The Great Lakes Entomologist

Volume 11
Number 1 - Spring 1978 *Number 1 - Spring 1978*

Article 4

April 1978

Pre-Management Assessment of Aquatic Macroinvertebrates in a Small, Sedimentary Drainage Area of the Maumee and Lake Erie Basin

W. P. McCafferty
Purdue University

PRE-MANAGEMENT ASSESSMENT OF AQUATIC MACROINVERTEBRATES IN A SMALL, SEDIMENTARY DRAINAGE AREA OF THE MAUMEE AND LAKE ERIE BASIN[1,2]

W. P. McCafferty[3]

ABSTRACT

In order to establish baseline data adjunct to the research and development of soil conservation practices for sediment reduction in the Maumee River and Lake Erie, the aquatic macroinvertebrates of Black Creek and adjacent areas in northeastern Indiana were studied from 1974-1975. A total of 90 species of Insecta and Crustacea were taken, 69 from Black Creek. Species diversity indices ranged from 1.04 to 2.75 in two downstream locations and were generally reflective of stressed conditions related to channelization and sedimentation from the agrarian drainage area. Benthic species from the adjacent Maumee River potentially contribute in part to population maintenance in Black Creek.

A field study was carried out from 1974-1975 on the macroinvertebrates of the Black Creek drainage system of Allen County, in northeast Indiana. Both quantitative and qualitative baselines were sought in order to facilitate biological monitoring of the environmental effects related to developing land use practices and physical alteration of the creek.

Black Creek (Fig. 1) drains a watershed of approximately 12,000 acres, located about 13 miles northeast of Fort Wayne, Indiana. The creek and associated tributaries are entrenched and drain a primary farming area, being subject to sedimentary erosion and other "run-off" pollutants. Flow is highly intermittent, ranging from virtually no flow at times to approximately 1 cubic meter/second at high run-off times in the lower reaches. Substrate is predominantly silt-marl-clay with only occasional deposits of sand or mixed fine gravel and rarely stones. Natural pool-riffle sequences are not present due to previous channelization practices. Banks are mostly bare or with grasses and weeds. Only on sites 15 and 16 (Fig. 1) were forest tracts adjacent to both sides of the stream. Some wooded areas exist on the southwest bank at site 10.

Black Creek runs its course for approximately 7.5 miles eastward and then southward, emptying into the Maumee River. This drainage area was chosen as being representative of the physical, geologic, and socio-economic characteristics of the Maumee Basin of Indiana and Ohio. The Maumee Basin is a major drainage contributor to Lake Erie and is a major source of lake sedimentation. The study of macroinvertebrates was designed, therefore, to compliment the larger prototype research and development of soil conservation practices for the reduction of sediment and related pollutants in the Maumee River and Lake Erie. The deleterious effects of suspended and settled sediments on aquatic biota, particularly macrobenthos, have recently been reviewed and studied by Rosenberg and Snow (1975).

METHODS

Macroinvertebrates were qualitatively sampled from 16 Black Creek sites (Fig. 1) using kick screen, tea-strainer, and hand picking techniques, twice during July, 1974, and twice during August, 1974. Similar samples were taken from the Maumee River at sites 17 and

[1]Supported by funds from U.S. EPA Grant No. G005103.
[2]Purdue Agricultural Experiment Station Journal No. 6829.
[3]Department of Entomology, Purdue University, West Lafayette, Indiana 47907.

