ERRATA

Page 1	Line 8	Add s to "Description"
Page 63	Table B-19	Taxa (5) -- "HYDROPSYCHIDAE" -- highly faded
Page 63	Table B-20	Taxa (11-15) -- "SIPHLONURIDAE, HEPTAGENIIDAE, SIALIS, HYDROPSYCHIDAE, HYDROPHILIDAE" -- highly faded
Page 70	Line 1	"DRIFT" -- faded in some copies
Page 78	Line 6	"(19.0 org/10 m^3)" -- highly faded
Page 78	Line 7	"(43.2 org/10 m^3)" -- highly faded
Page 188	Fig. F-1	Station SN 4 should be relocated 4 cm upriver
Page 207	Table H-1	Total No. Recovered -- "367" -- faded in some copies
Page 236	Line 16	Change paraistes to "parasites"
Page 249	Line 17	Change Water J. Soya to "Walter J. Soya"

ECOLOGICAL STUDIES OF THE SUSQUEHANNA RIVER IN THE VICINITY OF THE SUSQUEHANNA STEAM ELECTRIC STATION

Annual Report for 1976

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For

PENNSYLVANIA POWER AND LIGHT COMPANY

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INTRODUCTION

This is the sixth annual progress report on the ecological studies conducted as part of the investigative environmental monitoring program of the Susquehanna Steam Electric Station (Susquehanna SES). The objective of the ecological studies is to collect biological data to establish a baseline of the aquatic ecology of the Susquehanna River near the Susquehanna SES. Throughout 1976 water chemistry, macroinvertebrates, and larval and adult fishes were studied. Description of sampling procedures and results, including detailed tabulation of data, are presented in this report. The Pennsylvania Power and Light Company (PP&L) finances all the studies.

The nuclear-powered Susquehanna SES will be a 2,100 megawatt facility located on a 422.5-ha site in Salem Township, Luzerne County, approximately 8 km northeast of Berwick, Pennsylvania. The site is within the Ridge and Valley Section of the Appalachian Valley Province (Fenneman 1938). About 40% of the site is flat and the remainder is hilly rather than mountainous. Elevations range from 150 m above mean sea level on the flood plain to a maximum of 325 m near the northwest property line. Units 1 and 2 are presently scheduled to go on-line in 1980 and 1982, respectively.

In 1976 most studies were conducted near the proposed location of the intake and discharge structures of the Susquehanna SES. Upriver, the "Wyoming Region" of the northern anthracite coal field lies beneath or adjacent to the River. Acid mine drainages from this area, which enter from abandoned strip and shaft mines, degrade the water quality of the River at the site.

The slope of the River bed near the site is about 0.3 m/km. Maximum depth at any point across the River ranges from 1 to 5 m and the width varies from 100 to 480 m. During periods of low flow, which normally occur in late summer and early autumn, abandoned eel walls help maintain River pools, some of which are several kilometers long. In times of moderate to high flow the River level increases from 1 to 3 m, and its flow characteristics are similar to those of an open channel.

In addition to the aquatic studies, samples of River and well water and River silt were collected for determination of background radiation levels by Radiation Management Corporation, 3508 Market Street, Philadelphia, Pennsylvania. Thermoluminescent dosimeters, placed on the River bottom near the proposed location of the Station's discharge, were monitored quarterly.

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PHYSICOCHEMICAL ANALYSES

by

Theodore V. Jacobsen and Walter J. Soya

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ABSTRACT

In 1976 physicochemical data were collected in the Susquehanna River near the Susquehanna SES site. These baseline data have been collected since 1971 to evaluate the effects of the Susquehanna SES upon the water quality of the River.

River temperature ranged from -1.5 to 26.6 C and River level fluctuated between 148.56 and 153.16 m above msl. Flow was greatest (3,269 m^3/s) on 19 February and least (106 m^3/s) on 12 September. River velocity can be approximated with the equation $Y = 0.356X - 52.795$, where Y is velocity and X is River level.

On 22 June, after three days of heavy rainfall, the River transported a large sediment load (about 145,500 metric tons), 4% of which was iron, past the site. The total iron concentration (52.8 mg/l) was the highest recorded since 1972.

Statistical analysis of data from 1973 through 1976 showed that the water quality had improved at the site. There were significant trends in annual decreases of total iron ($P<0.01$), sulfate ($P<0.01$), specific conductance ($P<0.001$), and turbidity ($P<0.01$), and in annual increases of pH ($P<0.001$) and dissolved oxygen ($P<0.001$). The termination of mine pumping in 1972 and recent improvements in sewage treatment facilities are probable causes for this change. However, the River is not expected to meet the 1971 water quality standards of the Pennsylvania Department of Environmental Resources by 1983.

INTRODUCTION

This report presents physicochemical data collected from the Susquehanna River near the Susquehanna SES in 1976. The objective of the water chemistry program since 1971 has been to establish baseline values for evaluation of possible effects on the River from the construction and operation of the Susquehanna SES. Records of physicochemical data have been presented in previous annual reports from 1971 through 1975 (Ichthyological Associates 1972, 1973, and 1974; Smith and Soya 1976; and Jacobsen and Soya 1976).

The River near the Susquehanna SES site is polluted by coal mine drainages (Gale et al. 1976). This has occurred in the Susquehanna River Basin since the middle 1800's (Skelly and Loy 1973). It was not a major problem until 1961 when the Glen Alden Corporation began pumping mine water from its south Wilkes-Barre shaft into the Solomon's Creek tributary (Pennsylvania Department of Health 1963). In 1972, after Tropical Storm Agnes, pumping ceased, but pollution continues because mine effluents still enter the River by gravity flow through several seeps, bore holes, and creeks upriver from the site (Fig. A-1).

Raw sewage enters the River at West Nanticoke, Shickshinny, and Mocanaqua. In the Wilkes-Barre area sewage now undergoes primary treatment (personal communication, Stanley J. Lehman, Pennsylvania Department of Environmental Resources, 2 March 1977). These communities are expected to initiate or upgrade treatment of their sewage by 1983 (Pennsylvania Department of Environmental Resources 1976).

PROCEDURES

Throughout 1976 physicochemical data were collected at Ichthyological Associates Laboratory and the SSES-A sampling station (Fig. A-2). The Laboratory is located on the west River bank, 1,220 m east of the Susquehanna SES. SSES-A is 270 m downstream from the Laboratory about 40 m from the west River bank.

Physicochemical parameters and reference to methods of analyses are in Table A-1. In 1976 analytical methods for the determination of pH, sulfate, total iron, and turbidity were revised to comply with Environmental Protection Agency (EPA) approved methodology (EPA 1974). All analyses were conducted within the holding time interval recommended by the EPA.

At the Laboratory, River temperature and depth were recorded continuously on seven-day graphs. Sensors for both recorders were located on the River bottom about 20 m from the west bank. On 9 September the temperature sensor was replaced and located approximately 10 m downstream from the depth sensor and 10 m farther offshore. River temperature (C) was read directly from the graph, but River depth (ft) was converted to River level (m) above mean sea level (msl). Daily means of temperature and level were determined by averaging hourly values at 0100 through 2400 h from the continuous recordings. In addition, daily minimum and maximum values and their respective hours of occurrence were tabulated. When either a minimum or maximum value remained constant for several hours in a day only the first hour of occurrence was tabulated.

The daily River flow at the Laboratory was calculated with data provided by the U.S. Geological Survey from the Wilkes-Barre and Danville gaging stations.

At SSES-A the weekly sampling frequency was modified beginning in March to collect more data during periods of maximum biological and chemical change. Samples were collected semimonthly in March; semiweekly in April, May, and June; weekly in July, August, and September; and semimonthly in October, November, and December.

Air and water temperatures, pH (measured in the Laboratory after 30 July), Secchi disc, and River velocity were determined at SSES-A before collection of a 1-liter grab sample and a 300-ml dissolved oxygen sample. Total alkalinity, sulfate, specific conductance, total iron, residues, turbidity, and dissolved oxygen were determined in the Laboratory. Dissolved iron, and after 30 June, total iron analyses were performed by personnel from the PP&L Water Laboratory, Hazleton, Pennsylvania.

Turbidity was measured colorimetrically prior to 30 June, and nephelometrically for the remainder of the year. Colorimetric results were recorded in Jackson turbidity units (JTU) and nephelometric results in nephelometric turbidity units (NTU). The Jackson, nephelometric, and formazin (FTU) turbidity units are considered comparable by EPA (1974).

The 1976 physicochemical data at SSES-A were compared with those obtained at the site in previous years (1972-75). The monthly means of the parameters were plotted with a Hewlett-Packard 9871A printer. Those parameter values which increased or decreased were then statistically tested to determine if significant trends existed. Nonparametric statistics were used to: 1) determine if year to year changes had occurred, and, if so, 2) determine if a trend among years was present. Friedman's two-way analysis of variance test (S) was used in the first determination and Page's distribution free test (L) for ordered alternatives, in the second (Hollander and Wolfe 1973). The tests were based on monthly mean values, but only years with twelve monthly means (1973-76) were used.

Once each month, personnel from the PP&L Water Laboratory collected physicochemical data at the boat ramp located 90 m upriver from Ichthyological Associates Laboratory. A grab sample was collected by wading into the River on the ramp. Water temperature and dissolved oxygen were measured in the field; all other determinations were made at the PP&L Water Laboratory according to Standard Methods (APHA 1975).

Physicochemical data from five major mine drainages and treatment levels of the larger sewage effluents from the Lackawanna River to Berwick were provided by Lawrence A. Pawlush, Pennsylvania Department of Environmental Resources (PDER), Wilkes-Barre, Pennsylvania.

RESULTS AND DISCUSSION

In 1976 the daily mean River temperature ranged from -1.4 C on 16 January to 25.5 C on 28 June; it varied least (Standard Error = 0.04) in January, and most (SE = 0.80) in April (Table A-2). The extreme variability in April, when daily mean River temperature ranged from 7.0 to 18.3 C, was caused by unseasonably warm weather which occurred after the middle of the month. The minimum temperature of -1.5 C occurred for a 24-h period beginning at 1400 h on 15 January. The maximum temperature, 26.6 C, was recorded at 1500 h on 26 August. Daily water temperature ranges of 0.5 C or greater occurred in each month except February. These fluctuations in water temperature were usually greater than 1 C most days from June through September when maximum ranges of 2.7, 2.4, 2.2, and 2.3 C were recorded, respectively.

The minimum River level and the minimum daily mean River level, both 148.56 m above msl, occurred on 9 through 13 September and on 10 through 12 September, respectively (Table A-3). The maximum level (153.16 m above msl) and the maximum daily mean level (153.07 m above msl) were recorded on 19 February. Variability of the daily mean level was least in September and most in February,

Daily River flow past Ichthyological Associates Laboratory in 1976 was greatest (3,269 m^3/s) on 19 February and least (106 m^3/s) on 12 September (Table A-4). The maximum monthly flow (1,240 m^3/s) occurred in February and the minimum (143 m^3/s) in September. Variability was greatest (SE = 169.5) in February and least (SE = 5.9) in September.

Results of the physicochemical analyses of samples collected at SSES-A are presented in Tables A-5 through A-8. Minimum, maximum, and monthly mean values for each parameter are summarized in Table A-9.

The velocity of the River at SSES-A was measured 36 times in 1976. It ranged from 0.02 m/s on 8 September to 1.25 m/s on 26 February when the River level at the Laboratory was 148.59 m and 151.27 m above msl, respectively. Velocity and River level were closely correlated (r = 0.89); velocity (*Y*) can be estimated from River level (*X*) with the equation: $Y = 0.356X - 52.795$. This was derived from data collected during periods of low to moderately high River level. When high River level occurs the relationship becomes curvilinear based on a velocity of 3.1 m/s which was measured near SSES-A when the River level was 155.60 m above msl on 27 September 1975. It was observed that a velocity calculated from a River level greater than 151.35 m above msl was less than the actual velocity. This shortcoming, however, should not severely limit the practical use of the equation, because in 1976, the River level exceeded this elevation only 5% of the time.

A total of 45 parameters was analyzed each month from samples collected at the boat ramp by personnel from the PP&L Water Laboratory (Table A-10). As in previous years, the relatively high values of iron, sulfate, aluminum, manganese, and magnesium were indicative of mine drainage pollution. In 9 of the 12 monthly samples the concentration of total iron exceeded the 1.5 mg/l limit established for the River by the PDER (1971). Values of total manganese did not surpass the 1.0 mg/l limit of the PDER in any month. On all dates the River water was undersaturated with calcium carbonate as determined by the Langelier saturation index (APHA 1975). The potential for saturation was greatest (-1.1 pH units) in June and July and least (-2.4 pH units) in January.

Several extreme values were documented at SSES-A in 1976 after a heavy rainfall from 19 to 22 June caused the River level to increase 1.80 m during a 19-h period. The sediment load on the 22nd was unusually heavy as shown by values of Secchi disc (2 cm), turbidity (1600 JTU), and residues (total

1,490 mg/l; fixed total, 1,380 mg/l; nonfiltrable 601 mg/l; and fixed nonfiltrable, 565 mg/l) (Table A-9). Also, the total iron concentration (52.8 mg/l) was the maximum recorded at the site since sampling began in 1972. It was estimated that 145,500 metric tons of sediment, 4% of which was iron, was transported past the site on 22 June.

Frequently during 1976 values for total iron, sulfate, and specific conductance were notably less than those recorded in previous years. Total iron concentration in 14 of 53 samples was less than the 1.5 mg/l limit established for the River by the PDER (1971). Whereas, from 1972 through 1975 concentrations in only 6 of 369 samples were less than 1.5 mg/l. The maximum values for sulfate (87 mg/l) and specific conductance (346 µmhos/cm) were 33% and 25% less than the 1975 maxima, respectively. Both the annual mean and maximum values for sulfate and specific conductance decreased successively since 1972. These results indicated that possible long-term changes in River water quality had occurred.

From the time of initial sampling (1972 or 1973) through 1976 monthly means of total iron, sulfate, specific conductance, and turbidity usually decreased annually and those of dissolved oxygen and pH usually increased (Fig. A-3). Trends in the total iron and turbidity data were disrupted in 1976 due to the heavy iron and silt loads in the River on 22 June. Seasonal cycles are evident within the overall trends for specific conductance, sulfate, and dissolved oxygen. The pH data, however, did not exhibit seasonal fluctuations until 1974.

Using Friedman's test, significant changes were found in the annual results of turbidity ($S = 8.175$, $DF = 3$, $P<0.05$), dissolved oxygen ($S = 14.725$, $DF = 3$, $P<0.01$), pH ($S = 10.325$, $DF = 3$, $P<0.05$), specific conductance ($S = 10.600$, $DF = 3$, $P<0.05$), sulfate ($S = 8.125$, $DF - 3$, $P<0.05$), and total iron ($S = 9.700$, $DF = 3$, $P<0.05$) from 1973 through 1976. Page's test confirmed that significant annual trends existed in the data for each of these parameters: dissolved oxygen ($L = 337$, $P<0.001$) and pH ($L = 331.5$, $P<0.001$) increased while turbidity ($L = 326.5$, $P<0.01$), specific conductance ($L = 332$, $P<0.001$), sulfate ($L = 326.5$, $P<0.01$), and total iron ($L = 329$, $P<0.01$) decreased.

These trends show an overall improvement in the Susquehanna River water quality at the site from 1973 through 1976 even though the annual River flow was similar. Values associated with acid mine drainage (iron, sulfate, hydrogen ion concentration, and specific conductance) decreased substantially after mine pumping was terminated in 1972 (Ichthyological Associates 1972, 1973, and 1974; Smith and Soya 1976; and Jacobsen and Soya 1976). However, gravity flows of mine water continue to enter the River, from drainages that are controlled to some degree by the water table. Therefore, the improved River water quality may have partially resulted because less mine pollutants entered the River, particularly during periods of low River flow. The chemistry of acid mine drainage, including iron oxidation, has been explained in detail by Barnes and Romberger (1968) and its direct application to the River was studied intensely by Gale et al. (1976).

The decrease in mine pollution increased the water clarity (less turbidity) and the dissolved oxygen concentration. Turbidity decreased because less ferrous iron from the mines was oxidized into ferric hydroxide precipitate, much of which remains suspended in the water column to color the River brownish-orange in summer. Since less iron was oxidized, there was less demand on the amount of dissolved oxygen in the River. Decreases in the demand for dissolved oxygen may have also occurred because the amount of untreated sewage that enters the River from the Wilkes-Barre area decreased since 1972.

Although the water quality of the River at the site improved throughout the past five years, it is not expected to meet the water quality standards of the PDER by 1983 (PDER 1976). Gravity flows of mine water continue to enter the River in the study area (Table A-11). These flows will pollute the River until either funds are made available for abatement programs or contaminants are leached from the abandoned mine deposits.

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Table A-1. Physicochemical parameters and methods of analyses, 1976.

Parameter	Method	Reference
River level	Seven-day continuous recordings from an ACCO Bristol, Model No. G500-15 bubbler-type water level gauge.	ACCO (1971)
River velocity	Direct reading current meter, Gurley (Price), Model No. 665, suspended from an anchored boat to 0.6 depth. Current was a mean of readings at 5-s intervals for 2 min.	Teledyne Gurley (1973)
River flow	River flow = 0.222 (a-b) + b, where a and b are mean daily River flows at Danville and Wilkes-Barre, respectively. Data provided by U.S. Geological Survey.	White (1973)
Air temperature	Calibrated, mercury thermometer.	EPA (1974)
Water temperature	Seven-day continuous recordings from a calibrated, Leeds and Northrup Speedomax Thermistor-type, Model R temperature recorder.	EPA (1974)
	Calibrated, mercury thermometer.	EPA (1974)
Dissolved oxygen	Modified Winkler full-bottle technique, proprietory reagents.	EPA (1974)
pH	Glass electrode.	EPA (1974)
Total alkalinity	Potentiometric titration.	EPA (1974)
Specific conductance	Self-contained conductance meter, Hydrolab, Model No. TC-2 at 25 C.	EPA (1974)
Sulfate	Turbidimetric, Hach Model DR-EL Portable Water Engineer's Laboratory (Jan-Jun).	Hach (1969)
	Turbidimetric (Jul-Dec).	EPA (1974)
Total iron	Phenanthroline (Jan-Jun).	APHA (1975)
	Atomic absorption spectrophotometric determination of soluble iron (Jul-Dec).	EPA (1974)
Dissolved iron	Atomic absorption spectrophotometric determination of dissolved iron.	EPA (1974)
Total residue	Evaporation at 105 C.	EPA (1974)
Fixed total residue	Ignition of total residue at 550 C.	APHA (1975)
Nonfiltrable residue	Suspended solids analysis by membrane filter technique (matched-weight filters).	Millipore (1973)
Fixed nonfiltrable residue	Ignition of nonfiltrable residue at 550 C.	APHA (1975)
Turbidity	Colorimetric, Hach Model DR-EL Portable Water Engineer's Laboratory (Jan-Jun).	Hach (1969)
	Nephelometric (Jul-Dec).	EPA (1974)
Secchi disc depth	Limit of visibility	Welch (1948)

Table A-2. Daily minimum, maximum, and mean temperature (C) of the Susquehanna River at Ichthyological Associates Laboratory, 1976.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN						FEB					
1	-1.1	0100	-1.1	0100	-1.1	1	-0.7	0100	-0.7	0100	-0.7
2	-1.1	0100	-1.1	0100	-1.1	2	-0.6	0100	-0.6	0100	-0.6
3	-1.1	0100	-1.1	0100	-1.1	3	-0.6	0100	-0.6	0100	-0.6
4	-1.1	0100	-1.1	0100	-1.1	4	-0.6	0100	-0.6	0100	-0.6
5	-1.1	0100	-1.1	0100	-1.1	5	-0.6	0100	-0.6	0100	-0.6
6	-1.1	0100	-1.1	0100	-1.1	6	-0.6	0100	-0.6	0100	-0.6
7	-1.1	0100	-1.1	0100	-1.1	7	-0.6	0100	-0.4	0800	-0.5
8	-1.4	0400	-1.1	0100	-1.3	8	-0.4	0100	-0.4	0100	-0.4
9	-1.3	0100	-1.3	0100	-1.3	9	-0.4	0100	-0.4	0100	-0.4
10	-1.3	0100	-1.2	0200	-1.2	10	-0.3	0100	-0.3	0100	-0.3
11	-1.2	0100	-1.2	0100	-1.2	11	-0.3	0100	-0.2	1200	-0.3
12	-1.2	0100	-1.2	0100	-1.2	12	-0.3	1200	-0.2	0100	-0.3
13	-1.2	0100	-1.2	0100	-1.2	13	-0.3	0100	-0.2	1600	-0.3
14	-1.2	0100	-1.2	0100	-1.2	14	-0.2	0100	-0.2	0100	-0.2
15	-1.5	1400	-1.2	0100	-1.3	15	-0.2	0100	-0.2	0100	-0.2
16	-1.5	0100	-1.3	2000	-1.4	16	-0.2	2000	-0.1	0100	-0.2
17	-1.3	0100	-1.3	0100	-1.3	17	-0.1	0100	0.0	1700	0.1
18	-1.3	0100	-1.3	0100	-1.3	18	0.0	0100	0.0	0100	0.0
19	-1.3	0100	-1.2	1400	-1.3	19	0.0	0100	0.1	1200	0.1
20	-1.2	0100	-1.2	0100	-1.2	20	0.1	0100	0.2	1600	0.1
21	-1.2	0100	-1.1	1400	-1.1	21	0.2	0100	0.2	0100	0.2
22	-1.2	1600	-1.1	0100	-1.1	22	0.2	0100	0.3	2300	0.2
23	-1.2	0100	-0.7	1600	-0.7	23	0.3	0100	0.6	2400	0.5
24	-0.7	0100	-0.7	0100	-0.7	24	0.6	0100	0.7	0600	0.7
25	-0.7	0100	-0.7	0100	-0.7	25	0.7	0100	0.8	0900	0.8
26	-0.7	0100	-0.7	0100	-0.7	26	0.9	0100	0.9	0100	0.9
27	-0.7	0100	-0.7	0100	-0.7	27	0.9	0100	1.2	2400	1.1
28	-0.7	0100	-0.7	0100	-0.7	28	1.2	0100	1.4	1500	1.3
29	-0.7	0100	-0.7	0100	-0.7	29	1.4	0100	1.4	0100	1.4
30	-0.7	0100	-0.7	0100	-0.7						
31	-0.7	0100	-0.7	0100	-0.7						
MEAN					-1.1	MEAN					0.0
SE					0.04	SE					0.11

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR						APR					
1	1.4	0100	2.1	1600	1.8	1	7.1	0100	7.2	1200	7.2
2	2.1	0100	2.4	2400	2.2	2	7.0	1600	7.2	0100	7.1
3	2.4	0100	2.7	1800	2.6	3	7.0	0100	7.0	0100	7.0
4	2.7	0100	2.7	0100	2.7	4	7.0	0100	7.0	0100	7.0
5	2.7	0100	2.9	1400	2.8	5	7.0	0100	7.0	0100	7.0
6	2.9	0100	2.9	0100	2.9	6	7.0	0100	7.0	0100	7.0
7	2.9	0100	3.2	2400	3.0	7	7.0	0100	7.0	0100	7.0
8	3.3	0100	3.3	0100	3.3	8	7.0	0100	7.1	0200	7.1
9	3.4	0100	3.4	0100	3.4	9	7.1	0100	7.1	0100	7.1
10	3.4	0100	3.4	0100	3.4	10	7.1	0100	7.1	0100	7.1
11	3.3	0100	3.3	0100	3.3	11	--	--	--	--	--
12	3.2	2100	3.3	0100	3.3	12	--	--	--	--	--
13	3.2	0100	3.2	0100	3.2	13	7.2	0900	8.0	1600	7.8
14	3.2	0100	3.2	0100	3.2	14	7.3	0900	9.2	1600	8.4
15	3.2	0100	3.2	0100	3.2	15	8.4	0100	10.8	2100	9.8
16	3.1	2400	3.2	0100	3.2	16	10.8	0100	11.8	1800	11.3
17	3.1	0100	3.1	0100	3.1	17	11.8	0100	12.8	2000	12.2
18	3.1	0100	3.1	0100	3.1	18	12.8	0100	14.8	2000	13.7
19	3.1	0100	3.1	0100	3.1	19	14.8	0100	15.6	1200	15.0
20	3.1	0100	3.1	0100	3.1	20	--	--	--	--	--
21	3.1	0100	3.7	2400	3.3	21	15.8	0800	18.2	2300	17.6
22	3.7	0100	4.0	1600	3.9	22	18.2	0100	18.4	1600	18.3
23	4.0	0100	4.1	1500	4.0	23	18.1	1100	18.5	1700	18.3
24	4.1	0100	4.7	1600	4.4	24	17.7	1300	18.3	0100	17.9
25	4.7	0100	4.8	1700	4.7	25	15.8	2200	17.7	0100	16.9
26	4.8	0100	4.9	1600	4.8	26	13.8	2400	15.8	0100	15.0
27	4.9	0100	5.7	2400	5.1	27	11.7	2300	13.8	0100	12.5
28	5.7	0100	5.9	2000	5.8	28	10.8	1700	11.7	0100	11.1
29	4.9	1000	6.1	2400	5.6	29	9.9	1700	10.7	0100	10.3
30	6.1	0100	6.9	2400	6.5	30	9.9	0100	10.1	2000	10.0
31	6.9	0100	7.1	0900	7.1						
MEAN					3.7	MEAN					11.0
SE					0.22	SE					0.80

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY						JUN					
1	10.1	0100	10.2	1500	10.1	1	17.0	0100	17.3	1100	17.0
2	10.2	0100	11.0	2400	10.6	2	--	--	--	--	--
3	11.0	0100	11.9	2400	11.5	3	17.3	0900	18.4	1900	18.1
4	11.8	1100	11.9	0100	11.8	4	18.2	0100	19.9	1500	19.1
5	11.6	1000	12.0	1800	11.8	5	18.9	0100	20.2	1500	19.6
6	12.0	0100	13.1	2400	12.5	6	18.9	2400	20.0	0100	19.5
7	13.1	0100	13.9	1900	13.4	7	18.1	0700	19.6	1600	18.9
8	13.9	0100	14.2	1900	14.0	8	19.1	0100	20.7	1500	19.9
9	14.0	1000	14.2	1500	14.1	9	20.1	0100	21.9	1600	21.1
10	14.0	0900	14.7	2000	14.2	10	21.8	0100	23.0	1600	22.4
11	14.7	0100	15.0	1700	14.9	11	22.3	0600	23.5	1500	22.8
12	14.0	1200	15.0	0100	14.8	12	22.2	0500	23.7	1700	23.0
13	13.4	0100	15.0	2000	14.3	13	21.6	2400	22.8	0100	22.2
14	14.5	1000	15.1	2400	14.9	14	20.9	2400	21.5	0100	21.1
15	15.1	0100	16.4	1800	15.7	15	20.8	0300	22.8	1400	21.9
16	16.4	0100	17.3	1900	16.6	16	22.5	0300	24.5	1400	23.8
17	16.7	0100	17.3	1600	17.0	17	23.9	0600	25.1	1500	24.5
18	17.1	0400	17.3	0100	17.2	18	23.8	0600	25.2	1500	24.6
19	15.2	2400	17.3	0100	16.5	19	24.9	0800	25.5	1700	25.1
20	14.1	1600	15.2	0100	14.6	20	24.7	2400	25.6	1700	25.1
21	13.8	1200	14.2	0100	13.9	21	23.0	2400	24.7	0100	24.0
22	13.5	1700	13.9	0100	13.7	22	20.1	1100	22.8	0100	20.7
23	13.4	0800	13.5	0100	13.5	23	20.5	0100	22.0	2400	21.3
24	13.1	1200	13.7	2300	13.4	24	22.0	0100	23.5	2300	22.8
25	12.4	2400	13.7	0100	13.0	25	23.6	0100	24.6	1800	24.1
26	12.1	0700	12.3	0100	12.2	26	24.1	0700	25.2	1700	24.8
27	12.1	0100	13.3	1800	12.7	27	24.4	0700	25.7	1400	25.0
28	13.3	0100	14.9	1400	14.3	28	24.8	0300	26.2	1400	25.5
29	14.9	0100	15.9	1400	15.5	29	24.9	0600	25.9	1400	25.4
30	15.8	0100	16.7	1700	16.3	30	23.7	2400	25.2	0100	24.7
31	16.3	0600	17.2	1700	16.8						
MEAN					14.1	MEAN					22.3
SE					0.34	SE					0.46

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL						AUG					
1	22.9	2400	23.7	1400	23.3	1	23.1	2400	24.7	0100	24.1
2	22.2	0600	23.2	1500	22.7	2	21.8	0800	22.8	1300	22.3
3	22.0	0700	22.4	1400	22.3	3	21.1	0800	22.8	1600	22.0
4	21.8	0700	22.2	1400	21.9	4	21.2	0800	22.9	1500	22.2
5	21.3	0800	22.5	1900	21.9	5	21.7	0700	23.5	1500	22.7
6	22.0	0400	23.8	1600	22.9	6	22.7	0900	23.4	1500	22.9
7	23.1	0700	23.9	1400	23.3	7	22.0	2400	22.7	0100	22.3
8	22.5	2400	23.2	1200	23.0	8	21.4	2400	22.0	0100	21.7
9	22.0	0700	23.8	1500	22.8	9	20.1	2400	21.4	0100	20.9
10	22.7	0700	24.5	1400	23.5	10	20.0	0200	20.8	1700	20.2
11	23.2	0700	23.9	1400	23.5	11	19.6	0900	20.4	1700	20.1
12	22.9	0700	24.0	1200	23.4	12	20.5	0100	21.8	1800	21.2
13	21.3	1900	22.9	0100	22.0	13	21.5	0100	22.8	1500	22.1
14	21.0	2200	21.8	1300	21.4	14	22.2	0100	23.6	1500	22.9
15	20.1	1100	20.6	1600	20.3	15	23.0	0400	23.8	1500	23.3
16	20.2	0100	20.8	1600	20.5	16	22.3	2400	23.2	1300	22.9
17	20.2	0600	21.4	1500	20.9	17	21.7	0700	22.6	1500	22.2
18	20.1	0600	22.0	1800	21.1	18	21.3	0700	22.4	1400	22.0
19	21.3	0400	23.0	1900	22.1	19	21.7	0600	23.0	1500	22.4
20	22.2	0600	24.1	1500	23.3	20	21.8	0900	23.2	1500	22.9
21	23.2	2400	23.7	1300	23.5	21	22.3	0800	24.1	1800	23.4
22	22.8	0600	24.1	1400	23.5	22	23.4	0800	25.1	1500	24.3
23	22.7	2400	23.4	0100	23.0	23	24.2	0800	25.9	1500	25.1
24	22.2	0800	24.0	1400	23.0	24	24.2	0700	26.3	1400	25.2
25	22.6	0700	24.4	1500	23.4	25	24.2	0700	26.0	1500	25.0
26	22.1	0700	24.3	1400	23.3	26	24.4	0800	26.6	1500	25.4
27	22.3	0700	23.4	1700	23.0	27	--	--	--	--	--
28	22.3	0700	24.7	1300	23.6	28	--	--	--	--	--
29	23.2	0600	24.8	1400	23.9	29	--	--	--	--	--
30	23.8	0700	24.7	1500	24.2	30	--	--	--	--	--
31	23.5	0600	24.9	1400	24.3	31	--	--	--	--	--
MEAN					22.7	MEAN					22.8
SE					0.19	SE					0.28

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP					
1	--	--	--	--	--
2	--	--	--	--	--
3	--	--	--	--	--
4	--	--	--	--	--
5	--	--	--	--	--
6	--	--	--	--	--
7	--	--	--	--	--
8	--	--	--	--	--
9	21.0	1000	22.1	1400	21.7
10	20.7	2400	21.8	1600	21.2
11	19.2	2400	21.0	1500	20.2
12	18.6	0800	20.8	1500	19.5
13	18.9	0700	21.2	1600	20.2
14	19.9	0700	21.8	1400	20.8
15	20.9	0700	21.8	1400	21.3
16	20.4	2100	21.2	0100	20.8
17	20.1	0600	21.0	1300	20.4
18	20.0	0600	20.7	1700	20.3
19	19.9	0800	21.2	1500	20.5
20	20.0	0700	20.5	0100	20.2
21	19.8	0800	20.5	1500	20.0
22	18.0	2400	19.4	1400	19.0
23	17.1	0700	18.4	1500	17.8
24	17.2	0800	18.7	1500	17.9
25	16.7	0900	18.4	1500	17.4
26	16.5	1100	17.2	0100	16.8
27	16.4	2400	16.9	1400	16.7
28	16.0	0700	16.9	1400	16.3
29	15.2	0800	16.2	1400	15.7
30	14.5	2400	15.2	0100	14.9
MEAN					19.1
SE					0.43

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
OCT					
1	14.1	0900	14.6	1600	14.4
2	14.4	0100	14.9	1600	14.7
3	14.8	0100	15.6	1600	15.1
4	15.1	0600	16.2	1400	15.7
5	15.3	0700	16.1	1600	15.8
6	15.8	0400	16.8	1500	16.3
7	16.4	0600	17.5	1500	16.9
8	16.9	0800	17.2	1600	17.1
9	13.9	2200	17.0	0100	15.6
10	11.3	2400	13.7	0100	12.2
11	10.8	2300	11.3	0100	11.0
12	10.1	1000	10.7	0100	10.5
13	10.0	0900	10.8	2400	10.4
14	10.4	2000	10.8	0100	10.6
15	10.2	0800	10.9	1700	10.6
16	10.5	1000	11.1	1500	10.9
17	10.4	2400	11.0	0100	10.8
18	9.8	2400	10.3	0100	10.0
19	9.0	1000	9.8	0100	9.3
20	8.9	0800	9.0	0100	8.9
21	9.0	0100	9.3	1500	9.2
22	8.1	2200	9.2	0100	8.5
23	7.7	0800	8.1	0100	7.8
24	7.6	0900	7.8	0100	7.7
25	7.6	0100	7.8	2300	7.7
26	7.7	1100	7.8	0100	7.8
27	6.8	2300	7.7	0100	7.0
28	6.2	0900	6.8	0100	6.4
29	5.8	0900	6.2	0100	6.0
30	5.7	0900	5.9	0100	5.8
31	5.9	0100	6.6	2400	6.2
MEAN					10.9
SE					0.64

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
NOV					
1	6.3	2300	6.6	0100	6.5
2	5.9	0700	6.2	0100	6.0
3	6.0	0900	6.1	0100	6.0
4	5.9	0800	6.3	1400	6.1
5	5.8	1400	6.2	0100	6.0
6	5.6	0800	5.9	0100	5.7
7	5.8	0100	5.8	0100	5.8
8	5.1	2300	5.9	0100	5.6
9	4.3	2000	5.1	0100	4.6
10	4.0	0900	4.2	0100	4.1
11	4.0	0700	4.2	1600	4.1
12	3.6	0800	4.1	0100	3.9
13	3.4	2200	3.7	0100	3.6
14	3.2	2400	3.3	0100	3.3
15	3.1	0900	3.2	0100	3.2
16	3.1	0100	3.1	0100	3.1
17	3.0	0300	3.1	0100	3.0
18	2.9	0800	3.0	0100	3.0
19	2.9	0100	3.6	1400	3.3
20	3.6	0100	3.9	1500	3.8
21	3.8	0700	4.1	1300	4.0
22	3.4	2100	3.9	0100	3.7
23	3.0	2400	3.3	0100	3.2
24	2.9	0700	3.1	0100	3.0
25	2.8	0900	2.9	0100	2.8
26	2.4	0800	3.1	1700	2.8
27	3.0	0100	3.8	2100	3.4
28	3.8	0100	4.9	1700	4.4
29	4.2	2400	4.9	0100	4.8
30	2.1	2400	4.1	0100	3.1
MEAN					4.2
SE					0.22

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
DEC					
1	1.7	1000	2.1	0100	1.9
2	1.1	2300	1.8	0100	1.7
3	0.7	2200	0.8	0100	0.8
4	0.7	0100	0.7	0100	0.7
5	0.7	0100	1.0	1400	0.8
6	0.8	0100	1.2	1400	1.0
7	1.1	0100	1.7	1600	1.4
8	0.7	0800	1.7	0100	0.8
9	0.7	0100	0.7	0100	0.7
10	0.7	0100	0.7	0100	0.7
11	0.7	0100	0.9	1300	0.8
12	0.9	0100	1.1	2200	1.0
13	0.8	2000	1.2	0100	1.0
14	0.8	0100	0.8	0100	0.8
15	0.7	1000	0.8	0100	0.7
16	0.8	0100	0.8	0100	0.8
17	0.3	1100	0.9	0800	0.5
18	0.3	0100	0.7	2100	0.5
19	0.5	0400	0.7	0100	0.6
20	0.6	0100	1.0	1300	1.0
21	0.6	1900	1.0	0100	0.9
22	0.3	2300	0.6	0100	0.5
23	0.3	0100	0.4	1000	0.3
24	0.3	0100	0.8	1600	0.6
25	0.7	0100	0.7	0100	0.7
26	0.7	0100	0.9	1800	0.8
27	0.7	1000	0.8	0100	0.7
28	0.7	0100	0.7	0100	0.7
29	0.7	0100	0.8	1300	0.7
30	0.7	0100	0.8	1200	0.8
31	0.6	0800	0.8	1300	0.7
MEAN					0.8
SE					0.06

Table A-3. Daily minimum, maximum, and mean level (m above msl) of the Susquehanna River at Ichthyological Associates Laboratory, 1976.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN						FEB					
1	149.53	2400	149.60	0100	149.57	1	150.36	1600	150.57	0100	150.42
2	149.47	1200	149.53	0100	149.50	2	150.36	0100	150.48	2200	150.39
3	149.41	1900	149.47	0100	149.44	3	150.02	2400	150.48	0100	150.27
4	149.35	2000	149.44	0900	149.41	4	149.84	1500	150.02	0100	149.90
5	149.32	0100	149.38	0900	149.32	5	149.87	1200	149.90	0100	149.87
6	148.99	1600	149.60	0100	149.14	6	149.84	1600	149.87	0100	149.87
7	148.96	1600	149.11	0100	149.05	7	149.66	2100	149.87	0600	149.87
8	148.99	0400	149.02	0100	148.99	8	149.63	2200	149.75	0700	149.69
9	149.02	0100	149.11	0900	149.05	9	149.60	1100	149.63	0100	149.60
10	148.89	2000	149.11	0400	148.99	10	149.50	1700	149.60	0100	149.57
11	148.83	2300	148.93	0300	148.89	11	149.53	0100	149.53	0100	149.53
12	148.80	0200	148.96	2400	148.83	12	149.50	0300	149.66	2400	149.57
13	148.89	2100	148.99	0300	148.96	13	149.69	0100	149.96	1500	149.87
14	148.93	0100	149.14	1200	149.08	14	149.90	0100	149.90	0100	149.90
15	149.14	0100	149.26	1100	149.20	15	149.90	0100	149.99	1600	149.96
16	149.14	1800	149.23	0700	149.20	16	149.84	1300	149.93	0100	149.87
17	149.14	0100	149.26	1000	149.23	17	149.96	0100	151.82	0100	150.69
18	149.11	1800	149.44	0400	149.20	18	151.91	0100	153.10	2300	152.64
19	149.08	1900	149.17	0700	149.14	19	153.01	1800	153.16	0400	153.07
20	148.99	1400	149.11	0100	149.02	20	152.83	2400	153.04	0800	152.98
21	148.96	0700	148.99	0100	148.99	21	152.22	2400	152.80	0100	152.55
22	148.99	0100	149.11	2300	149.20	22	151.91	1800	152.19	0100	152.03
23	148.96	1700	149.14	0400	149.05	23	151.97	0100	152.37	2400	152.19
24	148.89	1800	148.99	0900	148.96	24	151.85	2400	152.37	0100	152.13
25	148.83	1400	148.89	0100	148.86	25	151.42	2400	151.82	0100	151.61
26	148.83	0100	149.50	2400	149.05	26	151.15	2300	151.42	0100	151.30
27	149.57	0100	152.13	2400	150.69	27	151.00	2100	151.12	0100	151.09
28	151.97	2400	152.22	0400	152.16	28	150.97	0300	151.00	0100	151.00
29	151.36	2400	151.94	0100	151.58	29	151.00	0100	151.03	0300	151.03
30	151.00	2400	151.33	0100	151.21						
31	150.60	2400	151.00	0100	150.75						
MEAN					149.47	MEAN					150.77
SE					0.153	SE					0.214

