SURVEY OF BENTHIC MACROINVERTEBRATES AND ANALYSIS OF WATER AND SEDIMENT FROM THE BUFFALO RIVER 1970

PREPARED FOR

Allied Chemical Corporation
Buffalo, New York

BY

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PREFACE

This report, which is a product of a study funded in part by the Allied Chemical Corporation of Buffalo, New York, is intended to provide information on the changes in the quality of the Buffalo River as a result of the activities of man.

Special Reports are issued by the Great Lakes Laboratory as a means of making preliminary data available to the university community and the general public. These reports do not constitute formal publication.

Other publications in this series include:

NUMBER	TITLE
1	Selected References Concerning the Algae of Lake Erie. (Updated in Special Report #6)
2	Survey of Benthic Macroinvertebrates and Analysis of Water and Sediment from the Buffalo River - 1969.
3	Fish Protein Concentrate: A Review of Pertinent Literature with an Emphasis on Production from Freshwater Fish. (Out of Print)
4	Algae as Indicators of Pesticides.

NUMBER	TITLE
5	Fish Protein Concentrate: A Review of Pertinent Literature with an Emphasis on Production from Freshwater Fish. II - A Supplement. (Out of Print)
6	Selected References Concerning the Algae of Lake Erie. II.
7	Fish Protein Concentrate: Protein Value of Lake Erie Carp, Sheepshead and Alewife as Raw Material. (Out of Print)
9	Chromium, Cadmium, Arsenic, Selenium, Mercury and Aquatic Life: A Brief Literature Review.
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13	Influence of the Upper Niagara River Ice Boom on the Climate of Buffalo, New York.
14	Survey of Benthic Macroinvertebrates and Analysis of Water and Sediment from the Buffalo River - 1972.

NUMBER	TITLE
15	Bibliography of Water Quality Data for Erie and Niagara Counties.
16	Measurement of Primary Productivity in Freshwater via the Uptake of Radioactive Carbon.
17	Clarification of Marine Regulations and Enforcement for Non-Commercial Craft - Greater Buffalo Area.
18	Benthic Survey - A Comparison of Various Bio-Indexing Systems Applied to Benthic Macroinvertebrate Data.

Additional copies of these reports can be obtained from the Great Lakes Laboratory.

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INTRODUCTION

For the past three years, staff of the Great Lakes Laboratory, with the aid of grants from the Allied Chemical Corporation of Buffalo, has been conducting quantitative analyses of the water, sediment and macroscopic benthic invertebrates of the Buffalo River. In this report, the latter is considered to be the stream that is formed by the confluence of Buffalo and Cayuga Creeks. This is the definition of the Buffalo River that is employed by the United States Geological Survey. Harding and Gilbert (1968) provided a detailed description of the 31 tributaries and other aspects of the 436 square mile drainage basin of the Buffalo River.

The purpose of the award by Allied was twofold - to provide aid to students and additional information of man-made changes affecting the river. The investigation was intended to provide an evaluation of the impact of the Buffalo River Improvement Project, as well as the consequences of pollution abatement by those discharging wastes into this stream. The Improvement Project was a cooperative venture involving the City of Buffalo and four industries (Allied Chemical, Donner-Hanna Coke, Mobil Oil and Republic Steel), all of which are located on the river (Figure 1).

However, in order to fully understand the above, one should be familiar with the other changes that have occurred in this stream. Prior