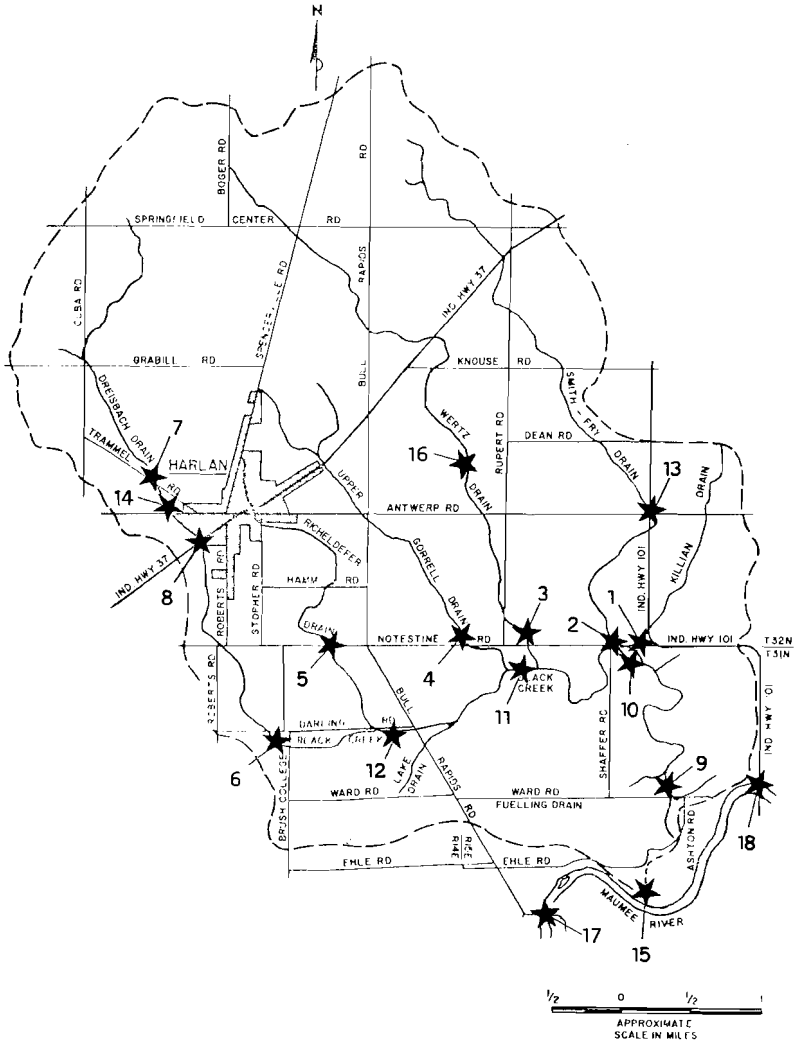

Fig. 1. Sampling sites of the Black Creek drainage area and Maumee River.

18 (Fig. 1) and three sites along Wann Brook, a small stream about 5 miles east of Black Creek, and similar to Black Creek except that it has not been channelized since 1968.

Quantitative measurements were secured by regular artificial substrate samples taken at sites 9 and 10 on Black Creek and the Maumee River sites beginning in August, 1974, and continuing through December, 1975. Samples consisted of cylindrical wire BBQ baskets, 10.25" × 6.5" diameter, and were charged with approximately 15 clean limestone rocks (Beak et al., 1973). Samplers remained in place for at least 4 weeks to provide maximum colonization time (Weber, 1973). Specimens were preserved in Pamples Solution.

Sorting and identification were carried out on the aquatic Crustacea and Insecta which were retained by a No. 30 U.S. Standard sieve. Where species determinations could not

https://scholar.valpo.edu/tgle/vol11/iss1/4
DOI: 10.22543/0090-0222.1316

be made, specimens were sorted to consistent "kinds" assumed to approximate species. Species diversity indices were computed (Cairns and Dickson, 1971) for the artificial substrate samples in terms of $\bar{d} = -\Sigma (Ni/N) \log_2 (Ni/N)$. Voucher material from the study is deposited in the Purdue University Entomological Collection.

RESULTS AND DISCUSSION

A systematic list of the 90 species taken during this study is presented in Table 1. Site distribution of the species within Black Creek is indicated in the table. A total of 69 species were taken from Black Creek; totals for individual Black Creek sites and Wann Brook and the Maumee River are indicated at the end of the table.

Table 1. Macroinvertebrates sampled in the Black Creek Study Area. Numbers following each species indicate Black Creek sites where sampled; M = Maumee River; W = Wann Brook.

EPHEMEROPTERA	
Baetidae	
Baetis intercalaris group sp. (9,10,M)	*Callibaetis fluctuans* (2,5,6,12,13,15)
B. sp. A (M)	*Cloeon alamance* (3,10,11,13)
B. sp. B (M)	*Pseudocloeon* sp. (M)
Heptageniidae	
Heptagenia diabasia (W)	*Stenonema nepotellum* (9)
H. maculipennis (9,M,W)	*S. terminatum* (9,M,W)
Stenacron interpunctatum (2,9,10,M,W)	*S.* sp. A (9,M)
Stenonema integrum (9,M,W)	*S.* sp. B (M)
Tricorythidae	
Tricorythodes atratus (9,M,W)	
Caenidae	
Caenis simulans (3,4,9,10,M,W)	*Caenis* sp. (3,15)
Potamanthidae	
Potamanthus myops (M,W)	
Ephemeridae	
Hexagenia limbata (W)	
Polymitarcidae	
Ephoron album (9,W)	
ODONATA	
Aeshnidae	
Boyeria vinosa (9,10,W)	
Gomphidae	
Dromogomphus spinosus (3,9,10,W)	
Libellulidae	
Libellula sp. (10)	
Calopterygidae	
Calopteryx maculatum (2,10,14,16,M,W)	*Hetaerina americana* (W)