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR						APR					
1	150.78	2400	150.97	2400	150.91	1	149.81	0100	150.27	2400	149.96
2	150.78	0100	150.82	1500	150.82	2	150.30	0100	150.91	2300	150.66
3	150.82	0100	151.30	2400	150.94	3	150.78	1700	150.91	0100	150.85
4	151.36	0100	152.10	2100	151.82	4	150.60	2300	150.78	0100	150.72
5	151.85	1500	152.03	0100	151.91	5	150.30	2400	150.60	0100	150.45
6	151.58	2200	151.85	0100	151.73	6	150.08	2400	150.30	0100	150.17
7	151.33	2300	151.55	0100	151.46	7	149.90	2100	150.05	0100	149.96
8	151.06	2400	151.30	0100	151.18	8	149.75	2200	149.90	0100	149.81
9	150.75	2400	151.06	0100	150.91	9	149.63	2000	149.75	0100	149.69
10	150.45	2400	150.75	0100	150.60	10	149.53	2400	149.63	0100	149.60
11	150.30	2400	150.45	0100	150.36	11	149.44	2100	149.53	0100	149.50
12	150.21	2300	150.30	0100	150.27	12	149.38	1800	148.44	0100	149.41
13	150.11	2200	150.21	0100	150.17	13	149.32	2200	149.38	0100	149.35
14	149.96	2100	150.11	0100	150.02	14	149.29	1800	149.32	0100	149.32
15	149.90	1800	149.96	0100	149.93	15	149.23	1500	149.29	0100	149.26
16	149.84	2400	149.90	0100	149.87	16	149.14	2300	149.23	0100	149.20
17	149.75	2200	149.84	0100	149.81	17	149.11	1400	149.14	0100	149.14
18	149.60	2000	149.75	0100	149.66	18	149.11	0100	149.87	2400	149.29
19	149.53	1500	149.60	0100	149.57	19	149.93	0100	150.17	1100	150.11
20	149.53	0100	149.57	1900	149.53	20	--	--	--	--	--
21	149.60	0100	149.84	2200	149.69	21	149.50	2100	149.57	0800	149.53
22	149.84	0100	150.05	2400	149.93	22	149.38	2100	149.47	0100	149.44
23	150.05	2400	150.33	2100	150.21	23	149.29	2100	149.38	0100	149.32
24	150.21	2200	150.30	0100	150.27	24	149.20	1800	149.29	0100	149.23
25	150.02	2300	150.21	0100	150.11	25	149.17	1100	149.20	0100	149.20
26	149.87	2100	150.02	0100	149.93	26	149.23	0100	149.38	2300	149.29
27	149.81	1200	149.87	0100	149.84	27	149.38	0100	150.14	2400	149.72
28	149.81	0100	149.81	0100	149.81	28	150.17	0100	150.33	1000	150.30
29	149.84	0100	149.93	2100	149.90	29	150.11	2400	150.30	0100	150.21
30	149.93	0100	149.96	0300	149.96	30	150.08	0700	150.11	0100	150.08
31	149.81	2400	149.93	0100	149.87						
MEAN					150.35	MEAN					149.75
SE					0.124	SE					0.095

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY					
1	150.02	1300	150.08	0100	150.05
2	149.90	1800	150.02	0100	149.96
3	149.87	0400	149.99	2100	149.93
4	149.99	0100	150.02	0500	150.02
5	149.90	1800	149.96	0100	149.93
6	149.87	1600	149.90	0100	149.90
7	149.69	2200	149.87	0100	149.75
8	149.57	1700	149.69	0100	149.60
9	149.47	2200	149.57	0100	149.50
10	149.44	1500	149.47	0100	149.47
11	149.35	1900	149.44	0100	149.38
12	149.29	1500	149.35	0100	149.32
13	149.29	0100	149.47	2200	149.35
14	149.47	0100	149.53	1300	149.50
15	149.41	2200	149.53	0100	149.50
16	149.29	2200	149.41	0100	149.35
17	149.32	0100	149.32	0100	149.32
18	149.32	0100	149.96	1800	149.66
19	149.75	1600	149.90	0100	149.81
20	149.75	0100	149.96	1200	149.90
21	149.93	0100	150.39	2400	150.11
22	150.39	0100	150.48	0900	150.48
23	150.30	2400	150.48	0100	150.42
24	150.11	2000	150.30	0100	150.21
25	149.90	2200	150.08	0100	149.99
26	149.72	2200	149.90	0100	149.81
27	149.60	2000	149.72	0100	149.66
28	149.53	2300	149.60	0100	149.57
29	149.47	2000	149.53	0100	149.50
30	149.41	2300	149.47	0100	149.44
31	149.32	1800	149.41	0100	149.35
MEAN					149.73
SE					0.058

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUN					
1	149.29	0100	149.29	0100	149.29
2	--	--	--	--	--
3	149.35	0900	149.38	0400	149.35
4	149.38	0100	149.41	0100	149.38
5	149.23	2400	149.35	0100	149.32
6	149.17	1100	149.23	2100	149.20
7	149.17	0100	149.32	0100	149.23
8	149.26	1600	149.32	1100	149.29
9	149.32	0100	149.60	0100	149.53
10	149.50	2400	149.57	2400	149.57
11	149.47	0100	149.26	0100	149.38
12	149.11	2400	149.26	0100	149.17
13	149.02	1900	149.11	0100	149.05
14	148.99	0500	149.02	0100	148.99
15	148.99	0100	148.99	0100	148.99
16	148.96	2400	148.99	1700	148.99
17	149.96	0100	149.02	2400	148.99
18	148.99	0400	149.17	2400	149.05
19	149.20	0100	149.26	0700	149.23
20	149.17	1100	149.23	2400	149.20
21	149.23	0100	151.00	2400	149.99
22	150.50	2400	151.05	0200	150.82
23	150.05	2400	150.50	0100	150.24
24	149.69	2200	149.99	0100	149.84
25	149.47	2300	149.69	0100	149.57
26	149.41	0900	149.47	0100	149.41
27	149.38	2400	149.44	0100	149.44
28	149.29	1200	149.38	0100	149.32
29	149.26	1400	149.35	0200	149.29
30	149.26	0100	149.53	2200	149.32
MEAN					149.39
SE					0.074

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL					
1	149.50	0500	149.69	2100	149.60
2	149.69	0100	149.87	1200	149.81
3	149.75	0100	149.84	0800	149.78
4	149.53	2400	149.87	0100	149.66
5	149.41	1400	149.53	0100	149.44
6	149.29	2000	149.41	0100	149.35
7	149.20	1900	149.29	0100	149.23
8	149.11	2100	149.20	0100	149.14
9	149.02	2300	149.11	0100	149.08
10	148.99	1100	149.02	0100	148.99
11	148.99	0100	149.08	1300	149.05
12	149.08	0100	149.11	0700	149.08
13	149.08	0100	149.96	2000	149.44
14	149.66	2300	149.90	0100	149.75
15	149.60	2200	149.66	0100	149.63
16	149.44	2200	149.60	0100	149.53
17	149.29	2300	149.44	0100	149.35
18	149.20	1800	149.29	0100	149.23
19	149.14	2300	149.17	0100	149.17
20	149.11	1200	149.14	0100	149.11
21	148.99	2200	149.08	0100	149.05
22	148.89	1900	148.99	0100	148.93
23	148.83	0700	148.86	0100	148.83
24	148.83	0600	148.86	0100	148.83
25	148.80	1000	148.83	0100	148.80
26	148.74	1900	148.80	0100	148.77
27	148.68	1700	148.74	0100	148.71
28	148.65	1600	148.68	0100	148.68
29	148.65	0100	148.71	2100	148.65
30	148.71	0100	148.77	0900	148.74
31	148.71	0100	148.99	2400	148.83
MEAN					149.17
SE					0.064

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
AUG					
1	148.99	0100	149.20	0900	149.17
2	148.96	2300	149.14	0100	149.05
3	148.96	0100	149.20	1300	149.14
4	148.99	2200	149.17	0100	149.08
5	148.86	1800	148.99	0100	148.93
6	148.74	2300	148.86	0100	148.80
7	148.74	0100	148.74	0100	148.74
8	148.74	0100	149.23	2300	148.93
9	149.26	0100	150.02	2200	149.57
10	149.90	1900	150.02	0100	149.96
11	149.69	2400	149.90	0100	149.81
12	149.47	2300	149.69	0100	149.60
13	149.29	2400	149.47	0100	149.38
14	149.20	1600	149.29	0100	149.23
15	149.20	0100	149.32	2100	149.23
16	149.29	1200	149.32	0100	149.29
17	149.32	0100	149.44	1900	149.38
18	149.38	2200	149.47	0100	149.44
19	149.20	2200	149.38	0100	149.29
20	149.02	2200	149.17	0100	149.11
21	148.89	2300	149.02	0100	148.89
22	148.83	1800	148.89	0100	148.86
23	148.80	0800	148.83	0100	148.80
24	148.74	1900	148.77	0100	148.77
25	148.68	1200	148.71	0100	148.68
26	148.62	1600	148.68	0100	148.65
27	148.59	1400	148.65	0100	148.62
28	148.59	0100	148.77	1900	148.71
29	148.71	0700	148.77	2300	148.77
30	148.77	0100	148.96	1300	148.89
31	148.83	1300	148.93	0100	148.86
MEAN					149.08
SE					0.063

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP						OCT					
1	148.83	0100	148.93	1700	148.89	1	148.96	1700	149.02	0100	148.99
2	148.83	1900	148.93	0100	148.89	2	148.83	2100	148.96	0100	148.89
3	148.71	1900	148.83	0100	148.77	3	148.80	2200	148.83	0100	148.83
4	148.65	1500	148.68	0100	148.68	4	148.77	1100	148.80	0100	148.77
5	148.65	0100	148.68	1600	148.65	5	148.71	0900	148.74	0100	148.71
6	148.65	1900	148.68	0100	148.68	6	148.68	0100	148.68	0100	148.68
7	148.65	0100	148.65	0100	148.65	7	148.62	1600	148.65	0100	148.65
8	148.59	2200	148.62	0100	148.62	8	148.62	0100	148.65	1300	148.65
9	148.56	1300	148.59	0100	148.59	9	148.65	0100	151.39	2400	149.60
10	148.56	0100	148.59	1700	148.56	10	151.55	0100	152.55	2400	152.19
11	148.56	0400	148.59	0100	148.56	11	152.00	2400	152.67	0700	152.46
12	148.56	0100	148.56	0100	148.56	12	151.15	2400	151.94	0100	151.52
13	148.56	0100	148.62	1700	148.59	13	150.57	2300	151.12	0100	150.82
14	148.62	0100	148.68	1500	148.65	14	150.27	2400	151.54	0100	150.42
15	148.65	2000	148.68	0100	148.68	15	150.11	2000	150.27	0100	150.17
16	148.62	1200	148.68	2400	148.65	16	149.99	1500	150.08	0100	150.02
17	148.68	0100	148.68	0100	148.68	17	149.93	1700	149.99	0100	149.96
18	148.68	0100	148.74	1800	148.71	18	149.75	2200	149.90	0100	149.81
19	148.74	0100	148.83	2400	148.77	19	149.63	2100	149.75	0100	149.69
20	148.83	0100	148.96	1600	148.93	20	149.57	0600	149.72	2400	149.60
21	148.93	2400	148.99	0400	148.96	21	149.75	0100	151.03	2000	150.54
22	148.83	1900	148.93	0100	148.86	22	151.03	2000	151.82	2000	151.42
23	148.74	1700	148.80	0100	148.77	23	151.33	2300	151.79	0100	151.58
24	148.65	1800	148.71	0100	148.68	24	150.91	2400	151.30	0100	151.09
25	148.62	1900	148.65	0100	148.65	25	150.78	0800	150.91	0100	150.82
26	148.62	0100	148.65	2000	148.62	26	150.78	0100	150.88	1700	150.85
27	148.65	0100	148.68	0400	148.68	27	150.69	2400	150.88	0100	150.82
28	148.68	0100	148.74	2000	148.71	28	150.36	2400	150.69	0100	150.51
29	148.74	0100	148.96	2200	148.83	29	150.08	2300	150.36	0100	150.21
30	148.99	0100	149.05	1400	149.02	30	149.90	2400	150.08	0100	149.99
						31	149.90	0100	149.99	2300	149.93
MEAN					148.72	MEAN					150.14
SE					0.023	SE					0.193

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
NOV						DEC					
1	149.99	0100	150.48	2300	150.24	1	148.99	0100	148.99	0100	148.99
2	150.48	2400	150.60	0900	150.54	2	148.96	1300	148.99	0100	148.99
3	150.17	2300	150.45	0100	150.33	3	148.80	1500	148.96	0100	148.86
4	149.96	2200	150.17	0100	150.05	4	148.80	1900	148.86	0100	148.83
5	149.87	1300	149.96	0100	149.90	5	148.80	0100	148.83	0400	148.83
6	149.81	2200	149.87	0100	149.84	6	148.80	0100	148.83	0900	148.80
7	149.75	1800	149.81	0100	149.78	7	148.80	0100	149.47	2400	148.96
8	149.69	2200	149.75	0100	149.72	8	149.57	0100	149.78	0500	149.72
9	149.60	2200	149.69	0100	149.66	9	149.75	0100	149.90	1000	149.84
10	149.53	1700	149.60	0100	149.57	10	149.72	0400	149.75	0100	149.72
11	149.44	1700	149.53	0100	149.47	11	149.63	1700	149.75	0100	149.69
12	149.38	2200	149.44	0100	149.41	12	149.53	2000	149.60	0100	149.57
13	149.32	2200	149.38	0100	149.35	13	149.50	2200	149.53	0100	149.53
14	149.26	2400	149.32	0100	149.29	14	149.41	2100	149.50	0100	149.47
15	149.26	0100	149.26	0100	149.26	15	149.20	1800	149.41	0100	149.29
16	149.20	2000	149.23	0100	149.23	16	149.05	2300	149.23	0400	149.14
17	149.14	1300	149.20	0100	149.17	17	149.08	0100	149.11	0200	149.11
18	149.11	1000	149.14	0100	149.11	18	149.14	0100	149.14	0100	149.14
19	149.05	1800	149.11	0100	149.08	19	149.11	1200	149.14	0100	149.11
20	149.05	0100	149.05	0100	149.05	20	149.11	0100	149.11	0100	149.11
21	149.02	0100	149.02	0100	149.02	21	149.11	0100	149.11	0100	149.11
22	149.02	0100	149.02	0100	149.02	22	149.11	0100	149.17	0600	149.14
23	149.02	0100	149.02	0100	149.02	23	149.02	1800	149.26	0600	149.14
24	148.96	2300	149.02	0100	148.99	24	148.96	1800	149.08	0400	149.02
25	148.93	1000	148.96	0100	148.93	25	148.93	2200	149.02	0900	148.99
26	148.86	2000	148.89	0100	148.89	26	148.93	0100	148.96	1100	148.96
27	148.86	0100	148.86	0100	148.86	27	148.93	0300	148.96	0100	148.96
28	148.86	0100	148.86	0100	148.86	28	148.93	1500	148.96	0100	148.96
29	148.86	0100	148.93	1800	148.89	29	148.83	1600	148.93	0100	148.86
30	148.93	0100	148.99	1500	148.96	30	148.86	1700	149.02	0800	148.93
						31	148.83	1300	148.93	1100	148.86
MEAN					149.38	MEAN					149.15
SE					0.087	SE					0.054

Table A-4. Daily flow (m^3/s) of the Susquehanna River at Ichthyological Associates Laboratory, 1976.

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	442	889	1195	652	659	310	445	268	185	216	835	211
2	408	869	1119	1070	610	327	566	228	180	191	968	210
3	377	737	1344	1157	596	337	538	264	153	170	827	193
4	340	582	2063	1072	629	352	473	232	133	155	684	171
5	322	494	2010	892	601	314	378	190	130	140	608	163
6	282	522	1814	727	584	265	330	163	126	131	577	158
7	257	466	1581	625	517	285	287	154	119	123	545	258
8	259	437	1376	550	446	305	263	223	113	123	507	500
9	234	420	1146	486	398	412	243	470	108	666	468	548
10	201	395	944	435	370	414	226	608	109	2558	429	525
11	185	406	837	394	335	349	229	544	110	2665	395	494
12	174	438	773	356	311	282	241	444	106	1722	373	450
13	193	577	710	329	353	238	413	362	111	1162	351	422
14	242	594	635	309	412	217	513	305	124	897	323	378
15	294	615	586	288	388	215	470	312	124	756	299	306
16	287	574	556	267	324	212	423	326	121	671	282	269
17	261	1127	524	249	314	221	354	363	134	630	266	269
18	226	2795	457	351	475	254	298	372	152	558	254	275
19	202	3269	414	675	528	305	271	309	166	484	243	259
20	186	3153	419	543	593	286	249	251	198	443	234	251
21	174	2691	511	426	743	774	225	209	204	1073	228	245
22	188	2161	625	373	929	1130	197	181	178	1771	225	258
23	167	2296	776	328	878	764	180	162	153	1784	219	284
24	155	2240	780	285	731	563	177	147	134	1385	209	427
25	163	1774	686	264	618	445	166	134	123	1158	198	486
26	356	1506	594	306	528	393	150	123	118	1194	189	452
27	1394	1343	545	510	464	380	136	122	126	1152	183	412
28	2324	1281	553	801	433	326	127	146	143	958	180	392
29	1819	1300	598	765	402	305	127	150	182	774	189	320
30	1468		622	690	373	318	147	187	224	651	207	363
31	1117		580		327		201	173		630		387
MEAN	474	1240	883	539	512	377	292	262	143	871	383	333
SE	97.9	169.5	84.0	47.8	29.4	36.0	23.6	22.6	5.9	122.2	40.1	20.8

Table A-5. Physicochemical data collected at SSES-A on the Susquehanna River, January, February, and March, 1976.

DATE	8 JAN	14 JAN	21 JAN	29 JAN		
TIME	1415	1100	1330	1400		
RIVER LEVEL(M ABOVE MSL)	148.99	149.08	148.96	151.49		
TEMPERATURE(C)						
AIR	-10.0	7.0	6.0	-4.0		
WATER	2.0	2.0	1.0	0.0		
WEATHER	SUNNY	OVERCAST	SNOW	OVERCAST	MEAN	SE
SECCHI DISC(CM)	120	70	160	10	90	29.0
TURBIDITY(JTU)	11	27	9	155	51	31.4
OXYGEN						
DISSOLVED(MG/L)	13.90	13.35	13.75	13.85	13.71	0.112
PERCENT SATURATION	101	97	98	96	98	1.0
ALKALINITY(MG/L)	44	52	51	23	43	6.0
PH	7.0	6.9	6.9	6.8	6.9	0.04
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	250	310	270	110	235	38.9
SULFATE(MG/L)	83	87	77	28	69	12.3
IRON(MG/L)						
TOTAL	1.76	2.25	1.85	4.95	2.70	0.677
DISSOLVED	1.18	0.93	1.37	0.22	0.93	0.225
PERCENT DISSOLVED	67	41	74	4	47	14.2
RESIDUE(MG/L)						
TOTAL	171	211	198	225	201	10.3
FIXED TOTAL	117	155	141	175	147	10.9
NONFILTRABLE	6	18	10	136	43	28.0
FIXED NONFILTRABLE	5	14	5	121	36	25.3

DATE	5 FEB	12 FEB	19 FEB	26 FEB		
TIME	1400	1600	1430	1330		
RIVER LEVEL(M ABOVE MSL)	149.87	149.57	153.07	151.27		
TEMPERATURE(C)						
AIR	-9.0	0.0	8.0	15.0		
WATER	-0.5	2.0	2.0	3.5		
WEATHER	SNOW	OVERCAST	P.CLOUDY	P.CLOUDY	MEAN	SE
VELOCITY(M/S)	--	0.41	--	1.25	0.83	0.343
SECCHI DISC(CM)	100	130	3	30	66	26.5
TURBIDITY(JTU)	12	10	340	55	104	70.9
OXYGEN						
DISSOLVED(MG/L)	13.70	13.80	13.50	13.20	13.55	0.118
PERCENT SATURATION	92	99	101	99	98	1.8
ALKALINITY(MG/L)	20	19	18	12	17	1.6
PH	6.4	6.8	7.3	6.9	6.9	0.17
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	192	230	93	115	158	28.8
SULFATE(MG/L)	46	58	24	28	39	7.1
IRON(MG/L)						
TOTAL	1.61	1.58	2.67	2.14	2.00	0.231
DISSOLVED	1.21	1.16	0.03	0.18	0.65	0.280
PERCENT DISSOLVED	75	73	1	8	39	18.0
RESIDUE(MG/L)						
TOTAL	138	150	518	170	244	81.9
FIXED TOTAL	100	119	503	146	217	85.7
NONFILTRABLE	15	21	433	48	129	90.8
FIXED NONFILTRABLE	12	3	378	43	109	80.6

DATE	3 MAR	10 MAR		
TIME	1330	1200		
RIVER LEVEL(M ABOVE MSL)	150.88	150.60		
TEMPERATURE(C)				
AIR	-2.5	-2.0		
WATER	5.0	3.0		
WEATHER	OVERCAST	P.CLOUDY	MEAN	SE
VELOCITY(M/S)	0.72	0.67	0.70	0.020
SECCHI DISC(CM)	60	55	58	2.0
TURBIDITY(JTU)	21	19	20	0.8
OXYGEN				
DISSOLVED(MG/L)	12.40	13.30	12.85	0.367
PERCENT SATURATION	96	98	97	0.8
ALKALINITY(MG/L)	32	37	35	2.0
PH	6.8	6.9	6.9	0.04
SPECIFIC CONDUCTANCE				
AT 25 C(μMHOS/CM)	130	130	130	0.0
SULFATE(MG/L)	31	31	31	0.0
IRON(MG/L)				
TOTAL	1.12	1.18	1.15	0.024
DISSOLVED	0.27	0.30	0.29	0.012
PERCENT DISSOLVED	24	25	25	0.4
RESIDUE(MG/L)				
TOTAL	107	114	111	2.9
FIXED TOTAL	92	92	92	0.0
NONFILTRABLE	27	24	26	1.2
FIXED NONFILTRABLE	15	15	15	0.0

Table A-6. Physicochemical data collected at SSES-A on the Susquehanna River, April, May, and June, 1976.

DATE	7 APR	9 APR	13 APR	15 APR	21 APR	23 APR	28 APR	30 APR		
TIME	1430	1430	1600	1320	1430	1400	1400	1400		
RIVER LEVEL(M ABOVE MSL)	149.96	149.69	149.35	149.17	149.53	149.32	150.21	150.05		
TEMPERATURE(C)										
AIR	15.0	8.0	18.0	19.0	23.0	22.5	14.5	14.0		
WATER	9.0	9.0	9.0	12.0	18.5	19.0	10.5	10.0		
WEATHER	P.CLOUDY	SUNNY	SUNNY	OVERCAST	SUNNY	SUNNY	OVERCAST	SUNNY	MEAN	SE
VELOCITY(M/S)	0.48	0.44	0.31	0.23	0.37	0.28	--	--	0.35	0.036
SECCHI DISC(CM)	72	126	140	130	71	88	68	60	94	10.8
TURBIDITY(JTU)	18	16	14	18	24	12	18	34	19	2.3
OXYGEN										
DISSOLVED(MG/L)	11.70	11.80	12.40	12.15	9.90	11.40	10.70	10.96	11.38	0.275
PERCENT SATURATION	100	99	106	111	105	121	95	96	104	2.9
ALKALINITY(MG/L)	36	37	42	48	38	44	52	36	42	2.0
PH	7.2	7.5	7.3	7.4	7.1	6.8	7.0	7.1	7.2	0.08
SPECIFIC CONDUCTANCE										
AT 25 C(μMHOS/CM)	150	170	210	230	170	210	200	140	185	10.7
SULFATE(MG/L)	38	48	48	58	43	50	33	48	46	2.6
IRON(MG/L)										
TOTAL	1.30	1.28	1.31	1.49	1.20	1.21	1.40	1.84	1.38	0.070
DISSOLVED	0.59	0.70	0.18	0.05	0.57	0.58	0.19	0.40	0.41	0.080
PERCENT DISSOLVED	45	55	14	3	48	48	14	22	31	6.7
RESIDUE(MG/L)										
TOTAL	121	130	149	158	118	133	153	129	136	5.0
FIXED TOTAL	97	104	121	132	91	105	114	102	108	4.5
NONFILTRABLE	10	9	7	7	12	13	25	30	14	2.9
FIXED NONFILTRABLE	9	8	6	6	12	11	22	25	12	2.4

DATE	4 MAY	7 MAY	11 MAY	14 MAY	17 MAY	20 MAY	27 MAY	29 MAY		
TIME	1415	1600	1330	1345	1600	1500	1400	1115		
RIVER LEVEL(M ABOVE MSL)	149.99	149.72	149.38	149.53	149.32	149.96	149.63	149.53		
TEMPERATURE(C)										
AIR	11.5	21.0	11.0	14.0	14.5	14.0	20.5	20.0		
WATER	10.5	14.0	15.5	15.0	18.0	14.0	13.5	17.0		
WEATHER	OVERCAST	OVERCAST	OVERCAST	OVERCAST	P.CLOUDY	OVERCAST	P.CLOUDY	OVERCAST	MEAN	SE
VELOCITY(M/S)	--	--	--	--	--	--	0.22	0.12	0.17	0.041
SECCHI DISC(CM)	110	115	137	113	65	38	105	100	98	10.5
TURBIDITY(JTU)	9	12	12	12	23	45	12	10	17	4.0
OXYGEN										
DISSOLVED(MG/L)	10.50	10.70	11.65	11.55	9.95	10.10	10.20	9.95	10.58	0.228
PERCENT SATURATION	93	103	115	113	105	98	96	102	103	2.6
ALKALINITY(MG/L)	42	40	47	54	39	38	43	47	44	1.8
PH	7.1	6.8	7.5	7.7	7.3	7.0	6.9	7.1	7.2	0.10
SPECIFIC CONDUCTANCE										
AT 25 C(μMHOS/CM)	160	160	180	210	210	150	170	190	179	7.7
SULFATE(MG/L)	45	40	42	47	48	45	42	47	45	1.0
IRON(MG/L)										
TOTAL	1.27	1.21	1.31	1.01	1.47	2.30	1.59	1.58	1.47	0.130
DISSOLVED	0.48	0.52	0.11	0.06	0.16	0.18	0.58	0.35	0.31	0.068
PERCENT DISSOLVED	38	43	8	6	11	8	36	22	22	5.1
RESIDUE(MG/L)										
TOTAL	127	135	139	144	155	156	128	147	141	3.7
FIXED TOTAL	89	90	103	100	117	124	100	108	104	4.1
NONFILTRABLE	14	13	10	8	14	36	13	13	15	2.9
FIXED NONFILTRABLE	12	12	5	5	14	29	11	11	12	2.5

DATE	1 JUN	4 JUN	8 JUN	11 JUN	16 JUN	18 JUN	22 JUN	25 JUN	30 JUN		
TIME	1545	1315	1400	1415	1440	1615	1340	1545	1630		
RIVER LEVEL(M ABOVE MSL)	149.29	149.57	149.29	149.35	148.99	149.05	150.75	149.53	149.29		
TEMPERATURE(C)											
AIR	11.0	18.0	22.0	28.5	27.0	28.5	24.0	28.0	22.0		
WATER	17.0	20.0	20.5	23.5	24.0	25.0	20.0	25.0	24.0		
WEATHER	OVERCAST	P.CLOUDY	SUNNY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	P.CLOUDY	HVY.RAIN	MEAN	SE
VELOCITY(M/S)	0.23	0.23	0.22	0.24	0.18	0.23	1.03	0.55	0.45	0.37	0.087
SECCHI DISC(CM)	98	67	67	61	61	60	2	37	42	55	8.3
TURBIDITY(JTU)	14	28	50	18	37	34	1600	56	33	208	165.2
OXYGEN											
DISSOLVED(MG/L)	9.30	12.30	11.00	9.80	10.20	10.20	7.20	7.75	8.50	9.58	0.506
PERCENT SATURATION	96	132	121	115	120	120	78	93	101	108	5.5
ALKALINITY(MG/L)	48	58	62	49	62	57	24	36	34	48	4.3
PH	7.1	7.8	7.7	--	--	--	--	7.2	--	7.5	0.16
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	220	220	220	210	250	260	120	190	240	214	13.0
SULFATE(MG/L)	53	47	58	65	62	58	23	27	66	51	5.0
IRON(MG/L)											
TOTAL	1.52	1.72	1.98	1.66	2.00	2.28	52.80	3.62	2.70	7.81	5.339
DISSOLVED	0.10	0.02	0.04	0.11	0.03	0.02	0.13	0.26	0.24	0.11	0.029
PERCENT DISSOLVED	7	1	2	7	2	1	0	7	9	4	1.1
RESIDUE(MG/L)											
TOTAL	160	168	160	162	180	181	1490	195	189	321	138.7
FIXED TOTAL	111	113	118	112	130	137	1380	152	136	265	132.2
NONFILTRABLE	8	25	24	19	24	34	601	67	53	95	60.3
FIXED NONFILTRABLE	5	13	10	11	15	14	565	58	30	80	57.7

Table A-7. Physicochemical data collected at SSES-A on the Susquehanna River, July, August, and September, 1976.

DATE	8 JUL	14 JUL	21 JUL	30 JUL		
TIME	1415	1420	1420	1400		
RIVER LEVEL(M ABOVE MSL)	149.14	149.72	149.05	148.74		
TEMPERATURE(C)						
AIR	23.0	28.0	23.0	27.5		
WATER	23.0	21.5	23.5	24.5		
WEATHER	OVERCAST	P.CLOUDY	LT.RAIN	OVERCAST	MEAN	SE
VELOCITY(M/S)	0.33	0.53	0.29	0.18	0.33	0.065
SECCHI DISC(CM)	55	15	60	52	46	9.2
TURBIDITY(NTU)	17	66	13	16	28	11.4
OXYGEN						
DISSOLVED(MG/L)	7.80	7.20	9.95	8.25	8.30	0.528
PERCENT SATURATION	90	80	117	99	97	7.0
ALKALINITY(MG/L)	30	42	41	58	43	5.2
PH	7.3	--	7.5	--	7.4	0.08
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	240	220	250	320	258	19.5
SULFATE(MG/L)	47	37	47	66	49	5.4
IRON(MG/L)						
TOTAL	3.05	7.43	2.40	1.92	3.70	1.131
DISSOLVED	0.25	0.13	0.16	0.04	0.15	0.039
PERCENT DISSOLVED	8	2	7	2	5	1.4
RESIDUE(MG/L)						
TOTAL	195	270	172	229	217	19.1
FIXED TOTAL	137	216	132	175	165	17.5
NONFILTRABLE	29	119	21	25	49	21.1
FIXED NONFILTRABLE	23	105	13	12	38	20.0

DATE	5 AUG	11 AUG	18 AUG	25 AUG		
TIME	1545	1445	1115	1500		
RIVER LEVEL(M ABOVE MSL)	148.89	149.01	149.44	148.68		
TEMPERATURE(C)						
AIR	29.0	27.0	23.0	28.5		
WATER	23.5	20.5	22.0	25.5		
WEATHER	P.CLOUDY	SUNNY	P.CLOUDY	SUNNY	MEAN	SE
VELOCITY(M/S)	0.25	0.62	0.50	0.14	0.38	0.099
SECCHI DISC(CM)	59	19	55	51	46	8.2
TURBIDITY(NTU)	12	50	18	12	23	8.1
OXYGEN						
DISSOLVED(MG/L)	8.80	7.70	8.00	11.00	8.88	0.667
PERCENT SATURATION	102	86	92	137	104	10.2
ALKALINITY(MG/L)	39	28	30	53	38	5.1
PH	7.8	7.4	7.4	8.0	7.7	0.13
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	270	180	190	300	235	26.5
SULFATE(MG/L)	48	24	31	62	41	7.7
IRON(MG/L)						
TOTAL	2.19	4.95	2.58	2.06	2.95	0.606
DISSOLVED	0.25	0.15	0.45	0.06	0.23	0.075
PERCENT DISSOLVED	11	3	17	3	9	3.0
RESIDUE(MG/L)						
TOTAL	189	205	162	195	188	8.2
FIXED TOTAL	137	164	132	146	145	6.3
NONFILTRABLE	25	101	37	17	45	17.1
FIXED NONFILTRABLE	12	86	31	14	36	15.5

DATE	2 SEP	8 SEP	16 SEP	22 SEP		
TIME	1415	1615	1530	1500		
RIVER LEVEL(M ABOVE MSL)	148.86	148.59	148.62	148.86		
TEMPERATURE(C)						
AIR	18.0	23.5	20.0	18.0		
WATER	21.0	21.5	21.0	19.0		
WEATHER	OVERCAST	SUNNY	LT.RAIN	P.CLOUDY	MEAN	SE
VELOCITY(M/S)	0.19	0.02	0.14	0.19	0.14	0.036
SECCHI DISC(CM)	55	65	70	67	64	2.9
TURBIDITY(NTU)	11	11	11	12	11	0.2
OXYGEN						
DISSOLVED(MG/L)	8.95	11.90	8.40	8.25	9.38	0.765
PERCENT SATURATION	100	135	92	88	104	9.6
ALKALINITY(MG/L)	42	50	72	49	53	5.8
PH	7.7	7.8	7.8	7.7	7.8	0.03
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	280	320	340	280	305	13.4
SULFATE(MG/L)	47	72	64	46	57	5.7
IRON(MG/L)						
TOTAL	2.02	2.40	2.22	2.12	2.19	0.072
DISSOLVED	0.06	0.08	0.04	0.11	0.07	0.013
PERCENT DISSOLVED	3	3	2	5	3	0.6
RESIDUE(MG/L)						
TOTAL	202	216	197	183	200	6.1
FIXED TOTAL	161	166	165	153	161	2.6
NONFILTRABLE	19	14	11	16	15	1.5
FIXED NONFILTRABLE	10	8	7	12	9	1.0

Table A-8. Physicochemical data collected at SSES-A on the Susquehanna River, October, November, and December, 1976.

DATE	15 OCT	28 OCT		
TIME	1600	1430		
RIVER LEVEL(M ABOVE MSL)	150.14	150.48		
TEMPERATURE(C)				
AIR	21.0	5.5		
WATER	10.5	6.0		
WEATHER	SUNNY	P.CLOUDY	MEAN	SE
VELOCITY(M/S)	0.76	--	0.76	--
SECCHI DISC(CM)	33	47	40	5.7
TURBIDITY(NTU)	23	14	19	3.7
OXYGEN				
DISSOLVED(MG/L)	10.00	11.60	10.80	0.653
PERCENT SATURATION	89	91	90	0.8
ALKALINITY(MG/L)	33	33	33	0.0
PH	7.3	7.4	7.4	0.04
SPECIFIC CONDUCTANCE				
AT 25 C(µMHOS/CM)	170	150	160	8.2
SULFATE(MG/L)	32	36	34	1.6
IRON(MG/L)				
TOTAL	3.08	1.82	2.45	0.514
DISSOLVED	0.55	0.46	0.51	0.037
PERCENT DISSOLVED	18	25	22	2.9
RESIDUE(MG/L)				
TOTAL	156	141	149	6.1
FIXED TOTAL	122	109	116	5.3
NONFILTRABLE	41	28	35	5.3
FIXED NONFILTRABLE	30	19	25	4.5

DATE	12 NOV	24 NOV		
TIME	1115	1115		
RIVER LEVEL(M ABOVE MSL)	149.41	148.99		
TEMPERATURE(C)				
AIR	6.0	4.0		
WATER	3.5	2.5		
WEATHER	SUNNY	P.CLOUDY	MEAN	SE
VELOCITY(M/S)	0.53	0.30	0.42	0.094
SECCHI DISC(CM)	135	136	136	0.4
TURBIDITY(NTU)	6	8	7	0.8
OXYGEN				
DISSOLVED(MG/L)	12.50	12.70	12.60	0.082
PERCENT SATURATION	93	93	93	0.0
ALKALINITY(MG/L)	28	28	28	0.0
PH	7.4	7.4	7.4	0.00
SPECIFIC CONDUCTANCE				
AT 25 C(µMHOS/CM)	200	260	230	24.5
SULFATE(MG/L)	47	44	46	1.2
IRON(MG/L)				
TOTAL	1.71	2.40	2.06	0.282
DISSOLVED	1.05	0.45	0.75	0.245
PERCENT DISSOLVED	61	19	40	17.1
RESIDUE(MG/L)				
TOTAL	148	190	169	17.1
FIXED TOTAL	110	140	125	12.2
NONFILTRABLE	8	10	9	0.8
FIXED NONFILTRABLE	6	6	6	0.0

DATE	16 DEC	28 DEC		
TIME	1445	1030		
RIVER LEVEL(M ABOVE MSL)	149.08	148.89		
TEMPERATURE(C)				
AIR	4.0	0.0		
WATER	0.0	0.5		
WEATHER	OVERCAST	OVERCAST	MEAN	SE
SECCHI DISC(CM)	118	138	128	8.2
TURBIDITY(NTU)	3	9	6	2.4
OXYGEN				
DISSOLVED(MG/L)	13.70	13.60	13.65	0.041
PERCENT SATURATION	95	96	96	0.4
ALKALINITY(MG/L)	43	28	36	6.1
PH	7.2	7.2	7.2	0.00
SPECIFIC CONDUCTANCE				
AT 25 C(µMHOS/CM)	220	265	243	18.4
SULFATE(MG/L)	19	61	40	17.1
IRON(MG/L)				
TOTAL	1.93	2.19	2.06	0.106
DISSOLVED	0.92	0.70	0.81	0.090
PERCENT DISSOLVED	48	32	40	6.5
RESIDUE(MG/L)				
TOTAL	154	197	176	17.6
FIXED TOTAL	118	152	135	13.9
NONFILTRABLE	13	11	12	0.8
FIXED NONFILTRABLE	6	7	7	0.4

Table A-9. Ranges of values and monthly means for physicochemical data collected at SSES-A, 1976.

PARAMETER	RANGE VALUES MINIMUM	DAY	MAXIMUM	DAY	MONTHLY MEANS MINIMUM	MONTH	MAXIMUM	MONTH
VELOCITY(M/S)	0.02	8 SEP	1.25	26 FEB	0.14	SEP	0.83	FEB
SECCHI DISC(CM)	2	22 JUN	160	21 JAN	40	OCT	136	NOV
TURBIDITY[a]	3	16 DEC	1600	22 JUN	6	DEC	208	JUN
OXYGEN								
DISSOLVED(MG/L)	7.20	22 JUN	13.90	8 JAN	8.30	JUL	13.71	JAN
PERCENT SATURATION	78	22 JUN	137	25 AUG	90	OCT	108	JUN
ALKALINITY(MG/L)	12	26 FEB	72	16 SEP	17	FEB	53	SEP
PH	6.4	5 FEB	8.0	25 AUG	6.9	FEB	7.8	SEP
SPECIFIC CONDUCTANCE								
AT 25 C(μMHOS/CM)	93	19 FEB	340	16 SEP	130	MAR	305	SEP
SULFATE(MG/L)	19	16 DEC	87	14 JAN	31	MAR	69	JAN
IRON (MG/L)								
TOTAL	1.01	14 MAY	52.80	22 JUN	1.15	MAR	7.81	JUN
DISSOLVED	0.02	4 JUN	1.37	21 JAN	0.07	SEP	0.93	JAN
PERCENT DISSOLVED	0	22 JUN	75	5 FEB	3	SEP	47	JAN
RESIDUE(MG/L)								
TOTAL	107	3 MAR	1490	22 JUN	111	MAR	321	JUN
FIXED TOTAL	89	4 MAY	1380	22 JUN	92	MAR	265	JUN
NONFILTRABLE	6	8 JAN	601	22 JUN	9	NOV	129	FEB
FIXED NONFILTRABLE	3	12 FEB	565	22 JUN	6	NOV	109	FEB

[a] JTU, Jan-Jun and NTU, Jul-Dec.

Table A-10. Physicochemical data collected monthly at Ichthyological Associates boat ramp on the Susquehanna River, 1976. Samples were collected and analyzed by the Pennsylvania Power and Light Company, Hàzleton, Pennsylvania.

Sample Number Date Time	152 27 Jan 1309	153 17 Feb 1330	154 15 Mar 1405	155 12 Apr 1330	156 11 May 1325	157 7 Jun 1353
River temperature (F)	32.9	37.4	39.2	48.2	59.0	68.0
Color (Pt - Co units)	30.0	11.5	21.3	39.0	22.5	23.5
Turbidity (FTU)	125	43	7.4	7.3	8.3	17
pH at 25 C	7.20	7.30	7.45	7.45	7.70	7.55
Specific conductance at 25 C (µmhos/cm)	210	190	195	215	210	245
Analysis (mg/1)						
Suspended matter	351.1	114.8	12.1	11.0	21.4	91.4
Ammonia nitrogen (as N)	0.16	0.38	0.08	0.22	0.20	0.31
Nitrate nitrogen (as N)	1.06	0.80	0.96	0.75	0.47	0.49
Methyl orange alkalinity (as $CaCO_3$)	28	35	41	45	49	56
Hardness (as $CaCO_3$)	61.5	66.0	78.5	89.5	85.0	99
Total dissolved solids at 103 C	123.2	114.4	128.8	139.0	121.2	157.0
Loss on ignition	35.8	39.4	34.4	43.8	32.6	54.8
Silicon dioxide (SiO_2)	3.00	5.10	4.64	3.00	1.45	0.23
Calcium (Ca)	18.8	20.0	23.2	26.0	25.6	29.6
Magnesium (Mg)	3.5	3.9	5.0	6.0	5.1	6.1
Sodium (Na)	14.2	9.0	6.4	7.0	6.9	8.1
Potassium (K)	1.8	1.9	1.5	1.7	2.2	2.0
Bicarbonate (HCO_3)	34.2	42.7	50.0	54.9	59.8	68.3
Sulfate (SO_4)	35.0	29.0	37.0	50.0	35.0	42.0
Chloride (Cl)	20.6	14.7	9.1	9.7	8.5	10.3
Nitrate (NO_3)	4.67	3.55	4.25	3.30	2.10	2.18
Phosphate (PO_4)	1.54	0.44	0.13	0.16	0.12	0.14
Total mineral solids	135.8	129.9	146.8	161.6	146.6	168.8
Dissolved oxygen (O_2)	15+	14.0	13.3	10.8	10.7	11.0
Ion Analysis (me/1)						
Positive ions						
Calcium (Ca)	0.94	1.00	1.16	1.30	1.28	1.48
Magnesium (Mg)	0.29	0.32	0.41	0.49	0.42	0.50
Sodium (Na)	0.62	0.39	0.28	0.30	0.30	0.35
Potassium (K)	0.05	0.05	0.04	0.04	0.06	0.05
Total	1.90	1.76	1.89	2.13	2.06	2.38
Negative ions						
Bicarbonate (HCO_3)	0.56	0.70	0.82	0.90	0.98	1.12
Sulfate (SO_4)	0.73	0.60	0.77	1.04	0.73	0.87
Chloride (Cl)	0.58	0.41	0.26	0.27	0.24	0.29
Nitrate (NO_3)	0.08	0.06	0.07	0.05	0.03	0.04
Phosphate (PO_4)	0.05	0.01	trace	0.01	0.00	trace
Total	2.00	1.78	1.92	2.27	1.98	2.32
Trace Metal Analysis (mg/1)						
Iron (Fe), total	9.10	2.38	1.26	1.80	1.23	1.17
Iron (Fe), dissolved	--[a]	0.09	0.53	0.67	0.33	0.36
Aluminum (Al), total	2.65	0.80	0.62	0.62	0.39	0.45
Aluminum (Al), dissolved	--[a]	0.02	0.07	0.12	0.05	0.02
Manganese (Mn), total	0.56	0.21	0.20	0.31	0.26	0.29
Manganese (Mn), dissolved	--[a]	0.09	0.00	0.00	0.02	0.04
Copper (Cu), total	0.01	0.01	0.00	0.00	0.00	0.00
Copper (Cu), dissolved	--[a]	0.01	0.00	0.00	0.00	0.00
Zinc (Zn), total	0.06	0.02	0.00	0.00	0.00	0.01
Zinc (Zn), dissolved	--[a]	0.00	0.00	0.00	0.00	0.00

Table A-10 (cont.)