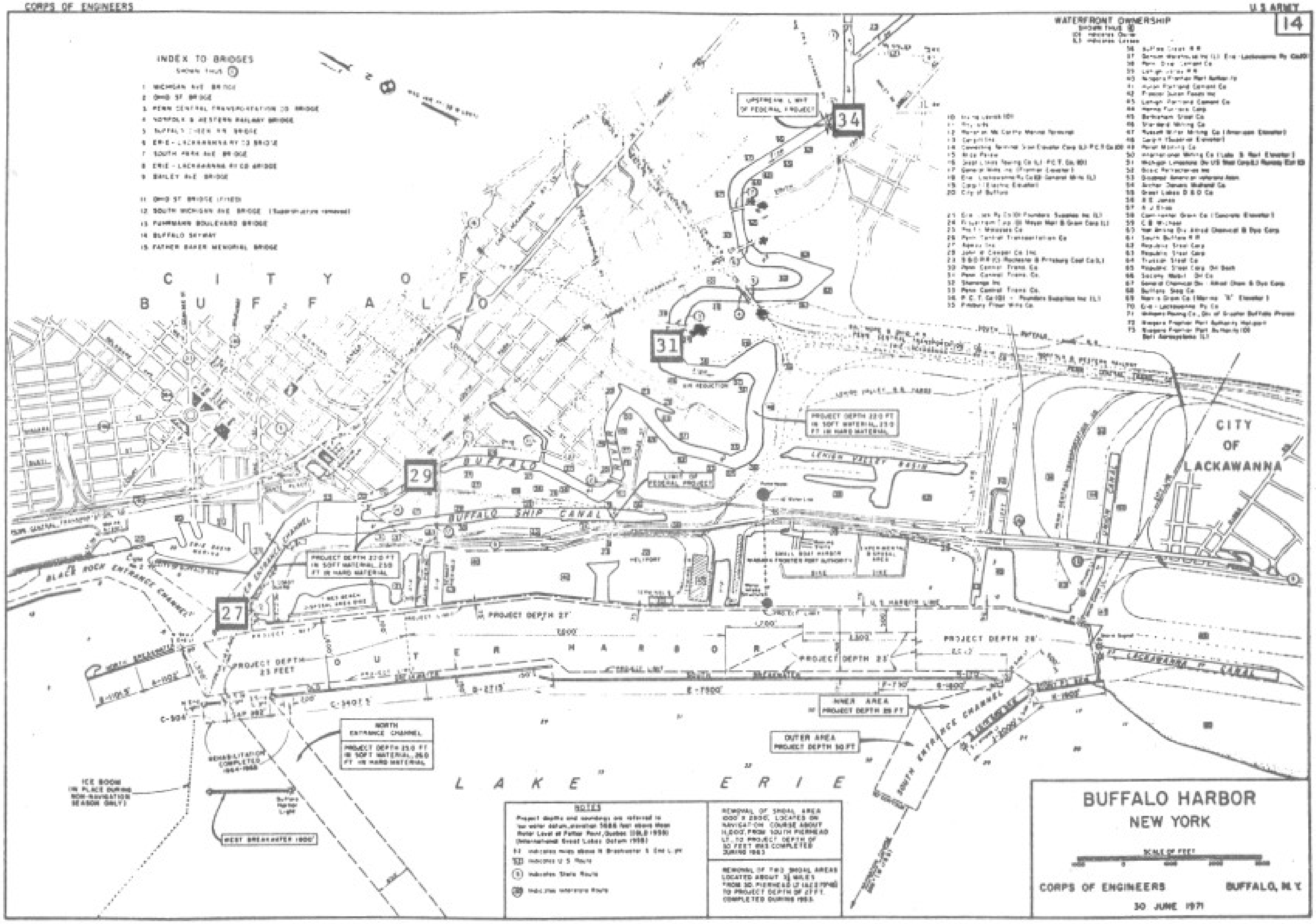

Figure 1. Map of Buffalo River and Surrounding Area.

to 1800 the Buffalo River was a narrow, shallow stream. Although no accurate records have been located to date, it was estimated that the river was no wider than 15 meters nor deeper than two meters at its mouth. In 1818 a sand bar at the mouth of the river was removed by the Village of Buffalo. By redirecting the flow of the river through the construction of two piers, the citizens were able to harness the erosion capacity of the spring run-off to cut a channel approximately 30 meters wide, three meters in depth and extending upstream from Lake Erie for a distance of 1600 meters. Completion of the Erie Canal in 1825, which brought more aquatic transportation to the area, prompted additional dredging of this section of the Buffalo River in order to achieve a water depth of four meters. The depth at the mouth of the river was increased to approximately five meters in 1870, six meters in 1890 and seven meters in 1900 (Barrick 1970).