Table 1 (Continued)

Coenagrionidae

Argia apicalis (M)
A. fumipennis (M)
A. moesta (9,M)
A. sedula (M)
Enallagma sp. (3,M)
Ischnura posita (M)
I. verticalis (3,9,10,14,16,M)

PLECOPTERA

Perlidae

Perlesta placida (2,13,M,W)

Taeniopterygidae

Taeniopteryx burksi (M)

HEMIPTERA

Corixidae

Sigara modesta (2,7,13,14,15,16,W)
Trichocorixa calva (2,3,4,5,7,10,15,W)
Trichocorixa sp. (W)

Gerridae

Gerris remigis (W)

Veliidae

Rhagovelia obesa (9,11)

MEGALOPTERA

Sialidae

Sialis sp. (9,12,15)

COLEOPTERA

Haliplidae

Peltodytes duodecimpunctatus (3,7,9,10,12,15)

Dytiscidae

Agabus sp. (2,3)
Deronectes griseostriatus (9)
Hydroporus wickhami (4)
Hygrotus sayi (4,14,16)
Laccophilus fasciatus (2,5,6)
L. sp. (3,5)

Hydrophilidae

Berosus peregrinus (2,4,6,9,10,11,15)
B. sp. (W)
Enochrus nebulosus (4,6,15)
E. perplexus (14,16)
Helophorus sp. (16,W)
Laccobius sp. (2,11,12,13,14,15)
Paracymus subcupreus (9)
Tropisternus lateralis (4,5,10,14,16,W)
T. mixtus (11,13)

Dryopidae

Helichus fastigiatus (9)

Elmidae

Ancyronyx variegatus (W)
Dubiraphia bivittata (9,10)
Stenelmis sexlineata (9,15,M.W)

TRICHOPTERA

Hydropsychidae

Cheumatopsyche pettiti (2,9,11,13,15,M,W)
Hydropsyche orris (M)
Hydropsyche simulans (M,W)
H. sp. (9,10,M,W)

Table 1 (Continued)

Phryganeidae

Ptilostomis ocellifera (10)

Limnephilidae

Limnephilus sp. (14)

DIPTERA

Tipulidae

Tipula sp. (9)

Culicidae

Anopheles quadrimaculata (3)

Ceratopogonidae

Palpomyia sp. (9,10)

Chironomidae

sp. A (2,3,4,5,6,9,10,14,15,M,W)
sp. B (2,9,10,13,15,M,W)
sp. C (9,10,13,14,16,M,W)
sp. D (9,10,M)
sp. E (9,M)
sp. F (3,9,10,14,16)
sp. G (9,W)
sp. H (9)
sp. I (10)
sp. J (9,10)

Simuliidae

Simulium sp. (3,9,11,M)

Stratiomyidae

Stratiomys sp. (9,11,15)
Euparyphus sp. (9)

Tabanidae

Chrysops sp. (9,W)

Empididae

sp. (M)

Ephydridae

sp. A (3,M)
sp. B (W)

AMPHIPODA

Hyalella azteca (2,9,10,15,M,W)

ISOPODA

Lirceus sp. (2,9,10,11,13,15,M,W)

DECAPODA

Orconectes rusticus mirus (2,5,9,10,13,15,M,W)
O. sp. (M)

Total species collected: Black Creek sites, 1:0, 2:16, 3:15, 4:8, 5:7, 6:5, 7:3, 8:0, 9:43, 10:27, 11:9, 12:4, 13:12, 14:11, 15:16, 16:9; Maumee River: 39; Wann Brook: 37.