Sample Number Date Time	158 12 Jul 1307	159 11 Aug 1413	160 13 Sep 1417	161 4 Oct 1318	162 2 Nov 1436	163 6 Dec 1510
River temperature (F)	74.3	68.9	71.6	61.7	42.6	32.9
Color (Pt - Co units)	10.6	20	12.9	45.8	54.1	64.6
Turbidity (FTU)	19.0	58	10.4	8.7	18.0	8.8
pH at 25 C	7.50	7.45	7.70	7.30	7.40	7.35
Specific conductance at 25 C (μmhos/cm)	270	185	365	325	165	300
Analysis (mg/l)						
Suspended matter	29.8	108.8	14.7	1.9	30.4	12.4
Ammonia nitrogen (as N)	0.14	0.32	0.25	0.42	0.30	0.65
Nitrate nitrogen (as N)	0.80	0.67	0.52	0.87	0.76	1.13
Methyl orange alkalinity (as $CaCO_3$)	55	46	70	58	42	62
Hardness (as $CaCO_3$)	105.5	71.5	139	107.5	65.6	122
Total dissolved solids at 103 C	162.0	115.4	224.4	177.6	108.8	187.4
Loss on ignition	46.0	41.2	69.6	55.6	34.2	50.0
Silicon dioxide (SiO_2)	2.53	4.20	0.98	2.82	4.78	3.69
Calcium (Ca)	34.0	23.2	39.6	33.2	20.4	36.4
Magnesium (Mg)	5.0	3.3	9.7	6.0	3.5	7.5
Sodium (Na)	8.7	6.9	11.4	9.4	4.9	10.0
Potassium (K)	2.4	2.5	2.5	2.3	2.0	1.6
Bicarbonate (HCO_3)	67.1	56.1	85.4	70.8	51.2	75.6
Sulfate (SO_4)	47.7	24.5	65.8	46.8	27.4	59.6
Chloride (Cl)	10.3	8.5	14.0	12.1	6.1	13.3
Nitrate (NO_3)	3.52	2.98	2.28	3.85	3.35	4.99
Phosphate (PO_4)	0.63	0.48	0.09	0.09	0.09	0.25
Total mineral solids	181.3	138.5	231.8	187.2	123.7	212.7
Dissolved oxygen (O_2)	8.3	7.2	10.6	8.7	11.6	15+
Ion Analysis (me/l)						
Positive ions						
Calcium (Ca)	1.70	1.16	1.98	1.66	1.02	1.82
Magnesium (Mg)	0.41	0.27	0.80	0.49	0.29	0.62
Sodium (Na)	0.38	0.30	0.50	0.41	0.15	0.44
Potassium (K)	0.06	0.06	0.06	0.06	0.05	0.04
Total	2.55	1.79	3.34	2.62	1.51	2.92
Negative ions						
Bicarbonate (HCO_3)	1.10	0.92	1.40	1.16	0.84	1.24
Sulfate (SO_4)	0.99	0.51	1.37	0.97	0.57	1.24
Chloride (Cl)	0.29	0.24	0.39	0.34	0.17	0.38
Nitrate (NO_3)	0.06	0.05	0.04	0.06	0.05	0.08
Phosphate (PO_4)	0.02	0.02	trace	0.00	0.00	0.01
Total	2.46	1.74	3.20	2.53	1.63	2.95
Trace Metal Analysis (mg/l)						
Iron (Fe), total	5.51	4.15	2.41	2.08	2.37	3.47
Iron (fe), dissolved	0.02	0.18	0.02	1.04	0.50	2.13
Aluminum (Al), total	2.49	1.03	0.55	0.50	0.72	0.57
Aluminum (Al), dissolved	0.08	0.01	0.00	0.12	0.14	0.16
Manganese (Mn), total	0.52	0.25	0.52	0.40	0.17	0.49
Manganese (Mn), dissolved	0.02	0.00	0.33	0.20	0.01	0.16
Copper (Cu), total	0.01	0.00	0.00	0.00	0.01	0.01
Copper (Cu), dissolved	0.00	0.00	0.00	0.00	0.00	trace
Zinc (Zn), total	0.03	0.03	0.02	0.02	0.02	0.02
Zinc (Zn), dissolved	0.01	0.01	0.00	0.01	0.00	0.01

[a]Metals in solution not run due to Laboratory error. Sample disposed of before analysis was completed.

Table A-11. Minimum, maximum, and mean values of physicochemical parameters determined at 5 major acid mine drainages in the study area (Fig. A-1), 1976. Data were provided by the Pennsylvania Department of Environmental Resources, Wilkes-Barre, Pennsylvania.

	Temperature (C)	Dissolved Oxygen (mg/l)	pH (field)	pH (lab)	Alkalinity (mg/l)	Acidity pH 8 (mg/l)	Sulfate (mg/l)	Total Iron (mg/l)
Old Forge Borehole								
No. Samples	7	3	6	7	7	7	7	7
Minimum	8.0	3.0	5.6	3.1	2	0	560	21.5
Maximum	18.0	3.7	6.8	5.9	80	120	950	61.0
Mean	15.4	3.3	6.0	5.0	44	59	664	41.9
Duryea Outfall								
No. Samples	6	6	5	6	6	6	6	6
Minimum	8.0	1.0	5.5	5.9	16	0	420	25.0
Maximum	18.0	6.0	6.6	6.5	66	84	650	46.6
Mean	13.9	3.8	5.9	6.1	51	46	582	39.8
South Wilkes-Barre Outfall								
No. Samples	7	3	6	7	7	7	7	7
Minimum	8.0	6.4	5.4	3.9	0	0	480	39.8
Maximum	18.0	6.5	6.9	7.2	70	350	1640	189
Mean	15.4	6.5	5.8	5.8	47	181	1121	123
Buttonwood Tunnel								
No. Samples	7	3	6	7	7	7	7	7
Minimum	8.0	1.6	5.5	4.9	36	140	900	34.5
Maximum	18.0	3.1	6.0	5.9	76	300	1740	205
Mean	15.9	2.3	5.8	5.6	54	191	1210	102
Nescopeck Creek								
No. Samples	5	5	5	5	5	5	5	5
Minimum	0.0	9.1	4.8	4.5	6	0	6	0.09
Maximum	26.0	12.0	6.9	7.6	40	24	76	5.35
Mean	11.3	10.8	6.3	6.0	16	9	36	1.57

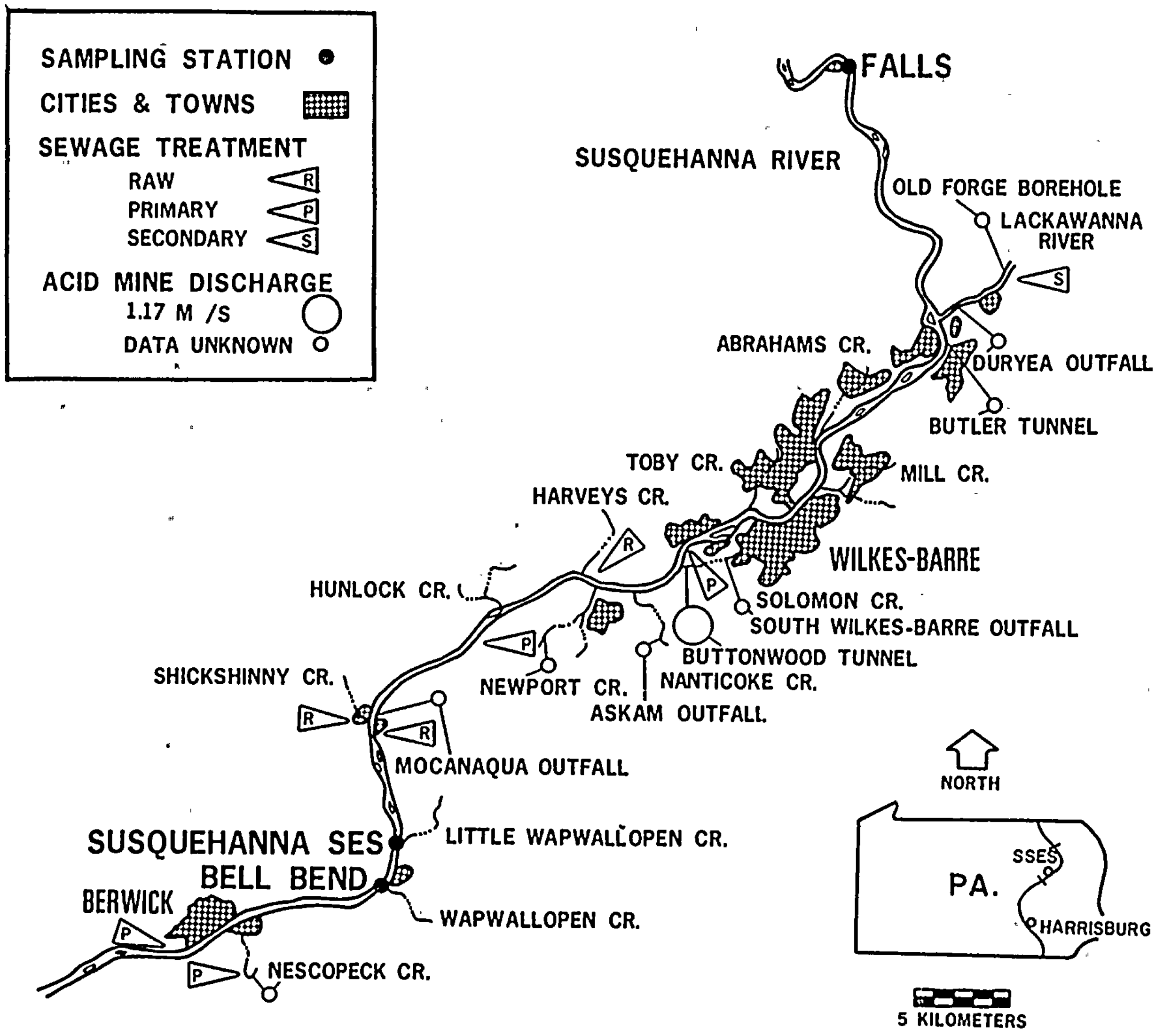

Fig. A-1. Map of sampling locations and sewage and acid mine effluents in the study area, 1976.

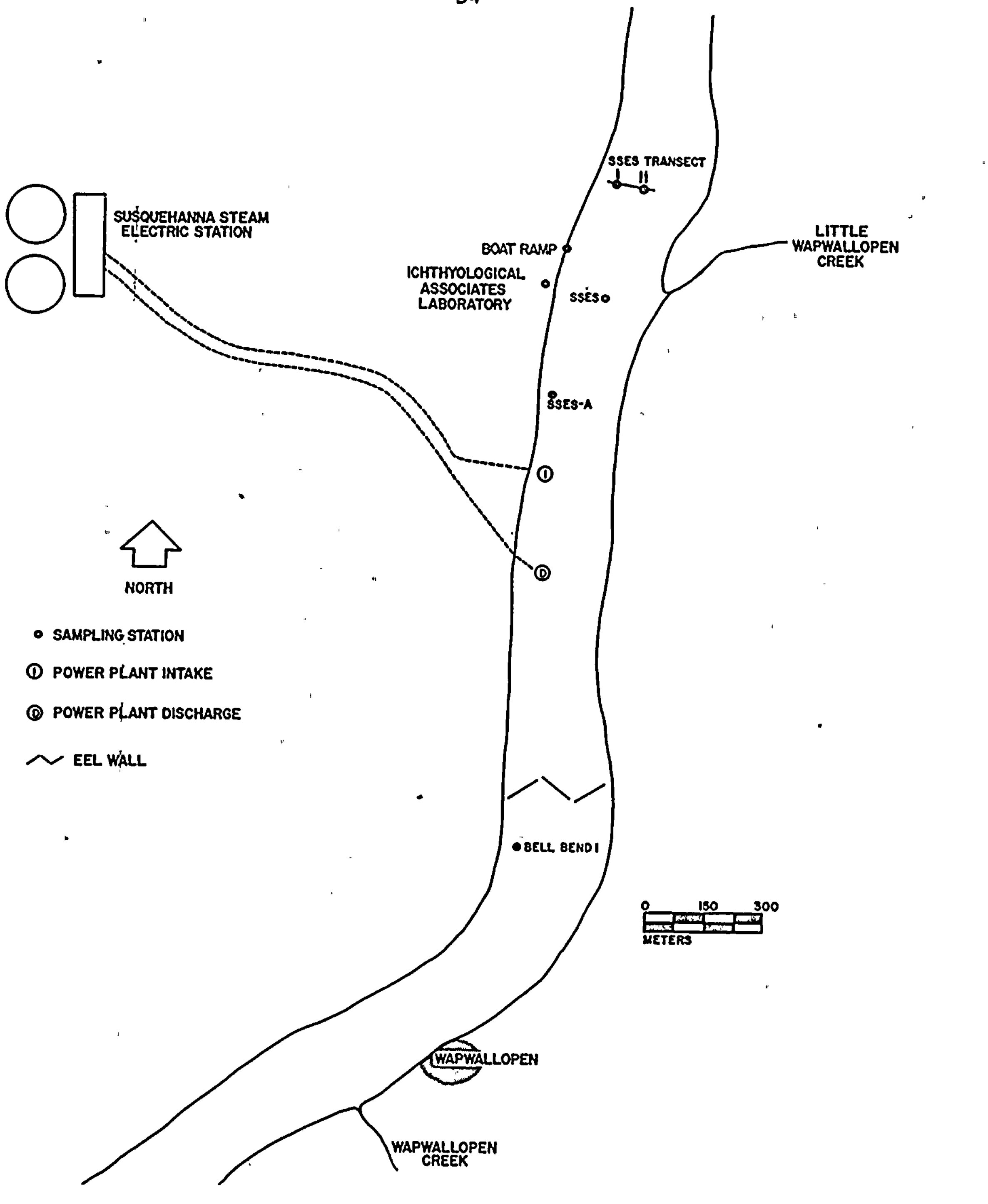

Fig. A-2. Sampling stations for physicochemical analyses (Ichthyological Associates Laboratory, SSES-A, and Boat Ramp), benthic macroinvertebrates (SSES Transect and Bell Bend I), macroinvertebrate drift (SSES), and larval fishes (SSES-A) on the Susquehanna River at the Susquehanna SES site, 1976.

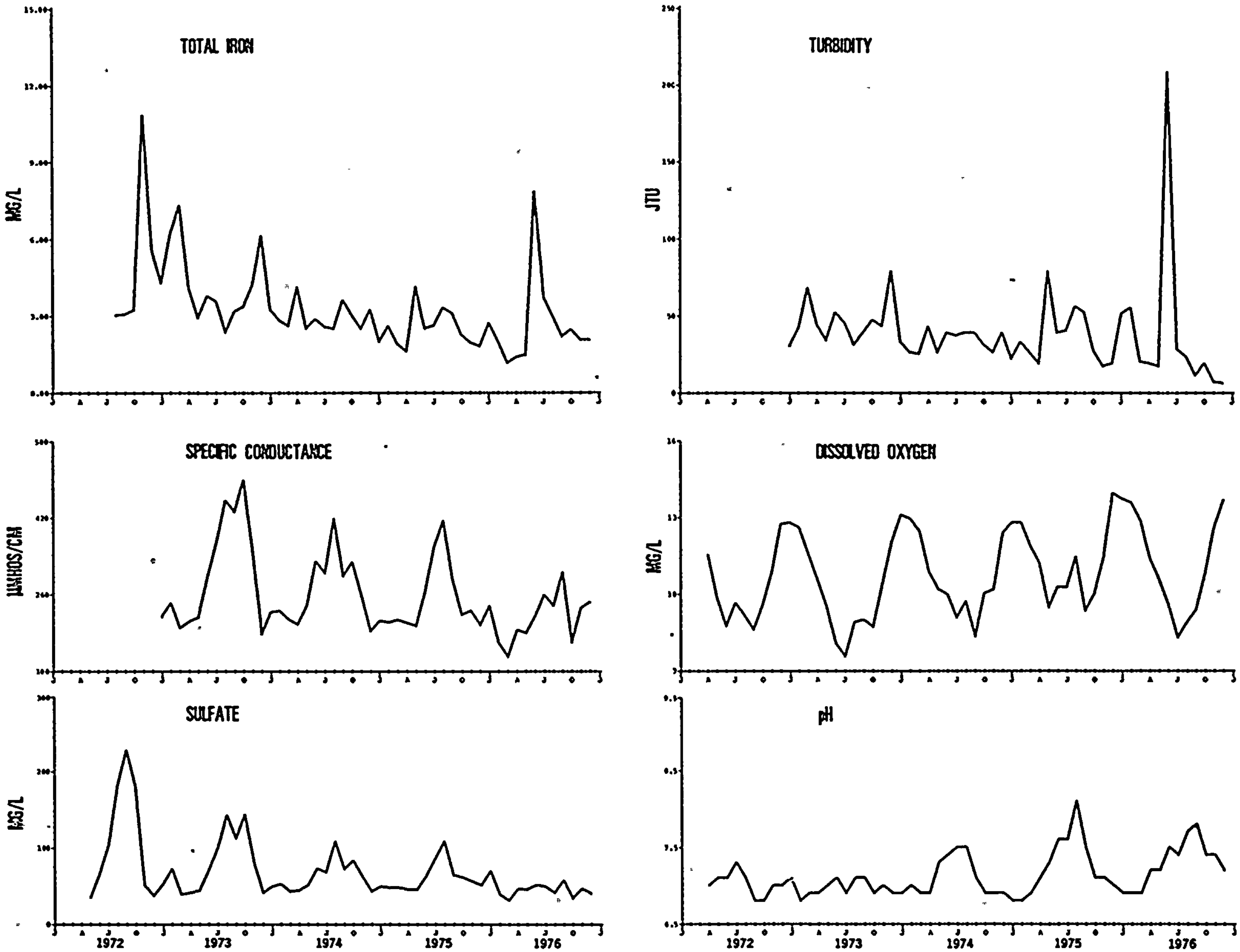

Fig. A-3. Trends in monthly means of total iron, specific conductance, sulfate, turbidity, dissolved oxygen, and pH in the Susquehanna River at the Susquehanna SES site from 1972 through 1976.

BENTHIC MACROINVERTEBRATES

by

William G. Deutsch

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ABSTRACT

The benthic macroinvertebrate community that inhabits the Susquehanna River was sampled in April, June, and October 1976 at three sites. Two sites were located on a transect above the proposed Susquehanna SES intake structure and one site was located below the proposed discharge structure. Greatest macroinvertebrate densities occurred in October, and ranged from 12,248 organisms/m^2 at SSES II to 26,061/m^2 at SSES I. These densities were from 19 to 40 fold higher than in October 1975, and indicated a rapid recovery from the harmful effects of Hurricane Eloise (September 1975). Oligochaetes (Nais sp. and Limnodrilus sp.), hydropsychid caddisflies (Cheumatopsyche sp. and Hydropsyche phalerata), and chironomids (Rheotanytarsus sp. and Cricotopus sp.) composed from 87% to 93% of the total number of organisms at all sites.

INTRODUCTION

The objective of this study was to monitor seasonal changes in the benthic macroinvertebrate community that inhabits the Susquehanna River near the Susquehanna SES. As in 1975, special attention was given to the taxonomy and life history of the most common organisms, particularly the chironomids.

PROCEDURES

Three replicate dome suction samples (Gale and Thompson 1975) were collected at SSES I, SSES II, and Bell Bend I on 26-28 April, 28-30 June, and 5-7 October (Table B-1; Fig. A-2).

The dome sampler was lowered from a boat to the River bottom. A scuba diver moved the sampler upriver or laterally (to an undisturbed site) and placed it in an area where an adequate seal between the sampler band and the substrate could be established. The area (0.163 m^2) enclosed by the dome was vacuumed for 5 minutes with a hose leading to a bilge pump, mounted on the sampler. Sand, gravel, and organisms were pumped into a No. 76 mesh (216 μ) nylon net; larger stones were carefully vacuumed and discarded. This procedure was repeated until all samples were collected at a site (Ichthyological Associates 1973). The net was returned to the boat by the diver.

One of the three replicate samples was used for biomass estimates. It was washed, sieved (U.S. Standard No. 60 sieve), and sorted while organisms were alive (Deutsch 1976a). Damp weights were taken after freshly sorted organisms were centrifuged on screens (3,200 rpm for 15 s), and dry weights were made after organisms were dehydrated at 100 C for at least 12 h.

The other two replicates were sieved, washed, and preserved in 10% buffered formalin. After a sample was sorted, 1/4 of the residue was randomly selected in an acrylic subsampler (Ichthyological Associates 1973). Each subsample was examined with a stereo microscope (8X), and macroinvertebrates removed. The number of subsampled organisms was multiplied by 4, and added to the number of organisms picked when the sample was initially sorted, to obtain the total number of organisms per sample. Density per square meter was determined by multiplying the number of organisms per sample by 6.135. Organisms were identified with the keys of Ross (1944), Burks (1953), Pennak (1953), Parrish (1968), Hilsenhoff (1970), Mason (1973), and Beck (1976).

Statistical analyses of macroinvertebrate data included determinations of diversity (Wilhm and Dorris 1968), equitability (Lloyd and Ghelardi 1964), percent similarity, and coefficient of community (Whittaker and Fairbanks 1958). To calculate diversity and coefficient of community, numbers of immature or damaged insects which could not be identified to genus were omitted. Numbers of organisms at all taxonomic levels were included in percent similarity determinations. All data were stored on and processed with a Hewlett Packard 9830 computer.

RESULTS AND DISCUSSION

Organism Density and Percent Composition

Densities of macroinvertebrates ranged from 3,126 to 26,061 organisms/m^2 ($\bar{x}$ = 13,528 org/m^2) at SSES I, from 4,549 to 12,248 org/m^2 ($\bar{x}$ = 9,132 org/m^2) at SSES II, and from 9,497 to 22,089 org/m^2 ($\bar{x}$ = 14,372 org/m^2) at Bell Bend I (Tables B-2 through B-10). Greatest densities at all sites were found in October, but they were probably higher in mid- and late summer when samples were not collected. During 1973 and 1974, when sampling was conducted more frequently, maximum densities of macroinvertebrates at SSES were found in September (Ichthyological Associates 1974, Deutsch 1976b).

The macroinvertebrate fauna near the Susquehanna SES is clearly capable of rapid recovery from natural catastrophies. The River bottom was severely scoured as a result of Hurricane Eloise (25-28 September 1975), and macroinvertebrate densities in October 1975 were low at SSES I ($\bar{x}$ = 641 org/m^2)

and SSES II ($\bar{x}$ = 662 org/m^2) (Deutsch 1976a). By April 1976, however, densities at the two sites averaged 6,862 org/m^2; by October 1976 they were from 19 to 40 fold higher than they had been the previous October.

As in previous years, oligochaetes (Nais sp. and Limnodrilus sp.). trichopterans (Cheumatopsyche sp. and Hydropsyche phalerata), and chironomids (Rheotanytarsus sp. and Cricotopus sp.) numerically dominated the benthos near the Susquehanna SES (Table B-11). Organisms in these taxa composed fipm 87% (Bell Bend I) to 93% (SSES II) of the 1976 total (Fig. B-1). The average number of taxa was somewhat higher at Bell Bend I (41) than at SSES I (35) or SSES II (33) (Table B-12). Because samples were not collected in September 1976, the characteristic high numbers of chironomids found at this time in 1972 through 1974 were not included in percent composition calculations, and this group was probably underestimated in numerical importance.

An additional 43 macroinvertebrate taxa were added to the existing species list (Table B-13). Most of these organisms had been collected in previous years, but were more specifically identified in 1976. More than half of the additions were chironomids, and most identifications have already been verified by William M. Beck (Florida A & M University). Eleven new trichopteran identifications were verified by Jay W. Chapin (Clemson University) or Guenter Schuster (University of Tennessee).

As in previous years, Rheotanytarsus was the most common chironomid near the Susquehanna SES; it composed from 39% (Bell Bend I) to 59% (SSES I) of the chironomid population in 1976 (Table B-14). Greatest densities were found in October, and were about twice as high at SSES I (5,046 org/m^2) as at SSES II (2,344 org/m^2) or Bell Bend I (2,902 org/m^2). In 1975, it was also collected in much greater densities at SSES I than at other sites (Deutsch 1976a).

Cricotopus was the second-most abundant chironomid, and composed from 10% (SSES I) to 18% (Bell Bend I) of the 1976 chironomid population. Densities of it ranged from 902 org/m^2 (SSES II) to 2,043/m^2 (Bell Bend I) in April, but it was absent at all sites in June samples. Similar fluctuations were observed in 1975 (Deutsch 1976a), and this indicated a large emergence of adults in late spring. By October 1976, low densities of Cricotopus (80-368 org/m^2) were found at all sites.

Seasonal changes in the chironomid community at all sampling sites are presented in Figs. B-2 through B-4.

Community Indices

Statistical analyses did not reveal notable differences in macroinvertebrate community structure between any sites. All sites were highly similar in October, as was indicated by percent similarities and coefficient of communities which were greater than 70% (Tables B-15 through B-18). Diversities ($\bar{d}$) varied from 2.76 to 3.09 at SSES I, from 1.78 to 2.96 at SSES II, and from 2.74 to 3.36 at Bell Bend I. Equitability of $\bar{d}$ ranged from 20 to 43%, except at SSES II in April, when large numbers of naidid worms (72% of all organisms) resulted in a low diversity (1.78) and equitability (10%) (Table B-12).

Biomass

Oligochaetes, hydropsychid caddisflies, and chironomids composed from 50 to 89% of the total macroinvertebrate damp weight at all sites. Damp weights ranged from 30.0 to 65.4 kg/ha ($\bar{x}$ = 49.5 kg/ha) at SSES I, from 11.6 to 70.4 kg/ha ($\bar{x}$ = 33.2 kg/ha) at SSES II, and from 20.1 to 116.2 kg/ha ($\bar{x}$ = 66.6 kg/ha) at Bell Bend I (Tables B-19 through B-27). Greatest damp weights were found in October, and were mainly composed of hydropsychid caddisflies (from 60% at Bell Bend I to 84% at SSES I). Dry weights were from 19 to 26% of damp weights at all sites.

Total annual biomass was from 3 to 4 fold higher in 1976 than in 1975 at all sites. This increase in 1976 was largely due to recovery from the harmful effects of Hurricane Eloise, and to a lesser extent by sampling later in spring (April 1976 vs. March 1975).

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Table B-1. Description and location of benthic macroinvertebrate sampling stations on the Susquehanna River, 1976 (see Fig. A-2).

Station	Depth[a] (m)	Substrate Type[b]	Location
SSES Transect			The Transect follows a line E2°S from the west bank, 354 m upriver from the dock at Ichthyological Associates Laboratory.
SSES I	0.6	gravel-pebble	Along Transect 32 m from the west bank.
SSES II	1.0	pebble-cobble	Along Transect 103 m from the west bank.
Bell Bend I	1.3	gravel-pebble with boulders	35 m from west bank, 1,480 m downriver from the dock at Ichthyological Associates Laboratory.

[a]Station depths when River surface elevation is 148.6 m above msl at Ichthyological Associates Laboratory.

[b]Based on predominant particle size (Cummins 1962).

Table B-2. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 28 April 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
NEMATODA	44	3	23.5	4.6
NAIDIDAE	94	38	66.0	13.0
TUBIFICIDAE	112	48	80.0	15.7
GAMMARUS	1	0	0.5	0.1
PERLIDAE	0	1	0.5	0.1
POTAMANTHUS	1	1	1.0	0.2
EPHEMERELLA	0	2	1.0	0.2
EPHEMERELLA INVARIA	2	3	2.5	0.5
EPHEMERELLA WALKERI	2	1	1.5	0.3
BAETIDAE	1	0	0.5	0.1
STENONEMA	13	8	10.5	2.1
STENONEMA ITHACA	0	4	2.0	0.4
CHEUMATOPSYCHE	3	3	3.0	0.6
STENELMIS	14	18	16.0	3.1
ANTOCHA SAXICOLA	1	0	0.5	0.1
SIMULIIDAE	1	2	1.5	0.3
EMPIDIDAE	9	2	5.5	1.1
CHIRONOMIDAE (PUPAE)	46	39	42.5	8.3
ABLABESMYIA MALLOCHI	3	1	2.0	0.4
ABLABESMYIA ORNATA	2	1	1.5	0.3
CONCHAPELOPIA GRP	9	6	7.5	1.5
TANYPODINAE SP#1	5	0	2.5	0.5
GLYPTOTENDIPES	6	0	3.0	0.6
POLYPEDILUM	20	9	14.5	2.8
RHEOTANYTARSUS	44	43	43.5	8.5
TANYTARSUS	12	6	9.0	1.8
CRICOTOPUS	196	132	164.0	32.2
PSECTROCLADIUS	3	3	3.0	0.6
THIENEMANNIELLA	0	1	0.5	0.1
TOTAL ORGANISMS	644	375	510	
ORGANISMS/M2	3951	2301	3126	
TOTAL TAXA	24	23	24.5	

Table B-3. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 28 June 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
HYDRA	2	1	1.5	0.1
TURBELLARIA	8	1	4.5	0.2
NEMATODA	6	5	5.5	0.3
NAIDIDAE	698	113	405.5	21.8
TUBIFICIDAE	107	41	74.0	4.0
GAMMARUS	2	1	1.5	0.1
TAENIOPTERYX	1	0	0.5	0.0
LEUCTRA	0	1	0.5	0.0
ACRONEURIA	0	1	0.5	0.0
NEOPERLA	3	1	2.0	0.1
NEOPHASGANOPHORA	1	0	0.5	0.0
PERLESTA	0	1	0.5	0.0
EPHORON	0	1	0.5	0.0
POTAMANTHUS	1	2	1.5	0.1
CAENIS	317	207	262.0	14.1
EPHEMERELLA DEFICIENS	0	1	0.5	0.0
ISONYCHIA	20	21	20.5	1.1
STENONEMA	78	24	51.0	2.7
STENONEMA SP#1	0	3	1.5	0.1
STENONEMA SP#2	0	1	0.5	0.0
SIALIS	3	4	3.5	0.2
CHAULIODES	0	1	0.5	0.0
POLYCENTROPUS	1	0	0.5	0.0
CHEUMATOPSYCHE	625	445	535.0	28.8
HYDROPSYCHE PHALERATA	81	70	75.5	4.1
HYDROPTILIDAE	0	6	3.0	0.2
STENELMIS	19	13	16.0	0.9
SIMULIIDAE	1	2	1.5	0.1
SIMULIIDAE (PUPAE)	0	5	2.5	0.1
CHIRONOMIDAE (PUPAE)	24	12	18.0	1.0
ABLABESMYIA MALLOCHI	0	1	0.5	0.0
CONCHAPELOPIA GRP	110	89	99.5	5.4
CHIRONOMUS	0	1	0.5	0.0
CRYPTOCHIRONOMUS	8	2	5.0	0.3
ENDOCHIRONOMUS GRP	1	0	0.5	0.0
GLYPTOTENDIPES	0	3	1.5	0.1
MICROTENDIPES	8	2	5.0	0.3
POLYPEDILUM	47	33	40.0	2.2
RHEOTANYTARSUS	276	133	204.5	11.0
STENOCHIRONOMUS	0	1	0.5	0.0
TANYTARSUS	0	1	0.5	0.0
ZAVRELIA	0	1	0.5	0.0
PSEUDODIAMESA	0	1	0.5	0.0
EUKIEFFERIELLA	1	11	6.0	0.3
SPHAERIUM	0	3	1.5	0.1
TOTAL ORGANISMS	2449	1266	1858	
ORGANISMS/M2	15025	7767	11396	
TOTAL TAXA	26	39	33.5	

Table B-4. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 6 October 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	17	25	21.0	0.5
NEMATODA	30	23	26.5	0.6
NAIDIDAE	598	645	621.5	14.6
TUBIFICIDAE	69	18	43.5	1.0
PERLIDAE	7	25	16.0	0.4
POTAMANTHUS	4	2	3.0	0.1
ISONYCHIA	3	18	10.5	0.2
STENONEMA	89	109	99.0	2.3
COENAGRIONIDAE	1	2	1.5	0.0
NEURECLIPSIS	4	6	5.0	0.1
HYDROPSYCHIDAE (PUPAE)	1	0	0.5	0.0
CHEUMATOPSYCHE	1796	1598	1697.0	39.9
HYDROPSYCHE BIFIDA GRP	6	6	6.0	0.1
HYDROPSYCHE PHALERATA	129	251	190.0	4.5
HYDROPTILIDAE	20	12	16.0	0.4
OECETIS	1	10	5.5	0.1
OECETIS CINERACENS	0	12	6.0	0.1
ELMIDAE (ADULTS)	0	1	0.5	0.0
DUBIRAPHIA	0	1	0.5	0.0
STENELMIS	10	5	7.5	0.2
SIMULIIDAE	7	5	6.0	0.1
EMPIDIDAE	296	319	307.5	7.2
CERATOPOGONIDAE	0	1	0.5	0.0
CHIRONOMIDAE	7	17	12.0	0.3
CHIRONOMIDAE (PUPAE)	14	30	22.0	0.5
CONCHAPELOPIA GRP	33	25	29.0	0.7
CRYPTOCHIRONOMUS	0	8	4.0	0.1
GLYPTOTENDIPES	7	8	7.5	0.2
POLYPEDILUM	18	8	13.0	0.3
RHEOTANYTARSUS	703	942	822.5	19.4
TANYTARSUS	4	0	2.0	0.0
CRICOTOPUS	26	0	13.0	0.3
EUKIEFFERIELLA	26	43	34.5	0.8
PSECTROCLADIUS	69	275	172.0	4.0
PISIDIUM	8	1	4.5	0.1
SPHAERIUM	18	24	21.0	0.5
TOTAL ORGANISMS	4021	4475	4248	
ORGANISMS/M2	24669	27454	26061	
TOTAL TAXA	28	31	31.0	

Table B-5. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 27 April 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	0	1	0.5	0.0
NEMATODA	4	10	7.0	0.4
NAIDIDAE	241	2230	1235.5	71.5
TUBIFICIDAE	27	112	69.5	4.0
ISOTOMURUS PALUSTRIS	0	1	0.5	0.0
TAENIOPTERYX	2	0	1.0	0.1
PERLIDAE	0	8	4.0	0.2
POTAMANTHUS	6	5	5.5	0.3
CAENIS	2	0	1.0	0.1
EPHEMERELLA	4	4	4.0	0.2
EPHEMERELLA INVARIA	1	1	1.0	0.1
EPHEMERELLA WALKERI	1	1	1.0	0.1
ISONYCHIA	1	0	0.5	0.0
STENONEMA	14	43	28.5	1.6
CHIMARRA OBSCURA	0	2	1.0	0.1
HYDROPSYCHIDAE (PUPAE)	0	2	1.0	0.1
CHEUMATOPSYCHE	7	8	7.5	0.4
HYDROPSYCHE BIFIDA GRP	1	0	0.5	0.0
HYDROPSYCHE PHALERATA	2	3	2.5	0.1
OECETIS	0	4	2.0	0.1
STENELMIS	9	5	7.0	0.4
SIMULIIDAE	0	5	2.5	0.1
EMPIDIDAE	11	16	13.5	0.8
CHIRONOMIDAE	0	11	5.5	0.3
CHIRONOMIDAE (PUPAE)	32	32	32.0	1.9
ABLABESMYIA MALLOCHI	1	3	2.0	0.1
ABLABESMYIA ORNATA	1	0	0.5	0.0
ABLABESMYIA RHAMPHE	0	1	0.5	0.0
CONCHAPELOPIA GRP	17	28	22.5	1.3
TANYPODINAE SP#1	0	3	1.5	0.1
CHIRONOMINAE	1	1	1.0	0.1
ENDOCHIRONOMUS GRP	0	1	0.5	0.0
POLYPEDILUM	20	19	19.5	1.1
RHEOTANYTARSUS	31	60	45.5	2.6
TANYTARSUS	15	40	27.5	1.6
ZAVRELIA	0	8	4.0	0.2
CRICOTOPUS	143	151	147.0	8.5
EUKIEFFERIELLA	6	0	3.0	0.2
EUKIEFFERIELLA COERULESCENS GRP SP#1	1	0	0.5	0.0
PSECTROCLADIUS	13	18	15.5	0.9
RHEOCRICOTOPUS SP#1	0	1	0.5	0.0
THIENEMANNIELLA	1	1	1.0	0.1
PISIDIUM	0	1	0.5	0.0
TOTAL ORGANISMS	615	2840	1728	
ORGANISMS/M2	3773	17423	10598	
TOTAL TAXA	28	33	32.0	

Table B-6. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 29 June 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	9	2	5.5	0.7
NEMATODA	3	17	10.0	1.3
NAIDIDAE	179	53	116.0	15.6
TUBIFICIDAE	35	5	20.0	2.7
NEOPERLA	1	0	0.5	0.1
CAENIS	47	45	46.0	6.2
EPHEMERELLA DEFICIENS	1	0	0.5	0.1
ISONYCHIA	2	1	1.5	0.2
HEPTAGENIA	2	0	1.0	0.1
RHITHROGENA	3	1	2.0	0.3
STENONEMA	17	13	15.0	2.0
STENONEMA SP#1	1	1	1.0	0.1
STENONEMA SP#3	2	0	1.0	0.1
SIALIS	1	0	0.5	0.1
CHEUMATOPSYCHE	466	194	330.0	44.5
HYDROPSYCHE BIFIDA GRP	1	1	1.0	0.1
HYDROPSYCHE PHALERATA	48	16	32.0	4.3
HYDROPTILIDAE	35	32	33.5	4.5
STENELMIS	6	11	8.5	1.1
CHIRONOMIDAE (PUPAE)	7	9	8.0	1.1
ABLABESMYIA MALLOCHI	1	0	0.5	0.1
CONCHAPELOPIA GRP	33	40	36.5	4.9
CRYPTOCHIRONOMUS	0	2	1.0	0.1
GLYPTOTENDIPES	1	3	2.0	0.3
MICROTENDIPES	3	2	2.5	0.3
POLYPEDILUM	13	14	13.5	1.8
RHEOTANYTARSUS	34	52	43.0	5.8
CORYNONEURA	1	0	0.5	0.1
EUKIEFFERIELLA	12	5	8.5	1.1
TOTAL ORGANISMS	964	519	742	
ORGANISMS/M2	5914	3184	4549	
TOTAL TAXA	27	21	25.0	

Table B-7. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 7 October 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	6	0	3.0	0.2
NEMATODA	41	57	49.0	2.5
NAIDIDAE	218	104	161.0	8.1
TUBIFICIDAE	29	55	42.0	2.1
PERLIDAE	9	2	5.5	0.3
POTAMANTHUS	5	1	3.0	0.2
EPHEMERELLA	1	2	1.5	0.1
ISONYCHIA	3	3	3.0	0.2
STENONEMA	65	35	50.0	2.5
COENAGRIONIDAE	5	1	3.0	0.2
NEURECLIPSIS	4	11	7.5	0.4
CHEUMATOPSYCHE	965	660	812.5	40.7
HYDROPSYCHE BIFIDA GRP	1	1	1.0	0.1
HYDROPSYCHE PHALERATA	85	42	63.5	3.2
MACRONEMA ZABRATA	1	1	1.0	0.1
HYDROPTILIDAE	4	0	2.0	0.1
CERACLEA TARSIPUNCTATA	0	1	0.5	0.0
OECETIS	21	21	21.0	1.1
OECETIS CINERACENS	43	32	37.5	1.9
ELMIDAE (ADULTS)	0	1	0.5	0.0
STENELMIS	2	0	1.0	0.1
SIMULIIDAE	0	1	0.5	0.0
EMPIDIDAE	83	11	47.0	2.4
CHIRONOMIDAE	0	4	2.0	0.1
CHIRONOMIDAE (PUPAE)	32	6	19.0	1.0
CONCHAPELOPIA GRP	29	13	21.0	1.1
GLYPTOTENDIPES	4	8	6.0	0.3
POLYPEDILUM	12	8	10.0	0.5
RHEOTANYTARSUS	492	272	382.0	19.1
CRICOTOPUS	49	24	36.5	1.8
EUKIEFFERIELLA	32	8	20.0	1.0
PSECTROCLADIUS	151	178	164.5	8.2
PISIDIUM	0	3	1.5	0.1
SPHAERIUM	10	25	17.5	0.9
TOTAL ORGANISMS	2402	1591	1997	
ORGANISMS/M2	14736	9761	12248	
TOTAL TAXA	28	29	29.5	

