

BRIEF NOTE

Transparency Tube Monitoring as an Indicator of Fish Community Health

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ABSTRACT: Transparency tubes have been shown to be useful tools for suspended solids estimation in flowing waters. Suspended solids and turbidity can impact streams in a number of ways from habitat smothering to visual impairments. Comparison of transparency tube data to the Index of Biotic Integrity (IBI) as measured by the Ohio Environmental Protection Agency shows a strong correlation. Additional data must be gathered to determine whether this is a true relationship.

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INTRODUCTION

The Cuyahoga River is located in northeast Ohio. Tinkers Creek is the largest tributary to the Cuyahoga with a stream length of 26 miles, comprising a 259-square-kilometer drainage area.

Turbidity has been identified as a potential contributing cause of biological community impairment in Tinkers Creek. Turbidity is associated with the suspended sediment load in a stream. Sediment can be a problem in rapidly developing areas and streams with poor bank stability and riparian habitat. Elevated suspended sediment and turbidity levels may result in sub-lethal effects on fish (Waters, 1995).

MATERIALS AND METHODS

Three sample sites were selected in Tinkers Creek and one each in the reference sites, Furnace Run and Yellow Creek. Furnace Run and Yellow Creek were sampled near their confluence with the Cuyahoga River (Riverview Road and Yellow Creek Road, respectively). Tinkers Creek was sampled at Old Mill Road (upstream of Pond Brook), State Route 91 and Canal Road (near its confluence with the Cuyahoga River). From May through December 2004, water quality data was collected at the five sites in the Cuyahoga River Basin. Samples were collected by members of the Friends of the Crooked River, a citizen-based river advocacy group, and Ohio EPA. A total of 137 transparency samples were collected at the sites described above, Furnace Run (N = 38), Yellow Creek (N = 38), Tinkers Creek Old Mill Road (N = 12), Tinkers Creek at State Route 91 (N = 13), and Tinkers Creek at Canal Road (N = 36).

Sampling methods were chosen based on ease of collection and cost of analysis. With these two considerations in mind, one of the sampling techniques chosen was the Ohio Sediment Stick[®]. The sediment stick is a clear plastic tube with a solid white bottom. A black dot located on the bottom is used to determine water clarity. The transparency tube is filled with water and the water level is reduced until the black dot is visible; a measurement of water depth is then recorded. Transparency tubes have been shown capable of predicting total suspended solids concentrations (Anderson and Davic, 2004).

Fish communities were assessed by electrofishing methods using Ohio EPA protocols (Ohio EPA, 1989). Results were reported as the Index of Biotic Integrity (IBI) score.

Furnace Run and Yellow Creek commonly achieved transparency results of .914 meters, the maximum possible. Tinkers Creek

occasionally achieved full transparency at the Canal Road and Old Mill Road sites.

When compared to the total suspended solids concentrations analyzed by the Bedford Heights, Solon and Twinsburg wastewater treatment plants, the strong correlation previously reported by Anderson and Davic (2004) held true in this sample effort. This correlation supports the previous report and indicates that the sediment stick is a cost-effective method of gathering useful water quality data. This type of data can be helpful in establishing general watershed conditions.

Patterns observed in the data were very interesting. Both Furnace Run and Yellow Creek (reference sites) became more turbid than Tinkers Creek immediately following a rain event. The reference streams returned to a clear state (a sediment stick reading of .889 meters or greater) more quickly than Tinkers Creek. The Tinkers Creek monitoring site in Twinsburg (SR 91) never achieved complete clarity (a sediment stick reading of .914 meters) and always appeared turbid. Ongoing development in the Furnace Run and Yellow Creek watersheds causes the rapid increases in turbidity from construction site runoff. This rapid turbidity change also occurs in Tinkers Creek. Currently, both Furnace Run and Yellow Creek have healthier, less impacted watersheds which allow a return to clear conditions following a rain event. The Tinkers Creek watershed is showing signs of impact which preclude a complete return to clarity. The Canal Road site on Tinkers Creek returned to a clear state, in part due to dilution from the wastewater treatment plants. During median stream flows, approximately 70% of Tinkers Creek flow is comprised of sewage treatment plant effluent. The waste water treatment plant effluent is clearer than background conditions which contributes to greater sediment stick readings.

Ohio EPA previously conducted aquatic community assessments as part of basin-wide water quality evaluations. Fish communities were evaluated utilizing standard sampling protocols (Ohio EPA, 1989). Results showed Furnace Run and Yellow Creek to have greater Index of Biotic Integrity scores (48 and 40 respectively) than the Tinkers Creek sites (32, 22 and 24).

DISCUSSION

The sediment stick results show the impacts of development on suspended material in the water column. Watersheds with relatively intact riparian zones and moderate to low suburbanization will discharge solids during run-off events and return relatively quickly to a less turbid condition. The Tinkers Creek watershed is more developed and shows the long-term impacts associated with channel disturbance and altered adjacent land use patterns.

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An interesting association found between the sediment stick readings and Ohio EPA's fish community index merits further investigation. Ohio EPA utilizes the IBI (modified from Karr, 1981) as one tool for assessing fish community health. Regression analysis shows a very strong correlation between the fish population, using Ohio EPA's IBI (Ohio EPA, 1989) and sediment stick median values (Fig. 1). If this proves to be a true representation of stream conditions, an additional valuable use of the Ohio Sediment Stick[®] may be to help initially screen for watershed health.

LITERATURE CITED

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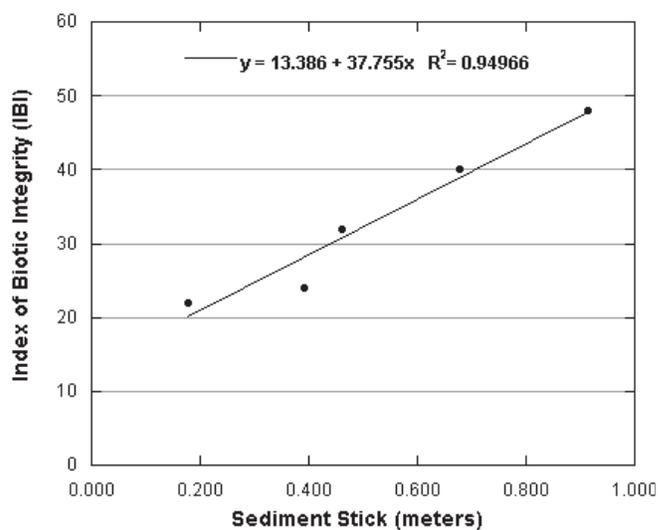


FIGURE 1. Plot of median sediment stick values and IBI scores. Sites sampled include Furnace Run, Yellow Creek, Tinkers Creek at Canal Road, Tinkers Creek at State Route 91, and Tinkers Creek at Old Mill Road.