The opening of the canal system resulted in many changes. The availability of a more rapid and economical means of transporting raw materials and finished products encouraged the establishment of heavy industry (iron and flour mills, chemical plants, etc.) along the river. Industry attracted workers. Buffalo's population increased from 3,000 to 42,000 between 1825 and 1850. As roads and means of land transportation improved, the number of people residing in the Buffalo River drainage basin also increased. Sewer systems were constructed, particularly in the late 1930's when Federal Emergency Administration of Public Works (WPA) funds were available. Precipitation that once flowed off woodlands amd farms into the tributaries of the Buffalo River was carried in pipes out of the drainage basin. As a result, the discharge of the river decreased.

Between 1917 and 1927 the City of Buffalo straightended, widened and dredged the Buffalo River an additional 3,000 meters upstream. During the 1930's the federal government and the city jointly maintained the river. However, due to legal and financial problems the federal government, through the U.S. Army Corps of Engineers, assumed the full responsibility for this project. The Corps has maintained a channel depth of approximately seven meters. During the 1970 study, dredging was conducted between mid-August and October.

The widening and deepening of the channel plus the alterations in the upper watershed have decreased the flow rate of the river. During the summer months, when evaporation was high and precipitation low, there was little or no discharge from the Buffalo River. In fact, the river sometimes flowed "upstream." This created two major problems. Industry along the river no longer had an adequate source of cooling water. Under the stagnant conditions that existed in the river, heated water discharged by industry was "recycled" into the intake pipes. This "closed" system resulted in surface temperatures in the river that exceeded 40°C. Also, when evaporation decreased and precipitation increased in the fall, the pollutants deposited in the river during the late spring and summer were carried in a "slug" into the Buffalo Harbor and the Niagara River. Detrimental effects on fish and fowl were noted from such "slugs" (International Joint Commission Advisory Board 1967).

The Buffalo River Improvement Project was instituted to alleviate the above problems. Since 1967, a minimum of 100 million gallons per day (100 MGD) of water have been pumped from an intake in Buffalo Harbor, located southwest of the Small Boat Harbor, to the four participating industries (See Pump House and Water Intake Structure on Figure 1). The corporations used the water for cooling in their manufacturing processes. The water also diluted their wastes prior to being released into the river. The additional volume provided low-flow augmentation.

In 1965 each of the industries along the river were informed by the Federal Water Pollution Control Administration (FWPCA) to submit water pollution abatement plans that would be realized by 1970 (FWPCA 1966). Each company, with the exception of the Mobil Oil Corporation, did so. Mobile was excused because they believed that their Buffalo operation was going to be closed. However, due to several economic factors, the refinery has remained in operation. During 1970 Mobil, as a result of pressure from regulatory agencies, the courts and citizen groups, instituted a crash program in order to be in compliance with water quality criteria. Therefore, by October 1970 there had been a substantial reduction in discharges by Mobile to the lower Buffalo River.

The communities discharging wastes into the Buffalo River and its tributaries also by 1965 had been ordered by state and federal agencies to abate their pollution. However, to date none has implemented measures that have resulted in a decrease in municipal effluents to the river from their treatment plants and/or storm-sanitary sewer overflows. Seven major communities have treatment systems which discharge to the Buffalo River or its tributaries (Erie-Niagara Regional Water Resources Planning Board 1969). These plants serve a population of 52,874 (FWPCA 1966). All of these towns, whose average population growth was 33 percent between 1960 and 1970, had primary sewage treatment plants, trickling filters and/or septic tanks. Most of the plants were more than 20 years old, as well as hydraulically and organically overloaded (Table 1).

Table 1

SEWAGE TREATMENT PLANTS IN THE BUFFALO RIVER BASIN

	Type[1]	Average Flow (1966)	Design Capacity	Discharge
Depew Village	P	1.80 MGD	2.00 MGD	Cayuga
Lancaster Village	SK	1.30 MGD	0.50 MGD	Cayuga
East Aurora	TF	1.25 MGD	1.40 MGD	Cazenovia
Lancaster SD #1	SK	0.30 MGD	0.03 MGD	Cayuga
West Seneca SD #6	I	0.18 MGD	0.30 MGD	Buffalo River
Jerge-Elma	TF	0.006 MGD	0.006 MGD	Buffalo Creek
Cheektowaga SD #3	TF	1.50 MGD	1.00 MGD	Buffalo River

[1]ABBREVIATIONS: P - Primary SK - Septic Tank I - Imhoff Tank TF - Trickling Filter

Several major overflow pipes from combined (sanitary-storm) sewer collection systems also terminate in the river.