Table B-8. Number and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 26 April 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
NEMATODA	6	5	5.5	0.3
URNATELLA GRACILIS	1	0	0.5	0.0
NAIDIDAE	1011	763	887.0	47.2
TUBIFICIDAE	64	56	60.0	3.2
ISOTOMURUS PALUSTRIS	1	1	1.0	0.1
PERLIDAE	0	1	0.5	0.0
POTAMANTHUS	4	9	6.5	0.3
EPHEMERELLA	5	2	3.5	0.2
EPHEMERELLA COXALIS	0	1	0.5	0.0
EPHEMERELLA INVARIA	1	1	1.0	0.1
BAETIDAE	0	6	3.0	0.2
PSEUDOCLOEON	0	1	0.5	0.0
ISONYCHIA	0	1	0.5	0.0
EPEORUS	1	0	0.5	0.0
STENONEMA	103	70	86.5	4.6
STENONEMA FUSCUM	0	1	0.5	0.0
STENONEMA INTERPUNCTATUM GRP	0	1	0.5	0.0
STENONEMA ITHACA	0	7	3.5	0.2
COENAGRIONIDAE	1	0	0.5	0.0
TRICHOPTERA (PUPAE)	0	2	1.0	0.1
CHIMARRA OBSCURA	0	1	0.5	0.0
POLYCENTROPUS	0	2	1.0	0.1
CHEUMATOPSYCHE	6	19	12.5	0.7
HYDROPSYCHE PHALERATA	0	2	1.0	0.1
OECETIS CINERACENS	0	4	2.0	0.1
STENELMIS	19	21	20.0	1.1
ANTOCHA SAXICOLA	0	1	0.5	0.0
EMPIDIDAE	12	22	17.0	0.9
EMPIDIDAE (PUPAE)	1	1	1.0	0.1
CHIRONOMIDAE	0	28	14.0	0.7
CHIRONOMIDAE (PUPAE)	41	47	44.0	2.3
ABLABESMYIA MALLOCHI	4	1	2.5	0.1
CONCHAPELOPIA GRP	50	94	72.0	3.8
TANYPODINAE SP#1	3	0	1.5	0.1
CHIRONOMINAE	10	0	5.0	0.3
CRYPTOCHIRONOMUS	0	9	4.5	0.2
ENDOCHIRONOMUS GRP	8	5	6.5	0.3
POLYPEDILUM	57	53	55.0	2.9
RHEOTANYTARSUS	71	112	91.5	4.9
TANYTARSUS	59	37	48.0	2.6
ZAVRELIA	12	1	6.5	0.3
CORYNONEURA	0	1	0.5	0.0
CRICOTOPUS	379	287	333.0	17.7
EUKIEFFERIELLA	1	19	10.0	0.5
HETEROTRISSOCLADIUS	1	0	0.5	0.0
PSECTROCLADIUS	50	74	62.0	3.3
RHEOCRICOTOPUS SP#1	6	0	3.0	0.2
SYNORTHOCLADIUS	0	1	0.5	0.0
PISIDIUM	1	0	0.5	0.0
TOTAL ORGANISMS	1989	1770	1880	
ORGANISMS/M2	12202	10859	11531	
TOTAL TAXA	29	37	34.5	

Table B-9. Number and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 30 June 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
HYDRA	5	5	5.0	0.3
TURBELLARIA	23	23	23.0	1.5
NEMATODA	6	2	4.0	0.3
URNATELLA GRACILIS	0	4	2.0	0.1
NAIDIDAE	279	80	179.5	11.6
TUBIFICIDAE	107	55	81.0	5.2
GAMMARUS	1	1	1.0	0.1
ACRONEURIA	0	1	0.5	0.0
NEOPERLA	0	1	0.5	0.0
POTAMANTHUS	0	1	0.5	0.0
CAENIS	312	164	238.0	15.4
EPHEMERELLA DEFICIENS	1	0	0.5	0.0
ISONYCHIA	23	3	13.0	0.8
STENONEMA	103	75	89.0	5.7
STENONEMA SP#2	5	1	3.0	0.2
SIALIS	8	7	7.5	0.5
HYDROPSYCHIDAE (PUPAE)	3	0	1.5	0.1
CHEUMATOPSYCHE	448	168	308.0	19.9
HYDROPSYCHE BIFIDA GRP	1	0	0.5	0.0
HYDROPSYCHE PHALERATA	30	6	18.0	1.2
HYDROPTILIDAE	11	1	6.0	0.4
CERACLEA	0	1	0.5	0.0
CERACLEA TARSIPUNCTATA	1	1	1.0	0.1
OECETIS	1	4	2.5	0.2
OECETIS CINERACENS	1	0	0.5	0.0
DUBIRAPHIA	1	0	0.5	0.0
STENELMIS	10	4	7.0	0.5
SIMULIIDAE	3	4	3.5	0.2
EMPIDIDAE	2	0	1.0	0.1
CHIRONOMIDAE (PUPAE)	88	39	63.5	4.1
ABLABESMYIA MALLOCHI	0	1	0.5	0.0
CONCHAPELOPIA GRP	120	70	95.0	6.1
CRYPTOCHIRONOMUS	9	4	6.5	0.4
GLYPTOTENDIPES	4	10	7.0	0.5
MICROTENDIPES	9	6	7.5	0.5
POLYPEDILUM	35	12	23.5	1.5
RHEOTANYTARSUS	408	212	310.0	20.0
TANYTARSUS	15	7	11.0	0.7
ZAVRELIA	4	5	4.5	0.3
DIAMESA	4	0	2.0	0.1
EUKIEFFERIELLA	16	1	8.5	0.5
PSECTROCLADIUS	12	4	8.0	0.5
SPHAERIUM	3	1	2.0	0.1
TOTAL ORGANISMS	2112	984	1548	
ORGANISMS/M2	12957	6037	9497	
TOTAL TAXA	35	35	36.5	

Table B-10. Number and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 5 October 1976.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
HYDRA	1	0	0.5	0.0
TURBELLARIA	11	20	15.5	0.4
NEMATODA	63	17	40.0	1.1
NAIDIDAE	93	1022	557.5	15.5
TUBIFICIDAE	19	118	68.5	1.9
PERLIDAE	0	2	1.0	0.0
POTAMANTHUS	4	0	2.0	0.1
CAENIS	8	1	4.5	0.1
ISONYCHIA	5	39	22.0	0.6
STENONEMA	327	276	301.5	8.4
STENONEMA SP#2	0	2	1.0	0.0
SIALIS	1	2	1.5	0.0
NEURECLIPSIS	26	43	34.5	1.0
CHEUMATOPSYCHE	1145	1382	1263.5	35.1
HYDROPSYCHE BIFIDA GRP	0	4	2.0	0.1
HYDROPSYCHE PHALERATA	26	131	78.5	2.2
MACRONEMA ZABRATA	0	1	0.5	0.0
HYDROPTILIDAE	0	3	1.5	0.0
OECETIS	20	20	20.0	0.6
OECETIS CINERACENS	46	47	46.5	1.3
ELMIDAE (ADULTS)	0	1	0.5	0.0
STENELMIS	4	1	2.5	0.1
SIMULIIDAE	1	7	4.0	0.1
SIMULIIDAE (PUPAE)	0	4	2.0	0.1
EMPIDIDAE	72	254	163.0	4.5
CHIRONOMIDAE	2	6	4.0	0.1
CHIRONOMIDAE (PUPAE)	8	58	33.0	0.9
CONCHAPELOPIA GRP	46	196	121.0	3.4
CHIRONOMUS	2	0	1.0	0.0
CRYPTOCHIRONOMUS	2	0	1.0	0.0
ENDOCHIRONOMUS GRP	0	6	3.0	0.1
GLYPTOTENDIPES	19	84	51.5	1.4
PARACHIRONOMUS PECTINATELLAE	0	12	6.0	0.2
POLYPEDILUM	12	26	19.0	0.5
RHEOTANYTARSUS	218	728	473.0	13.1
CRICOTOPUS	33	87	60.0	1.7
EUKIEFFERIELLA	2	12	7.0	0.2
PSECTROCLADIUS	44	272	158.0	4.4
PISIDIUM	9	1	5.0	0.1
SPHAERIUM	16	31	23.5	0.7
TOTAL ORGANISMS	2285	4916	3601	
ORGANISMS/M2	14018	30160	22089	
TOTAL TAXA	29	33	32.0	

Table B-11. Density and percent total of major macroinvertebrate groups collected at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1976.

	APRIL		JUNE		OCTOBER		
	NO./M2	%	NO./M2	%	NO./M2	%	% TOTAL/YEAR
SSES I							
OLIGOCHAETA	896	28.7	2942	25.8	4080	15.7	19.5
EPHEMEROPTERA	117	3.7	2074	18.2	690	2.6	7.1
TRICHOPTERA	18	0.6	3767	33.1	11816	45.3	38.4
COLEOPTERA	98	3.1	98	0.9	52	0.2	0.6
DIPTERA	1847	59.1	2374	20.8	8868	34.0	32.3
PELECYPODA	0	0.0	9	0.1	156	0.6	0.4
MISCELLANEOUS	150	4.8	132	1.2	399	1.5	1.7
SSES II							
OLIGOCHAETA	8006	75.5	834	18.3	1245	10.2	36.8
EPHEMEROPTERA	255	2.4	417	9.2	353	2.9	3.7
TRICHOPTERA	89	0.8	2432	53.5	5807	47.4	30.4
COLEOPTERA	43	0.4	52	1.1	9	0.1	0.4
DIPTERA	2123	20.0	712	15.6	4347	35.5	26.2
PELECYPODA	3	0.0	0	0.0	117	1.0	0.4
MISCELLANEOUS	80	0.8	101	2.2	371	3.0	2.0
BELL BEND I							
OLIGOCHAETA	5810	50.4	1598	16.8	3840	17.4	26.1
EPHEMEROPTERA	656	5.7	2110	22.2	2031	9.2	11.1
TRICHOPTERA	110	1.0	2077	21.9	8877	40.2	25.7
COLEOPTERA	123	1.1	46	0.5	18	0.1	0.4
DIPTERA	4779	41.5	3386	35.7	6788	30.7	34.7
PELECYPODA	3	0.0	12	0.1	175	0.8	0.4
MISCELLANEOUS	49	0.4	267	2.8	359	1.6	1.6

Table B-12. Number of taxa, diversity, and equitability of macroinvertebrates at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1976.

	APRIL			JUNE			OCTOBER		
	TAXA	DIV.	EQU.	TAXA	DIV.	EQU.	TAXA	DIV.	EQU.
SSES I									
REP 1	24	3.06	50.0	26	2.88	38.5	28	2.62	28.6
REP 2	23	2.97	47.8	39	3.14	30.8	31	2.82	32.3
COMBINED	28	3.09	42.9	43	3.04	27.9	33	2.76	27.3
SSES II									
REP 1	28	2.90	35.7	27	2.67	33.3	28	2.92	39.3
REP 2	33	1.44	9.1	21	3.11	57.1	29	2.94	37.9
COMBINED	40	1.78	10.0	28	2.89	35.7	32	2.96	34.4
BELL BEND I									
REP 1	29	2.51	27.6	35	3.31	40.0	29	2.74	31.0
REP 2	37	2.91	29.7	35	3.39	42.9	33	3.23	39.4
COMBINED	45	2.74	20.0	41	3.36	36.6	37	3.18	35.1

Table B-13. Macroinvertebrates collected in the study area of the Susquehanna River, 1971-76 (asterisk denotes 1976 additions).

Porifera
- Spongillidae
  - Spongilla lacustris

Coelenterata
- Hydroida
  - Hydra sp.
- Trachylina
  - Craspedacusta sowerbii

Platyhelminthes
- Turbellaria
  - Dugesia tigrina

Nematoda

Bryozoa
- Lophopodidae
  - Lophopodella carteri
  - Pectinatella magnifica
- Plumatellidae
  - Plumatella repens *

Endoprocta
- Urnatella gracilis

Annelida
- Oligochaeta
  - Lumbricidae
  - Aeolosomatidae
    - Aeolosoma sp.
  - Naididae
    - Chaetogaster langi
    - Nais behningi
    - N. elinguis
    - N. pardalis
    - Pristina schmiederi
    - P. sima
    - Slavina appendiculata
  - Tubicidae
    - Branchiura sowerbyi
    - Limnodrilus hoffmeisteri
    - Peloscolex multisetosus
  - Lumbriculidae
    - Lumbriculus variegatus
- Hirudinea
  - Rhynchobdellida
    - Glossiphoniidae
      - Actinobdella inequiannulata
      - Helobdella stagnalis
      - Placobdella ornata
      - P. parasitica
    - Piscicolidae
      - Myzobdella lugubris
  - Pharyngobdellida
    - Erpobdellidae
      - Erpobdella punctata

Arthropoda
- Crustacea
  - Branchiura
    - Argulus sp.
  - Isopoda
    - Asellus communis
  - Amphipoda
    - Gammarus sp.
    - Hyalella azteca
  - Decapoda
    - Cambarus bartoni
    - Orconectes limosus
    - O. propinquus

Arachnoidea
- Hydracarina

Insecta
- Collembola
  - Sminthuridae
    - Sminthurides aquaticus
  - Isotomidae
    - Isotomurus palustris
- Plecoptera
  - Pteronarcidae
    - Allonarcys biloba
    - Pteronarcys sp.
  - Nemouridae
    - Amphinemura delosa
    - Nemoura sp.
  - Taeniopterygidae
    - Taeniopteryx burski
  - Capniidae
    - Allocapnia sp.
  - Perlidae
    - Acroneuria abnormis
    - A. arida
    - A. lycorias
    - A. ruralis
    - Neoperla clymene
    - Neophasganophora capitata
    - Paragnetina media
    - Perlesta sp. *
  - Perlodidae
    - Isoperla richardsoni
- Ephemeroptera
  - Ephemeridae
    - Ephemera guttulata
    - Hexagenia limbata
  - Potamanthidae
    - Potamanthus verticus
  - Polymitarcidae
    - Ephoron leukon
  - Canidae
    - Caenis sp.
  - Tricorythidae
    - Tricorythodes sp.
  - Ephemerellidae
    - Ephemerella bicolor
    - E. coxalis
    - E. deficiens
    - E. dorothea
    - E. invaria
    - E. needhami
    - E. septentrionalis
    - E. verisimilis
    - E. walkeri
  - Leptophlebiidae
    - Choroterpes sp.
    - Habrophlebia sp.
    - Paraleptophlebia sp.
  - Baetidae
    - Baetis sp.
    - Callibaetis sp.
    - Centroptilum sp.
  - Siphlonuridae
    - Isonychia sp.
    - Siphlonurus quebecensis

Table B-13 (cont.)

Insecta (cont.)
- Heptageniidae
  - *Epeorus*
  - *Heptagenia lucidipennis*
  - *Heptagenia* sp.
  - *Rhithrogena* sp.
  - *Stenonema carolina*
  - *S. fuscum*
  - *S. interpunctatum*
  - *S. ithaca*
- Odonata
  - Gomphidae
    - *Dromogomphus spinosus*
  - Aeschnidae
    - *Boyeria vinosa*
  - Libellulidae
    - *Didymops transversa*
    - *Macromia illinoinesis*
    - *Somatochlora* sp.
  - Agrionidae
    - *Agrion* sp.
  - Coenagrionidae
    - *Argia* sp.
- Hemiptera
  - Gerridae
    - *Gerris* sp.
    - *Metrobates* sp.
    - *Trepobates* sp.
  - Notonectidae
    - *Notonecta* sp.
  - Nepidae
    - *Ranatra* sp.
  - Belostomatidae
    - *Belostoma* sp.
- Megaloptera
  - Sialidae
    - *Sialis vagans*
  - Corydalidae
    - *Chauliodes* sp.
    - *Corydalus cornutus*
- Trichoptera
  - Glossosomatidae
    - *Agapetus* sp.
    - *Glossosoma nigrior* *
    - *Glossosoma* sp.
    - *Protoptila* sp.
  - Philopotamidae
    - *Chimarra obscura*
  - Psychomyiidae
    - *Neureclipsis* sp.
    - *Polycentropus* sp.
    - *Psychomyia flavida* *
    - *Psychomyia* sp.
  - Hydropsychidae
    - *Cheumatopsyche campyla* *
    - *C. speciosa* *
    - *Hydropsyche betteni*
    - *H. bifida* grp.
    - *H. cheilonis* *
    - *H. morosa* *
    - *H. phalerata*
    - *Macronema carolina* *
    - *M. zabrata*
    - *Potamyia* sp.
  - Hydroptilidae
    - *Agralea* sp.
  - Limnephilidae
    - *Limnephilus* sp.
    - *Pycnopsyche guttifer* *
  - Leptoceridae
    - *Ceraclea maculata* *
    - *C. tarsipunctata* *
    - *Ceraclea* sp.
    - *Nectopsyche* sp. *
    - *Oecetis cineracens*
    - *Oecetis* sp.
    - *Triaenoides injusta*
  - Lepidostomatidae
    - *Lepidostoma* sp. *
- Lepidoptera
  - Pyralidae
    - *Nymphula* sp.
    - *Paragyractis* sp. *
- Coleoptera
  - Haliplidae
    - *Peltodytes* sp.
  - Gyrinidae
    - *Dineutus* sp. *
  - Hydrophilidae
    - *Berosus peregrinus*
    - *Helophorus* sp. *
    - *Hydrobius* sp.
    - *Tropisternus* sp.
  - Psephenidae
    - *Psephenus herricki*
  - Dryopidae
    - *Helichus* sp.
  - Elmidae
    - *Dubiraphia vittata*
    - *Macronychus glabratus*
    - *Optioservus* sp.
    - *Promoresia tardella*
    - *Stenelmis bicarinata*
- Diptera
  - Tipulidae
    - *Antocha saxicola* *
    - *Tipula* spp.
  - Psychodidae
  - Chaoboridae
    - *Chaoborus* sp. *
  - Simuliidae
    - *Simuliium vittatum*
  - Stratiomyiidae
  - Rhagionidae
    - *Atherix variegata*
  - Empididae
    - *Hemerodromia* sp.
    - *Roederiodes* sp. *
  - Chironomidae
    - Tanypodinae
      - *Ablabesmyia auriensis* *
      - *A. mallochi*
      - *A. ornata*
      - *A. peleensis*
      - *A. rhamphe*
      - *Conchapelopia* grp.
      - *Procladius* sp.

Table B-13 (cont.)

Chironomidae (cont.)
  Chironominae
    Chironomus attenuatus *
    C. stigmaterus *
    Cladotanytarsus sp. *
    Cryptochironomus fulvus *
    Cryptotendipes sp. *
    Dicrotendipes modestus
    Endochironomus grp.
    Glyptotendipes lobiferous
    Micropsectra sp. *
    Microtendipes sp.
    Parachironomus carinatus *
    P. monochromus *
    P. pectinatellae *
    Polypedilum convictum *
    P. halterale *
    Rheotanytarsus exiguus *
    Stenochironomus sp. *
    Tanytarsus sp.
    Tribelos fusicornis *
    Zavrelia sp.
  Diamesinae
    Diamesa sp.
    Lobodiamesa sp.*
    Pseudodiamesa sp. *
  Orthocladiinae
    Cardiocladius obscurus *
    Corynoneura taris*
    Cricotopus bicinctus
    Cricotopus spp.
    Eukiefferiella coerulescens grp. sp. #1*
    E. coerulescens grp. sp. #2*
    Eukiefferiella sp.
    Heterotrissocladius sp.
    Orthocladius sp.
    Psectrocladius vernalis*
    Psectrocladius sp. #1
    Rheocricotopus sp.
    Synorthocladius sp.*
    Thienemanniella sp.
Ceratopogonidae
    Bezzia sp.

Mollusca
  Gastropoda
    Physidae
      Physa gyrina
    Lymnaeidae
      Lymnea humilis
    Planorbidae
      Gyraulus parvus
      Helisoma trivolvis
    Ancylidae
      Ferrissia sp.
  Pelecypoda
    Sphaeriidae
      Pisidium sp.
      Sphaerium striatinum
      S. transversum
    Unionidae
      Alasmidonta undulata
      A. varicosa
      Anodonta cataracta
      Elliptio complanatus
      Lampsilis cariosa
      Lasmigonia subviridis

Table B-14. Density and percent composition of Chironomidae collected with a dome sampler at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1976.

	APRIL		JUNE		OCTOBER		
	NO./M2	%	NO./M2	%	NO./M2	%	% TOTAL/YEAR
SSES I							
CONCHAPELOPIA	46	2.6	610	26.0	178	2.6	7.5
POLYPEDILUM	89	4.9	245	10.4	80	1.1	3.7
RHEOTANYTARSUS	267	14.8	1255	53.4	5046	72.7	59.2
TANYTARSUS	55	3.1	3	0.1	12	0.2	0.6
CRICOTOPUS	1006	55.9	0	0.0	80	1.1	9.8
EUKIEFFERIELLA	0	0.0	37	1.6	212	3.0	2.2
PSECTROCLADIUS	18	1.0	0	0.0	1055	15.2	9.7
MISCELLANEOUS	319	17.7	199	8.5	279	4.0	7.2
SSES II							
CONCHAPELOPIA	138	6.8	224	31.5	129	3.2	7.2
POLYPEDILUM	120	5.9	83	11.6	61	1.5	3.9
RHEOTANYTARSUS	279	13.8	264	37.1	2344	57.8	42.5
TANYTARSUS	169	8.3	0	0.0	0	0.0	2.5
CRICOTOPUS	902	44.5	0	0.0	224	5.5	16.6
EUKIEFFERIELLA	21	1.1	52	7.3	123	3.0	2.9
PSECTROCLADIUS	95	4.7	0	0.0	1009	24.9	16.3
MISCELLANEOUS	301	14.8	89	12.5	166	4.1	8.2
BELL BEND I							
CONCHAPELOPIA	442	9.5	583	17.4	742	12.9	12.8
POLYPEDILUM	337	7.2	144	4.3	117	2.0	4.3
RHEOTANYTARSUS	561	12.0	1902	56.6	2902	50.5	38.9
TANYTARSUS	294	6.3	67	2.0	0	0.0	2.6
CRICOTOPUS	2043	43.8	0.	0.0	368	6.4	17.5
EUKIEFFERIELLA	61	1.3	52	1.6	43	0.7	1.1
PSECTROCLADIUS	380	8.2	49	1.5	969	16.9	10.2
MISCELLANEOUS	546	11.7	561	16.7	610	10.6	12.5

Table B-15. Percent similarity between macroinvertebrate samples collected at SSES I, SSES II, and Bell Bend I in April, June, and October on the Susquehanna River, 1976.

			APRIL	JUNE	OCTOBER
SSES I	VS.	SSES II	39.6	75.8	85.7
SSES I	VS.	BELL BEND I	54.4	76.1	82.2
SSES II	VS.	BELL BEND I	73.6	60.4	79.0

Table B-16. Coefficient of community between macroinvertebrate samples collected at SSES I, SSES II, and Bell Bend I in April, June, and October on the Susquehanna River, 1976.

			APRIL	JUNE	OCTOBER
SSES I	VS.	SSES II	51.1	47.9	80.6
SSES I	VS.	BELL BEND I	43.1	58.5	70.7
SSES II	VS.	BELL BEND I	51.8	50.0	72.5

Table B-17. Percent similarity between April and June, April and October, and June and October macroinvertebrate samples collected at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1976.

			SSES I	SSES II	BELL BEND I
APRIL	VS.	JUNE	34.4	27.9	36.6
APRIL	VS.	OCTOBER	30.3	22.5	39.3
JUNE	VS.	OCTOBER	65.6	67.6	61.8

Table B-18. Coefficient of community between April and June, April and October, and June and October macroinvertebrate samples collected at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1976.

			SSES I	SSES II	BELL BEND I
APRIL	VS.	JUNE	26.8	30.8	32.3
APRIL	VS.	OCTOBER	38.6	46.9	34.4
JUNE	VS.	OCTOBER	35.7	36.4	56.0

Table B-19. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 28 April 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	1	0.2	<0.1	--	<0.1	--
OLIGOCHAETA	271	46.3	252.7	51.7	52.1	48.1
EPHEMERELLIDAE	7	1.2	47.2	9.7	16.1	14.9
HEPTAGENIIDAE	5	0.9	13.7	2.7	3.6	3.3
HYDROPSYCHIDAE	3	0.5	21.1	4.3	6.3	5.8
LEPTOCERIDAE	1	0.2	<0.1	--	<0.1	--
ELMIDAE	1	0.2	<0.1	--	<0.1	--
SIMULIIDAE	1	0.2	<0.1	--	<0.1	--
EMPIDIDAE	5	0.9	9.5	1.9	2.8	2.6
EMPIDIDAE (PUPAE)	1	0.2	<0.1	--	<0.1	--
CHIRONOMIDAE	251	42.9	119.8	24.5	22.3	20.6
CHIRONOMIDAE (PUPAE)	38	6.5	25.0	5.1	5.2	4.8
TOTAL	585		489.0		108.4	
TOTAL/M2	3589		2996.3		665.0	
BIOMASS (KG/HA)			30.0		6.7	

Table B-20. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 28 June 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
HYDRA	4	0.3	<0.1	--	<0.1	--
TURBELLARIA	2	0.1	<0.1	--	<0.1	--
NEMATODA	3	0.2	<0.1	--	<0.1	--
OLIGOCHAETA	219	15.6	95.3	11.0	18.7	11.8
PISCICOLIDAE	1	0.1	<0.1	--	<0.1	--
GAMMARUS	1	0.1	<0.1	--	<0.1	--
PERLIDAE	2	0.1	<0.1	--	<0.1	--
POTAMANTHIDAE	5	0.4	7.2	0.8	1.4	0.9
CAENIDAE	86	6.1	49.0	5.7	10.5	6.6
EPHEMERELLIDAE	1	0.1	<0.1	--	<0.1	--
SIPHLONURIDAE	23	1.6	55.6	6.4	10.4	6.5
[illegible]TAGENIIDAE	51	3.6	43.0	5.0	7.5	4.7
[illegible]IS	3	0.2	2.9	0.3	0.2	0.1
HYDROPSYCHIDAE	620	44.0	508.7	58.9	91.7	57.7
HYDROPHILIDAE	1	0.1	<0.1	--	<0.1	--
ELMIDAE	6	0.4	1.5	0.2	0.9	0.6
ANTOCHA SAXICOLA	1	0.1	<0.1	--	<0.1	--
SIMULIIDAE	3	0.2	<0.1	--	<0.1	--
CERATOPOGONIDAE	5	0.4	<0.1	--	<0.1	--
CHIRONOMIDAE	351	24.9	95.7	11.1	16.6	10.5
CHIRONOMIDAE (PUPAE)	18	1.3	4.6	0.5	0.9	0.6
SPHAERIIDAE	2	0.1	<0.1	--	<0.1	--
TOTAL	1408		863.5		158.8	
TOTAL/M2	8638		5297.5		974.2	
BIOMASS (KG/HA)			53.0		9.7	

Table B-21. Number, damp weight, dry weight, and percent total of benthic macroinverterbates collected with a dome sampler at SSES I on the Susquehanna River, 6 October 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
TURBELLARIA	7	0.6	6.0	0.6	1.5	0.7
NEMATODA	4	0.4	<0.1	--	<0.1	--
OLIGOCHAETA	72	6.5	29.1	2.7	6.6	3.1
PERLIDAE	5	0.4	<0.1	--	<0.1	--
POTAMANTHIDAE	1	0.1	<0.1	--	<0.1	--
SIPHLONURIDAE	2	0.2	<0.1	--	<0.1	--
HEPTAGENIIDAE	30	2.7	23.7	2.2	4.8	2.3
PSYCHOMYIIDAE	6	0.5	10.7	1.0	1.6	0.8
HYDROPSYCHIDAE	763	68.6	897.3	84.2	177.0	83.6
LEPTOCERIDAE	7	0.6	0.8	0.1	0.5	0.2
ELMIDAE	1	0.1	2.3	0.2	1.3	0.6
ELMIDAE (ADULTS)	1	0.1	0.4	0.0	0.4	0.2
EMPIDIDAE	37	3.3	12.3	1.2	2.9	1.4
CHIRONOMIDAE	110	9.9	17.5	1.6	2.6	1.2
CHIRONOMIDAE (PUPAE)	18	1.6	2.4	0.2	0.3	0.1
SPHAERIIDAE	48	4.3	63.5	6.0	12.1	5.7
TOTAL	1112		1066.0		211.6	
TOTAL/M2	6822		6539.9		1298.2	
BIOMASS (KG/HA)			65.4		13.0	

Table B-22. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 27 April 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	4	1.1	<0.1	--	<0.1	--
OLIGOCHAETA	55	14.6	7.2	2.5	2.0	2.7
CAPNIIDAE	1	0.3	<0.1	--	<0.1	--
PERLIDAE	1	0.3	46.4	16.2	14.2	19.2
POTAMANTHIDAE	1	0.3	1.7	0.6	0.8	1.1
EPHEMERELLIDAE	3	0.8	4.1	1.4	2.0	2.7
HEPTAGENIIDAE	22	5.9	71.1	24.9	18.6	25.2
HYDROPSYCHIDAE	6	1.6	39.2	13.7	10.8	14.6
LEPTOCERIDAE	5	1.3	<0.1	--	<0.1	--
HYDROPHILIDAE	1	0.3	5.3	1.9	1.8	2.4
ELMIDAE	7	1.9	1.5	0.5	1.2	1.6
EMPIDIDAE	7	1.9	4.0	1.4	1.1	1.5
CHIRONOMIDAE	230	61.2	93.1	32.6	17.9	24.2
CHIRONOMIDAE (PUPAE)	33	8.8	12.4	4.3	3.5	4.7
TOTAL	376		286.0		73.9	
TOTAL/M2	2307		1754.6		453.4	
BIOMASS (KG/HA)			17.5		4.5	

Table B-23. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 29 June 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
TURBELLARIA	1	0.2	<0.1	--	<0.1	--
NEMATODA	2	0.5	<0.1	--	<0.1	--
OLIGOCHAETA	28	6.4	13.4	7.1	2.7	6.6
PISCICOLIDAE	1	0.2	<0.1	--	<0.1	--
POTAMANTHIDAE	1	0.2	3.3	1.7	0.9	2.2
CAENIDAE	16	3.7	5.7	3.0	1.4	3.4
SIPHLONURIDAE	3	0.7	<0.1	--	<0.1	--
HEPTAGENIIDAE	15	3.4	13.8	7.3	2.9	7.1
HYDROPSYCHIDAE	303	69.3	139.7	73.7	29.0	71.1
ELMIDAE	10	2.3	2.5	1.3	1.1	2.7
CHIRONOMIDAE	53	12.1	10.6	5.5	2.5	6.1
CHIRONOMIDAE (PUPAE)	4	0.9	0.6	0.3	0.3	0.7
TOTAL	437		189.6		40.8	
TOTAL/M2	2681		1163.2		250.3	
BIOMASS (KG/HA)			11.6		2.5	

Table B-24. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 7 October 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
TURBELLARIA	1	0.1	<0.1	--	<0.1	--
NEMATODA	17	1.8	2.3	0.2	0.9	0.4
OLIGOCHAETA	19	2.0	6.9	0.6	1.6	0.7
GAMMARUS	1	0.1	0.5	0.0	0.2	0.1
PERLIDAE	3	0.3	<0.1	--	<0.1	--
POTAMANTHIDAE	2	0.2	<0.1	--	<0.1	--
EPHEMERELLIDAE	1	0.1	1.4	0.1	0.5	0.2
SIPHLONURIDAE	13	1.4	44.7	3.9	8.6	3.8
HEPTAGENIIDAE	56	5.8	24.0	2.1	4.2	1.9
COENAGRIONIDAE	1	0.1	0.6	0.1	0.1	0.0
SIALIS	5	0.5	83.5	7.3	16.5	7.4
PSYCHOMYIIDAE	19	2.0	48.8	4.3	7.5	3.4
HYDROPSYCHIDAE	611	63.8	882.8	76.9	170.9	76.4
LEPTOCERIDAE	65	6.8	23.2	2.0	5.9	2.6
ELMIDAE	2	0.2	3.7	0.3	1.8	0.8
EMPIDIDAE	12	1.3	2.6	0.2	0.8	0.4
CHIRONOMIDAE	110	11.5	10.3	0.9	1.9	0.8
CHIRONOMIDAE (PUPAE)	15	1.6	0.5	0.0	0.3	0.1
SPHAERIIDAE	5	0.5	12.1	1.1	2.0	0.9
TOTAL	958		1147.9		223.7	
TOTAL/M2	5877		7042.3		1372.4	
BIOMASS (KG/HA)			70.4		13.7	

Table B-25. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 26 April 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	1	0.2	<0.1	--	<0.1	--
OLIGOCHAETA	55	13.4	35.3	10.8	10.4	14.1
POTAMANTHIDAE	2	0.5	8.8	2.7	2.9	3.9
EPHEMERELLIDAE	2	0.5	17.7	5.4	4.3	5.8
HEPTAGENIIDAE	35	8.6	100.9	30.9	24.8	33.5
HYDROPSYCHIDAE	6	1.5	28.1	8.6	5.6	7.6
LEPTOCERIDAE	7	1.7	<0.1	--	<0.1	--
ELMIDAE	9	2.2	4.3	1.3	2.2	3.0
EMPIDIDAE	8	2.0	7.5	2.3	1.9	2.6
EMPIDIDAE (PUPAE)	1	0.2	<0.1	--	<0.1	--
CHIRONOMIDAE	249	60.9	109.4	33.5	19.3	26.1
CHIRONOMIDAE (PUPAE)	27	6.6	11.5	3.5	1.9	2.6
UNIDENTIFIED TERRESTRIAL	6	1.5	3.4	1.0	0.7	0.9
SPHAERIIDAE	1	0.2	<0.1	--	<0.1	--
TOTAL	409		326.9		74.0	
TOTAL/M2	2509		2005.5		454.0	
BIOMASS(KG/HA)			20.1		4.5	

Table B-26. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 30 June 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
HYDRA	10	0.8	<0.1	--	<0.1	--
TURBELLARIA	23	1.9	<0.1	--	<0.1	--
NEMATODA	1	0.1	<0.1	--	<0.1	--
OLIGOCHAETA	101	8.5	79.4	7.7	15.3	7.3
GAMMARUS	1	0.1	<0.1	--	<0.1	--
ASTACIDAE	1	0.1	20.1	1.9	5.1	2.4
POTAMANTHIDAE	2	0.2	32.9	3.2	9.5	4.5
CAENIDAE	141	11.8	95.8	9.3	21.2	10.1
SIPHLONURIDAE	45	3.8	218.8	21.2	44.6	21.2
HEPTAGENIIDAE	102	8.5	97.6	9.4	17.4	8.3
SIALIS	11	0.9	29.5	2.9	4.2	2.0
HYDROPSYCHIDAE	295	24.7	333.7	32.3	70.5	33.5
LEPTOCERIDAE	1	0.1	3.1	0.3	0.7	0.3
ELMIDAE	3	0.3	<0.1	--	<0.1	--
ELMIDAE (ADULTS)	1	0.1	2.4	0.2	1.2	0.6
SIMULIIDAE	4	0.3	<0.1	--	<0.1	--
CERATOPOGONIDAE	2	0.2	<0.1	--	<0.1	--
CHIRONOMIDAE	376	31.5	103.0	10.0	18.4	8.7
CHIRONOMIDAE (PUPAE)	71	6.0	17.7	1.7	2.6	1.2
SPHAERIIDAE	2	0.2	<0.1	--	<0.1	--
TOTAL	1193		1034.0		210.7	
TOTAL/M2	7319		6343.6		1292.6	
BIOMASS(KG/HA)			63.4		12.9	

Table B-27. Number, damp weight, dry weight, and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 5 October 1976.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
TURBELLARIA	6	0.4	12.7	0.7	2.2	0.6
OLIGOCHAETA	50	3.1	16.4	0.9	3.6	1.0
PERLIDAE	2	0.1	<0.1	--	<0.1	--
CAENIDAE	3	0.2	1.3	0.1	0.3	0.1
SIPHLONURIDAE	39	2.4	186.2	9.8	36.5	10.1
HEPTAGENIIDAE	262	16.0	177.7	9.4	27.8	7.7
PSYCHOMYIIDAE	30	1.8	47.8	2.5	6.9	1.9
HYDROPSYCHIDAE	905	55.4	1131.6	59.8	226.2	62.4
LEPTOCERIDAE	17	1.0	4.8	0.3	1.3	0.4
ELMIDAE	1	0.1	1.8	0.1	0.9	0.2
EMPIDIDAE	37	2.3	8.8	0.5	2.0	0.6
CHIRONOMIDAE	195	11.9	71.5	3.8	12.2	3.4
CHIRONOMIDAE (PUPAE)	19	1.2	1.5	0.1	0.4	0.1
SPHAERIIDAE	68	4.2	231.4	12.2	42.2	11.6
TOTAL	1634		1893.5		362.5	
TOTAL/M2	10025		11616.5		2223.9	
BIOMASS(KG/HA)			116.2		22.2	

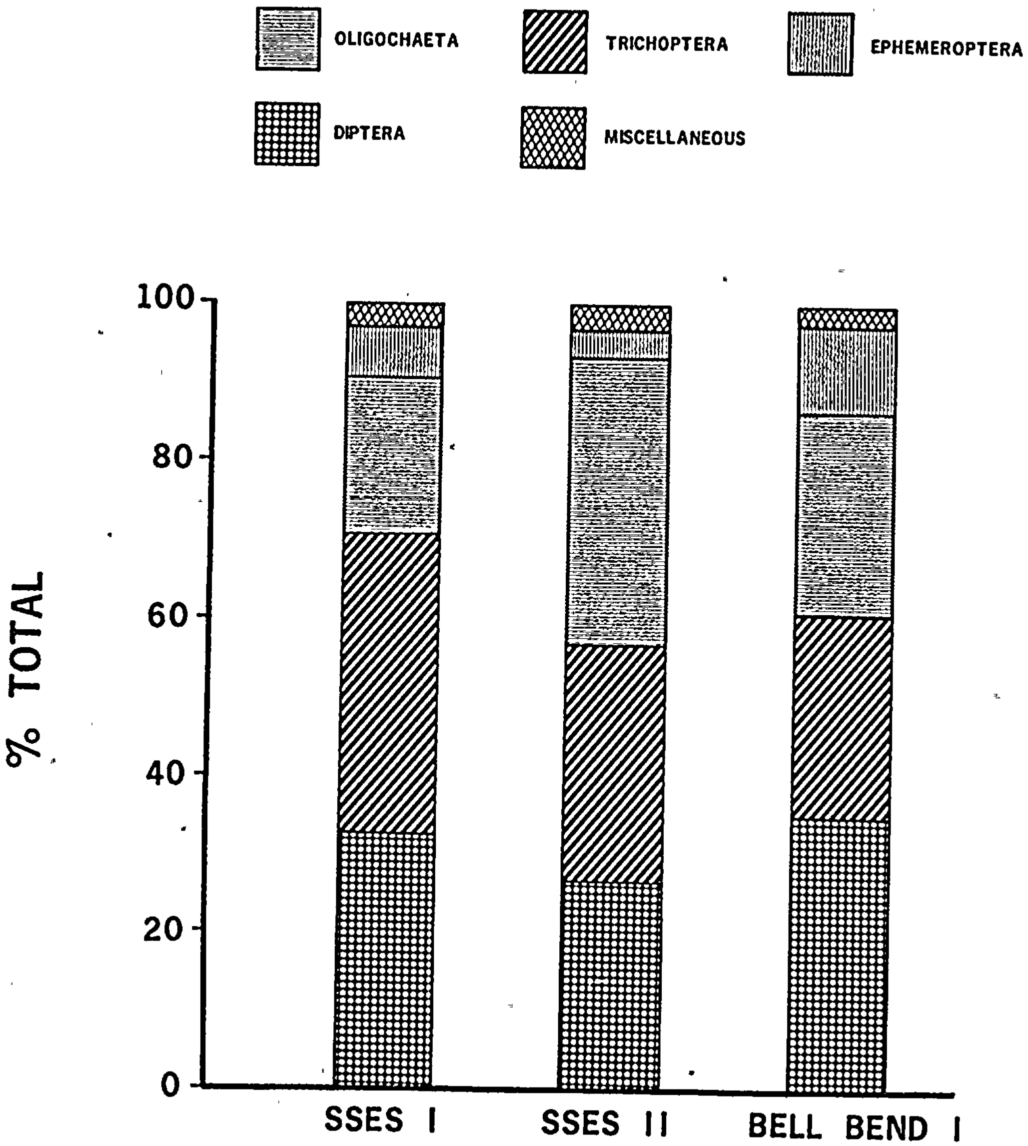

Fig. B-1. Percent composition of major macroinvertebrate groups collected at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1976.

