment procedures for evaluation of point and nonpoint source pollution impacts on aquatic life has escalated in response to national laws, such as the Clean Water Act (PL 95–217), and state legislation dealing with environmental quality. These laws, and supporting regulations, require several analyses, including aquatic life, to determine the water quality status as related to legally supported state water quality standards. Currently, the states and EPA Regional Offices review the status of waters based on instream ambient water conditions for priority waters. A 'use attainability analysis', involving evaluation of the physical, chemical and biological quality of waters and economic factors, is conducted if a preliminary analysis of historical monitoring data indicates that ambient stream conditions do not, or are not, expected to meet designated state water quality standards, even after implementation of best available technology controls for point source discharges. The labor and funds available to conduct use attainment assessments are limited, which in turn, place high value on assessment methods that are cost effective and provide meaningful results for water use decisionmaking.

Currently, there are hundreds of 'standard methods' for use in measuring impacts of pollution discharges to biological communities. Most of these methods employ counts of individuals and diversity (kinds) of organisms present in the community. The
'reference station' approach is used where aquatic life communities in affected areas are compared to life in unaffected areas. Generally, high counts and low diversity are characteristic of environments stressed by heavy loads of organic wastes, while both low counts and diversity are found in habitats affected by toxic and acidic pollutants. Clean water areas have moderate to high counts of macroinvertebrates with relatively even distribution of the individuals among the kinds that are present.

We hypothesized that estimates of macroinvertebrate biomass could potentially provide assessments of biological quality more efficiently than conventional tedious, labor intensive counts of individual organisms. Secondly, we hypothesized that biomass, or weight of tissue, that is supported by the watershed could be more intrinsic to characterizations of pollution-caused changes in community structure than individual counts. To test these hypotheses, we selected a small stream in Southwestern Ohio receiving a sewage treatment plant (STP) discharge. Standard collection gear (APHA, 1981) was employed for collection of stream macroinvertebrates, and data were evaluated using counts of individuals and several popular biotic indices of water quality status.

The analytical phase of this study (Mason et al., 1983) contains information on the study area and quality assurance aspects of laboratory derived biomass estimates, such as effects of drying and ashing times on weights of tissue. This paper presents data synthesis and interpretation from Part 1. 'Laboratory Analytical Methods' to test our hypotheses.

2. Study Area-Water Physics and Chemistry

2.1. General Conditions

The study area is a five mile (8.1 km) reach of the East Fork, Little Miami River (Figure 1), a small headwater stream, located about 30 miles (48.3 km) east of Cincinnati, Ohio in a rural setting. The predominant geologic type is glacial till and land use is agricultural. The stream segment received a single point source discharge from the Williamsburg, Ohio activated sludge STP. During summer the discharge from the STP outfall was 9.5 l sec−1 (2.5 gal sec−1). However, as the discharge was intermittent and the pipe covered by flashy flow conditions, actual instream concentrations of the discharge could not be determined.

During normal summer flow the stream was 20–50 yards (18.3–45.7 m) wide and one (0.3 m) to three feet (1.0 m) deep. However, after heavy rains the stream would become swollen, carry large silt loads, and attain depths of six feet (1.8 m) or more in a few hours. This flashy flow (Figure 2) was evident in measurements for the year 1971 taken by U.S. Geological Survey at Station 1. The stream bottom type consisted of limestone bedrock overlain with sand, silt, gravel and rubble. The habitat alternated between riffle and pool, and the banks were heavily wooded with an estimated 50–75% closure at Station 1, 2E and 2W. Stations 3 and 4 (east bank) were bordered by a high wooded bluff.

The specific conductance, alkalinity, carbonate hardness, total phosphorus, ortho-