Therefore, over the past three years there has been an increase in the discharge from the Buffalo River during the spring to fall period, as well as a decrease in the quantity of wastes received by the stream from the industries along its lower reaches. At the same time, there has been an increase in the amounts of municipal sewage going into the tributaries of the river.

The award from Allied also provided an opportunity for college students to participate in environmental investigations. Such practical opportunities to become involved with the collection, analysis, organization and evaluation of data generally cannot be gained in the classroom or laboratory.

METHODS

Four stations were established on the Buffalo River:

Station 27 - at the Fuhrmann Boulevard Coast Guard Base

Station 29 - below the Michigan Avenue Bridge

Station 31 - below the New York Central Railroad Bridge

Station 34 - below the Erie-Lackawanna Railroad Bridge

The location of these sites is shown on Figure 1. Each of the collection areas, with the exception of Station 34, was within the federally maintained zone and the reaches that received discharges from the Buffalo River Improvement Project. Water samples were collected from two meters below the surface at mid-stream using a 1200 ml Kemmerer on 13 May, 13 August and 27 October 1970. The water was analyzed according to Standard Methods (American Public Health Association 1965) and the Laboratory Manual of the Cleveland Program Office of the Federal Water Pollution Control Administration (1967). Oxygen was fixed in the field using the Rideal-Stewart Technique. Alkalinity, pH (via Coleman Model 37A pH meter) and conductivity (via Yellow Springs Instrument Model 31 Conductivity Bridge) were performed immediately. Samples were refrigerated while the final tests were completed.

Sediment samples for chemical and macroinvertebrate analyses were gathered with a six inch Ekman Dredge at the same time and sites as the water. The above references were also employed in the analysis of the mud.

The macroinvertebrates were removed by passing each sample through #6 and #30 standard sieves. The animals were fixed (killed) and preserved in a solution of ethyl alcohol, distilled water and glycerin (75:20:5 by weight). Dr. Ronald Engel of the State University College at Oswego assisted with the quantitative and qualitative analyses. The taxonomic system employed was that of Pennak (1953). Results were equated to organisms per square meter.

RESULTS

Tables 2 through 7 contain the data collected during 1970.

Table 2a

WATER ANALYSIS PER STATION

Station	Date	pH	Alkal. mg/l	Cond. µmhos at 25°C	D.O. mg/l	D.O. percent saturation	Temp. °C	SOLIDS Dissolved mg/l	SOLIDS Suspended mg/l	SOLIDS Total mg/l
27	5/13	7.77	86	213	10.9	100.0	12.0	294	18	302
27	8/13	7.32	99	427	7.4	87.0	25.0	202	10	212
27	10/27	7.32	83	300	8.3	92.0	20.5	340	112	452
29	5/13	7.38	71	276	0.0	0.0	13.0	310	14	324
29	8/13	7.27	97	401	0.0	0.0	26.0	294	18	312
29	10/27	6.70	85	391	0.1	1.0	22.0	311	137	448
31	5/13	7.44	55	274	0.0	0.0	10.0	350	24	374
31	8/13	7.31	96	378	0.0	0.0	27.0	350	58	408
31	10/27	6.36	61	525	0.0	0.0	23.5	457	95	542
34	5/13	7.46	91	209	2.5	21.0	8.0	323	7	330
34	8/13	7.55	104	415	0.0	0.0	26.0	272	36	308
34	10/27	7.49	111	345	0.0	0.0	24.0	261	101	362

