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BRIEF NOTE

BENTHIC MACROINVERTEBRATE ASSESSMENT OF WATER QUALITY IN THE CUYAHOGA RIVER, OHIO—AN UPDATE¹BRUCE K. TRAUBEN² and JOHN H. OLIVE, Department of Biology, The University of Akron, Akron, OH 44325

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A benthic macroinvertebrate assessment of water quality in the Cuyahoga River, Ohio, was conducted during the summer of 1980 to determine whether changes in water quality had occurred since a similar study was conducted in 1973–74 (Olive 1976, Lauer 1976). Presented is a comparison of water quality indexes at 5 locations along the river, where comparable benthic invertebrate data are available. These locations are: (1) Hiram Rapids near Winchell Rd., 120 km; (2) Standing Rock Cemetery near Kent, 89 km;

(3) Boston Mills near Boston Mills Rd., 43 km; (4) Brecksville near Rt. 82, 32 km, and (5) Independence near Rockside Rd., 20 km (fig. 1).

Six multiple-plate artificial substrate samplers (Hester and Dendy 1962) were randomly distributed at each of the 5 sample locations. At least 6 weeks was allowed to provide sufficient time for the colonization of the benthic organisms. Indexes of water quality were calculated utilizing benthic community-structure parameters (Cairns 1974) which included the number of taxa, the number of individuals per taxon, the ecological density of organisms and the Shannon-Wiener index of species diversity (\bar{d}) (Wilhm and Dorris 1968). The percentage of pollution-tolerant, -facultative and -intolerant ben-

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thic organisms was determined (Weber 1973).

Benthic invertebrate samples were also collected from natural substrates using a modified shovel sampler (Prater et al. 1977) at Hiram Rapids and Brecksville for comparison to the samples collected from the artificial substrates. This comparison was necessary since benthic invertebrates were collected from only natural substrates during the 1973–74 assessment of the Cuyahoga River (Olive 1976, Lauer 1976). Mann Whitney U-tests (Elliott 1971) were performed on the percentages of pollution-tolerant organisms and on the Shannon-Wiener diversity index values to determine significant differences between collection methods. No significant differences ($p > 0.05$) were found in the percentages of pollution-tolerant organisms and Shannon-Wiener diversity index values between natural and artificial substrates.

The percent community composition based on numbers of benthic macroinvertebrates and Shannon-Wiener diversity index values for the 5 comparable stations

along the Cuyahoga River are summarized within fig. 2 and table 1, respectively. Examination of fig. 2 demonstrates that during the time interval of 1974–80, a pollution-intolerant fauna had replaced the tolerant fauna at Standing Rock whereas, at Brecksville and Independence, the pollution-tolerant fauna had become dominant over the facultative fauna. The Shannon-Wiener diversity index values vary little between 1974–80 (table 1) and were not found to be significantly different at Hiram Rapids, Standing Rock and Brecksville.

The data illustrates that the Cuyahoga River at Hiram Rapids is a relatively undamaged waterway (Olive 1976). The increases in percent composition of oligochaetes (Annelida) and planaria (Platyhelminthes) are significant ($p < 0.05$). Planaria feed opportunistically on oligochaetes (Pickavance 1971) and probably were able to increase their numbers given the increase in numbers of their prey. Continued moderate organic enrichment of the streambed due to septic tank drainage from stream-side homes (Trauben 1982) may have allowed the pollution-tolerant oligochaete population to increase.

A marked improvement in the benthic fauna occurred at Standing Rock. The pollution-tolerant fauna decreased by 100% and was essentially replaced by the more pollution-intolerant caddisfly, *Cheumatopsyche* sp. (Trichoptera). The populations of comparatively pollution-intolerant heptageniid mayflies (Ephemeroptera) and planarians also increased significantly. The mean Shannon-Wiener diversity index values indicate moderate pollution (Wilhm 1970) in 1974 and in 1980. According to Olive (1976), the major factor affecting the fauna in 1974 was excessive organic and inorganic silt. Siltation had declined visibly at this station by 1980 because of improvements made at the Ravenna Wastewater Treatment Plant and the construction of a new Franklin

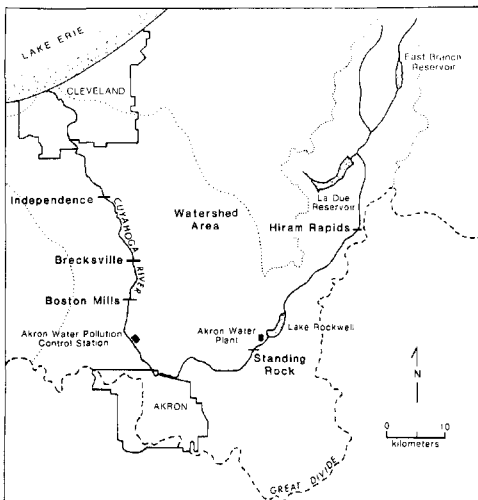


FIGURE 1. The locations of the sampling stations along the Cuyahoga River, Ohio. Following the direction of flow, the sampling locations are Hiram Rapids (120 km), Standing Rock Cemetery (89 km), Boston Mills (43 m), Brecksville (32 km), and Independence (20 km).