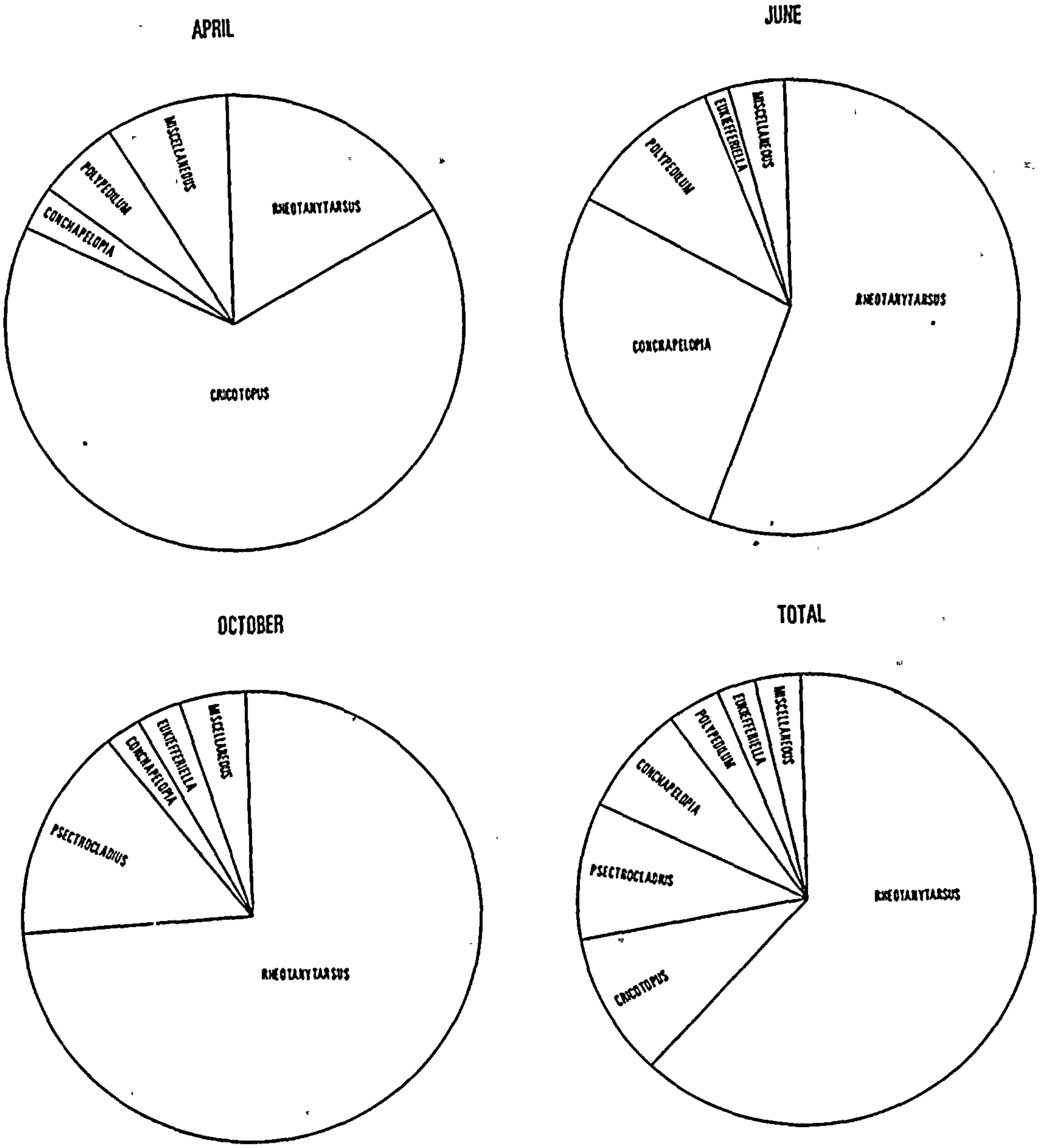

Fig. B-2. Percent composition of Chironomidae collected with a dome sampler at SSES I on the Susquehanna River, 1976.

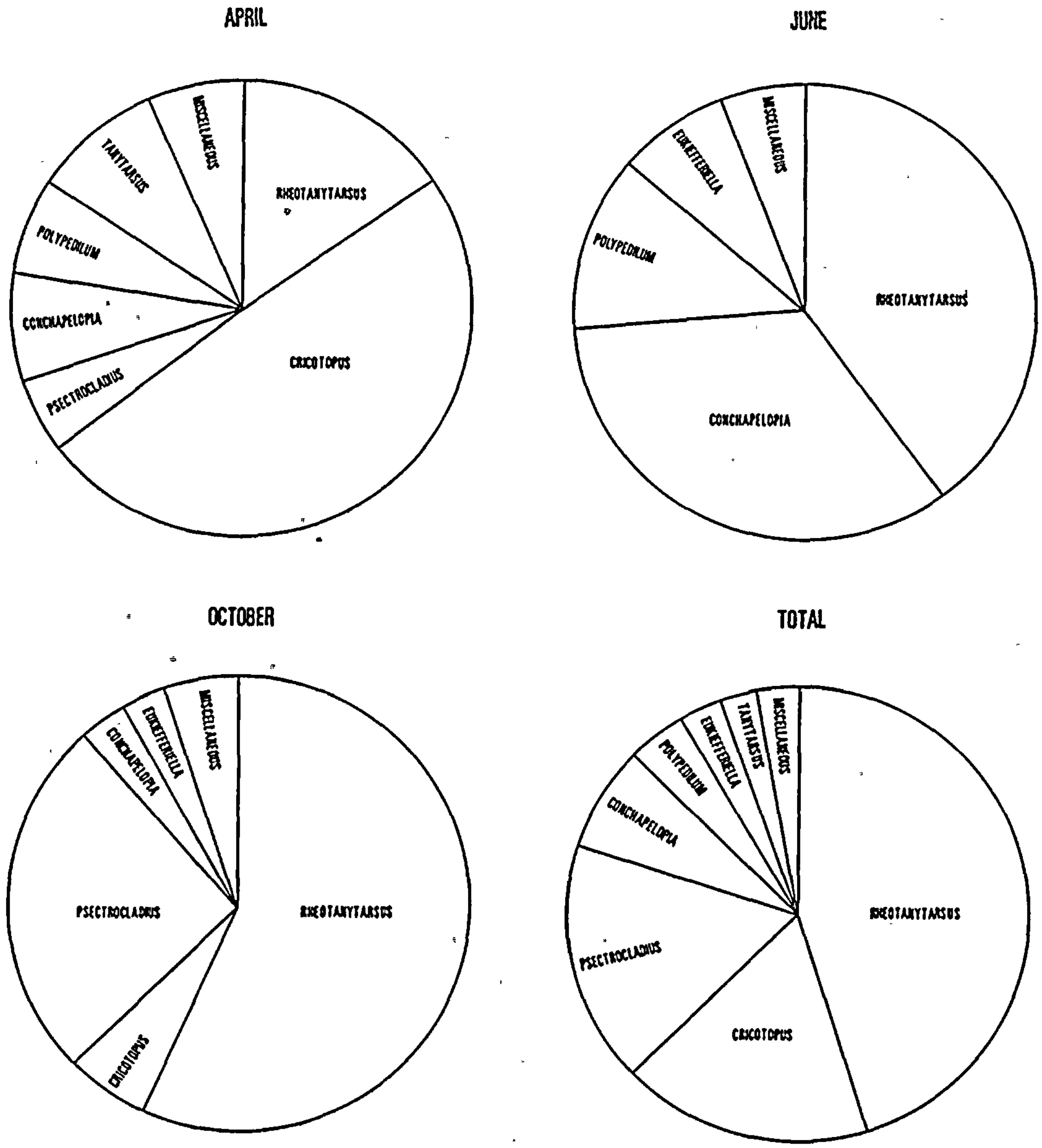

Fig. B-3. Percent composition of Chironomidae collected with a dome sampler at SSES II on the Susquehanna River, 1976.

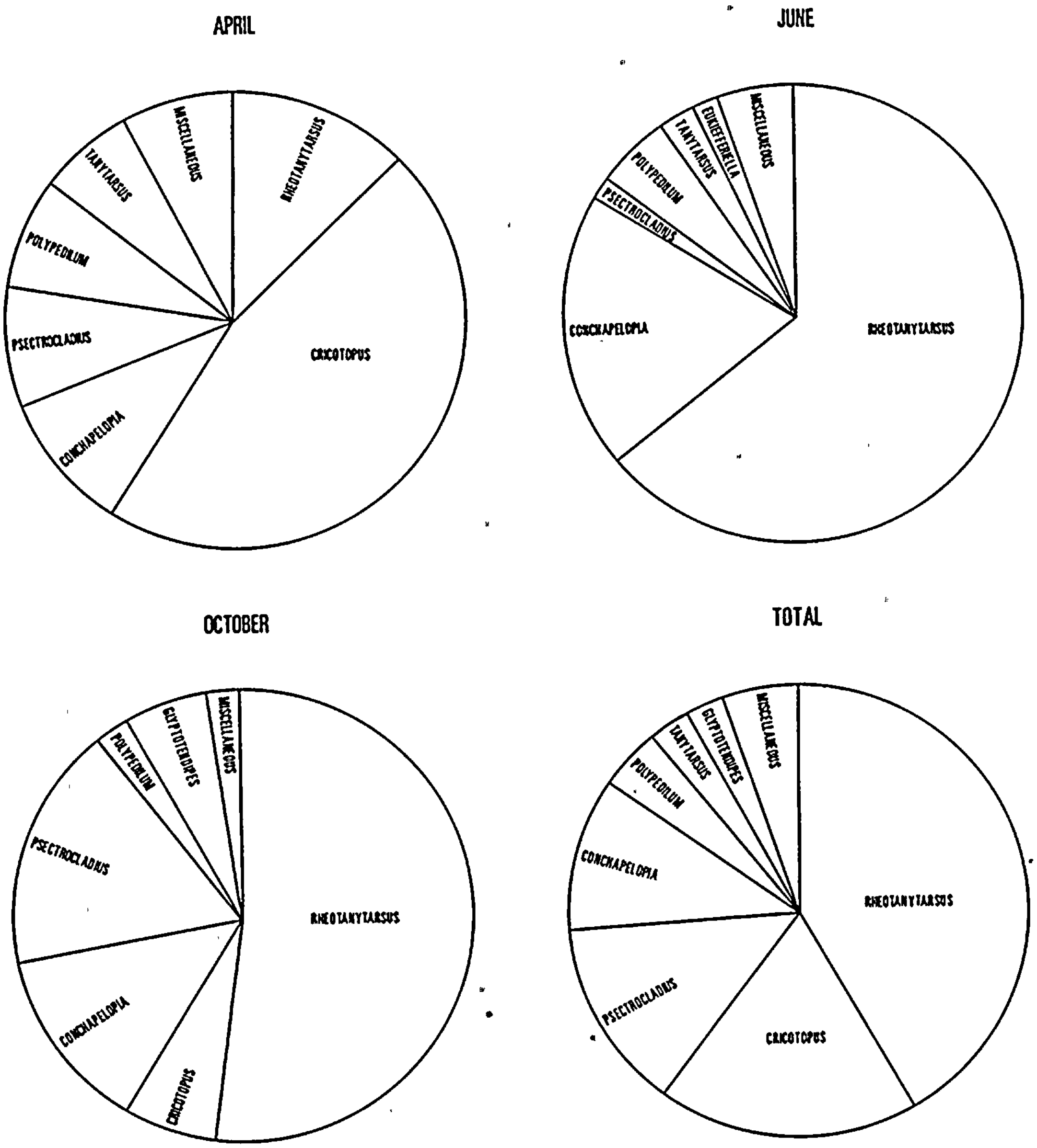

Fig. B-4. Percent composition of Chironomidae collected with a dome sampler at Bell Bend I on the Susquehanna River, 1976.

MACROINVERTEBRATE DRIFT

by

Lynn Sabin

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ABSTRACT

A total of 308 samples collected during diel pumping from June 1973 through May 1974 at SSES and Falls on the Susquehanna River was examined. The mean number of macroinvertebrate drift at SSES was 222.7 organisms/10 m^3 which was nearly twice as many as at Falls (114.1 org/10 m^3). Mean monthly density ranged from 5.2 to 859.1 org/10 m^3. Maximum abundance occurred in June, whereas the minimum was in March. Chironomids were the predominant component of the drift.

INTRODUCTION

Macroinvertebrate drift in the Susquehanna River was sampled monthly from June 1973 through May 1974. Samples were collected at a "control" site upriver at Falls, Pennsylvania (Fig. A-1) and near the Susquehanna SES at SSES (Fig. A-2). Objectives of the study were to determine the abundance and composition of the macroinvertebrate drift and to describe its seasonal and diel fluctuations.

PROCEDURES

A gasoline-powered, 10-cm (4-inch) pump was used to collect samples. The pump was mounted on a pontoon boat anchored in midchannel. The intake was positioned 1 m upstream from the boat and could be lowered and raised using a small hand winch to collect surface or bottom samples. Water was pumped through an interchangeable No. 76 (216 μ) mesh net on which an ABS quick-opening bucket (Gale 1975) was attached. Pumping rate was first estimated by timing the filling of a 1,280-liter trough five times; thereafter, the rate was checked each month by filling the tank twice. A set of four replicate samples was collected at two positions. Surface samples were taken about 50 cm below the water surface. The intake was then lowered to a position within 10-20 cm above the substrate for bottom samples. Visual inspection by a scuba diver revealed that benthic organisms were not drawn from the substrate when the intake was 10 cm or more above it. Samples were preserved in the field with 10% buffered formalin.

A series of samples was collected monthly at 3-h intervals throughout a 24-h period (Table C-1). Sampling usually began near the midpoint of the following intervals: 2230-0100, 0130-0400, 0430-0700, 0730-1000, 1030-1300, 1330-1600, 1630-1900, and 1930-2200 h. Both SSES and Falls were sampled within the same 72-h period and usually when River flow was either stationary or decreasing. This eliminated effects of catastrophic drift, a mechanical response of organisms to the disturbance of the substrate initiated by a great increase in water flow (Waters 1965), and better isolated the behavioral portion of the drift.

Heavy ice floes interrupted sampling in December 1973 at SSES and prevented sampling in December 1973 and January 1974 at Falls. Pump failure interrupted sampling at Falls in August 1973.

Macroscopic organisms were removed from the samples and tabulated. The entire residue (or 1/3 of it, if it was dense) was examined with a dissection microscope at 10X magnification so that minute organisms could be separated and counted. Number of organisms in the residue, after a correction factor (x3) was applied, was added to the total number of macroscopic organisms previously removed. One replicate surface and bottom sample from SSES (Tables C-2 through C-13) and two replicates from Falls (Tables C-14 through C-33) for each sampling interval were examined.

In most instances, invertebrates were identified to the family level. Keys by Claassen (1931), Johannsen (1934-37), Ross (1944), Burks (1953), and Pennak (1953) were used.

RESULTS

Density and Percent Composition

The mean number of drifting macroinvertebrates at SSES (222.7 organisms/10 m^3 of water) was nearly twice that at Falls (114.1 org/10 m^3). Mean monthly density ranged from 25.6 to 859.1 org/10 m^3 at SSES (Tables C-34 and C-35) and from 5.2 to 414.1 org/10 m^3 at Falls (Tables C-36 and C-37). Composition of the drift was similar in bottom and surface samples but density differed. Bottom samples averaged 33% more specimens than surface samples. Numerically dominant groups collected at SSES were midges (69.3%), naidid worms (10.2%), and water mites (7.6%). Midges predominated at Falls (40.9%), but hydropsychid caddisflies (21.9%) and mayflies (Heptageniidae 8.2%, Baetidae 6.6%, Caenidae 6.2%, Ephemeridae 3.8%) were also major components of the drift. Mayflies and caddisflies were more abundant at Falls than at SSES (2- and 5-fold increases, respectively).

Seasonal Fluctuations

At both sites, maximum numbers occurred in June and minimum numbers in March. At SSES, density of macroinvertebrate drift increased in December and January, accompanied by an increase in River flow. Naidid worms (0.1 - 158.9 org/10 m^3), mayflies (0.1 - 68.3 org/10 m^3), and midges (2.5 - 453.1 org/10 m^3) were most abundant in June and least numerous during November (Fig. C-1). The water mites were most abundant in November (51.9 org/10 m^3) with a second, smaller peak in abundance in August (35.9 org/10 m^3). Fewest were taken in February and March (0.7 org/10 m^3). Hydropsychid caddisflies were least abundant in the spring (0.6 org/10 m^3), and most abundant in August (15.4 org/10 m^3). When numbers of macroinvertebrates were adjusted to compensate for fluctuations in River flow (Fig. C-2), a sharp decline in the number of drifting midges was observed in July, possibly as a result of a midsummer emergence.

At Falls, densities of three families of mayflies (Caenidae 41.9 org/10 m^3, Ephemeridae 39.0 org/10 m^3, Heptageniidae 23.8 org/10 m^3) were greatest in June (Fig. C-1). Baetid mayflies were most abundant in August (37.3 org/10 m^3). Numbers of all mayflies were low during November, February, and March. Hydropsychid caddisflies were densest in June (137.5 org/10 m^3) and were also abundant in August (74.4 org/10 m^3). Density then declined to a minimum of 0.2 org/10 m^3 in February. Numbers of midges and elmid beetles were greatest in July (197.0 and 25.6 org/10 m^3, respectively) and lowest during November, February, and March (Fig. C-1).

Diel Periodicity

A nocturnal increase in activity was exhibited by mayflies at both sites, and by caddisflies, elmid beetles, and midges at Falls. Mayflies were most numerous shortly after dusk (52.2 org/10 m^3) and immediately before dawn (47.5 org/10 m^3) at Falls (Fig. C-3). At SSES, only a predawn peak was evident ([illegible] org/10 m^3). Caddisflies were most active near dusk at Falls (43.[illegible] org/10 m^3), slightly earlier than the mayflies. Midges exhibited erratic behavior patterns at SSES, but at Falls they, like mayflies, were most active shortly after dusk (68.7 org/10 m^3) (Fig. C-3).

DISCUSSION

Composition of the invertebrate drift was different at the two sites and reflected that of the benthic community fairly well. Mayflies and caddisflies, traditionally considered "clean-water" taxa, were most abundant at Falls, whereas midges and worms, often indicators of poor water quality, predominated at SSES.

Seasonal variations were probably caused by emergence of adult insects in the late summer and fall. This, however, was not the only factor that controlled invertebrate behavior. The abundance of naidid worms and water mites, which have no emergence periods, also fluctuated broadly. Fluctuations in water temperature and River flow were other factors that may have influenced drift and responses of different taxa to these factors probably vary. Water mites, for instance, were most abundant during months of lowest flow, whereas numbers of organisms in other taxa increased in December and January when River level rose.

Increased nocturnal activity of many macroinvertebrates may have been triggered by fluctuations in light intensity. At Falls, where light penetrated deeper into the water column than at SSES, diel changes in macroinvertebrate drift were more noticeable. Large concentrations of ferric iron limited light penetration at SSES and the bottom was often "totally dark" (Gale and Gale 1976). Photometer readings taken during the summer of 1976 near this site revealed that light did not penetrate to the River bottom. Even so, some taxa still exhibited diel periodicity, indicating that they may have had greater endogenous control of activity patterns, or, alternately, that activity may have been initiated by other external stimuli.

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Table C-1. Sampling dates, mean flow, pumping rate and duration, and number of replicate drift samples collected during diel pumping at SSES and Falls on the Susquehanna River, June 1973 through May 1974.

	Sampling Date		Mean River Flow (m^3/s)[a]		Pumping Rate (liter/min)	Pumping Duration (min/rep)	No. of Replicates	
	SSES	Falls	SSES	Falls			Surface	Bottom
Jun	13-14	12-13	222.0	188.0	1,150	5.5	3	3
Jul	26-27	27-28	95.6	105.2	2,250	5.0	4	4
Aug	21-22	22-23	134.5	105.7	2,250	5.0	4	4
Sep	21-22	22-23	110.5	93.3	2,250	5.0	4	4
Oct	12-13	13-14	69.2	60.0	2,250	5.0	4	4
Nov	16-17	17-18	95.7	100.9	2,250	5.0	4	4
Dec	20-21	--	843.0	--	2,250	5.0	4	4
Jan	26-27	--	960.0	--	2,250	5.0	4	4
Feb	18-19	19-20	244.0	212.5	2,250	5.0	4	4
Mar	18-19	19-20	525.0	483.0	2,250	5.0	4	4
Apr	24-25	25-26	489.5	439.0	2,250	5.0	4	4
May	28-29	29-30	255.5	218.0	2,250	5.0	4	4

[a]Calculated with data provided by the USGS from the Towanda, Old Forge, Wilkes-Barre, and Danville gauging stations (Ichthyological Associates 1974).

Table C-2. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, June 1973.

DATE	13 JUN	13 JUN	13 JUN	14 JUN	14 JUN	14 JUN	14 JUN	14 JUN		
STARTING TIME	1700	2000	2300	0200	0500	0800	1100	1400		
VOL. FILTERED(M3)	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	3	3	4	0	9	9	9	15	6.5	1.8
NAIDIDAE	73	63	29	58	76	91	147	108	80.6	22.6
TUBIFICIDAE	0	0	0	0	0	0	1	0	0.1	0.0
HYDRACARINA	2	5	6	0	2	0	0	3	2.3	0.6
COLLEMBOLA	1	1	3	0	1	0	1	0	0.9	0.2
EPHEMERIDAE	10	6	5	6	19	1	9	13	8.6	2.4
CAENIDAE	3	1	0	8	3	0	9	6	3.8	1.1
BAETIDAE	3	5	28	6	6	0	6	18	9.0	2.5
HEPTAGENIIDAE	4	5	7	4	14	0	7	15	7.0	2.0
COENAGRIONIDAE	0	1	0	0	0	0	0	0	0.1	0.0
HYDROPSYCHIDAE	0	2	0	3	0	3	0	4	1.5	0.4
COLEOPTERA	1	0	0	0	0	0	0	0	0.1	0.0
ELMIDAE	0	0	1	1	1	0	0	0	0.4	0.1
ELMIDAE (ADULTS)	0	0	4	1	0	1	0	0	0.8	0.2
PSYCHODIDAE	0	2	0	0	1	0	0	0	0.4	0.1
CULICIDAE	0	0	0	0	1	0	0	0	0.1	0.0
SIMULIIDAE	2	4	6	3	2	0	0	5	2.8	0.8
EMPIDIDAE	0	1	0	0	0	0	0	0	0.1	0.0
CHIRONOMIDAE	130	196	266	203	242	81	208	359	210.6	59.0
CHIRONOMIDAE (PUPAE)	11	8	90	9	22	2	12	16	21.3	6.0
TOTAL ORGANISMS/SAMPLE	243	303	449	302	399	188	409	562	356.9	
ORGANISMS/10M3	386	481	713	479	633	298	649	892	566.5	
TOTAL TAXA	12	15	12	11	14	7	10	11	12	

DATE	13 JUN	13 JUN	13 JUN	14 JUN	14 JUN	14 JUN	14 JUN	14 JUN		
STARTING TIME	1700	2000	2300	0200	0500	0800	1100	1400		
VOL. FILTERED(M3)	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	4	1	0	26	7	2	13	21	9.3	1.7
NAIDIDAE	77	88	100	131	64	76	169	252	119.6	22.1
TUBIFICIDAE	0	0	0	0	2	0	0	0	0.3	0.0
HYDRACARINA	2	0	0	3	0	6	6	3	2.5	0.5
COLLEMBOLA	1	0	0	3	0	0	0	3	0.9	0.2
EPHEMERIDAE	8	10	13	36	15	19	34	9	18.0	3.3
CAENIDAE	1	3	1	13	5	3	9	6	5.1	0.9
BAETIDAE	14	11	28	37	13	0	17	22	17.8	3.3
HEPTAGENIIDAE	11	8	13	36	13	16	32	5	16.8	3.1
COENAGRIONIDAE	0	1	0	0	0	0	0	0	0.1	0.0
CORIXIDAE	0	0	0	0	0	0	3	0	0.4	0.1
HYDROPSYCHIDAE	1	4	0	0	3	9	3	0	2.5	0.5
LEPTOCERIDAE	1	0	0	0	0	0	0	0	0.1	0.0
COLEOPTERA	0	1	0	0	0	0	0	0	0.1	0.0
ELMIDAE	1	1	2	1	1	0	3	0	1.1	0.2
ELMIDAE (ADULTS)	1	2	1	0	1	3	0	1	1.1	0.2
TIPULIDAE	0	0	0	0	0	0	0	3	0.4	0.1
PSYCHODIDAE	0	0	0	0	4	0	3	1	1.0	0.2
CULICIDAE	0	0	0	3	1	0	0	0	0.5	0.1
SIMULIIDAE	3	5	9	2	5	0	5	4	4.1	0.8
EMPIDIDAE	1	0	0	0	2	0	0	1	0.5	0.1
CERATOPOGONIDAE	0	0	0	0	0	1	0	0	0.1	0.0
CHIRONOMIDAE	361	162	294	434	274	327	377	356	323.1	59.7
CHIRONOMIDAE (PUPAE)	16	6	10	19	16	19	30	11	15.9	2.9
TOTAL ORGANISMS/SAMPLE	503	303	471	744	426	481	704	698	541.3	
ORGANISMS/10M3	798	481	748	1181	676	763	1117	1108	859.1	
TOTAL TAXA	16	14	10	13	16	11	14	15	14	

Table C-3. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, July 1973.

DATE	26 JUL	26 JUL	26 JUL	26 JUL	26 JUL	26 JUL	27 JUL	27 JUL		
STARTING TIME	0830	1130	1430	1730	2030	2330	0230	0530		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	2	9	6	1	0	6	3.1	0.7
NAIDIDAE	6	4	0	6	6	0	0	9	3.9	0.8
HYDRACARINA	18	9	20	60	48	36	6	48	30.6	6.5
CAENIDAE	0	0	6	0	6	0	0	6	2.3	0.5
BAETIDAE	1	3	0	0	0	1	4	1	1.3	0.3
HEPTAGENIIDAE	8	20	9	12	7	19	0	28	12.9	2.7
HYDROPSYCHIDAE	0	6	3	3	0	4	6	12	4.3	0.9
LEPTOCERIDAE	3	0	0	0	0	0	0	0	0.4	0.1
ELMIDAE (ADULTS)	0	0	0	0	0	2	7	1	1.3	0.3
TIPULIDAE	0	0	0	0	0	0	0	3	0.4	0.1
CULICIDAE	0	0	0	0	0	3	0	0	0.4	0.1
SIMULIIDAE	12	8	7	3	10	12	9	32	11.6	2.5
EMPIDIDAE	5	8	0	6	0	3	0	6	3.5	0.7
CHIRONOMIDAE	373	353	388	375	207	369	224	555	355.5	75.5
CHIRONOMIDAE (PUPAE)	25	18	20	6	43	50	31	123	39.5	8.4
PHYSIDAE	1	0	0	0	0	0	0	0	0.1	0.0
TOTAL ORGANISMS/SAMPLE	452	430	455	480	333	500	287	830	470.9	
ORGANISMS/10M3	400	381	403	425	295	442	254	735	416.7	
TOTAL TAXA	10	10	8	9	8	11	7	13	10	

DATE	26 JUL	26 JUL	26 JUL	26 JUL	26 JUL	26 JUL	27 JUL	27 JUL		
STARTING TIME	0830	1130	1430	1730	2030	2330	0230	0530		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	5	19	11	14	15	9	17	5	11.9	1.9
NAIDIDAE	7	0	9	0	3	3	7	3	4.0	0.6
HYDRACARINA	30	42	42	48	70	31	18	60	42.6	6.9
PLECOPTERA	0	3	0	0	1	0	0	0	0.5	0.1
CAENIDAE	0	12	3	0	16	10	3	9	6.6	1.1
BAETIDAE	6	0	1	0	18	8	0	0	4.1	0.7
HEPTAGENIIDAE	22	14	28	6	86	52	9	13	28.8	4.7
HYDROPSYCHIDAE	7	11	1	1	17	7	5	6	6.9	1.1
ELMIDAE	0	0	0	0	6	1	3	0	1.3	0.2
ELMIDAE (ADULTS)	0	0	0	0	2	8	8	0	2.3	0.4
SIMULIIDAE	8	9	4	12	25	15	14	13	12.5	2.0
EMPIDIDAE	8	5	3	6	6	5	3	0	4.5	0.7
EMPIDIDAE (PUPAE)	0	1	0	0	0	0	0	0	0.1	0.0
CHIRONOMIDAE	348	311	372	245	900	490	293	473	429.0	69.4
CHIRONOMIDAE (PUPAE)	59	18	9	20	283	34	21	60	63.0	10.2
TOTAL ORGANISMS/SAMPLE	500	445	483	352	1448	673	401	642	618.0	
ORGANISMS/10M3	442	394	427	312	1281	596	355	568	546.9	
TOTAL TAXA	10	11	11	8	14	13	12	9	11	

Table C-4. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, August 1973.

DATE	21 AUG	21 AUG	21 AUG	21 AUG	21 AUG	21 AUG	22 AUG	22 AUG		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	3	0	0	0	1	0.5	0.1
NAIDIDAE	0	0	2	0	0	0	0	0	0.3	0.1
HYDRACARINA	27	45	66	24	30	21	27	15	31.9	7.9
COLLEMBOLA	0	0	0	0	0	3	6	0	1.1	0.3
CAENIDAE	0	3	0	0	0	0	4	0	0.9	0.2
BAETIDAE	0	0	0	0	0	0	1	0	0.1	0.0
HEPTAGENIIDAE	0	0	0	0	3	1	0	0	0.5	0.1
COENAGRIONIDAE	0	0	0	0	3	3	3	0	1.1	0.3
HYDROPSYCHIDAE	7	53	21	33	27	1	7	5	19.3	4.8
COLEOPTERA	0	0	0	0	0	0	0	1	0.1	0.0
ELMIDAE (ADULTS)	0	0	0	0	0	1	0	0	0.1	0.0
DIPTERA (PUPAE)	0	0	0	0	0	1	0	0	0.1	0.0
TIPULIDAE (PUPAE)	0	0	0	0	3	0	0	0	0.4	0.1
CULICIDAE	0	0	0	0	0	1	0	0	0.1	0.0
SIMULIIDAE	4	5	6	8	13	6	13	6	7.6	1.9
EMPIDIDAE	3	5	5	7	0	2	1	0	2.9	0.7
EMPIDIDAE (PUPAE)	0	0	0	3	0	1	0	0	0.5	0.1
CHIRONOMIDAE	156	675	297	275	379	134	240	88	280.5	69.7
CHIRONOMIDAE (PUPAE)	87	93	31	31	50	45	30	68	54.4	13.5
TOTAL ORGANISMS/SAMPLE	284	879	428	384	508	220	332	184	402.4	
ORGANISMS/10M3	251	778	379	340	450	195	294	163	356.1	
TOTAL TAXA	6	7	7	8	8	13	10	7	8	

DATE	21 AUG	21 AUG	21 AUG	21 AUG	21 AUG	21 AUG	22 AUG	22 AUG		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	1	1	0	1	3	0.8	0.1
NAIDIDAE	0	1	1	0	0	0	0	0	0.3	0.0
HYDRACARINA	36	31	18	24	27	66	81	111	49.3	8.7
COLLEMBOLA	1	0	0	0	3	3	0	0	0.9	0.2
CAENIDAE	0	0	0	0	0	0	9	3	1.5	0.3
HEPTAGENIIDAE	1	0	0	0	0	0	0	0	0.1	0.0
ODONATA	0	0	0	0	3	0	3	0	0.8	0.1
COENAGRIONIDAE	0	0	0	0	3	0	0	3	0.8	0.1
HYDROPSYCHIDAE	16	20	5	8	16	20	18	22	15.6	2.8
ELMIDAE	0	1	4	3	0	2	0	1	1.4	0.2
ELMIDAE (ADULTS)	0	0	0	0	3	0	6	0	1.1	0.2
DIPTERA (PUPAE)	0	0	0	0	0	0	3	3	0.8	0.1
CULICIDAE	0	0	0	0	0	0	0	3	0.4	0.1
SIMULIIDAE	6	22	7	1	19	4	5	12	9.5	1.7
EMPIDIDAE	6	13	12	7	5	12	14	15	10.5	1.9
EMPIDIDAE (PUPAE)	0	0	3	1	1	0	0	3	1.0	0.2
CHIRONOMIDAE	337	560	415	517	287	238	369	527	406.3	72.2
CHIRONOMIDAE (PUPAE)	80	69	38	72	84	29	54	72	62.3	11.1
TOTAL ORGANISMS/SAMPLE	483	717	503	634	452	374	563	778	563.0	
ORGANISMS/10M3	427	635	445	561	400	331	498	688	498.2	
TOTAL TAXA	8	8	9	9	12	8	11	13	10	

Table C-5. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, September 1973.

DATE	21 SEP	21 SEP	21 SEP	21 SEP	21 SEP	21 SEP	21 SEP	22 SEP		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	1	0	0	0	0	0	5	0	0.8	0.4
NAIDIDAE	0	0	3	0	0	0	0	0	0.4	0.2
HYDRACARINA	3	3	9	18	3	9	9	4	7.3	4.2
CAENIDAE	1	0	0	0	0	0	0	0	0.1	0.1
BAETIDAE	0	0	0	0	0	1	0	0	0.1	0.1
HEPTAGENIIDAE	0	0	0	3	0	0	0	1	0.5	0.3
ODONATA	1	0	0	0	0	0	0	0	0.1	0.1
COENAGRIONIDAE	0	0	0	0	0	1	0	0	0.1	0.1
HYDROPSYCHIDAE	3	9	21	12	9	4	16	5	9.9	5.8
SIMULIIDAE	3	1	0	4	0	2	0	1	1.4	0.8
EMPIDIDAE	2	8	6	10	7	3	0	1	4.6	2.7
CHIRONOMIDAE	58	175	164	138	112	130	151	44	121.5	71.0
CHIRONOMIDAE (PUPAE)	22	39	19	41	27	10	21	16	24.4	14.2
TOTAL ORGANISMS/SAMPLE	94	235	222	226	158	160	202	72	171.1	
ORGANISMS/10M3	83	208	196	200	140	142	179	64	151.4	
TOTAL TAXA	9	6	6	7	5	8	5	7	7	

DATE	21 SEP	21 SEP	21 SEP	21 SEP	21 SEP	21 SEP	21 SEP	22 SEP		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	0	0	0	0	0	0	0.1	0.0
NAIDIDAE	9	0	0	0	0	15	7	0	3.9	1.0
HYDRACARINA	39	16	39	30	31	15	15	24	26.1	6.9
BAETIDAE	0	0	0	0	0	0	1	1	0.3	0.1
HEPTAGENIIDAE	1	0	0	0	0	0	0	1	0.3	0.1
TRICHOPTERA (PUPAE)	0	0	3	0	0	0	0	0	0.4	0.1
HYDROPSYCHIDAE	17	3	25	17	27	8	3	6	13.3	3.5
LEPTOCERIDAE	0	0	0	3	0	3	0	6	1.5	0.4
ELMIDAE	0	1	0	0	0	0	0	0	0.1	0.0
TIPULIDAE	0	0	1	0	0	0	0	0	0.1	0.0
SIMULIIDAE	4	2	0	5	0	0	0	2	1.6	0.4
EMPIDIDAE	10	6	23	4	8	31	4	3	11.1	2.9
CHIRONOMIDAE	254	249	248	262	247	638	175	135	276.0	73.1
CHIRONOMIDAE (PUPAE)	36	39	62	55	63	56	7	18	42.0	11.1
PHYSIDAE	0	0	0	0	0	6	0	0	0.8	0.2
TOTAL ORGANISMS/SAMPLE	370	317	401	376	376	772	212	196	377.5	
ORGANISMS/10M3	327	281	355	333	333	683	188	173	334.1	
TOTAL TAXA	8	8	7	7	5	8	7	9	7	

Table C-6. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, October 1973.

DATE	12 OCT	12 OCT	12 OCT	12 OCT	12 OCT	12 OCT	12 OCT	13 OCT		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	0	0	0	0	0	1	3	0.5	1.2
HYDRACARINA	1	17	1	8	31	24	24	26	16.5	40.4
HEPTAGENIIDAE	0	0	0	0	1	0	0	0	0.1	0.3
PSYCHOMYIIDAE	0	0	0	0	0	0	1	0	0.1	0.3
HYDROPSYCHIDAE	0	5	1	4	12	11	10	9	6.5	15.9
LEPTOCERIDAE	0	0	0	0	0	1	0	0	0.1	0.3
SIMULIIDAE	0	1	0	0	0	0	1	0	0.3	0.6
EMPIDIDAE	3	11	0	8	3	4	16	12	7.1	17.4
CHIRONOMIDAE	1	9	2	7	11	8	20	14	9.0	22.0
CHIRONOMIDAE (PUPAE)	0	0	0	0	3	1	1	0	0.6	1.5
TOTAL ORGANISMS/SAMPLE	5	43	4	30	59	49	73	64	40.9	
ORGANISMS/10M3	4	38	4	27	52	43	65	57	36.2	
TOTAL TAXA	3	5	3	5	6	6	7	5	5	

DATE	12 OCT	12 OCT	12 OCT	12 OCT	12 OCT	12 OCT	12 OCT	13 OCT		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
TRICLADIDA	0	0	0	0	0	1	0	0	0.1	0.1
NAIDIDAE	1	1	1	0	6	9	0	3	2.6	1.4
HYDRACARINA	38	5	34	45	78	232	69	39	67.5	36.8
COENAGRIONIDAE	0	0	0	0	0	0	0	1	0.1	0.1
HYDROPSYCHIDAE	11	7	14	5	18	53	16	14	17.3	9.4
LEPTOCERIDAE	0	0	0	0	0	3	0	0	0.4	0.2
SIMULIIDAE	1	0	0	0	0	0	0	0	0.1	0.1
EMPIDIDAE	12	14	24	17	54	65	20	63	33.6	18.3
CHIRONOMIDAE	7	14	17	15	30	286	37	63	58.6	32.0
CHIRONOMIDAE (PUPAE)	0	0	0	0	0	11	3	9	2.9	1.6
PHYSIDAE	0	0	0	0	0	1	0	0	0.1	0.1
TOTAL ORGANISMS/SAMPLE	70	41	90	82	186	661	145	192	183.4	
ORGANISMS/10M3	62	36	80	73	165	585	128	170	162.3	
TOTAL TAXA	6	5	5	4	5	9	5	7	6	

Table C-7. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, November 1973.

DATE	16 NOV	16 NOV	16 NOV	16 NOV	16 NOV	16 NOV	16 NOV	17 NOV		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	1	0	0	0	1	0.3	0.5
TARDIGRADA	0	0	0	3	0	0	0	4	0.9	1.6
NAIDIDAE	0	0	0	0	0	0	0	1	0.1	0.2
HYDRACARINA	30	39	113	139	31	7	5	9	46.6	84.2
EPHEMERIDAE	0	0	0	0	0	0	1	0	0.1	0.2
HEPTAGENIIDAE	0	0	0	0	0	1	0	0	0.1	0.2
HYDROPSYCHIDAE	0	1	0	2	0	1	0	0	0.5	0.9
ELMIDAE	0	0	0	0	1	0	0	1	0.3	0.5
SIMULIIDAE	0	0	0	0	0	0	0	1	0.1	0.2
EMPIDIDAE	2	0	5	14	1	5	1	4	4.0	7.2
CHIRONOMIDAE	4	1	0	7	3	2	1	1	2.4	4.3
TOTAL ORGANISMS/SAMPLE	36	41	118	166	36	16	8	22	55.4	
ORGANISMS/10M3	32	36	104	147	32	14	7	19	49.0	
TOTAL TAXA	3	3	2	6	4	5	4	8	4	

DATE	16 NOV	16 NOV	16 NOV	16 NOV	16 NOV	16 NOV	16 NOV	17 NOV		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
TRICLADIDA	0	0	0	0	1	0	0	0	0.1	0.2
HYDRACARINA	79	119	85	184	34	20	19	25	70.6	85.2
COLLEMBOLA	0	0	1	0	0	0	0	1	0.3	0.3
HYDROPSYCHIDAE	0	1	1	2	0	3	0	1	1.0	1.2
ELMIDAE	0	0	2	0	0	0	0	0	0.3	0.3
EMPIDIDAE	2	6	6	23	4	3	12	3	7.4	8.9
CHIRONOMIDAE	0	2	0	3	4	4	4	3	2.5	3.0
CHIRONOMIDAE (PUPAE)	0	0	0	0	0	0	2	4	0.8	0.9
TOTAL ORGANISMS/SAMPLE	81	128	95	212	43	30	37	37	82.9	
ORGANISMS/10M3	72	113	84	188	38	27	33	33	73.3	
TOTAL TAXA	2	4	5	4	4	4	4	6	4	

Table C-8. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, December 1973.