Table 2b

WATER ANALYSIS PER STATION

Station	Date	PHOSPHATES Dissolved mg/l	Suspended mg/l	Total mg/l	NITROGEN NO_3-N mg/l	Org-N mg/l	NH_4-N mg/l	Total-N mg/l
27	5/13	0.01	2.29	2.30	0.560	0.91	1.57	3.04
27	8/13	0.40	0.24	0.64	0.155	2.59	1.43	4.18
27	10/27	0.07	0.80	0.87	0.650	4.02	2.88	7.47
29	5/13	0.07	1.15	1.22	0.549	1.26	4.10	5.91
29	8/13	0.50	0.56	1.06	0.315	3.32	1.94	5.58
29	10/27	0.42	1.80	2.22	1.070	3.26	2.51	6.84
31	5/13	0.06	0.76	0.82	0.570	1.12	3.66	5.35
31	8/13	0.09	1.39	1.48	0.950	3.78	3.01	7.74
31	10/27	0.38	0.72	1.10	1.600	3.57	2.79	7.48
34	5/13	0.04	1.27	1.31	0.790	1.54	2.16	4.50
34	8/13	0.07	0.95	1.02	0.460	3.99	3.03	7.48
34	10/27	0.92	1.22	2.14	0.800	3.29	1.65	5.74

Table 3a

WATER ANALYSIS PER DATE

Station	Date	pH	Alkal. mg/l	Cond. µmhos at 25°C	D.O. mg/l	D.O. percent saturation	Temp. °C	SOLIDS Dissolved mg/l	SOLIDS Suspended mg/l	SOLIDS Total mg/l
27	5/13	7.77	86	213	10.9	100.0	12.0	294	18	302
29	5/13	7.38	71	276	0.0	0.0	13.0	310	14	324
31	5/13	7.44	55	274	0.0	0.0	10.0	350	24	374
34	5/13	7.46	91	209	2.5	21.0	8.0	323	7	330
27	8/13	7.32	99	427	7.4	87.0	25.0	202	10	212
29	8/13	7.27	97	401	0.0	0.0	26.0	294	18	312
31	8/13	7.31	96	378	0.0	0.0	27.0	350	58	408
34	8/13	7.55	104	415	0.0	0.0	26.0	272	36	308
27	10/27	7.32	83	300	8.3	92.0	20.5	340	112	452
29	10/27	6.70	85	391	0.1	1.0	22.0	311	137	448
31	10/27	6.36	61	525	0.0	0.0	23.5	457	95	542
34	10/27	7.49	111	345	0.0	0.0	24.0	261	101	362

Table 3b

WATER ANALYSIS PER DATE

Station	Date	PHOSPHATE Dissolved mg/l	PHOSPHATE Suspended mg/l	PHOSPHATE Total mg/l	NITROGEN NO_3-N mg/l	NITROGEN Org-N mg/l	NITROGEN NH_4-N mg/l	NITROGEN Total-N mg/l
27	5/13	0.01	2.29	2.30	0.560	0.91	1.57	3.04
29	5/13	0.07	1.15	1.22	0.549	1.26	4.10	5.91
31	5/13	0.06	0.76	0.82	0.570	1.12	3.66	5.35
34	5/13	0.04	1.27	1.31	0.790	1.54	2.16	4.50
27	8/13	0.40	0.24	0.64	0.155	2.59	1.43	4.18
29	8/13	0.50	0.56	1.06	0.315	3.32	1.94	5.39
31	8/13	0.09	1.39	1.48	0.950	3.78	3.01	7.74
34	8/13	0.07	0.95	1.02	0.460	3.99	3.03	7.48
27	10/27	0.07	0.80	0.87	0.650	4.02	2.88	7.47
29	10/27	0.42	1.80	2.22	1.070	3.26	2.51	6.84
31	10/27	0.38	0.72	1.10	1.600	3.57	2.79	7.48
34	10/27	0.92	1.22	2.14	0.800	3.29	1.65	5.74