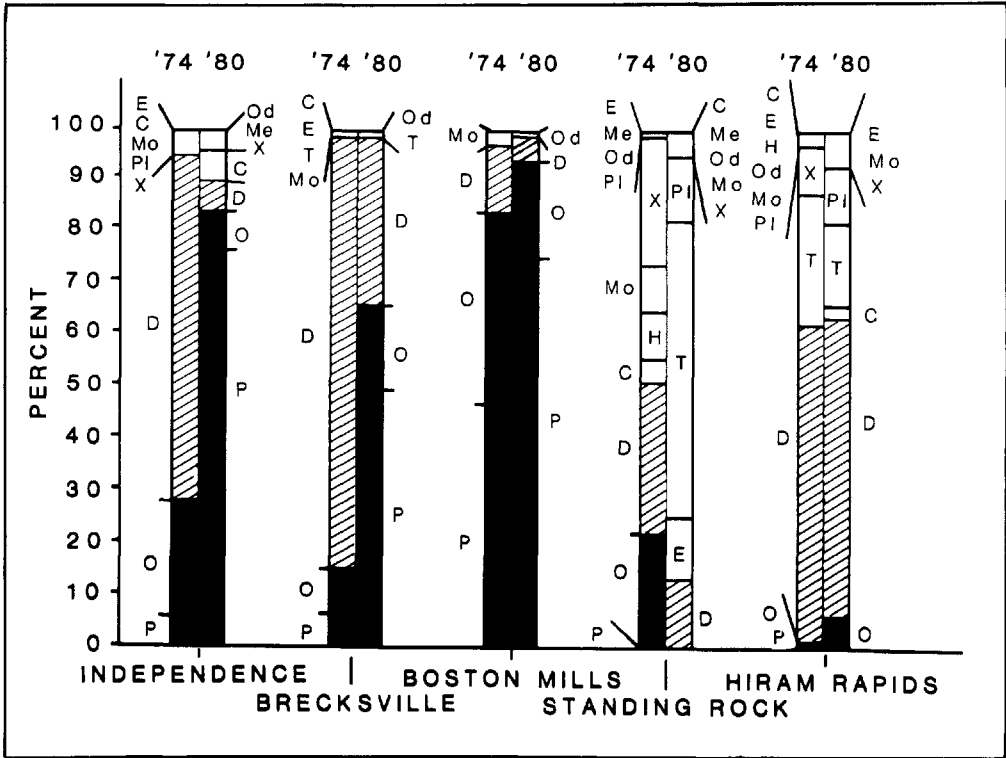


FIGURE 2. The percent composition of major benthic macroinvertebrate groups. Percentages are based on the pooled number of individuals collected during the summer 1974 and 1980. Code: C = Coleoptera, D = Diptera, E = Ephemeroptera, H = Hemiptera, Me = Megaloptera, Mo = Mollusca except *Physa* sp. (Gastropoda), O = Oligochaeta, Od = Odonata, P = *Physa* sp., Pl = Platyhelminthes, T = Trichoptera, X = non-insect arthropods. Pollution-tolerant, -facultative, and -intolerant organisms are depicted by black, shaded, and white bars, respectively.

Hills Wastewater Treatment Plant. The final effluent from these wastewater treatment plants (combined average flow = 2.0 MGD) enters the Cuyahoga River approximately 1.4 km above Standing Rock via Breakneck Creek.

The composition of the benthic fauna below the Akron Water Pollution Control Station at Boston Mills in 1980 closely resembled the community found in 1974. In both years, large percentages of pollution-tolerant organisms, low Shannon-Wiener diversity index values, and high densities of organisms (Lauer 1976, Trauben 1982) indicate excessive organic pollution.

Further downstream at Brecksville and Independence, the pollution-tolerant *Physa* sp. (Gastropoda) comprised a greater percentage of the benthic macroinvertebrate community in 1980 mainly because of a sharp decrease in the number of chironomid larvae (Diptera) rather than an increase in the abundance of snails. The low density of chironomid larvae at Independence is associated with the presence of several species of glossiphonid leeches of which one (*Helobdella stagnalis*) is known to be an efficient predator on chironomid larvae (Hilsenhoff 1963). Since no leeches were collected at Brecksville, leech preda-

TABLE 1
Shannon-Wiener diversity index value (\bar{d}) for
5 locations along the Cuyahoga River, Ohio,
during the summer 1974 and 1980.

Station (distance from mouth)	\bar{d} mean \pm 1 SD	
	1974* (n)	1980 (n)
Hiram Rapids (120 km)	2.7 \pm 0.4 (4)	3.0 \pm 0.4** (7)
Standing Rock (89 km)	2.4 \pm 0.6 (4)	2.1 \pm 0.4 (4)
Boston Mills (43 km)	1.2 \pm 0.6 (4)	1.0 \pm 0.8 (2)
Brecksville (32 km)	1.7 \pm 0.6 (4)	1.5 \pm 0.5** (8)
Independence (20 km)	1.7 \pm 0.4 (4)	1.5 \pm 0.2 (3)

*Calculated from pooled monthly data for June, July, August and September (Lauer 1976).

**Includes values for \bar{d} calculated with data from samples of the natural substrate.

tion alone did not reduce the chironomid communities.

Many factors (e.g., larval migration, disease, or mass emergences of adults) may have affected the benthic chironomid communities, but a lack of experimental controls prevents us from determining which were important. An increase in the amount of pollution was probably not a factor since organisms less tolerant of pollution than chironomids were collected at both stations, although in low abundances. Low Shannon-Wiener diversity index values and large percentages of pollution-tolerant and facultative organisms indicate excessive pollution in 1974 and 1980 at Brecksville and Independence.

In summary, the 1980 study revealed improvement in water quality at only one location, i.e. Standing Rock Cemetery near Kent, since the 1974 study. A greater percentage of the benthic macroinvertebrate fauna was comprised of pollution-tolerant organisms in 1980 than in 1974 at the other 4 stations (fig. 2). The Shannon-Wiener indexes of species diver-

sity remained unchanged at all 5 stations (table 1). Recent improvements at the Akron Water Pollution Control Station are expected to permit compliance with existing Ohio EPA standards (City of Akron 1982).

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