DATE	20 DEC	20 DEC	20 DEC	20 DEC	20 DEC		
STARTING TIME	0900	1200	1500	1800	2400		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	6	6	0	3	0	3.0	2.0
TARDIGRADA	3	3	0	0	0	1.2	0.8
NAIDIDAE	28	44	9	0	13	18.8	12.5
TUBIFICIDAE	0	13	0	0	0	2.6	1.7
HYDRACARINA	21	21	15	3	9	13.8	9.2
COLLEMBOLA	3	6	0	6	9	4.8	3.2
PLECOPTERA	0	0	0	0	3	0.6	0.4
EPHEMEROPTERA	3	12	0	3	0	3.6	2.4
BAETIDAE	0	0	4	0	0	0.8	0.5
HEPTAGENIIDAE	3	7	0	0	3	2.6	1.7
HYDROPSYCHIDAE	3	12	4	3	1	4.6	3.1
COLEOPTERA	0	3	0	0	0	0.6	0.4
HYDROPHILIDAE	0	0	0	0	3	0.6	0.4
ELMIDAE	0	4	3	0	0	1.4	0.9
PSYCHODIDAE	1	1	1	0	3	1.2	0.8
SIMULIIDAE	0	0	0	0	3	0.6	0.4
EMPIDIDAE	3	6	1	6	9	5.0	3.3
CHIRONOMIDAE	81	188	49	32	74	84.8	56.3
TOTAL ORGANISMS/SAMPLE	155	326	86	56	130	150.6	
ORGANISMS/10M3	137	288	76	50	115	111.1	
TOTAL TAXA	11	14	8	7	11	10	

DATE	20 DEC	20 DEC	20 DEC	20 DEC	20 DEC		
STARTING TIME	0900	1200	1500	1800	2400		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	9	4	1	0	0	2.8	1.8
TARDIGRADA	3	0	0	0	0	0.6	0.4
NAIDIDAE	58	44	0	6	25	26.6	16.7
TUBIFICIDAE	1	0	0	0	1	0.4	0.3
HIRUDINEA	0	0	0	0	1	0.2	0.1
HYDRACARINA	6	24	18	6	30	16.8	10.5
COLLEMBOLA	9	3	0	3	12	5.4	3.4
EPHEMEROPTERA	0	3	0	0	9	2.4	1.5
BAETIDAE	1	0	0	0	0	0.2	0.1
HEPTAGENIIDAE	12	6	0	0	6	4.8	3.0
HYDROPSYCHIDAE	3	2	1	1	10	3.4	2.1
PSYCHODIDAE	0	3	0	0	6	1.8	1.1
SIMULIIDAE	3	0	0	0	0	0.6	0.4
EMPIDIDAE	0	6	0	0	12	3.6	2.3
CERATOPOGONIDAE	3	0	0	0	0	0.6	0.4
CHIRONOMIDAE	95	105	55	22	170	89.4	56.0
TOTAL ORGANISMS/SAMPLE	203	200	75	38	282	159.6	
ORGANISMS/10M3	180	177	66	34	250	117.7	
TOTAL TAXA	12	10	4	5	11	8	

Table C-9. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, January 1974.

DATE	26 JAN	26 JAN	26 JAN	26 JAN	27 JAN	27 JAN	27 JAN	27 JAN		
STARTING TIME	1400	1700	2000	2300	0200	0500	0800	1100		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	1	0	0	9	4	11	3.1	3.8
NAIDIDAE	3	4	1	4	4	0	2	4	2.8	3.4
AMPHIPODA	0	0	0	0	1	0	0	0	0.1	0.2
HYDRACARINA	0	0	0	3	0	3	0	0	0.8	0.9
COLLEMBOLA	3	3	0	9	0	0	0	0	1.9	2.3
NEMOURIDAE	0	0	0	0	1	0	0	0	0.1	0.2
EPHEMEROPTERA	0	0	0	6	3	0	0	3	1.5	1.8
BAETIDAE	0	0	0	1	0	0	0	0	0.1	0.2
HEPTAGENIIDAE	3	0	0	8	0	0	3	3	2.1	2.6
PHILOPOTAMIDAE	1	0	0	0	0	0	0	0	0.1	0.2
PSYCHOMYIIDAE	0	1	0	0	0	0	0	2	0.4	0.5
HYDROPSYCHIDAE	2	0	5	3	1	7	2	2	2.8	3.4
ELMIDAE	0	0	0	0	0	0	3	3	0.8	0.9
CHAOBORIDAE	0	0	0	1	0	0	0	0	0.1	0.2
EMPIDIDAE	3	0	4	0	0	1	0	0	1.0	1.2
CHIRONOMIDAE	126	69	39	82	39	49	39	66	63.6	78.3
TOTAL ORGANISMS/SAMPLE	141	77	50	117	49	69	53	94	81.3	
ORGANISMS/10M3	125	68	44	104	43	61	47	83	71.9	
TOTAL TAXA	7	4	5	9	6	5	6	8	6	

DATE	26 JAN	26 JAN	26 JAN	26 JAN	27 JAN	27 JAN	27 JAN	27 JAN		
STARTING TIME	1400	1700	2000	2300	0200	0500	0800	1100		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	6	0	0	12	6	3.0	1.9
NAIDIDAE	8	6	12	0	4	9	3	4	5.8	3.7
TUBIFICIDAE	0	1	0	0	1	1	0	0	0.4	0.2
AMPHIPODA	0	1	0	0	0	0	0	0	0.1	0.1
HYDRACARINA	6	3	6	0	0	0	3	0	2.3	1.5
COLLEMBOLA	0	3	0	0	3	0	0	6	1.5	1.0
EPHEMEROPTERA	3	6	3	6	0	6	0	3	3.4	2.2
EPHEMERIDAE	0	0	0	0	1	0	0	0	0.1	0.1
BAETIDAE	1	0	0	0	0	0	0	1	0.3	0.2
HEPTAGENIIDAE	3	10	3	3	3	0	0	10	4.0	2.6
COENAGRIONIDAE	0	0	0	0	0	0	0	1	0.1	0.1
CORIXIDAE	0	1	0	0	0	0	0	0	0.1	0.1
GLOSSOSOMATIDAE	0	0	0	0	1	0	0	0	0.1	0.1
PHILOPOTAMIDAE	0	0	0	0	1	0	0	0	0.1	0.1
PSYCHOMYIIDAE	1	0	0	0	0	0	0	0	0.1	0.1
HYDROPSYCHIDAE	5	8	3	4	1	6	8	2	4.6	3.0
HYDROPTILIDAE	0	0	0	0	3	4	0	3	1.3	0.8
LEPTOCERIDAE	0	3	0	0	0	0	0	0	0.4	0.2
LEPIDOPTERA	0	0	0	0	0	1	0	0	0.1	0.1
PSEPHENIDAE	0	0	0	0	0	0	3	0	0.4	0.2
ELMIDAE	3	1	0	3	0	0	0	0	0.9	0.6
TIPULIDAE	0	0	1	0	0	0	3	0	0.5	0.3
PSYCHODIDAE	0	0	3	0	0	0	0	6	1.1	0.7
CHAOBORIDAE	0	0	0	0	0	3	0	0	0.4	0.2
STRATIOMYIIDAE	0	0	0	0	0	0	1	0	0.1	0.1
EMPIDIDAE	0	3	0	4	0	0	0	1	1.0	0.6
CERATOPOGONIDAE	0	3	0	3	0	3	0	0	1.1	0.7
CHIRONOMIDAE	127	126	143	149	93	83	99	142	120.3	78.1
CHIRONOMIDAE (PUPAE)	0	0	0	0	0	0	3	0	0.4	0.2
TOTAL ORGANISMS/SAMPLE	157	175	174	178	111	116	135	185	153.9	
ORGANISMS/10M3	139	155	154	158	98	103	119	164	136.2	
TOTAL TAXA	9	14	8	8	10	9	9	12	10	

Table C-10. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, February 1974.

DATE	18 FEB	18 FEB	18 FEB	18 FEB	18 FEB	19 FEB	19 FEB	19 FEB		
STARTING TIME	1200	1500	1800	2100	2400	0300	0600	0900		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	1	0	1	6	0	1	0	0	1.1	1.8
NAIDIDAE	4	2	0	0	3	3	1	3	2.0	3.2
HYDRACARINA	3	0	0	0	0	0	3	0	0.8	1.2
COLLEMBOLA	0	0	0	0	0	3	4	0	0.9	1.4
PERLIDAE	0	0	0	0	1	0	0	0	0.1	0.2
EPHEMEROPTERA	0	0	0	3	0	0	3	3	1.1	1.8
HEPTAGENIIDAE	0	0	0	3	0	6	3	1	1.6	2.6
HYDROPSYCHIDAE	5	1	0	0	0	0	0	0	0.8	1.2
HYDROPTILIDAE	0	0	0	3	0	0	0	0	0.4	0.6
ELMIDAE	0	0	0	0	0	1	0	0	0.1	0.2
PSYCHODIDAE	0	3	0	0	0	0	0	0	0.4	0.6
EMPIDIDAE	1	0	1	3	0	0	0	0	0.6	1.0
CHIRONOMIDAE	68	111	25	71	22	26	69	35	53.4	84.4
TOTAL ORGANISMS/SAMPLE	82	117	27	89	26	40	83	42	63.3	
ORGANISMS/10M3	73	104	24	79	23	35	73	37	56.0	
TOTAL TAXA	6	4	3	6	3	6	6	4	5	

DATE	18 FEB	18 FEB	18 FEB	18 FEB	18 FEB	19 FEB	19 FEB	19 FEB		
STARTING TIME	1200	1500	1800	2100	2400	0300	0600	0900		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	6	0	0	0	0	0.8	1.0
NAIDIDAE	8	0	0	6	0	1	2	1	2.3	2.9
TUBIFICIDAE	0	0	0	1	0	0	0	0	0.1	0.2
HYDRACARINA	0	0	0	3	0	0	0	3	0.8	1.0
COLLEMBOLA	6	0	0	0	0	3	10	3	2.8	3.6
PERLIDAE	3	1	0	0	0	0	1	2	0.9	1.1
EPHEMEROPTERA	3	4	0	0	0	6	0	3	2.0	2.6
CAENIDAE	0	0	0	0	0	6	0	0	0.8	1.0
EPHEMERELLIDAE	0	0	0	1	0	0	0	0	0.1	0.2
BAETIDAE	1	0	0	0	3	0	3	0	0.9	1.1
HEPTAGENIIDAE	2	0	0	1	0	3	1	6	1.6	2.1
PSYCHOMYIIDAE	0	0	0	1	0	0	0	0	0.1	0.2
HYDROPSYCHIDAE	2	0	4	0	2	3	2	4	2.1	2.8
TIPULIDAE	3	0	0	0	0	0	1	0	0.5	0.7
CULICIDAE	0	3	0	0	0	0	0	0	0.4	0.5
EMPIDIDAE	2	0	0	0	4	0	0	3	1.1	1.5
CHIRONOMIDAE	119	52	20	47	35	62	59	79	59.1	77.4
CHIRONOMIDAE (PUPAE)	0	0	0	0	1	0	0	0	0.1	0.2
TOTAL ORGANISMS/SAMPLE	149	60	24	66	45	84	79	104	76.4	
ORGANISMS/10M3	132	53	21	58	40	74	70	92	67.6	
TOTAL TAXA	10	4	2	8	5	7	8	9	7	

Table C-11. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, March 1974.

DATE	18 MAR	18 MAR	18 MAR	18 MAR	18 MAR	19 MAR	19 MAR	19 MAR		
STARTING TIME	1100	1400	1700	2000	2300	0200	0500	0800		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	6	3	0	0	0	0	1.1	3.9
NAIDIDAE	1	3	1	4	1	0	2	0	1.5	5.2
TUBIFICIDAE	5	1	4	0	1	4	0	1	2.0	6.9
HYDRACARINA	0	0	3	3	0	0	0	0	0.8	2.6
PLECOPTERA	0	0	3	0	0	0	0	0	0.4	1.3
BAETIDAE	0	0	0	0	1	0	0	0	0.1	0.4
HEPTAGENIIDAE	0	0	0	0	4	1	)	0	0.6	2.2
PSYCHOMYIIDAE	0	0	1	0	0	1	0	0	0.3	0.9
HYDROPSYCHIDAE	0	0	1	0	0	2	0	0	0.4	1.3
LEPTOCERIDAE	0	0	0	0	0	0	1	0	0.1	0.4
PSYCHODIDAE	0	0	0	1	0	0	0	0	0.1	0.4
EMPIDIDAE	0	3	0	0	0	0	0	0	0.4	1.3
CHIRONOMIDAE	25	11	39	12	25	17	28	12	21.1	73.2
TOTAL ORGANISMS/SAMPLE	31	18	58	23	32	25	31	13	28.9	
ORGANISMS/10M3	27	16	51	20	28	22	27	12	25.6	
TOTAL TAXA	3	4	8	5	5	5	3	2	4	

DATE	18 MAR	18 MAR	18 MAR	18 MAR	18 MAR	19 MAR	19 MAR	19 MAR		
STARTING TIME	1100	1400	1700	2000	2300	0200	0500	0800		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	1	0	0	0	0	0.1	0.3
NAIDIDAE	2	1	3	1	6	0	1	0	1.8	4.9
TUBIFICIDAE	0	3	1	1	0	0	0	1	0.8	2.1
HYDRACARINA	0	0	0	6	0	0	0	0	0.8	2.1
COLLEMBOLA	0	0	0	12	0	3	0	0	1.9	5.2
EPHEMEROPTERA	0	0	0	0	0	3	0	0	0.4	1.0
BAETIDAE	0	0	0	1	0	0	0	0	0.1	0.3
HEPTAGENIIDAE	0	0	3	7	0	3	0	0	1.6	4.5
HYDROPSYCHIDAE	0	3	4	0	1	0	2	0	1.3	3.5
PSYCHODIDAE	0	0	0	0	3	3	0	0	0.8	2.1
EMPIDIDAE	0	0	3	0	0	0	0	0	0.4	1.0
CHIRONOMIDAE	26	22	39	42	35	20	13	12	26.1	72.8
TOTAL ORGANISMS/SAMPLE	28	29	53	71	45	32	16	13	35.9	
ORGANISMS/10M3	25	26	47	63	40	28	14	12	31.7	
TOTAL TAXA	2	4	6	8	4	5	3	2	4	

Table C-12. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, April 1974.

DATE	24 APR	24 APR	24 APR	24 APR	24 APR	24 APR	24 APR	25 APR		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	1	1	0	2	3	2	0	0	1.1	1.7
NAIDIDAE	1	7	0	4	3	2	4	0	2.6	3.9
TUBIFICIDAE	0	1	1	0	0	0	1	0	0.4	0.6
HYDRACARINA	15	12	0	6	9	0	3	0	5.6	8.3
COLLEMBOLA	0	0	0	0	0	3	0	0	0.4	0.6
EPHEMERIDAE	0	1	0	0	0	0	0	0	0.1	0.2
EPHEMERELLIDAE	0	0	1	0	0	0	0	0	0.1	0.2
BAETIDAE	0	0	1	0	0	0	1	0	0.3	0.4
HEPTAGENIIDAE	0	0	0	0	0	3	2	3	1.0	1.5
PSYCHOMYIIDAE	1	0	0	0	1	0	0	0	0.3	0.4
HYDROPSYCHIDAE	0	0	0	0	1	0	0	0	0.1	0.2
HYDROPTILIDAE	0	0	0	6	0	0	0	0	0.8	1.1
ELMIDAE	0	0	4	0	0	0	4	1	1.1	1.7
ELMIDAE (ADULTS)	0	0	0	0	0	3	0	0	0.4	0.6
EMPIDIDAE	4	4	0	2	0	0	1	0	1.4	2.0
CHIRONOMIDAE	23	54	54	91	73	36	61	24	52.0	76.6
CHIRONOMIDAE (PUPAE)	0	0	0	0	0	0	1	1	0.3	0.4
TOTAL ORGANISMS/SAMPLE	45	80	61	111	90	49	78	29	67.9	
ORGANISMS/10M3	40	71	54	98	80	43	69	26	60.1	
TOTAL TAXA	6	7	5	6	6	6	9	4	6	

DATE	24 APR	24 APR	24 APR	24 APR	24 APR	24 APR	24 APR	25 APR		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	1	0	0	0	0	0	0.1	0.1
NAIDIDAE	9	3	1	11	7	10	1	4	5.8	5.2
TUBIFICIDAE	0	0	0	2	1	1	4	0	1.0	0.9
AMPHIPODA	0	0	0	0	0	0	1	0	0.1	0.1
HYDRACARINA	3	18	18	3	6	39	0	3	11.3	10.2
EPHEMEROPTERA	0	0	0	0	0	0	1	0	0.1	0.1
CAENIDAE	0	0	0	0	0	0	3	0	0.4	0.3
EPHEMERELLIDAE	3	0	0	0	0	0	0	0	0.4	0.3
BAETIDAE	0	0	0	0	1	0	1	1	0.4	0.3
HEPTAGENIIDAE	3	0	0	0	0	1	2	8	1.8	1.6
PSYCHOMYIIDAE	0	0	0	0	0	1	1	0	0.3	0.2
HYDROPSYCHIDAE	1	1	3	2	13	1	3	1	3.1	2.8
HYDROPTILIDAE	0	3	0	0	0	0	3	3	1.1	1.0
LEPTOCERIDAE	0	0	0	0	0	0	0	3	0.4	0.3
ELMIDAE	0	6	0	0	0	3	0	1	1.3	1.1
ELMIDAE (ADULTS)	0	0	0	4	0	0	0	0	0.5	0.5
PSYCHODIDAE	0	0	0	0	3	0	0	0	0.4	0.3
EMPIDIDAE	1	4	1	4	4	0	4	4	2.8	2.5
CHIRONOMIDAE	94	73	73	79	92	104	64	42	77.6	70.5
CHIRONOMIDAE (PUPAE)	1	0	0	0	5	3	0	3	1.5	1.4
TOTAL ORGANISMS/SAMPLE	115	108	97	105	132	163	88	73	110.1	
ORGANISMS/10M3	102	96	86	93	117	144	78	65	97.5	
TOTAL TAXA	8	7	6	7	9	9	12	11	9	

Table C-13. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples collected during diel pumping at SSES on the Susquehanna River, May 1974.

DATE	28 MAY	28 MAY	28 MAY	28 MAY	28 MAY	28 MAY	28 MAY	29 MAY		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	47	61	67	32	52	74	116	85	66.8	36.6
HYDRACARINA	0	0	0	1	3	0	0	0	0.5	0.3
BAETIDAE	11	16	10	4	9	16	37	15	14.8	8.1
HEPTAGENIIDAE	6	6	1	3	1	6	35	25	10.4	5.7
MEGALOPTERA	3	0	0	0	0	0	0	3	0.8	0.4
HYDROPSYCHIDAE	0	0	0	3	0	0	3	0	0.8	0.4
ELMIDAE (ADULTS)	0	0	0	0	0	0	0	1	0.1	0.1
PSYCHODIDAE	3	0	0	0	0	0	0	0	0.4	0.2
SIMULIIDAE	0	0	0	0	1	1	3	2	0.9	0.5
EMPIDIDAE	0	0	1	0	0	0	3	0	0.5	0.3
CHIRONOMIDAE	89	78	90	52	68	82	128	75	82.8	45.3
CHIRONOMIDAE (PUPAE)	4	0	2	0	9	9	7	1	4.0	2.2
TOTAL ORGANISMS/SAMPLE	163	161	171	95	143	188	332	207	182.5	
ORGANISMS/10M3	144	142	151	84	127	166	294	183	161.5	
TOTAL TAXA	7	4	6	6	7	6	8	8	7	

DATE	28 MAY	28 MAY	28 MAY	28 MAY	28 MAY	28 MAY	28 MAY	29 MAY		
STARTING TIME	0600	0900	1200	1500	1800	2100	2400	0300		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	3	0	0	0	0	0	3	0.8	0.3
NAIDIDAE	121	101	90	137	137	59	87	86	102.3	36.3
TUBIFICIDAE	2	0	0	0	0	1	0	4	0.9	0.3
ISOPODA	0	0	0	0	3	0	0	0	0.4	0.1
HYDRACARINA	18	0	7	3	0	3	0	3	4.3	1.5
COLLEMBOLA	3	3	0	3	0	0	0	0	1.1	0.4
CAENIDAE	0	0	0	0	3	0	0	0	0.4	0.1
BAETIDAE	17	18	22	13	10	26	47	50	25.4	9.0
HEPTAGENIIDAE	6	3	6	6	2	21	13	40	12.1	4.3
HYDROPSYCHIDAE	0	0	0	0	0	3	0	1	0.5	0.2
ELMIDAE	3	0	0	0	0	3	0	0	0.8	0.3
ELMIDAE (ADULTS)	0	3	0	0	0	0	1	11	1.9	0.7
SIMULIIDAE	3	0	3	0	3	4	4	9	3.3	1.2
SIMULIIDAE (PUPAE)	0	0	0	1	0	0	0	0	0.1	0.0
EMPIDIDAE	0	0	3	0	0	4	0	0	0.9	0.3
CHIRONOMIDAE	130	99	117	123	104	118	121	160	121.5	43.2
CHIRONOMIDAE (PUPAE)	7	6	2	5	2	4	7	7	5.0	1.8
TOTAL ORGANISMS/SAMPLE	310	236	250	291	264	246	280	374	281.4	
ORGANISMS/10M3	274	209	221	258	234	218	248	331	249.0	
TOTAL TAXA	10	8	8	8	8	11	7	11	9	

Table C-14. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, June 1973.

DATE	12 JUN	12 JUN	12 JUN	12 JUN	12 JUN	13 JUN	13 JUN	13 JUN		
STARTING TIME	1030	1330	1630	1930	2230	0130	0430	0730		
VOL. FILTERED(M3)	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	0	0	9	1	0	0	1.4	0.8
NAIDIDAE	1	1	1	1	1	0	0	2	0.9	0.5
HIRUDINEA	0	0	0	0	1	0	0	0	0.1	0.1
ISOPODA	0	0	0	1	0	0	0	0	0.1	0.1
HYDRACARINA	0	7	1	4	3	0	2	0	2.1	1.2
COLLEMBOLA	0	0	0	0	0	0	0	1	0.1	0.1
EPHEMEROPTERA	1	0	0	0	0	0	0	0	0.1	0.1
EPHEMERIDAE	5	8	8	10	33	37	26	15	17.8	9.7
CAENIDAE	5	10	15	24	15	43	49	22	22.9	12.5
BAETIDAE	8	2	6	7	28	21	7	1	10.0	5.5
HEPTAGENIIDAE	5	5	8	14	17	15	17	5	10.8	5.9
COENAGRIONIDAE	0	0	0	0	0	1	0	0	0.1	0.1
HYDROPSYCHIDAE	33	78	80	167	57	47	84	71	77.1	42.2
LEPTOCERIDAE	0	0	0	0	0	1	0	0	0.1	0.1
ELMIDAE	0	1	0	2	2	4	0	2	1.4	0.8
ELMIDAE (ADULTS)	0	0	0	0	5	4	0	0	1.1	0.6
SIMULIIDAE	8	6	9	8	8	11	12	4	8.3	4.5
CERATOPOGONIDAE	0	0	0	0	15	5	0	0	2.5	1.4
CHIRONOMIDAE	18	17	33	39	17	15	20	19	22.3	12.2
CHIRONOMIDAE (PUPAE)	1	1	2	3	0	0	16	6	3.6	2.0
TOTAL ORGANISMS/SAMPLE	85	137	163	280	211	205	233	148	182.8	
ORGANISMS/10M3	135	217	259	444	335	325	370	235	290.1	
TOTAL TAXA	10	12	10	12	14	13	9	11	11	

DATE	12 JUN	12 JUN	12 JUN	12 JUN	12 JUN	13 JUN	13 JUN	13 JUN		
STARTING TIME	1030	1330	1630	1930	2230	0130	0430	0730		
VOL. FILTERED(M3)	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	2	7	5	0	0	0	1.9	0.7
NAIDIDAE	0	1	2	0	1	0	2	1	0.9	0.3
TUBIFICIDAE	0	1	1	1	0	0	0	0	0.4	0.1
HIRUDINEA	0	0	0	0	0	0	1	0	0.1	0.0
ISOPODA	0	0	0	0	1	0	0	0	0.1	0.0
HYDRACARINA	1	11	0	4	4	4	8	3	4.4	1.6
COLLEMBOLA	0	0	1	0	0	0	0	0	0.1	0.0
EPHEMERIDAE	13	5	16	18	82	43	45	39	32.6	12.0
CAENIDAE	6	5	37	33	97	42	74	45	42.4	15.6
BAETIDAE	3	6	8	9	67	18	15	6	16.5	6.1
HEPTAGENIIDAE	5	2	12	8	43	28	22	25	18.1	6.7
COENAGRIONIDAE	0	0	0	0	2	0	0	0	0.3	0.1
HYDROPSYCHIDAE	34	48	115	167	154	76	90	110	99.3	36.4
LEPTOCERIDAE	0	0	2	1	1	1	0	0	0.6	0.2
HALIPLIDAE	0	1	0	0	0	0	0	0	0.1	0.0
ELMIDAE	3	3	1	1	6	3	0	0	2.1	0.8
ELMIDAE (ADULTS)	0	0	0	1	5	2	0	0	1.0	0.4
SIMULIIDAE	6	5	7	15	23	16	11	12	11.9	4.4
CERATOPOGONIDAE	0	0	0	0	1	0	0	0	0.1	0.0
CHIRONOMIDAE	15	27	44	45	47	32	34	39	35.4	13.0
CHIRONOMIDAE (PUPAE)	2	0	1	3	7	5	6	9	4.1	1.5
TOTAL ORGANISMS/SAMPLE	88	116	249	313	546	270	308	289	272.4	
ORGANISMS/10M3	140	184	395	497	867	429	489	459	432.3	
TOTAL TAXA	10	13	14	14	17	12	11	10	13	

Table C-15. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, June 1973.

DATE	12 JUN	12 JUN	12 JUN	12 JUN	13 JUN	13 JUN	13 JUN		
STARTING TIME	1030	1330	1930	2230	0130	0430	0730		
VOL. FILTERED(M3)	6.30	6.30	6.30	6.30	6.30	6.30	6.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	9	0	0	0	0	1	0	1.4	0.8
HIRUDINEA	0	0	0	0	0	1	1	0.3	0.2
HYDRACARINA	3	0	9	6	0	0	0	2.6	1.5
PERLIDAE	0	3	0	0	0	1	0	0.6	0.3
EPHEMERIDAE	4	1	0	42	15	81	7	21.4	12.1
CAENIDAE	12	9	0	9	6	52	10	14.0	7.9
EPHEMERELLIDAE	0	9	0	12	8	0	0	4.1	2.3
LEPTOPHLEBIIDAE	1	0	0	0	0	0	0	0.1	0.1
BAETIDAE	1	12	7	30	7	13	0	10.0	5.7
HEPTAGENIIDAE	9	15	16	18	10	35	3	15.1	8.6
HYDROPSYCHIDAE	48	90	139	72	18	80	74	74.4	42.2
HYDROPTILIDAE	0	3	0	0	0	0	0	0.4	0.2
ELMIDAE	0	0	3	0	6	2	1	1.7	1.0
ELMIDAE (ADULTS)	1	0	0	0	2	1	0	0.6	0.3
SIMULIIDAE	3	6	8	3	15	14	3	7.4	4.2
CERATOPOGONIDAE	0	0	0	0	0	1	0	0.1	0.1
CHIRONOMIDAE	15	14	17	6	15	43	25	19.3	10.9
CHIRONOMIDAE (PUPAE)	0	3	0	3	3	8	3	2.9	1.6
TOTAL ORGANISMS/SAMPLE	106	165	199	201	105	333	127	176.6	
ORGANISMS/10M3	168	262	316	319	167	529	202	245.2	
TOTAL TAXA	11	11	7	10	11	14	9	10	

DATE	12 JUN	12 JUN	12 JUN	12 JUN	12 JUN	13 JUN	13 JUN		
STARTING TIME	1030	1330	1630	1930	2230	0130	0730		
VOL. FILTERED(M3)	6.30	6.30	6.30	6.30	6.30	6.30	6.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	1	15	0	2.3	0.9
NAIDIDAE	0	5	0	3	0	1	0	1.3	0.5
HIRUDINEA	0	0	0	0	0	1	0	0.1	0.1
HYDRACARINA	0	9	3	6	3	6	0	3.9	1.6
COLLEMBOLA	0	0	0	0	3	0	0	0.4	0.2
PERLIDAE	0	0	3	0	1	0	0	0.6	0.2
EPHEMERIDAE	17	28	6	23	32	54	24	26.3	10.6
CAENIDAE	18	30	1	18	32	39	33	24.4	9.9
EPHEMERELLIDAE	0	3	0	1	1	5	3	1.9	0.7
BAETIDAE	4	9	3	9	25	26	6	11.7	4.7
HEPTAGENIIDAE	1	12	1	15	19	34	30	16.0	6.5
HYDROPSYCHIDAE	70	103	52	181	79	63	119	95.3	38.5
HYDROPTILIDAE	0	0	0	0	0	3	0	0.4	0.2
LEPTOCERIDAE	0	1	3	3	0	9	0	2.3	0.9
COLEOPTERA	0	3	1	0	0	0	0	0.6	0.2
ELMIDAE	0	0	0	0	16	5	0	3.0	1.2
ELMIDAE (ADULTS)	0	0	0	0	3	9	0	1.7	0.7
SIMULIIDAE	3	15	9	10	22	10	14	11.9	4.8
CERATOPOGONIDAE	0	0	0	0	4	1	3	1.1	0.5
CHIRONOMIDAE	38	74	17	42	34	31	41	39.6	16.0
CHIRONOMIDAE (PUPAE)	4	8	1	0	2	5	1	3.0	1.2
TOTAL ORGANISMS/SAMPLE	155	300	100	311	277	317	274	247.7	
ORGANISMS/10M3	246	476	159	494	440	503	435	313.0	
TOTAL TAXA	8	13	12	11	16	18	10	13	

Table C-16. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, July 1973.

DATE	27 JUL	27 JUL	27 JUL	27 JUL	28 JUL	28 JUL	28 JUL	28 JUL		
STARTING TIME	1500	1800	2100	2400	0300	0600	0900	1200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	3	0	0	0	0	0	0	0.4	0.1
NAIDIDAE	0	0	3	0	0	6	0	0	1.1	0.3
TUBIFICIDAE	0	0	1	0	0	4	0	1	0.8	0.2
AMPHIPODA	0	0	0	0	3	0	0	0	0.4	0.1
HYDRACARINA	6	3	3	0	0	0	3	6	2.6	0.8
COLLEMBOLA	0	0	6	0	0	0	0	0	0.8	0.2
PLECOPTERA	0	0	0	0	3	0	3	0	0.8	0.2
PERLIDAE	0	0	0	1	0	0	0	0	0.1	0.0
EPHEMERIDAE	3	0	9	7	0	0	0	0	2.4	0.7
CAENIDAE	15	0	30	35	20	51	0	18	21.1	6.2
BAETIDAE	0	0	5	6	6	10	3	6	4.5	1.3
HEPTAGENIIDAE	0	3	5	3	9	35	0	6	7.6	2.2
ODONATA	0	0	0	0	0	3	0	3	0.8	0.2
PSYCHOMYIIDAE	0	0	1	0	0	4	1	0	0.8	0.2
HYDROPSYCHIDAE	15	9	44	10	17	21	0	30	18.3	5.4
LEPTOCERIDAE	0	0	0	3	0	1	0	0	0.5	0.1
ELMIDAE	3	16	32	40	23	0	0	15	16.1	4.7
ELMIDAE (ADULTS)	0	3	2	8	1	0	0	0	1.8	0.5
TIPULIDAE	0	0	0	1	0	0	0	0	0.1	0.0
SIMULIIDAE	7	18	16	13	1	12	3	38	13.5	4.0
EMPIDIDAE	3	0	0	3	0	0	0	0	0.8	0.2
CERATOPOGONIDAE	0	0	2	3	0	0	0	0	0.6	0.2
CHIRONOMIDAE	256	353	232	159	85	300	41	332	219.8	64.5
CHIRONOMIDAE (PUPAE)	1	0	12	23	34	95	12	25	25.3	7.4
TOTAL ORGANISMS/SAMPLE	309	408	403	315	202	542	66	480	340.6	
ORGANISMS/10M3	273	361	357	279	179	480	58	425	301.4	
TOTAL TAXA	9	8	16	15	11	12	7	11	11	

DATE	27 JUL	27 JUL	27 JUL	27 JUL	28 JUL	28 JUL	28 JUL	28 JUL		
STARTING TIME	1500	1800	2100	2400	0300	0600	0900	1200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	3	0	6	0	0	0	3	0	1.5	0.4
NAIDIDAE	12	0	0	0	0	0	0	0	1.5	0.4
TUBIFICIDAE	1	0	3	4	3	0	1	0	1.5	0.4
AMPHIPODA	3	0	0	0	0	0	0	0	0.4	0.1
HYDRACARINA	0	0	0	3	0	0	6	3	1.5	0.4
PERLIDAE	0	0	1	0	0	0	0	0	0.1	0.0
EPHEMEROPTERA	0	0	0	0	0	3	0	0	0.4	0.1
EPHEMERIDAE	0	0	0	3	3	0	6	0	1.5	0.4
CAENIDAE	6	9	57	60	60	9	12	0	26.6	6.4
BAETIDAE	0	9	7	16	11	7	7	0	7.1	1.7
HEPTAGENIIDAE	0	9	25	34	22	3	0	6	12.4	3.0
ODONATA	0	0	3	0	0	0	0	0	0.4	0.1
PSYCHOMYIIDAE	0	0	0	1	4	2	12	0	2.4	0.6
HYDROPSYCHIDAE	24	42	99	26	20	6	15	9	30.1	7.2
LEPTOCERIDAE	0	0	0	6	0	0	0	0	0.8	0.2
ELMIDAE	10	111	77	74	53	3	21	3	44.0	10.5
ELMIDAE (ADULTS)	0	0	6	1	3	0	0	0	1.3	0.3
SIMULIIDAE	9	9	32	27	19	19	16	16	18.4	4.4
CERATOPOGONIDAE	0	0	0	0	0	0	3	0	0.4	0.1
CHIRONOMIDAE	184	441	375	234	163	35	302	130	233.0	55.7
CHIRONOMIDAE (PUPAE)	4	13	42	65	55	24	50	10	32.9	7.9
TOTAL ORGANISMS/SAMPLE	256	643	733	554	416	111	454	177	418.0	
ORGANISMS/10M3	227	569	649	490	368	98	402	157	369.9	
TOTAL TAXA	10	8	13	14	12	10	13	7	11	

Table C-17. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, July 1973.

DATE	27 JUL	27 JUL	27 JUL	27 JUL	28 JUL	28 JUL	28 JUL	28 JUL		
STARTING TIME	1500	1800	2100	2400	0300	0600	0900	1200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	3	0	0	0	13	4	0	2.5	1.2
HYDRACARINA	0	0	3	0	0	0	0	0	0.4	0.2
PERLIDAE	0	0	1	1	1	3	0	0	0.8	0.4
EPHEMERIDAE	0	0	0	0	1	1	0	3	0.6	0.3
CAENIDAE	0	7	8	14	23	28	4	3	10.9	5.2
EPHEMERELLIDAE	3	0	0	0	1	0	0	0	0.5	0.2
BAETIDAE	0	3	3	0	5	10	12	7	5.0	2.4
HEPTAGENIIDAE	0	3	15	14	14	5	15	3	8.6	4.1
COENAGRIONIDAE	0	0	0	0	0	3	3	0	0.8	0.4
PSYCHOMYIIDAE	1	0	0	0	1	4	0	3	1.1	0.5
HYDROPSYCHIDAE	6	12	7	15	4	6	17	16	10.4	5.0
HYDROPTILIDAE	0	0	7	0	0	0	1	0	1.0	0.5
LEPTOCERIDAE	0	0	9	6	0	0	0	0	1.9	0.9
ELMIDAE	0	17	17	22	9	17	6	22	13.8	6.6
ELMIDAE (ADULTS)	0	0	2	5	1	0	0	0	1.0	0.5
TIPULIDAE	0	0	0	1	0	0	0	0	0.1	0.1
SIMULIIDAE	3	4	16	8	9	4	9	11	8.0	3.8
CHIRONOMIDAE	70	201	119	101	47	128	119	197	122.8	58.8
CHIRONOMIDAE (PUPAE)	4	0	17	20	18	71	13	8	18.9	9.0
TOTAL ORGANISMS/SAMPLE	87	250	224	207	134	293	203	273	208.9	
ORGANISMS/10M3	77	221	198	183	119	259	180	242	184.8	
TOTAL TAXA	6	8	13	11	13	13	11	10	11	

DATE	27 JUL	27 JUL	27 JUL	27 JUL	28 JUL	28 JUL	28 JUL	28 JUL		
STARTING TIME	1500	1800	2100	2400	0300	0600	0900	1200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	3	0	8	11	7	6	0	0	4.4	1.1
HYDRACARINA	3	6	3	0	0	0	0	3	1.9	0.5
EPHEMERIDAE	0	6	6	3	0	3	3	0	2.6	0.7
CAENIDAE	9	15	74	28	26	21	6	4	22.9	5.9
EPHEMERELLIDAE	0	0	4	6	0	0	0	0	1.3	0.3
BAETIDAE	1	6	15	18	16	6	6	6	9.3	2.4
HEPTAGENIIDAE	6	7	41	28	36	2	12	0	16.5	4.3
PSYCHOMYIIDAE	1	3	6	2	7	5	5	1	3.8	1.0
HYDROPSYCHIDAE	27	30	81	14	7	12	9	9	23.6	6.1
HYDROPTILIDAE	0	1	15	3	0	3	0	0	2.8	0.7
ELMIDAE	18	53	133	33	17	6	21	4	35.6	9.2
ELMIDAE (ADULTS)	0	0	5	7	4	0	0	0	2.0	0.5
SIMULIIDAE	17	14	53	24	32	2	25	8	21.9	5.6
SIMULIIDAE (PUPAE)	0	0	1	0	0	0	0	0	0.1	0.0
EMPIDIDAE	3	3	0	1	0	0	0	0	0.9	0.2
CERATOPOGONIDAE	0	3	0	0	0	0	0	0	0.4	0.1
CHIRONOMIDAE	160	293	462	177	197	126	142	99	207.0	53.4
CHIRONOMIDAE (PUPAE)	5	10	52	47	63	30	36	6	31.1	8.0
TOTAL ORGANISMS/SAMPLE	253	450	959	402	412	222	265	140	387.9	
ORGANISMS/10M3	224	398	849	356	365	196	235	124	343.3	
TOTAL TAXA	12	14	16	15	11	12	10	9	12	

Table C-18. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, August 1973.

DATE	22 AUG	22 AUG	22 AUG	22 AUG	23 AUG		
STARTING TIME	1400	1700	2000	2300	0200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	3	0	0	0	0.6	0.3
NAIDIDAE	0	0	1	6	0	1.4	0.6
HYDRACARINA	0	6	0	3	3	2.4	1.0
PERLIDAE	0	0	0	2	1	0.6	0.3
CAENIDAE	0	4	7	11	16	7.6	3.3
BAETIDAE	5	23	19	34	64	29.0	12.4
HEPTAGENIIDAE	6	18	10	20	39	18.6	8.0
ODONATA	0	0	0	0	3	0.6	0.3
PSYCHOMYIIDAE	0	3	1	0	13	3.4	1.5
HYDROPSYCHIDAE	52	118	71	75	60	75.2	32.2
ELMIDAE	0	1	0	0	7	1.6	0.7
ELMIDAE (ADULTS)	0	0	0	5	3	1.6	0.7
SIMULIIDAE	0	20	15	16	20	14.2	6.1
EMPIDIDAE	1	3	3	0	0	1.4	0.6
CERATOPOGONIDAE	3	0	0	0	0	0.6	0.3
CHIRONOMIDAE	24	70	38	95	83	62.0	26.6
CHIRONOMIDAE (PUPAE)	8	13	26	8	7	12.4	5.3
TOTAL ORGANISMS/SAMPLE	99	282	191	275	319	233.2	
ORGANISMS/10M3	88	250	169	243	282	172.0	
TOTAL TAXA	7	12	10	11	13	11	

DATE	22 AUG	22 AUG	22 AUG	22 AUG	23 AUG		
STARTING TIME	1400	1700	2000	2300	0200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	3	0	0	0	0	0.6	0.2
NAIDIDAE	0	3	6	0	0	1.8	0.5
TUBIFICIDAE	1	1	0	0	2	0.8	0.2
HYDRACARINA	2	6	3	3	3	3.4	1.0
PLECOPTERA	0	0	3	0	0	0.6	0.2
PERLIDAE	0	0	0	1	1	0.4	0.1
CAENIDAE	12	18	4	9	29	14.4	4.3
BAETIDAE	28	16	55	77	125	60.2	17.9
HEPTAGENIIDAE	9	21	32	20	25	21.4	6.4
ODONATA	0	0	1	0	0	0.2	0.1
PSYCHOMYIIDAE	1	26	6	0	18	10.2	3.0
HYDROPSYCHIDAE	96	68	116	49	94	84.6	25.1
LEPTOCERIDAE	0	0	0	6	0	1.2	0.4
COLEOPTERA	0	0	0	1	0	0.2	0.1
ELMIDAE	4	0	0	11	4	3.8	1.1
ELMIDAE (ADULTS)	0	0	1	2	1	0.8	0.2
SIMULIIDAE	2	6	13	23	20	12.8	3.8
EMPIDIDAE	0	1	0	0	3	0.8	0.2
CHIRONOMIDAE	130	74	106	66	149	105.0	31.2
CHIRONOMIDAE (PUPAE)	15	13	22	6	12	13.6	4.0
TOTAL ORGANISMS/SAMPLE	303	253	368	274	486	336.8	
ORGANISMS/10M3	268	224	326	242	430	248.4	
TOTAL TAXA	12	12	13	13	14	13	

Table C-19. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, August 1973.