Table 4a

SEDIMENT ANALYSIS PER STATION

Station	Date	Total Solids %	Volatile Solids %	Fixed Solids %	Oil mg/g	Chemical Oxygen Demand mg/g	Biochemical Oxygen Demand mg/g	Chlorine Demand mg/g	Iron mg/g
27	5/13	42.5	11.1	88.9	6.6	107.5	7.5	10.1	45
27	8/13	13.1	16.7	83.7	5.1	44.9	8.1	16.5	41
27	10/27	41.7	14.5	85.5	9.0	112.6	6.1	11.2	18
29	5/13	46.9	8.6	92.4	2.8	75.4	2.8	6.1	41
29	8/13	25.0	14.9	85.1	10.3	116.6	8.2	19.2	45
29	10/27	25.0	16.1	83.9	4.1	109.6	14.5	21.9	43
31	5/13	36.3	11.9	88.1	13.7	126.3	1.1	13.4	49
31	8/13	43.0	6.2	93.8	9.4	145.6	7.0	10.1	42
31	10/27	33.8	14.1	85.9	8.3	109.5	18.0	17.8	49
34	5/13	41.0	7.3	92.7	0.2	71.8	6.3	5.2	25
34	8/13	35.8	14.5	85.5	4.9	90.9	8.2	15.9	30
34	10/27	34.5	13.7	86.3	19.9	116.0	13.7	15.7	72

Table 4b

SEDIMENT ANALYSIS PER STATION

Station	Date	PHOSPHATE Dissolved mg/g	PHOSPHATE Total mg/g	NITROGEN NO_3-N mg/g	NITROGEN Org-N mg/g	NITROGEN NH_4-N mg/g	NITROGEN Total-N mg/g
27	5/13	0.039	6.80	0.012	1.34	0.144	1.50
27	8/13	0.029	1.18	0.011	1.04	0.165	1.22
27	10/27	0.010	4.29	0.004	1.46	0.061	1.52
29	5/13	0.058	4.60	0.161	1.37	0.069	1.60
29	8/13	0.074	1.18	0.005	1.19	0.292	1.49
29	10/27	0.061	0.98	0.009	1.56	0.288	1.86
31	5/13	0.020	1.03	0.005	1.57	0.089	1.76
31	8/13	0.037	4.89	0.005	1.48	0.128	1.61
31	10/27	0.019	1.02	0.008	1.10	0.158	1.86
34	5/13	0.013	4.80	0.004	1.38	0.096	1.48
34	8/13	0.060	5.29	0.006	1.57	0.262	1.84
34	10/27	0.052	2.42	0.005	1.58	0.228	1.81

Table 5a

SEDIMENT ANALYSIS PER DATE

Station	Date	Total Solids %	Volatile Solids %	Fixed Solids %	Oil mg/g	Chemical Oxygen Demand mg/g	Biochemical Oxygen Demand mg/g	Chlorine Demand mg/g	Iron mg/g
27	5/13	42.5	11.1	88.9	6.6	107.5	7.5	10.1	45
29	5/13	46.9	8.6	92.4	2.8	75.4	2.8	6.1	41
31	5/13	36.3	11.9	88.1	13.7	126.3	1.1	13.4	49
34	5/13	41.0	7.3	92.7	0.2	71.8	6.3	5.2	25
27	8/13	13.1	16.7	83.7	5.1	44.9	8.1	16.5	41
29	8/13	25.0	14.9	85.1	10.3	116.6	8.2	19.2	45
31	8/13	43.0	6.2	93.8	9.4	145.6	7.0	10.1	42
34	8/13	35.8	14.5	85.5	4.9	90.9	8.2	15.9	30
27	10/27	41.7	14.5	85.5	9.0	112.6	6.1	11.2	18
29	10/27	25.0	16.1	83.9	4.1	109.6	14.5	21.9	43
31	10/27	33.8	14.1	85.9	8.3	109.5	18.0	17.8	49
34	10/27	34.5	13.7	86.3	19.9	116.0	13.7	15.7	72

Table 5b

SEDIMENT ANALYSIS PER DATE

Station	Date	PHOSPHATE Dissolved mg/g	PHOSPHATE Total mg/g	NITROGEN NO_3-N mg/g	NITROGEN Org-N mg/g	NITROGEN NH_4-N mg/g	NITROGEN Total-N mg/g
27	5/13	0.039	6.80	0.012	1.34	0.144	1.50
29	5/13	0.058	4.60	0.161	1.37	0.069	1.60
31	5/13	0.028	1.03	0.005	1.57	0.089	1.76
34	5/13	0.013	4.80	0.004	1.37	0.096	1.48
27	8/13	0.029	1.18	0.011	1.04	0.165	1.22
29	8/13	0.074	1.18	0.005	1.19	0.292	1.49
31	8/13	0.037	4.89	0.005	1.48	0.128	1.61
34	8/13	0.060	5.29	0.006	1.57	0.262	1.84
27	10/27	0.010	4.29	0.004	1.46	0.061	1.52
29	10/27	0.061	0.98	0.009	1.56	0.288	1.86
31	10/27	0.019	1.02	0.008	1.10	0.158	1.86
34	10/27	0.052	2.42	0.005	1.58	0.228	1.81