If numbers of species at Black Creek are compared and sites 9 and 10 are excluded because of sampling bias, it can be seen that sites 2, 3, and 15 were the richest with at least 15 species each. Numbers of species of Ephemeroptera, Plecoptera, and Trichoptera (which are generally dependent on high DO concentrations) contributed largely to richness differences between these sites and others. The absence of any species at sites 1 and 8 may be explained by the fact that site 1 on Killian Drain was essentially dry during sampling times, and site 8 was affected by immediate effluent from the community of Harlan.

When qualitatively sampled species from Black Creek and Wann Brook were compared, only 16 species were found in common between the two systems. All Wann Brook sites yielded relatively high numbers of Ephemeroptera, Plecoptera, and Trichoptera, having at least twice the number of these "clean water" insects than the richest site similarly sampled at Black Creek.

Benthic species made up all aquatic arthropods sampled in the Maumee River, 24 of which were found in common with benthic species taken in Black Creek. Most of the species in common were taken in the rock filled basket samplers in Black Creek, a substrate type generally atypical for Black Creek, but typical of much of Maumee River bottom in this area. Although severely limited by habitat availability in Black Creek, the proximal populations of these benthic species in the Maumee River may provide a constant enough source of colonization to maintain some presence of these species in Black Creek.

Species diversity data from two sites at Black Creek are summarized in Table 2. Species diversity indices range from 1.04 to 2.75, and the mean for the samples taken is 2.00 for site 9 and 2.50 for site 10. Species diversity values for the same periods on the Maumee River ranged from 1.42 to 3.53 with a mean of 2.30.

Wilhm and Dorris (1968) pointed out that in general, for $\bar{d}$ generated as herein, values of less than 1.00 are typical of heavy or catastrophic pollution, values of between 1.00 and 3.00 are indicative of moderate pollution, and values greater than 3.00 are typical of clean water situations. Accordingly, only Fall values for Black Creek (site 9) consistently indicated a critically polluted or stressed environment. All other values indicated a moderately polluted or stressed situation.

Interestingly, the substrate samplers in Black Creek apparently acted somewhat as a refugium, yielding species not easily found otherwise in Black Creek. In this sense, species diversity may have actually been overestimated by this technique. On the other hand, typical heavy silting in the rock sampler after each 4 week period may have offset this bias somewhat.

Obviously Black Creek was far from optimal regarding its carrying capacity for diverse

Table 2. Species diversity data for Black Creek.

Sample		Number of	Number of	Species
Site	Date	Species	Individuals	Diversity
9	9/74	10	165	1.82
9	10/74	13	474	1.70
10	11/74	10	95	2.58
9	5/75	13	105	2.69
9	6/75	9	132	2.68
9	8/75	10	96	2.74
9	8/75	9	110	2.44
10	9/75	10	88	2.75
9	10/75	5	39	1.62
9	11/75	5	57	1.04
10	11/75	8	38	2.74
10	12/75	11	159	1.92

https://scholar.valpo.edu/tgle/vol11/iss1/4
DOI: 10.22543/0090-0222.1316

aquatic communities during this study period, and several apparent factors may have contributed to this situation. Channelization and lack of natural pool-riffle environments, agricultural run-off, heavy siltation limiting substrate types, and the general lack of cover and adequate habitat for terrestrial adults may all have contributed to the stressed condition of Black Creek. Subsequent soil conservation practices and morphometric modifications in the stream may affect the faunistic composition and community diversity in the future. If the environment can be improved, it appears that the Maumee River and neighboring tributaries hold considerable potential as sources for rapid faunal recolonization into Black Creek.

LITERATURE CITED

Beak, T. W., T. C. Griffing, and A. G. Appleby. 1973. Use of artificial substrate samplers to assess water pollution. American Society for Testing and Materials. ASTM STP 528:227-241.

Cairns, J., Jr. and K. L. Dickson. 1971. A simple method for the biological assessment of the effects of waste discharges on aquatic bottom dwelling organisms. J. Wat. Poll. Contr. Fed. 43:755-772.

Rosenberg, D. M. and N. B. Snow. 1975. Ecological studies of aquatic organisms in the Mackenzie and Porcupine River drainages in relation to sedimentation. Fish. Mar. Serv. Tech. Rep. (Can.). 547.

Weber, C. I. (Ed.) 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. USEPA IBA027, Cin., O.

Wilhm, J. L. and T. C. Dorris. 1968. Biological parameters for water quality criteria. Bioscience 18:477-481.