DATE	22 AUG	22 AUG	22 AUG	22 AUG	23 AUG		
STARTING TIME	1400	1700	2000	2300	0200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	0	0	0	3	0.6	0.2
HYDRACARINA	5	9	3	6	0	4.6	1.7
COLLEMBOLA	0	0	3	0	0	0.6	0.2
EPHEMERIDAE	0	0	3	0	3	1.2	0.4
CAENIDAE	1	3	3	5	4	3.2	1.2
EPHEMERELLIDAE	0	0	0	0	1	0.2	0.1
BAETIDAE	14	16	47	60	52	37.8	13.9
HEPTAGENIIDAE	13	15	27	29	14	19.6	7.2
COENAGRIONIDAE	0	0	0	0	3	0.6	0.2
PSYCHOMYIIDAE	3	0	0	4	3	2.0	0.7
HYDROPSYCHIDAE	107	77	130	84	54	90.4	33.4
HYDROPTILIDAE	2	0	0	0	0	0.4	0.1
LEPTOCERIDAE	1	1	3	0	0	1.0	0.4
ELMIDAE	1	3	0	6	3	2.6	1.0
ELMIDAE (ADULTS)	0	0	0	2	1	0.6	0.2
SIMULIIDAE	7	3	12	11	17	10.0	3.7
EMPIDIDAE	1	0	0	0	0	0.2	0.1
CHIRONOMIDAE	131	48	65	71	56	74.2	27.4
CHIRONOMIDAE (PUPAE)	15	4	52	16	19	21.2	7.8
TOTAL ORGANISMS/SAMPLE	301	179	348	294	233	271.0	
ORGANISMS/10M3	266	158	308	260	206	199.9	
TOTAL TAXA	13	10	11	11	14	12	

DATE	22 AUG	22 AUG	22 AUG	22 AUG	23 AUG		
STARTING TIME	1400	1700	2000	2300	0200		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	3	0.6	0.2
NAIDIDAE	4	0	0	0	0	0.8	0.3
HYDRACARINA	18	9	6	3	3	7.8	2.5
CAENIDAE	1	4	3	6	3	3.4	1.1
EPHEMERELLIDAE	0	0	0	0	3	0.6	0.2
BAETIDAE	26	16	33	51	82	41.6	13.4
HEPTAGENIIDAE	49	24	26	18	21	27.6	8.9
PSYCHOMYIIDAE	0	11	0	5	6	4.4	1.4
HYDROPSYCHIDAE	170	88	55	45	73	86.2	27.9
HYDROPTILIDAE	3	0	3	0	3	1.8	0.6
LEPTOCERIDAE	0	0	0	3	6	1.8	0.6
ELMIDAE	9	6	4	3	1	4.6	1.5
ELMIDAE (ADULTS)	0	0	0	1	6	1.4	0.5
SIMULIIDAE	39	1	5	16	17	15.6	5.0
CHIRONOMIDAE	224	57	56	51	93	96.2	31.1
CHIRONOMIDAE (PUPAE)	32	3	25	10	5	15.0	4.8
TOTAL ORGANISMS/SAMPLE	575	219	216	212	325	309.4	
ORGANISMS/10M3	509	194	191	188	288	228.2	
TOTAL TAXA	11	10	10	12	15	12	

Table C-20. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, September 1973.

DATE	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	23 SEP	23 SEP		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	3	1	0	0	0	0	0	0.5	0.4
HYDRACARINA	3	0	3	0	0	0	0	0	0.8	0.6
EPHEMEROPTERA	0	0	0	0	0	3	12	3	2.3	1.9
EPHEMERIDAE	0	0	0	3	0	1	0	0	0.5	0.4
CAENIDAE	12	15	6	16	6	0	1	0	7.0	5.8
BAETIDAE	2	9	3	4	29	20	25	17	13.6	11.2
HEPTAGENIIDAE	3	1	6	0	14	33	34	44	16.9	13.9
PSYCHOMYIIDAE	0	9	5	8	0	0	0	0	2.8	2.3
HYDROPSYCHIDAE	25	9	16	9	22	23	49	28	22.6	18.7
ELMIDAE	3	1	0	0	0	0	0	0	0.5	0.4
SIMULIIDAE	0	3	0	0	1	3	1	2	1.3	1.0
CHIRONOMIDAE	40	51	44	61	34	39	45	54	46.0	37.9
CHIRONOMIDAE (PUPAE)	6	6	9	8	4	7	6	7	6.6	5.5
TOTAL ORGANISMS/SAMPLE	94	107	93	109	110	129	173	155	121.3	
ORGANISMS/10M3	83	95	82	96	97	114	153	137	107.3	
TOTAL TAXA	8	10	9	7	7	8	8	7	8	

DATE	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	23 SEP	23 SEP		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
TUBIFICIDAE	0	0	1	0	0	0	0	0	0.1	0.1
HYDRACARINA	3	0	0	3	0	3	0	0	1.1	0.5
PERLIDAE	0	0	0	0	0	0	1	0	0.1	0.1
EPHEMEROPTERA	0	0	0	0	0	40	9	0	6.1	2.7
EPHEMERIDAE	0	0	0	3	1	0	0	0	0.5	0.2
CAENIDAE	48	3	7	30	21	0	0	0	13.6	6.0
LEPTOPHLEBIIDAE	0	0	0	0	1	0	0	0	0.1	0.1
BAETIDAE	23	13	7	3	61	64	51	11	29.1	12.8
HEPTAGENIIDAE	9	12	21	31	27	24	69	12	25.6	11.3
PSYCHOMYIIDAE	1	1	16	15	1	4	1	0	4.9	2.1
HYDROPSYCHIDAE	22	20	29	63	61	31	60	12	37.3	16.4
LEPTOCERIDAE	6	0	0	6	1	1	0	0	1.8	0.8
ELMIDAE	0	6	3	2	0	1	7	0	2.4	1.0
ELMIDAE (ADULTS)	0	0	0	0	4	1	1	0	0.8	0.3
SIMULIIDAE	3	0	0	4	0	1	2	3	1.6	0.7
EMPIDIDAE	0	0	3	0	0	0	0	3	0.8	0.3
CHIRONOMIDAE	130	48	82	176	118	97	70	32	94.1	41.3
CHIRONOMIDAE (PUPAE)	14	10	13	2	8	7	1	7	7.8	3.4
TOTAL ORGANISMS/SAMPLE	259	113	182	338	304	274	272	80	227.8	
ORGANISMS/10M3	229	100	161	299	269	242	241	71	201.5	
TOTAL TAXA	10	8	10	12	11	12	11	7	10	

Table C-21. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, September 1973.

DATE	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	23 SEP	23 SEP		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	3	0	0	0	0.4	0.4
NAIDIDAE	0	3	0	0	0	0	0	0	0.4	0.4
HYDRACARINA	2	0	0	0	6	0	0	0	1.0	1.0
CAENIDAE	0	1	0	0	0	0	0	0	0.1	0.1
BAETIDAE	12	0	4	5	35	3	21	11	11.4	10.9
HEPTAGENIIDAE	15	31	13	10	49	3	25	13	19.9	19.0
PSYCHOMYIIDAE	7	1	0	3	5	0	0	0	2.0	1.9
HYDROPSYCHIDAE	27	26	17	11	41	7	28	25	22.8	21.7
HYDROPTILIDAE	1	0	0	0	0	0	0	0	0.1	0.1
LEPTOCERIDAE	2	0	0	0	6	0	0	0	1.0	1.0
ELMIDAE	3	0	0	0	0	0	0	0	0.4	0.4
SIMULIIDAE	3	2	0	0	4	0	0	0	1.1	1.1
CHIRONOMIDAE	55	50	61	22	94	4	26	14	40.8	38.9
CHIRONOMIDAE (PUPAE)	4	10	4	3	4	0	0	3	3.5	3.3
TOTAL ORGANISMS/SAMPLE	131	124	99	54	247	17	100	66	104.8	
ORGANISMS/10M3	116	110	88	48	219	15	88	58	92.7	
TOTAL TAXA	11	8	5	6	10	4	4	5	7	

DATE	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	22 SEP	23 SEP	23 SEP		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	3	0	0	0	0	0	0	0	0.4	0.3
HYDRACARINA	0	3	9	0	3	0	0	0	1.9	1.4
PLECOPTERA	0	0	0	0	0	0	3	0	0.4	0.3
PERLIDAE	0	0	0	3	0	0	0	0	0.4	0.3
EPHEMERIDAE	0	0	3	0	0	0	0	0	0.4	0.3
CAENIDAE	6	3	0	0	0	3	0	0	1.5	1.1
BAETIDAE	17	6	12	6	48	44	14	8	19.4	14.1
HEPTAGENIIDAE	27	16	38	68	49	30	39	37	38.0	27.7
PSYCHOMYIIDAE	7	0	0	0	1	7	1	0	2.0	1.5
HYDROPSYCHIDAE	13	29	30	35	17	8	26	35	24.1	17.6
LEPTOCERIDAE	0	3	0	0	0	0	0	0	0.4	0.3
ELMIDAE	0	1	0	3	0	0	0	0	0.5	0.4
ELMIDAE (ADULTS)	0	0	0	0	1	0	0	0	0.1	0.1
SIMULIIDAE	2	0	0	3	1	1	1	2	1.3	0.9
CHIRONOMIDAE	37	35	57	68	46	24	24	40	41.4	30.1
CHIRONOMIDAE (PUPAE)	6	7	9	9	3	2	0	6	5.3	3.8
TOTAL ORGANISMS/SAMPLE	118	103	158	195	169	119	108	128	137.3	
ORGANISMS/10M3	104	91	140	173	150	105	96	113	121.5	
TOTAL TAXA	9	9	7	8	9	8	7	6	8	

Table C-22. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, October 1973.

DATE	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	14 OCT	14 OCT		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	1	0	0	0	0	0	0.1	0.2
NAIDIDAE	0	0	1	0	1	0	0	0	0.3	0.5
HYDRACARINA	0	0	1	1	3	0	0	0	0.6	1.1
PLECOPTERA	0	0	0	0	1	0	0	0	0.1	0.2
EPHEMEROPTERA	3	0	3	1	7	2	0	3	2.4	4.3
BAETIDAE	0	0	0	1	4	0	0	0	0.6	1.1
HEPTAGENIIDAE	5	3	9	13	32	8	16	6	11.5	21.1
PSYCHOMYIIDAE	0	0	0	3	0	1	0	0	0.5	0.9
HYDROPSYCHIDAE	7	5	21	27	24	12	15	8	14.9	27.2
LEPTOCERIDAE	0	0	0	2	2	0	0	2	0.8	1.4
ELMIDAE	0	0	0	0	1	0	1	0	0.3	0.5
SIMULIIDAE	1	1	0	0	0	2	0	0	0.5	0.9
EMPIDIDAE	0	0	1	0	0	0	0	0	0.1	0.2
CERATOPOGONIDAE	1	0	0	0	0	0	0	0	0.1	0.2
CHIRONOMIDAE	28	8	53	30	8	15	17	8	20.9	38.2
CHIRONOMIDAE (PUPAE)	3	0	2	3	0	0	0	0	1.0	1.8
TOTAL ORGANISMS/SAMPLE	48	17	92	81	83	40	49	27	54.6	
ORGANISMS/10M3	42	15	81	72	73	35	43	24	48.3	
TOTAL TAXA	7	4	9	9	10	6	4	5	7	

DATE	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	14 OCT	14 OCT		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	0	0	0	0	0	1	0.3	0.3
NAIDIDAE	2	0	0	0	1	0	1	1	0.6	0.6
TUBIFICIDAE	0	0	0	0	0	1	0	0	0.1	0.1
HYDRACARINA	0	2	1	0	2	1	0	1	0.9	0.9
PLECOPTERA	0	0	0	1	0	4	0	0	0.6	0.6
EPHEMEROPTERA	1	5	0	1	10	6	12	16	6.4	6.5
EPHEMERIDAE	0	0	0	1	0	0	0	0	0.1	0.1
CAENIDAE	1	0	0	0	1	0	1	0	0.4	0.4
BAETIDAE	0	0	0	0	1	2	3	3	1.1	1.1
HEPTAGENIIDAE	14	3	15	17	16	21	21	15	15.3	15.5
PSYCHOMYIIDAE	0	1	0	1	1	1	1	1	0.8	0.8
HYDROPSYCHIDAE	19	13	15	35	40	34	25	29	26.3	26.7
LEPTOCERIDAE	1	0	1	2	0	1	0	0	0.6	0.6
ELMIDAE	0	1	1	0	1	0	1	0	0.5	0.5
SIMULIIDAE	0	0	1	1	0	1	1	2	0.8	0.8
EMPIDIDAE	2	1	0	0	0	0	0	0	0.4	0.4
CHIRONOMIDAE	23	32	47	83	29	24	14	57	38.6	39.3
CHIRONOMIDAE (PUPAE)	11	7	6	6	2	0	1	4	4.6	4.7
TOTAL ORGANISMS/SAMPLE	74	66	87	148	104	96	81	130	98.3	
ORGANISMS/10M3	65	58	77	131	92	85	72	115	86.9	
TOTAL TAXA	9	10	8	10	11	11	11	11	10	

Table C-23. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, October 1973.

DATE	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	14 OCT	14 OCT		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	4	1	0	0	4	0	0	0	1.1	1.8
HYDRACARINA	2	1	0	0	1	0	0	0	0.5	0.8
PLECOPTERA	0	0	0	0	1	0	0	0	0.1	0.2
EPHEMEROPTERA	0	0	0	0	0	0	0	1	0.1	0.2
EPHEMERIDAE	1	0	0	1	0	1	1	0	0.5	0.8
CAENIDAE	1	0	0	0	0	0	0	1	0.3	0.4
EPHEMERELLIDAE	0	1	0	0	0	0	1	0	0.3	0.4
BAETIDAE	1	1	0	2	4	2	2	0	1.5	2.4
HEPTAGENIIDAE	6	6	4	17	47	19	18	8	15.6	25.2
PSYCHOMYIIDAE	0	0	0	3	0	0	1	2	0.8	1.2
HYDROPSYCHIDAE	12	8	11	15	32	22	16	9	15.6	25.2
LEPTOCERIDAE	0	0	0	1	1	1	1	0	0.5	0.8
ELMIDAE	0	0	0	1	0	0	0	0	0.1	0.2
SIMULIIDAE	0	1	1	1	0	0	0	0	0.4	0.6
EMPIDIDAE	1	1	0	0	0	0	0	0	0.3	0.4
CERATOPOGONIDAE	0	0	0	0	1	0	0	0	0.1	0.2
CHIRONOMIDAE	23	10	25	56	29	27	5	8	22.9	36.9
CHIRONOMIDAE (PUPAE)	2	2	2	4	0	0	1	0	1.4	2.2
TOTAL ORGANISMS/SAMPLE	53	32	43	101	120	72	46	29	62.0	
ORGANISMS/10M3	47	28	38	89	106	64	41	26	54.9	
TOTAL TAXA	10	10	5	10	9	6	9	6	8	

DATE	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	13 OCT	14 OCT	14 OCT		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	0	0	1	0	0.1	0.2
NAIDIDAE	1	1	1	2	1	0	2	0	1.0	1.5
HIRUDINEA	0	0	0	0	0	1	0	0	0.1	0.2
AMPHIPODA	0	0	0	0	0	0	0	1	0.1	0.2
HYDRACARINA	1	2	3	0	0	0	1	0	0.9	1.3
PLECOPTERA	0	0	0	0	0	0	0	1	0.1	0.2
EPHEMEROPTERA	1	0	0	0	0	0	0	0	0.1	0.2
EPHEMERIDAE	0	0	0	1	1	0	0	0	0.3	0.4
CAENIDAE	0	1	0	0	0	0	1	0	0.3	0.4
EPHEMERELLIDAE	0	0	0	0	1	1	1	0	0.4	0.6
BAETIDAE	1	0	0	0	6	2	4	3	2.0	3.0
HEPTAGENIIDAE	3	8	8	13	22	21	22	20	14.6	21.7
PSYCHOMYIIDAE	0	1	2	1	1	2	0	3	1.3	1.9
HYDROPSYCHIDAE	9	6	7	17	9	24	21	19	14.0	20.8
HYDROPTILIDAE	0	1	1	0	0	0	0	0	0.3	0.4
LEPTOCERIDAE	0	0	3	4	0	1	0	3	1.4	2.0
SIMULIIDAE	1	0	1	1	0	0	0	0	0.4	0.6
EMPIDIDAE	2	1	0	1	0	0	0	0	0.5	0.7
CHIRONOMIDAE	10	34	30	65	23	17	17	24	27.5	40.8
CHIRONOMIDAE (PUPAE)	3	5	1	2	1	2	2	1	2.1	3.2
TOTAL ORGANISMS/SAMPLE	32	60	57	107	65	71	72	75	67.4	
ORGANISMS/10M3	28	53	50	95	58	63	64	66	59.6	
TOTAL TAXA	10	10	10	10	9	9	10	9	10	

Table C-24. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, November 1973.

DATE	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	18 NOV	18 NOV		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	1	0	0	0	1	0	0	0	0.3	2.1
NAIDIDAE	5	0	0	3	0	0	0	0	1.0	8.3
TUBIFICIDAE	0	0	1	0	0	0	0	0	0.1	1.0
HYDRACARINA	1	0	1	0	0	0	0	0	0.3	2.1
EPHEMEROPTERA	0	0	0	0	2	2	0	0	0.5	4.2
EPHEMERIDAE	0	0	0	1	0	1	0	0	0.3	2.1
HEPTAGENIIDAE	2	1	1	2	6	0	0	1	1.6	13.5
PSYCHOMYIIDAE	1	0	0	1	0	0	0	0	0.3	2.1
HYDROPSYCHIDAE	3	7	1	0	2	2	1	2	2.3	18.8
COLEOPTERA	0	0	1	0	0	0	0	0	0.1	1.0
EMPIDIDAE	1	0	0	0	1	1	0	0	0.4	3.1
CERATOPOGONIDAE	0	0	0	0	1	0	0	0	0.1	1.0
CHIRONOMIDAE	14	3	0	1	7	8	1	5	4.9	40.6
TOTAL ORGANISMS/SAMPLE	28	11	5	8	20	14	2	8	12.0	
ORGANISMS/10M3	25	10	4	7	18	12	2	7	10.6	
TOTAL TAXA	8	3	5	5	7	5	2	3	5	

DATE	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	18 NOV	18 NOV		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	1	0	0	0	0	0.1	1.2
NAIDIDAE	4	0	0	0	0	0	0	0	0.5	4.7
HYDRACARINA	1	0	1	1	0	0	0	0	0.4	3.5
EPHEMEROPTERA	0	0	0	2	0	2	1	0	0.6	5.9
BAETIDAE	0	0	1	0	0	0	1	0	0.3	2.4
HEPTAGENIIDAE	1	1	0	0	2	3	2	0	1.1	10.6
HYDROPSYCHIDAE	2	0	0	2	0	4	1	0	1.1	10.6
ELMIDAE	1	0	0	0	0	0	0	0	0.1	1.2
SIMULIIDAE	0	0	0	0	0	0	0	1	0.1	1.2
CHIRONOMIDAE	27	2	1	8	1	5	5	1	6.3	58.8
TOTAL ORGANISMS/SAMPLE	36	3	3	14	3	14	10	2	10.6	
ORGANISMS/10M3	32	3	3	12	3	12	9	2	9.4	
TOTAL TAXA	6	2	3	5	2	4	5	2	4	

Table C-25. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, November 1973.

DATE	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	18 NOV	18 NOV		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	1	0	0	0	0	0	0	0	0.1	1.0
NAIDIDAE	0	0	0	0	1	0	0	1	0.3	2.0
TUBIFICIDAE	2	0	0	0	0	0	1	0	0.4	3.1
HYDRACARINA	0	1	2	0	0	0	0	1	0.5	4.1
EPHEMERELLIDAE	0	0	0	2	0	0	0	1	0.4	3.1
HEPTAGENIIDAE	2	3	3	2	3	3	2	1	2.4	19.4
PSYCHOMYIIDAE	0	0	0	1	0	0	0	0	0.1	1.0
HYDROPSYCHIDAE	1	1	2	6	1	2	0	0	1.6	13.3
HYDROPTILIDAE	0	0	1	0	0	0	0	0	0.1	1.0
ELMIDAE	0	0	0	0	0	0	0	1	0.1	1.0
CERATOPOGONIDAE	0	1	0	0	0	0	0	0	0.1	1.0
CHIRONOMIDAE	5	7	12	8	3	5	5	3	6.0	49.0
CHIRONOMIDAE (PUPAE)	0	0	0	0	0	1	0	0	0.1	1.0
TOTAL ORGANISMS/SAMPLE	11	13	20	19	8	11	8	8	12.3	
ORGANISMS/10M3	10	12	18	17	7	10	7	7	10.8	
TOTAL TAXA	5	5	5	5	4	4	3	6	5	

DATE	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	17 NOV	18 NOV	18 NOV		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	0	0	1	2	0.4	2.7
NAIDIDAE	1	0	0	0	1	2	2	3	1.1	8.0
HYDRACARINA	0	2	0	0	0	0	0	0	0.3	1.8
EPHEMERELLIDAE	0	0	0	1	0	0	0	0	0.1	0.9
BAETIDAE	0	0	0	0	0	1	0	0	0.1	0.9
HEPTAGENIIDAE	1	0	2	1	5	5	3	0	2.1	15.0
PSYCHOMYIIDAE	1	0	0	0	0	0	0	0	0.1	0.9
HYDROPSYCHIDAE	2	0	6	0	0	2	1	2	1.6	11.5
HYDROPTILIDAE	1	0	1	0	1	1	0	0	0.5	3.5
LEPTOCERIDAE	0	0	0	0	0	1	0	0	0.1	0.9
ELMIDAE	0	0	0	0	1	0	1	0	0.3	1.8
SIMULIIDAE	0	0	0	0	0	1	0	0	0.1	0.9
CHIRONOMIDAE	10	2	14	0	8	8	10	5	7.1	50.4
CHIRONOMIDAE (PUPAE)	1	0	0	0	0	0	0	0	0.1	0.9
TOTAL ORGANISMS/SAMPLE	17	4	23	2	16	21	18	12	14.1	
ORGANISMS/10M3	15	4	20	2	14	19	16	11	12.5	
TOTAL TAXA	7	2	4	2	5	8	6	4	5	

Table C-26. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, February 1974.

DATE	19 FEB	19 FEB	19 FEB	19 FEB	19 FEB	20 FEB	20 FEB	20 FEB		
STARTING TIME	1200	1500	1800	2100	2400	0300	0600	0900		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE.	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	1	0	0	0	0.1	2.6
PERLIDAE	0	0	1	1	0	0	1	1	0.5	10.3
EPHEMEROPTERA	0	0	0	2	0	0	0	0	0.3	5.1
HEPTAGENIIDAE	5	1	1	0	0	0	1	1	1.1	23.1
HYDROPSYCHIDAE	0	0	0	0	1	0	0	0	0.1	2.6
ELMIDAE	0	0	0	0	1	0	0	0	0.1	2.6
SIMULIIDAE	0	0	0	0	0	0	1	0	0.1	2.6
CHIRONOMIDAE	8	2	3	2	0	2	2	1	2.5	51.3
TOTAL ORGANISMS/SAMPLE	13	3	5	5	3	2	5	3	4.9	
ORGANISMS/10M3	12	3	4	4	3	2	4	3	4.3	
TOTAL TAXA	2	2	3	3	3	1	4	3	3	

DATE	19 FEB	19 FEB	19 FEB	19 FEB	19 FEB	20 FEB	20 FEB	20 FEB		
STARTING TIME	1200	1500	1800	2100	2400	0300	0600	0900		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	1	0	0	0	0	0	0.1	0.8
NAIDIDAE	1	0	0	0	0	1	0	0	0.3	1.6
HYDRACARINA	1	0	0	0	0	0	0	0	0.1	0.8
COLLEMBOLA	1	0	0	0	0	0	0	0	0.1	0.8
PLECOPTERA	1	0	0	0	0	0	0	0	0.1	0.8
PERLIDAE	0	1	1	1	2	2	0	0	0.9	5.7
EPHEMEROPTERA	1	3	3	2	0	2	1	0	1.5	9.8
BAETIDAE	4	0	0	1	0	1	1	0	0.9	5.7
HEPTAGENIIDAE	10	7	2	1	2	4	0	1	3.4	22.1
HYDROPSYCHIDAE	0	0	1	2	0	1	0	0	0.5	3.3
ELMIDAE	0	1	1	0	0	1	0	0	0.4	2.5
PSYCHODIDAE	0	1	0	0	0	0	0	0	0.1	0.8
SIMULIIDAE	0	0	0	0	0	0	1	0	0.1	0.8
CHIRONOMIDAE	11	10	4	0	6	15	4	4	6.8	44.3
TOTAL ORGANISMS/SAMPLE	30	23	13	7	10	27	7	5	15.3	
ORGANISMS/10M3	27	20	12	6	9	24	6	4	13.5	
TOTAL TAXA	8	6	7	5	3	8	4	2	5	

Table C-27. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, February 1974.

DATE	19 FEB	19 FEB	19 FEB	19 FEB	19 FEB	20 FEB	20 FEB	20 FEB		
STARTING TIME	1200	1500	1800	2100	2400	0300	0600	0900		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	1	0	1	2	0	1	0	0.6	7.0
HYDRACARINA	0	1	0	0	0	0	0	0	0.1	1.4
PLECOPTERA	0	0	0	0	1	0	0	0	0.1	1.4
CAPNIIDAE	0	0	0	0	0	0	2	0	0.3	2.8
CAENIDAE	1	0	0	0	0	0	0	0	0.1	1.4
EPHEMERELLIDAE	0	0	1	0	0	1	0	0	0.3	2.8
BAETIDAE	0	0	0	0	0	0	1	0	0.1	1.4
HEPTAGENIIDAE	2	3	2	1	2	4	3	3	2.5	28.2
PSYCHOMYIIDAE	0	0	0	0	0	1	0	0	0.1	1.4
ELMIDAE	1	0	0	0	0	0	0	0	0.1	1.4
SIMULIIDAE	0	0	0	0	1	0	0	0	0.1	1.4
CHIRONOMIDAE	7	7	4	5	3	0	6	3	4.4	49.3
TOTAL ORGANISMS/SAMPLE	11	12	7	7	9	6	13	6	8.9	
ORGANISMS/10M3	10	11	6	6	8	5	12	5	7.9	
TOTAL TAXA	4	4	3	3	5	3	5	2	4	

DATE	19 FEB	19 FEB	19 FEB	19 FEB	19 FEB	20 FEB	20 FEB	20 FEB		
STARTING TIME	1200	1500	1800	2100	2400	0300	0600	0900		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	1	0	0	0	0	0	0.1	1.4
NAIDIDAE	0	0	1	0	0	0	0	0	0.1	1.4
HIRUDINEA	0	0	0	1	0	0	0	0	0.1	1.4
CAPNIIDAE	0	0	0	1	0	1	0	0	0.3	2.9
PERLIDAE	0	0	0	0	0	0	0	1	0.1	1.4
EPHEMERELLIDAE	0	1	0	2	1	1	0	0	0.6	7.2
BAETIDAE	2	0	0	0	0	0	1	1	0.5	5.8
HEPTAGENIIDAE	4	2	1	5	1	2	1	0	2.0	23.2
HYDROPSYCHIDAE	0	1	0	2	1	0	0	0	0.5	5.8
LEPTOCERIDAE	0	0	0	1	0	0	0	0	0.1	1.4
ELMIDAE	2	0	0	0	0	1	0	0	0.4	4.3
EMPIDIDAE	0	1	0	0	0	0	0	0	0.1	1.4
CHIRONOMIDAE	5	4	1	6	3	3	1	6	3.6	42.0
TOTAL ORGANISMS/SAMPLE	13	9	4	18	6	8	3	8	8.6	
ORGANISMS/10M3	12	8	4	16	5	7	3	7	7.6	
TOTAL TAXA	4	5	4	7	4	5	3	3	4	

Table C-28. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, March 1974.

DATE	19 MAR	19 MAR	19 MAR	19 MAR	20 MAR	20 MAR	20 MAR	20 MAR		
STARTING TIME	1400	1700	2000	2300	0200	0500	0800	1100		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
LEPTOPHLEBIIDAE	0	0	0	1	0	0	0	0	0.1	2.8
HEPTAGENIIDAE	0	0	0	0	0	0	0	1	0.1	2.8
PSYCHOMYIIDAE	0	0	1	0	0	1	0	0	0.3	5.6
HYDROPSYCHIDAE	1	1	0	0	0	0	0	0	0.3	5.6
CHIRONOMIDAE	9	4	1	3	3	7	0	2	3.6	80.6
CHIRONOMIDAE (PUPAE)	0	0	1	0	0	0	0	0	0.1	2.8
TOTAL ORGANISMS/SAMPLE	10	5	3	4	3	8	0	3	4.5	
ORGANISMS/10M3	9	4	3	4	3	7	0	3	4.0	
TOTAL TAXA	2	2	3	2	1	2	0	2	2	

DATE	19 MAR	19 MAR	19 MAR	19 MAR	20 MAR	20 MAR	20 MAR	20 MAR		
STARTING TIME	1400	1700	2000	2300	0200	0500	0800	1100		
VOL. FILTERED (M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	0	1	0	0	0	0.1	1.0
TUBIFICIDAE	0	0	0	0	0	1	0	0	0.1	1.0
BRANCHIURA	0	1	0	0	0	0	0	0	0.1	1.0
AMPHIPODA	0	0	0	0	0	1	0	0	0.1	1.0
COLLEMBOLA	1	0	0	0	0	0	0	0	0.1	1.0
PERLIDAE	0	0	0	0	0	1	0	0	0.1	1.0
EPHEMEROPTERA	1	0	0	0	0	0	1	0	0.3	2.1
CAENIDAE	0	0	0	0	0	1	0	0	0.1	1.0
EPHEMERELLIDAE	0	1	1	0	0	0	0	0	0.3	2.1
BAETIDAE	1	1	0	1	0	0	0	0	0.4	3.1
HEPTAGENIIDAE	1	0	0	2	1	1	0	0	0.6	5.2
HYDROPSYCHIDAE	1	0	1	0	1	1	0	1	0.6	5.2
ELMIDAE	0	0	0	0	0	0	0	1	0.1	1.0
ELMIDAE (ADULTS)	0	0	1	0	0	0	0	0	0.1	1.0
EMPIDIDAE	0	0	0	1	0	1	0	0	0.3	2.1
CHIRONOMIDAE	11	7	5	4	1	5	3	29	8.1	67.7
CHIRONOMIDAE (PUPAE)	0	0	1	0	1	0	0	0	0.3	2.1
SPHAERIIDAE	0	0	0	0	0	0	0	1	0.1	1.0
TOTAL ORGANISMS/SAMPLE	16	10	9	8	5	12	4	32	12.0	
ORGANISMS/10M3	14	9	8	7	4	11	4	28	10.6	
TOTAL TAXA	6	4	5	4	5	8	2	4	5	

Table C-29. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, March 1974.

DATE	19 MAR	19 MAR	19 MAR	19 MAR	20 MAR	20 MAR	20 MAR	20 MAR		
STARTING TIME	1400	1700	2000	2300	0200	0500	0800	1100		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	1	0	0	0	0	0	0	0.1	1.7
HYDRACARINA	0	0	1	0	0	0	0	0	0.1	1.7
PLECOPTERA	0	0	1	0	0	0	0	0	0.1	1.7
EPHEMERELLIDAE	0	0	0	0	0	1	0	1	0.3	3.4
BAETIDAE	1	0	0	0	0	0	0	0	0.1	1.7
HEPTAGENIIDAE	0	1	1	0	1	4	1	0	1.0	13.8
HYDROPSYCHIDAE	0	0	0	1	2	0	0	0	0.4	5.2
ELMIDAE	0	0	0	0	0	1	0	0	0.1	1.7
CHIRONOMIDAE	12	9	0	1	1	2	5	8	4.8	65.5
CHIRONOMIDAE (PUPAE)	0	2	0	0	0	0	0	0	0.3	3.4
TOTAL ORGANISMS/SAMPLE	13	13	3	2	4	8	6	9	7.3	
ORGANISMS/10M3	12	12	3	2	4	7	5	8	6.4	
TOTAL TAXA	2	4	3	2	3	4	2	2	3	

DATE	19 MAR	19 MAR	19 MAR	19 MAR	20 MAR	20 MAR	20 MAR	20 MAR		
STARTING TIME	1400	1700	2000	2300	0200	0500	0800	1100		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
TUBIFICIDAE	0	0	0	0	0	0	1	1	0.3	2.0
HYDRACARINA	2	0	0	0	0	1	1	0	0.5	4.1
PERLIDAE	0	0	0	1	0	0	0	0	0.1	1.0
EPHEMERIDAE	0	0	0	0	0	0	1	0	0.1	1.0
EPHEMERELLIDAE	2	0	1	0	0	0	3	0	0.8	6.1
LEPTOPHLEBIIDAE	0	1	0	0	1	0	0	0	0.3	2.0
BAETIDAE	2	0	0	0	1	3	1	0	0.9	7.1
HEPTAGENIIDAE	2	0	0	0	0	1	6	4	1.6	13.3
PSYCHOMYIIDAE	0	0	0	1	0	0	0	0	0.1	1.0
HYDROPSYCHIDAE	0	0	0	0	1	0	1	1	0.4	3.1
LEPTOCERIDAE	0	0	0	0	0	0	0	2	0.3	2.0
ELMIDAE	0	0	1	0	0	0	0	2	0.4	3.1
SIMULIIDAE	1	0	0	0	0	0	0	0	0.1	1.0
EMPIDIDAE	0	0	0	0	0	0	3	0	0.4	3.1
CHIRONOMIDAE	12	10	1	2	2	4	6	8	5.6	45.9
CHIRONOMIDAE (PUPAE)	0	2	0	0	1	0	0	0	0.4	3.1
SPHAERIIDAE	0	0	0	0	0	0	1	0	0.1	1.0
TOTAL ORGANISMS/SAMPLE	21	13	3	4	6	9	24	18	12.3	
ORGANISMS/10M3	19	12	3	4	5	8	21	16	10.8	
TOTAL TAXA	6	3	3	3	5	4	10	6	5	

Table C-30. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, April 1974.

DATE	25 APR	25 APR	25 APR	25 APR	25 APR	25 APR	26 APR	26 APR		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	0	0	1	0	1	0	1	0.4	1.3
AMPHIPODA	0	0	0	1	0	0	0	0	0.1	0.4
HYDRACARINA	0	0	1	0	0	0	0	0	0.1	0.4
PLECOPTERA	0	0	0	0	1	1	0	1	0.4	1.3
EPHEMERIDAE	0	0	0	0	0	1	0	0	0.1	0.4
CAENIDAE	0	1	0	0	0	0	0	0	0.1	0.4
EPHEMERELLIDAE	1	[illegible]	0	0	6	2	2	2	1.6	5.4
BAETIDAE	0	0	0	0	6	0	1	1	1.0	3.3
HEPTAGENIIDAE	0	[illegible]	1	0	7	5	4	2	2.4	7.9
PSYCHOMYIIDAE	1	[illegible]	0	0	1	1	2	0	0.8	2.5
HYDROPSYCHIDAE	0	4	1	0	1	1	7	1	1.9	6.3
HYDROPTILIDAE	0	[illegible]	0	1	0	0	0	2	0.4	1.3
ELMIDAE	0	0	0	0	0	1	0	2	0.4	1.3
EMPIDIDAE	0	0	0	1	0	1	0	0	0.3	0.8
CHIRONOMIDAE	5	25	16	33	7	14	5	9	14.3	47.7
CHIRONOMIDAE (PUPAE)	0	28	2	15	0	1	0	0	5.8	19.2
TOTAL ORGANISMS/SAMPLE	7	59	21	52	29	29	21	21	29.9	
ORGANISMS/10M3	6	52	19	46	26	26	19	19	26.4	
TOTAL TAXA	3	5	5	6	7	11	6	9	7	

DATE	25 APR	25 APR	25 APR	25 APR	25 APR	25 APR	26 APR	26 APR		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	2	0	0	0	0	0	0	0.3	0.6
NAIDIDAE	0	2	2	0	1	1	0	0	0.8	1.7
TUBIFICIDAE	0	0	1	0	1	0	0	0	0.3	0.6
ISOPODA	0	0	1	0	0	0	0	0	0.1	0.3
HYDRACARINA	0	2	1	1	0	0	0	0	0.5	1.1
PLECOPTERA	0	0	0	0	0	1	0	0	0.1	0.3
EPHEMEROPTERA	0	0	0	1	1	0	0	0	0.3	0.6
EPHEMERELLIDAE	0	2	3	1	6	2	1	0	1.9	4.2
BAETIDAE	1	0	0	0	3	3	3	0	1.3	2.8
HEPTAGENIIDAE	0	0	4	3	11	4	1	0	2.9	6.4
PSYCHOMYIIDAE	0	0	0	1	2	1	0	1	0.6	1.4
HYDROPSYCHIDAE	0	1	1	2	5	5	7	0	2.6	5.8
HYDROPTILIDAE	0	2	0	2	0	0	0	0	0.5	1.1
LEPTOCERIDAE	1	0	1	1	0	0	0	0	0.4	0.8
ELMIDAE	1	1	0	1	5	2	0	0	1.3	2.8
TIPULIDAE	0	1	0	0	0	0	0	0	0.1	0.3
EMPIDIDAE	0	0	0	0	0	0	0	1	0.1	0.3
CERATOPOGONIDAE	0	1	0	0	0	0	0	0	0.1	0.3
CHIRONOMIDAE	15	44	33	40	15	14	9	15	23.1	51.5
CHIRONOMIDAE (PUPAE)	0	34	6	18	0	1	0	0	7.4	16.4
SPHAERIIDAE	1	0	0	0	0	0	1	1	0.4	0.8
TOTAL ORGANISMS/SAMPLE	19	92	53	71	50	34	22	18	44.9	
ORGANISMS/10M3	17	81	47	63	44	30	19	16	39.7	
TOTAL TAXA	5	11	10	11	10	10	6	4	8	

Table C-31. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, April 1974.

DATE	25 APR	25 APR	25 APR	25 APR	25 APR	25 APR	26 APR	26 APR		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	0	2	1	0	0	0	0	1	0.5	1.6
HYDRACARINA	0	1	0	2	1	0	0	1	0.6	2.1
PERLIDAE	0	0	0	0	2	0	0	1	0.4	1.2
EPHEMERELLIDAE	0	0	0	1	1	1	1	1	0.6	2.1
BAETIDAE	0	0	0	0	6	5	1	0	1.5	4.9
HEPTAGENIIDAE	0	1	0	1	5	7	1	1	2.0	6.6
PSYCHOMYIIDAE	1	0	0	0	3	0	2	0	0.8	2.5
HYDROPSYCHIDAE	1	0	0	0	2	3	5	1	1.5	4.9
HYDROPTILIDAE	3	0	1	0	1	0	2	1	1.0	3.3
LEPTOCERIDAE	0	1	0	0	1	1	0	0	0.4	1.2
ELMIDAE	1	0	0	0	2	1	1	0	0.6	2.1
TIPULIDAE	0	0	0	0	0	0	1	0	0.1	0.4
EMPIDIDAE	0	0	1	0	1	0	0	1	0.4	1.2
CHIRONOMIDAE	17	4	24	4	16	13	11	20	13.6	44.9
CHIRONOMIDAE (PUPAE)	1	36	4	10	0	0	0	0	6.4	21.0
TOTAL ORGANISMS/SAMPLE	24	45	31	18	41	31	25	28	30.4	
ORGANISMS/10M3	21	40	27	16	36	27	22	25	26.9	
TOTAL TAXA	6	6	5	5	12	7	9	9	7	

DATE	25 APR	25 APR	25 APR	25 APR	25 APR	25 APR	26 APR	26 APR		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	1	0	0	0	0	0	0	0	0.1	0.3
NAIDIDAE	0	0	1	0	5	1	1	0	1.0	2.3
AMPHIPODA	0	0	0	0	1	0	0	0	0.1	0.3
HYDRACARINA	3	0	1	0	1	0	0	0	0.6	1.5
PERLIDAE	0	0	0	0	2	0	1	0	0.4	0.9
EPHEMERIDAE	1	0	0	0	0	0	0	1	0.3	0.6
EPHEMERELLIDAE	1	0	1	0	2	2	1	1	1.0	2.3
BAETIDAE	0	0	0	0	8	2	2	0	1.5	3.5
HEPTAGENIIDAE	1	0	1	0	16	5	10	0	4.1	9.6
PSYCHOMYIIDAE	2	1	0	1	0	0	0	1	0.6	1.5
HYDROPSYCHIDAE	1	0	1	0	2	4	4	3	1.9	4.4
HYDROPTILIDAE	2	1	0	1	1	0	0	0	0.6	1.5
LEPTOCERIDAE	0	0	2	0	3	0	1	0	0.8	1.8
ELMIDAE	1	0	1	1	1	3	0	0	0.9	2.0
SIMULIIDAE	0	0	0	0	1	0	0	0	0.1	0.3
EMPIDIDAE	0	0	0	0	0	1	0	0	0.1	0.3
CHIRONOMIDAE	31	12	27	26	30	6	19	10	20.1	47.1
CHIRONOMIDAE (PUPAE)	0	34	5	24	1	1	0	0	8.1	19.0
SPHAERIIDAE	0	1	0	0	0	1	1	0	0.4	0.9
TOTAL ORGANISMS/SAMPLE	44	49	40	53	74	26	40	16	42.8	
ORGANISMS/10M3	39	43	35	47	65	23	35	14	37.8	
TOTAL TAXA	10	5	9	5	14	10	9	5	8	

Table C-32. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 1) collected during diel pumping at Falls on the Susquehanna River, May 1974.