Table 6

BENTHIC MACROINVERTEBRATE ANALYSIS PER STATION

Station	Date	Class	Order	Family	#/m²
27	5/13	Oligochaeta	Plesiophora	-	4,805.0
		Gastropoda	Ctenobranchiata	Valvatidae	15.5
	8/13	Oligochaeta	Plesiophora	-	12,508.5
		Gastropoda	Ctenobranchiata	Valvatidae	77.5
		Insecta	Diptera	Chironomidae	186.0
		Turbellaria	Tricladida	Planariidae	31.0
		Hydrozoa	Hydroida	Hydridae	62.0
	10/27	Oligochaeta	Plesiophora	-	2,501.0
		Pelecypoda	Heterodonta	Sphaeriidae	15.5
		Insecta	Diptera	Chironomidae	15.5
		Phasmidia	Rhabditat	-	15.5
29	5/13	Oligochaeta	Plesiophora	-	46.5
	8/13	Oligochaeta	Plesiophora	-	1,891.0
		Gastropoda	Ctenobranchiata	Valvatidae	31.0
		Insecta	Diptera	Chironomidae	15.5
	10/27	Oligochaeta	Plesiophora	-	124.0
31	5/13	No Specimens Found			
	8/13	Oligochaeta	Plesiophora	-	217.0
	10/27	Oligochaeta	Plesiophora	-	15.5
34	5/13	Oligochaeta	Plesiophora	-	155.0
	8/13	Oligochaeta	Plesiophora	-	504.5
	10/27	Oligochaeta	Plesiophora	-	15.5

Table 7

BENTHIC MACROINVERTEBRATE ANALYSIS PER DATE

Station	Date	Class	Order	Family	#/m²
27	5/13	Oligochaeta	Plesiophora	-	4,805.0
		Gastropoda	Ctenobranchiata	Valvatidae	15.5
29		Oligochaeta	Plesiophora	-	46.5
31		No Specimens Found			
34		Oligochaeta	Plesiophora	-	155.0
27	8/13	Oligochaeta	Plesiophora	-	12,508.5
		Gastropoda	Ctenobranchiata	Valvatidae	77.5
		Insecta	Diptera	Chironomidae	186.0
		Turbellaria	Tricladia	Planariidae	31.0
		Hydrozoa	Hydroida	Hydridae	62.0
29		Oligochaeta	Plesiophora	-	1,891.0
		Gastropoda	Ctenobranchiata	Valvatidae	31.0
		Insecta	Diptera	Chironomidae	15.5
31		Oligochaeta	Plesiophora	-	217.0
34		Oligochaeta	Plesiophora	-	504.5
27	10/27	Oligochaeta	Plesiophora	-	2,501.0
		Pelecypoda	Heterodonta	Sphaeriidae	15.5
		Insecta	Diptera	Chironomidae	15.5
		Phasmidia	Rhabditat	-	15.5
29		Oligochaeta	Plesiophora	-	46.5
31		Oligochaeta	Plesiophora	-	15.5
34		Oligochaeta	Plesiophora	-	15.5

DISCUSSION

As stated previously, the federally maintained section of the Buffalo River, which includes Stations 27, 29 and 31, was dredged by the U.S. Army Corps of Engineers during the period from mid-August to mid-September. The 1970 level of Lake Erie was slightly higher than it was in 1969. As indicated by Blum (1965), the lake level has a strong influence on the discharge from the river. The higher the lake, the lower the average amount of flow from the river. Though it was not gauged, the average 1970 discharge was less in 1970 than in 1969.

With respect to water quality, the highest values for solids, nitrogen and phosphates were observed on 27 October. Alkalinities generally were highest on 13 August. Oxygen levels, in contrast to 1968 and 1969, were down; while conductivity and dissolved solids (Sweeney 1968a, 1969) were up at all stations with the exception of Station 27. It was believed that the decrease in the rate of flow of the river was a contributing factor to the latter. In 1970, there was a significant drop in suspended solids, particularly at Station 31. This was attributed to the initiation of pollution abatement measures by Republic Steel, Donner-Hanna Coke and Allied Chemical.

Contrasting the changes in water chemistry between stations on a sampling date, the poorest quality was observed at Station 31. However, there was a marked decrease in the differences that existed between Stations 31 and 34 during 1969 (Sweeney 1969). While conditions at Station 31 generally had improved during 1970, further deterioration was noted at Station 34, particularly with respect to organic nitrogen, total phosphates and conductivity.

The highest values for most of the sediment parameters also occurred on 27 October. The quality of the sediment has improved markedly over 1969. Most noteworthy has been the decrease since 1968 and 1969 in the quantities of total phosphates, organic nitrogen, chlorine and biochemical oxygen demands and oil at all stations with the exception of Station 34 (Sweeney 1968b, 1969). This also is attributed to reductions in discharges by industry.

Station 31 had the lowest quality sediment. However, material gathered at the above location was only slightly poorer than at Station 34. As in the case of the water, conditions at the latter point in the river continued to deteriorate.

Examination of the bottom dwelling macroinvertebrates also supported the conclusion that the quality of the downstream sections of the Buffalo River had improved. For the first time since the river was examined in 1962 (Blum 1963, 1964, 1965; Sweeney 1968c, 1969), macroscopic organisms were collected at Station 31. Even though the organisms collected are typical of polluted environments, the fact that these sludgeworms (oligochaetes) were present is an indication of a significant improvement. A greater variety of specimens were observed at Stations 27 and 29. Differences in numbers of invertebrates collected in 1969 and 1970 could be explained,

in part, by the fact that the summer and fall collections were made somewhat later in 1970 than in 1969. Hence, some of the organisms such as the midgeflies (chironomidae) had matured and flown away by the time the October 1970 sampling was conducted. The decrease in organisms during 1970 between August and October also probably was due to the dredging of the bottom by the Corps.

The above explanations could not explain the decrease in the quantity of life at Station 34. In the first place, Station 34 was not dredged. Secondly, while there generally is a reduction in sludgeworm productivity in the fall, the 97 percent decrease in sludgeworms at Station 34 between August and October was far in excess of the "normal" fall decline. During this period, there was an increase in the chemical and biochemical oxygen demands, as well as the oil and iron content of the sediment. It was believed that these chemical changes were major contributing factors to the decrease in the oligochaetes.

Each of the students who participated in the research benefited from the experience. They each have demonstrated a deeper understanding of the techniques and problems concerning the generation and interpretation of limnological data.

downstream of the confluence of Cayuga and Buffalo Creeks, as well as Cazenovia Creek below Cazenovia Park. The bottom material in these regions has a high oxygen demand and also adds both toxic materials and nutrients to the waters that flow into the lower Buffalo River. Therefore, until this source of undesirable material is removed, the full benefits of the upstream reductions of waste discharges will not be realized.

... through the Buffalo River Improvement

RECOMMENDATIONS

IMMEDIATE ACTION IS NECESSARY TO SPEED-UP POLLUTION ABATEMENT MEASURES BY COMMUNITIES THAT DISCHARGE WASTES INTO THE TRIBUTARIES OF THE BUFFALO RIVER. If the municipalities involved do not make a greater effort to accomplish the above, all county, state and federal regulatory agencies involved should institute action to force the parties to comply. Until such time that corrective measures are put into practice, no further development that could result in an increase in pollution in the Buffalo River Basin should be permitted.

While the industries on the Buffalo River should be commended for reducing their discharges to the river, they should continue to promote practices to decrease the possibly detrimental effects of their wastes on the quality of the water, sediment and aquatic life. These corporations also should utilize all powers at their disposal to get the upstream polluters to comply with abatement codes. Until the latter is accomplished, the state of the river, which runs by their "back doors," will remain poor. Likewise, upon viewing the river, the general public erroneously will continue to accuse industry of being the major cause of these problems.

After pollution abatement measures are implemented upstream, consideration should be given to the feasibility of dredging the sediments

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