DATE	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	30 MAY	30 MAY		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NAIDIDAE	5	1	1	0	3	1	1	0	1.5	3.4
TUBIFICIDAE	0	1	0	0	0	0	0	0	0.1	0.3
AMPHIPODA	0	0	0	0	1	0	0	0	0.1	0.3
HYDRACARINA	0	0	0	0	2	0	0	0	0.3	0.6
PERLIDAE	0	2	1	1	1	0	0	0	0.6	1.4
EPHEMEROPTERA	0	0	1	0	6	1	0	0	1.0	2.2
EPHEMERIDAE	4	0	2	0	6	0	2	0	1.8	3.9
CAENIDAE	0	0	0	0	1	0	1	0	0.3	0.6
EPHEMERELLIDAE	1	0	0	1	0	2	0	0	0.5	1.1
BAETIDAE	0	0	0	2	9	7	10	1	3.6	8.1
HEPTAGENIIDAE	0	0	1	0	6	5	5	0	2.1	4.7
PSYCHOMYIIDAE	0	0	0	0	0	2	0	0	0.3	0.6
HYDROPSYCHIDAE	1	0	2	0	1	2	0	2	1.0	2.2
ELMIDAE	0	0	0	0	2	1	1	0	0.5	1.1
ELMIDAE (ADULTS)	0	0	0	0	0	1	0	0	0.1	0.3
SIMULIIDAE	2	0	0	0	2	7	5	3	2.4	5.3
SIMULIIDAE (PUPAE)	0	0	17	0	0	0	0	0	2.1	4.7
CHIRONOMIDAE	26	7	14	11	34	30	24	14	20.0	44.7
CHIRONOMIDAE (PUPAE)	2	0	1	2	42	3	1	1	6.5	14.5
TOTAL ORGANISMS/SAMPLE	41	11	40	17	116	62	50	21	44.8	
ORGANISMS/10M3	36	10	35	15	103	55	44	19	39.6	
TOTAL TAXA	7	4	9	5	14	12	9	5	8	

DATE	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	30 MAY	30 MAY		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	0	0	1	0	0	0	0	0.1	0.2
NAIDIDAE	5	3	1	5	4	4	1	2	3.1	5.5
HYDRACARINA	1	3	1	1	0	0	0	0	0.8	1.3
PLECOPTERA	0	0	1	0	0	0	2	0	0.4	0.7
PERLIDAE	0	0	0	0	2	2	0	0	0.5	0.9
EPHEMEROPTERA	1	0	0	0	0	1	0	0	0.3	0.4
EPHEMERIDAE	4	1	3	5	0	0	2	2	2.1	3.7
CAENIDAE	1	1	0	0	0	0	1	0	0.4	0.7
EPHEMERELLIDAE	0	0	0	0	0	0	1	0	0.1	0.2
BAETIDAE	1	1	2	4	8	8	9	9	5.3	9.2
HEPTAGENIIDAE	3	1	4	3	3	2	3	0	2.4	4.2
PSYCHOMYIIDAE	0	0	0	0	1	0	1	0	0.3	0.4
HYDROPSYCHIDAE	0	1	1	0	1	0	4	4	1.4	2.4
LEPTOCERIDAE	1	1	1	1	0	0	2	0	0.8	1.3
ELMIDAE	1	0	0	0	1	0	0	0	0.3	0.4
ELMIDAE (ADULTS)	0	0	0	0	3	0	1	0	0.5	0.9
SIMULIIDAE	0	1	0	1	2	1	2	1	1.0	1.8
CERATOPOGONIDAE	0	0	0	0	1	0	0	0	0.1	0.2
CHIRONOMIDAE	27	21	17	27	31	27	27	16	24.1	42.3
CHIRONOMIDAE (PUPAE)	0	2	1	1	99	1	0	2	13.3	23.2
TOTAL ORGANISMS/SAMPLE	45	36	32	49	156	46	56	36	57.0	
ORGANISMS/10M3	40	32	28	43	138	41	50	32	50.4	
TOTAL TAXA	10	11	10	10	12	8	13	7	10	

Table C-33. Number, mean, and percent total of drifting macroinvertebrates in surface and bottom samples (replicate 2) collected during diel pumping at Falls on the Susquehanna River, May 1974.

DATE	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	30 MAY	30 MAY		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE	SURFACE		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	0	0	0	0	1	1	0.4	0.6
NAIDIDAE	2	4	6	4	6	4	4	8	4.8	7.2
TUBIFICIDAE	1	0	0	0	0	0	0	0	0.1	0.2
HYDRACARINA	1	0	1	0	2	1	0	1	0.8	1.1
PERLIDAE	0	0	0	0	1	0	2	1	0.5	0.8
EPHEMERIDAE	0	4	4	2	8	7	4	10	4.9	7.4
CAENIDAE	0	5	5	0	7	1	2	0	2.5	3.8
EPHEMERELLIDAE	0	0	2	0	0	1	0	0	0.4	0.6
LEPTOPHLEBIIDAE	0	0	0	0	0	0	1	0	0.1	0.2
BAETIDAE	1	9	3	0	22	6	25	13	9.9	15.0
HEPTAGENIIDAE	2	5	4	1	19	5	9	6	6.4	9.7
PSYCHOMYIIDAE	0	0	0	0	0	0	0	1	0.1	0.2
HYDROPSYCHIDAE	1	7	3	0	8	6	8	4	4.6	7.0
LEPTOCERIDAE	0	0	0	0	2	0	1	0	0.4	0.6
HALIPLIDAE	0	0	0	1	0	0	0	0	0.1	0.2
ELMIDAE	0	0	0	0	0	0	1	0	0.1	0.2
ELMIDAE (ADULTS)	0	0	0	0	0	1	0	0	0.1	0.2
SIMULIIDAE	0	1	0	0	1	3	3	3	1.4	2.1
CERATOPOGONIDAE	0	0	1	0	0	0	0	0	0.1	0.2
CHIRONOMIDAE	11	24	25	14	35	25	29	31	24.3	36.9
CHIRONOMIDAE (PUPAE)	9	4	2	1	9	5	1	0	3.9	5.9
TOTAL ORGANISMS/SAMPLE	28	64	56	23	120	65	91	79	65.8	
ORGANISMS/10M3	25	57	50	20	106	58	81	70	58.2	
TOTAL TAXA	8	10	11	6	12	12	14	11	11	

DATE	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	29 MAY	30 MAY	30 MAY		
STARTING TIME	0900	1200	1500	1800	2100	2400	0300	0600		
VOL. FILTERED(M3)	11.30	11.30	11.30	11.30	11.30	11.30	11.30	11.30		
DEPTH	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM	BOTTOM		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
NEMATODA	0	1	0	0	1	1	7	3	1.6	2.5
NAIDIDAE	4	1	0	12	5	2	0	5	3.6	5.6
HYDRACARINA	0	1	0	4	0	1	0	1	0.9	1.4
PERLIDAE	1	1	0	0	0	0	3	1	0.8	1.2
EPHEMERIDAE	1	1	1	5	0	5	4	7	3.0	4.6
CAENIDAE	2	2	0	0	0	2	2	3	1.4	2.1
EPHEMERELLIDAE	0	0	0	0	0	0	2	0	0.3	0.4
BAETIDAE	1	5	1	2	4	4	17	4	4.8	7.4
HEPTAGENIIDAE	2	2	1	4	1	1	14	8	4.1	6.4
COENAGRIONIDAE	1	0	0	0	0	0	0	0	0.1	0.2
HYDROPSYCHIDAE	1	2	0	0	0	0	8	10	2.6	4.1
LEPTOCERIDAE	1	1	2	0	0	0	1	0	0.6	1.0
LEPIDOPTERA	0	0	1	0	0	0	0	0	0.1	0.2
ELMIDAE	0	0	0	1	0	1	1	0	0.4	0.6
ELMIDAE (ADULTS)	0	0	0	0	0	1	2	1	0.5	0.8
SIMULIIDAE	1	1	0	0	0	1	2	0	0.6	1.0
CERATOPOGONIDAE	0	0	0	1	0	0	0	0	0.1	0.2
CHIRONOMIDAE	16	40	13	30	26	14	50	23	26.5	41.0
CHIRONOMIDAE (PUPAE)	3	3	0	6	84	0	0	5	12.6	19.5
TOTAL ORGANISMS/SAMPLE	34	61	19	65	121	33	113	71	64.6	
ORGANISMS/10M3	30	54	17	58	107	29	100	63	57.2	
TOTAL TAXA	12	13	6	9	6	11	13	12	10	

Table C-34. Percent total and mean number of drifting macroinvertebrates/10 m^3 in surface samples collected during diel pumping at SSES on the Susquehanna River, June 1973 through May 1974.

TAXA	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	MEAN	% TOT
NEMATODA	10.3	2.8	0.4	0.7	0.0	0.2	2.7	2.8	1.0	1.0	1.0	0.0	1.9	1.1
TARDIGRADA	0.0	0.0	0.0	0.0	0.0	0.8	1.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
NAIDIDAE	128.0	3.4	0.2	0.3	0.4	0.1	16.6	2.4	1.8	1.3	2.3	59.1	18.0	10.3
TUBIFICIDAE	0.2	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	1.8	0.3	0.0	0.3	0.2
AMPHIPODA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
HYDRACARINA	3.6	27.1	28.2	6.4	14.6	41.3	12.2	0.7	0.7	0.7	5.0	0.4	11.7	6.7
COLLEMBOLA	1.4	0.0	1.0	0.0	0.0	0.0	4.2	1.7	0.8	0.0	0.3	0.0	0.7	0.4
PLECOPTERA	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.3	0.0	0.0	0.1	0.0
NEMOURIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
PERLIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
EPHEMEROPTERA	0.0	0.0	0.0	0.0	0.0	0.0	3.2	1.3	1.0	0.0	0.0	0.0	0.4	0.2
EPHEMERIDAE	13.7	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	1.2	0.7
CAENIDAE	6.0	2.0	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.4
EPHEMERELLIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
BAETIDAE	14.3	1.1	0.1	0.1	0.0	0.0	0.7	0.1	0.0	0.1	0.2	13.1	2.5	1.5
HEPTAGENIIDAE	11.1	11.4	0.4	0.4	0.1	0.1	2.3	1.9	1.4	0.6	0.9	9.2	3.4	1.9
ODONATA	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COENAGRIONIDAE	0.2	0.0	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
MEGALOPTERA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.1	0.0
PHILOPOTAMIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
PSYCHOMYIIDAE	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.2	0.2	0.0	0.1	0.0
HYDROPSYCHIDAE	2.4	3.8	17.0	8.7	5.8	0.4	4.1	2.4	0.7	0.3	0.1	0.7	3.9	2.2
HYDROPTILIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.7	0.0	0.1	0.0
LEPTOCERIDAE	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
COLEOPTERA	0.2	0.0	0.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.0
HYDROPHILIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELMIDAE	0.6	0.0	0.0	0.0	0.0	0.2	1.2	0.7	0.1	0.0	1.0	0.0	0.3	0.2
ELMIDAE (ADULTS)	1.2	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.2	0.1
DIPTERA (PUPAE)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIPULIDAE	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIPULIDAE (PUPAE)	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSYCHODIDAE	0.6	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.3	0.1	0.0	0.3	0.2	0.1
CULICIDAE	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
CHAOBORIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
SIMULIIDAE	4.4	10.3	6.7	1.2	0.2	0.1	0.5	0.0	0.0	0.0	0.0	0.8	2.1	1.2
EMPIDIDAE	0.2	3.1	2.5	4.1	6.3	3.5	4.4	0.9	0.6	0.3	1.2	0.4	2.2	1.3
EMPIDIDAE (PUPAE)	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHIRONOMIDAE	334.3	314.6	248.2	107.5	8.0	2.1	75.0	56.3	47.2	18.7	46.0	73.2	112.1	64.1
CHIRONOMIDAE (PUPAE)	33.7	35.0	48.1	21.6	0.6	0.0	0.0	0.0	0.0	0.0	0.2	3.5	12.3	7.0
PHYSIDAE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ORGANISMS	566.5	416.7	356.1	151.4	36.2	49.0	133.3	71.9	56.0	25.6	60.1	161.5	175.0	
TOTAL TAXA	18	15	17	12	9	11	18	16	13	13	15	11	14	

Table C-35. Percent total and mean number of drifting macroinvertebrates/10 m^3 in bottom samples collected during diel pumping at SSES on the Susquehanna River, June 1973 through May 1974.

TAXA	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	MEAN	% TOT
TRICLADIA	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEMATODA	14.7	10.5	0.7	0.1	0.0	0.0	2.5	2.7	0.7	0.1	0.1	0.7	2.7	1.0
TARDIGRADA	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAIDIDAE	189.9	3.5	0.2	3.4	2.3	0.0	23.5	5.1	2.0	1.5	5.1	90.5	27.4	10.1
TUBIFICIDAE	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.1	0.7	0.9	0.8	0.3	0.1
HIRUDINEA	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ISOPODA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
AMPHIPODA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
HYDRACARINA	4.0	37.7	43.6	23.1	59.7	62.5	14.9	2.0	0.7	0.7	10.0	3.8	22.1	8.2
COLLEMBOLA	1.4	0.0	0.8	0.0	0.0	0.2	4.8	1.3	2.4	1.7	0.0	1.0	1.0	0.4
PLECOPTERA	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PERLIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.1	0.0
EPHEMEROPTERA	0.0	0.0	0.0	0.0	0.0	0.0	2.1	3.0	1.8	0.3	0.1	0.0	0.6	0.2
EPHEMERIDAE	28.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	2.5	0.9
CAENIDAE	8.1	5.9	1.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.3	0.3	1.4	0.5
EPHEMERELLIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0
BAETIDAE	28.2	3.7	0.0	0.2	0.0	0.0	0.2	0.2	0.8	0.1	0.3	22.5	4.8	1.8
HEPTAGENIIDAE	26.6	25.4	0.1	0.2	0.0	0.0	4.2	3.5	1.4	1.4	1.5	10.7	6.3	2.3
ODONATA	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
COENAGRIONIDAE	0.2	0.0	0.7	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
CORIXIDAE	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
TRICHOPTERA(PUPAE)	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLOSSOSOMATIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
PHILOPOTAMIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
PSYCHOMYIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.0
HYDROPSYCHIDAE	4.0	6.1	13.8	11.7	15.3	0.9	3.0	4.1	1.9	1.1	2.8	0.4	5.5	2.0
HYDROPTILIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	1.0	0.0	0.2	0.1
LEPTOCERIDAE	0.2	0.0	0.0	1.3	0.3	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.2	0.1
LEPIDOPTERA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
COLEOPTERA	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSEPHENIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
ELMIDAE	1.8	1.1	1.2	0.1	0.0	0.2	0.0	0.8	0.0	0.0	1.1	0.7	0.6	0.2
ELMIDAE(ADULTS)	1.8	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	0.6	0.2
DIPTERA(PUPAE)	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
TIPULIDAE	0.6	0.0	0.0	0.1	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.0	0.1	0.1
PSYCHODIDAE	1.6	0.0	0.0	0.0	0.0	0.0	1.6	1.0	0.0	0.7	0.3	0.0	0.4	0.1
CULICIDAE	0.8	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.0
CHAOBORIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
SIMULIIDAE	6.5	11.1	8.4	1.4	0.1	0.0	0.5	0.0	0.0	0.0	0.0	2.9	2.6	1.0
SIMULIIDAE(PUPAE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
STRATIOMYIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
EMPIDIDAE	0.8	4.0	9.3	9.8	29.8	6.5	3.2	0.9	1.0	0.3	2.4	0.8	5.8	2.2
EMPIDIDAE(PUPAE)	0.0	0.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
CERATOPOGONIDAE	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.1	0.0
CHIRONOMIDAE	512.9	379.6	359.5	244.2	51.9	2.2	79.1	106.4	52.3	23.1	68.7	107.5	168.4	62.3
CHIRONOMIDAE(PUPAE)	25.2	55.8	55.1	37.2	2.5	0.7	0.0	0.3	0.1	0.0	1.3	4.4	15.7	5.8
PHYSIDAE	0.0	0.0	0.0	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
TOTAL ORGANISMS	859.1	546.9	498.2	334.1	162.3	73.3	141.2	136.2	67.6	31.7	97.5	249.0	270.4	
TOTAL TAXA	22	12	15	14	10	7	16	28	17	12	18	14	15	

Table C-36. Percent total and mean number of drifting macroinvertebrates/10 m^3 in surface samples collected during diel pumping at Falls on the Susquehanna River, June 1973 through May 1974.

TAXA	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	MEAN	% TOT
NEMATODA	1.2	0.2	0.3	0.2	0.1	0.2	-	-	0.1	0.0	0.0	0.2	0.2	0.2
NAIDIDAE	1.8	1.6	0.9	0.4	0.6	0.6	-	-	0.3	0.1	0.4	2.8	0.9	1.0
TUBIFICIDAE	0.0	0.3	0.0	0.0	0.0	0.2	-	-	0.0	0.0	0.0	0.1	0.1	0.1
HIRUDINEA	0.3	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
ISOPODA	0.1	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
AMPHIPODA	0.0	0.2	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.1	0.0	0.0
HYDRACARINA	3.7	1.3	3.1	0.8	0.5	0.3	-	-	0.1	0.1	0.3	0.4	1.0	1.0
COLLEMBOLA	0.1	0.3	0.3	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.1	0.1
PLECOPTERA	0.0	0.3	0.0	0.0	0.1	0.0	-	-	0.1	0.1	0.2	0.0	0.1	0.1
CAPNIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	0.0
PERLIDAE	0.4	0.4	0.3	0.0	0.0	0.0	-	-	0.2	0.0	0.2	0.5	0.2	0.2
EPHEMEROPTERA	0.1	0.0	0.0	1.0	1.1	0.2	-	-	0.1	0.0	0.0	0.4	0.3	0.3
EPHEMERIDAE	30.9	1.3	0.5	0.2	0.2	0.1	-	-	0.0	0.0	0.1	2.9	3.6	3.8
CAENIDAE	29.7	14.2	4.8	3.2	0.1	0.0	-	-	0.1	0.0	0.1	1.2	5.2	5.5
EPHEMERELLIDAE	3.1	0.2	0.1	0.0	0.1	0.2	-	-	0.1	0.1	1.0	0.4	0.5	0.6
LEPTOPHLEBIIDAE	0.1	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.1	0.0	0.1	0.0	0.0
BAETIDAE	15.9	4.2	29.6	11.1	0.9	0.0	-	-	0.1	0.1	1.1	6.0	5.9	6.3
HEPTAGENIIDAE	20.3	7.2	16.9	16.3	12.0	1.8	-	-	1.6	0.5	1.9	3.8	7.8	8.3
ODONATA	0.0	0.3	0.3	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.1	0.1
COENAGRIONIDAE	0.1	0.3	0.3	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.1	0.1
PSYCHOMYIIDAE	0.0	0.8	2.4	2.1	0.6	0.2	-	-	0.1	0.1	0.7	0.2	0.6	0.7
HYDROPSYCHIDAE	120.4	12.7	73.3	20.1	13.5	1.7	-	-	0.1	0.3	1.5	2.5	22.1	23.5
HYDROPTILIDAE	0.3	0.4	0.2	0.1	0.0	0.1	-	-	0.0	0.0	0.6	0.0	0.2	0.2
LEPTOCERIDAE	0.1	1.1	0.4	0.4	0.6	0.0	-	-	0.0	0.0	0.2	0.2	0.3	0.3
COLEOPTERA	0.0	0.0	0.0	0.0	0.0	0.1	-	-	0.0	0.0	0.0	0.0	0.0	0.0
HALIPLIDAE	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.1	0.0	0.0
ELMIDAE	2.4	13.2	1.9	0.4	0.2	0.1	-	-	0.1	0.1	0.4	0.3	1.9	2.0
ELMIDAE (ADULTS)	1.4	1.2	1.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.1	0.3	0.4
TIPULIDAE	0.0	0.1	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.0	0.0	0.0
SIMULIIDAE	12.5	9.5	10.7	1.1	0.4	0.0	-	-	0.1	0.0	0.0	1.7	3.3	3.5
SIMULIIDAE (PUPAE)	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.9	0.1	0.1
EMPIDIDAE	0.0	0.3	0.7	0.0	0.2	0.2	-	-	0.0	0.0	0.3	0.0	0.1	0.2
CERATOPOGONIDAE	2.2	0.3	0.3	0.0	0.1	0.1	-	-	0.0	0.0	0.0	0.1	0.3	0.3
CHIRONOMIDAE	33.1	151.5	60.3	38.4	19.4	4.8	-	-	3.0	3.7	12.3	19.6	33.6	35.7
CHIRONOMIDAE (PUPAE)	5.2	19.5	14.9	4.5	1.1	0.1	-	-	0.0	0.2	5.4	4.6	5.2	5.5
TOTAL ORGANISMS	285.5	243.1	223.1	100.0	51.6	10.7	-	-	6.1	5.2	26.7	48.9	94.0	
TOTAL TAXA	22	25	21	15	18	16	-	-	16	11	18	21	18	

Table C-37. Percent total and mean number of drifting macroinvertebrates/10 m^3 in bottom samples collected during diel pumping at Falls on the Susquehanna River, June 1973 through May 1974.

TAXA	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	MEAN	% TOT
NEMATODA	3.3	0.7	0.5	0.2	0.2	0.2	-	-	0.1	0.1	0.2	0.8	0.6	0.4
NAIDIDAE	1.7	2.6	1.2	0.0	0.7	0.7	-	-	0.2	0.0	0.8	3.0	1.1	0.8
TUBIFICIDAE	0.3	0.7	0.4	0.1	0.1	0.0	-	-	0.0	0.2	0.1	0.0	0.2	0.1
HIRUDINEA	0.2	0.0	0.0	0.0	0.1	0.0	-	-	0.1	0.0	0.0	0.0	0.0	0.0
BRANCHIURA	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.1	0.0	0.0	0.0	0.0
ISOPODA	0.1	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.0	0.0	0.0
AMPHIPODA	0.0	0.2	0.0	0.0	0.1	0.0	-	-	0.0	0.1	0.1	0.0	0.0	0.0
HYDRACARINA	6.6	1.5	5.0	1.3	0.8	0.3	-	-	0.1	0.2	0.5	0.7	1.5	1.1
COLLEMBOLA	0.4	0.0	0.0	0.0	0.0	0.0	-	-	0.1	0.1	0.0	0.0	0.1	0.0
PLECOPTERA	0.0	0.0	0.3	0.2	0.3	0.0	-	-	0.1	0.0	0.1	0.2	0.1	0.1
CAPNIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	0.0
PERLIDAE	0.4	0.1	0.2	0.2	0.0	0.0	-	-	0.4	0.1	0.2	0.6	0.2	0.2
EPHEMEROPTERA	0.0	0.2	0.0	2.7	2.9	0.3	-	-	0.7	0.1	0.1	0.1	0.7	0.5
EPHEMERIDAE	47.1	1.8	0.0	0.4	0.2	0.0	-	-	0.0	0.1	0.1	2.3	5.1	3.8
CAENIDAE	54.0	21.9	7.9	6.7	0.3	0.0	-	-	0.0	0.1	0.0	0.8	8.9	6.6
EPHEMERELLIDAE	1.4	0.6	0.3	0.0	0.2	0.1	-	-	0.3	0.4	1.3	0.2	0.5	0.3
LEPTOPHLEBIIDAE	0.0	0.0	0.0	0.1	0.0	0.0	-	-	0.0	0.1	0.0	0.0	0.0	0.0
BAETIDAE	22.6	7.2	45.0	21.5	1.4	0.2	-	-	0.6	0.6	1.2	4.4	9.0	6.7
HEPTAGENIIDAE	27.2	12.8	21.7	28.2	13.2	1.4	-	-	2.4	1.0	3.1	2.9	10.9	8.1
ODONATA	0.0	0.2	0.1	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
COENAGRIONIDAE	0.2	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.1	0.0	0.0
PSYCHOMYIIDAE	0.0	2.7	6.5	3.0	0.9	0.1	-	-	0.0	0.1	0.6	0.1	1.2	0.9
HYDROPSYCHIDAE	154.6	23.8	75.6	27.2	17.8	1.2	-	-	0.4	0.4	2.0	1.8	27.9	20.8
HYDROPTILIDAE	0.3	1.2	0.8	0.0	0.1	0.2	-	-	0.0	0.0	0.5	0.0	0.3	0.2
LEPTOCERIDAE	2.2	0.3	1.3	0.9	0.9	0.1	-	-	0.1	0.1	0.5	0.6	0.7	0.5
LEPIDOPTERA	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.1	0.0	0.0
COLEOPTERA	0.4	0.0	0.1	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
HALIPLIDAE	0.1	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
ELMIDAE	4.0	35.2	3.7	1.3	0.2	0.2	-	-	0.3	0.2	0.9	0.3	4.7	3.5
ELMIDAE(ADULTS)	2.1	1.4	1.0	0.4	0.0	0.0	-	-	0.0	0.1	0.0	0.4	0.5	0.4
TIPULIDAE	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.0	0.0	0.0
PSYCHODIDAE	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.1	0.0	0.0	0.0	0.0	0.0
SIMULIIDAE	18.8	17.8	12.6	1.3	0.5	0.1	-	-	0.1	0.1	0.1	0.7	4.8	3.6
SIMULIIDAE(PUPAE)	0.0	0.1	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	0.0	0.0
EMPIDIDAE	0.0	0.4	0.4	0.3	0.4	0.0	-	-	0.1	0.3	0.1	0.0	0.2	0.1
CERATOPOGONIDAE	1.0	0.3	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.1	0.1	0.1
CHIRONOMIDAE	59.3	194.7	89.0	60.0	29.3	5.9	-	-	4.6	6.1	19.1	22.4	47.4	35.3
CHIRONOMIDAE(PUPAE)	5.7	28.3	12.7	5.8	3.0	0.1	-	-	0.0	0.3	6.9	11.4	7.2	5.4
SPHAERIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	-	-	0.0	0.1	0.3	0.0	0.0	0.0
TOTAL ORGANISMS	414.1	356.6	285.9	161.5	73.3	11.0	-	-	10.6	10.7	38.8	53.8	134.2	
TOTAL TAXA	23	22	20	18	21	14	-	-	19	22	24	20	20	

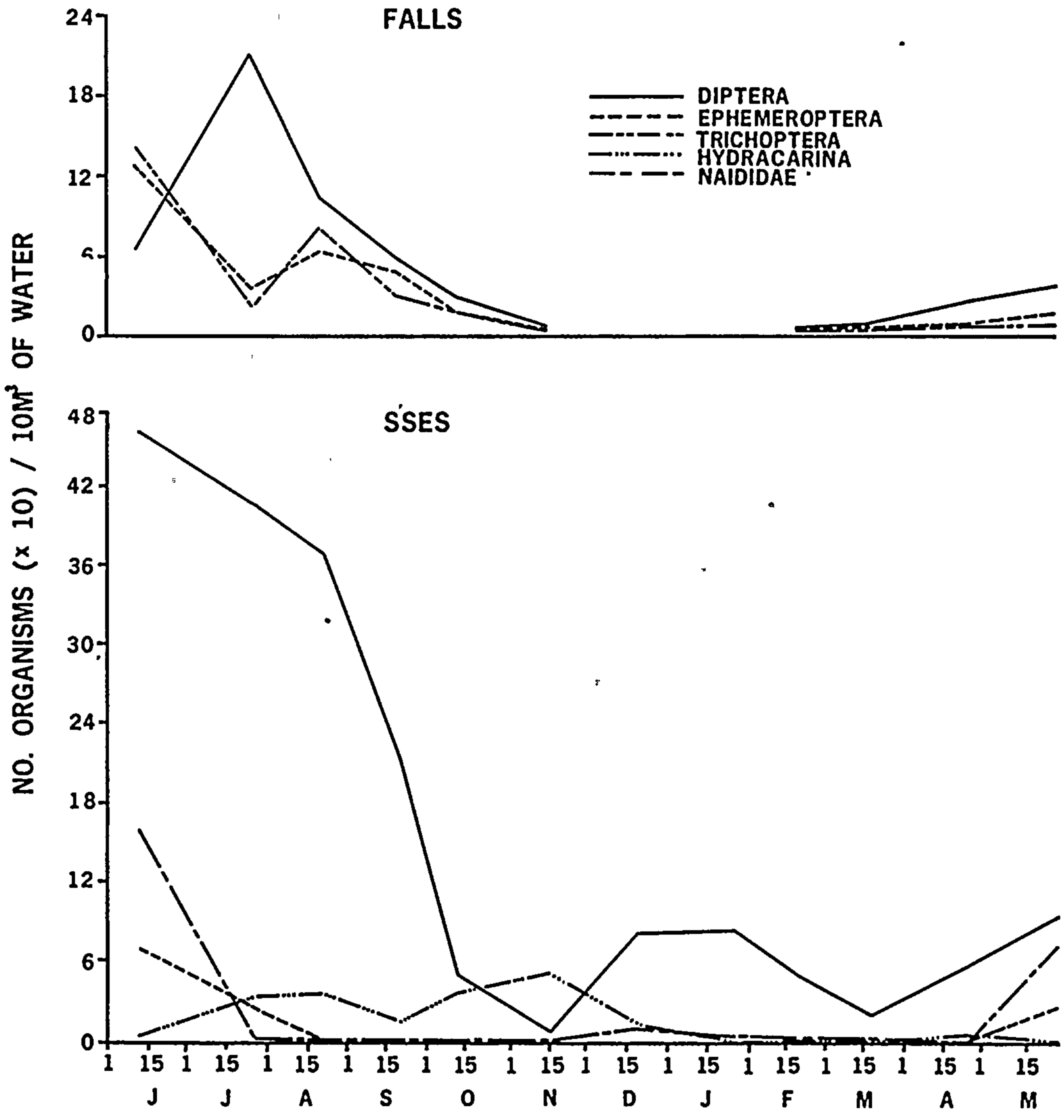

Fig. C-1. Mean number of drifting macroinvertebrates/10 m^3 collected monthly during diel pumping at Falls and SSES on the Susquehanna River, June 1973 through May 1974.

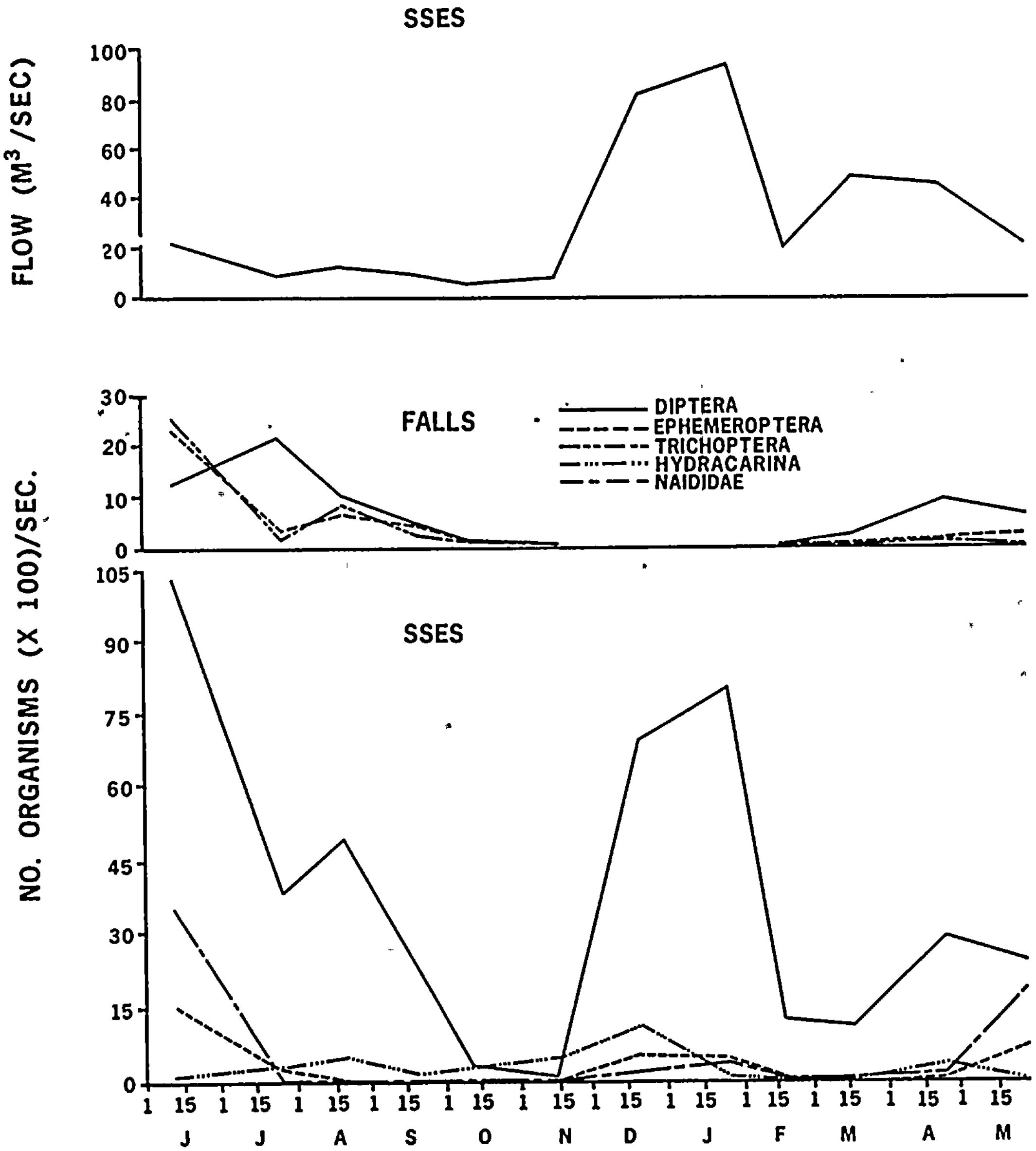

Fig. C-2. River flow and mean number of drifting macroinvertebrates/s collected monthly during diel pumping at Falls and SSES on the Susquehanna River, June 1973 through May 1974.

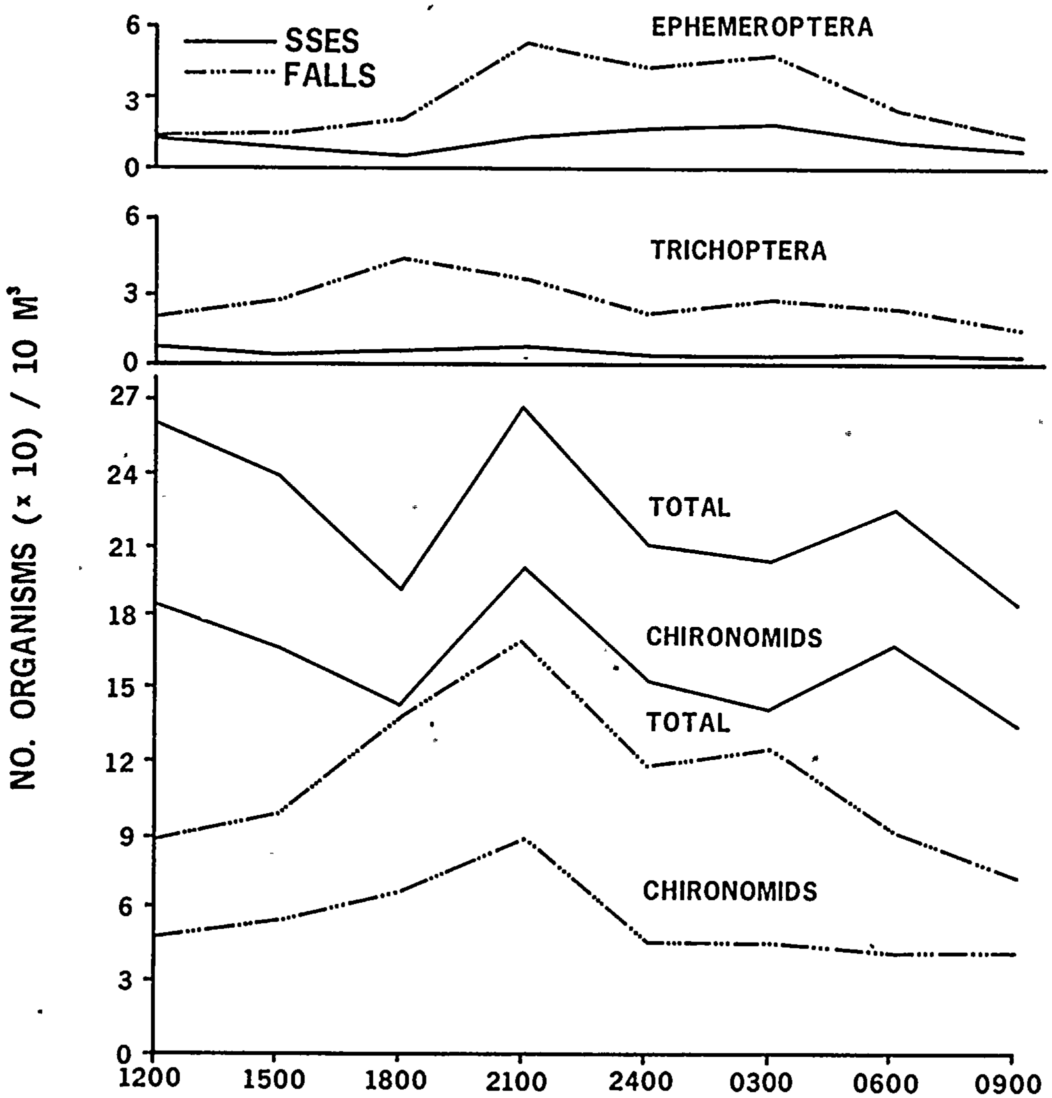

Fig. C-3. Mean number of drifting macroinvertebrates/10 m^3 collected at 3-h intervals during diel pumping at SSES and Falls on the Susquehanna River, June 1973 through May 1974.

DEVELOPMENT OF LARVAL FISHES

by

Gerard L. Buynak and Harold W. Mohr, Jr.

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ABSTRACT

Eggs of northern hog sucker, shorthead redhorse, rock bass, and redbreast sunfish were hatched and the larvae reared in the laboratory. The larval development of these four species was described.

INTRODUCTION

Eggs or larvae of at least 26 fishes have been found near the Susquehanna SES from 1974 through 1976. Identification of the larvae to species is a difficult problem because larvae of many fishes have not been adequately described. The purpose of this study was to describe the larval development of the northern hog sucker, shorthead redhorse, rock bass, and redbreast sunfish from the Susquehanna River.

PROCEDURES

Adult shorthead redhorse and northern hog sucker were captured using an electrofisher in the Susquehanna River near Berwick, Pennsylvania in 1974 and 1975, respectively. Eggs from several females of each species were stripped into a plastic pan that contained dampened sand and were fertilized with milt from several males of the same species. The eggs were rinsed several times and allowed to water harden for about 24 h.

Rock bass eggs were collected from a nest by scuba divers on 24 June 1975 near Port Trevorton, Pennsylvania, and redbreast sunfish eggs were collected on 22 July 1976 near Berwick, Pennsylvania. Stones with attached eggs were transported to the laboratory.

In the laboratory the eggs were hatched and larvae were reared in a miniature aquarium system (Gale 1977) using recirculated pool water. Free-swimming larvae were fed a powdered dry food (Tetramin E) to supplement natural foods which entered the aquaria with the pool water. As the larvae became larger they were given a more granular food (Tetramin L). A series of eggs and larvae of each species was preserved in 10% formalin.

Definitions of prolarvae, postlarvae, late postlarvae, and juvenile stages were taken from Hubbs (1943) and May and Gasaway (1967) with some minor modifications. Prolarvae were those still bearing yolk, postlarvae were those from when all yolk material was absorbed to when fins were present and some fin rays began to develop, late postlarvae were those from when fin rays began to develop in all fins to when scalation started, and juveniles as a stage resembling the adult.

Total length, urostyle length, postanal length, head length, eye diameter, and body depth of each larva was measured to the nearest 0.1 mm using an ocular micrometer. Myomere counts were made on pro-, post-, and late postlarvae using polarizing filters (Berry and Richards 1973). Fewer myomeres could be discerned without the filters. All myomeres posterior to an imaginary vertical line at the posterior margin of the anus were considered postanal (Siefert 1969). The other myomeres, including those bisected by the imaginary line, were considered preanal.

Lateral, dorsal, and ventral illustrations of various sized fish ranging from newly hatched through early juveniles, were traced by projecting their images onto drawing paper with a Bausch and Lomb Tri-Simplex Micro-Projector. To obtain a lateral illustration, a fish was placed in a petri dish and covered with preservative to prevent a blurred image. The specimen was positioned on the micro-projector stage, focused, and an outline of the fish traced. Occasionally the fish did not lie flat; this was corrected by placing a light-weight object such as a pin on the specimen. Other easily seen details such as fin rays, melanophores, and myomeres were brought into focus and traced on the outline.

When larvae were too large to be projected in their entirety, the illustration was drawn in two or more parts. The simplest and most accurate method was to end the drawing at an easily seen structure such as the dorsal fin, reposition the larvae, and continue the drawing. This method was repeated until the entire specimen was drawn. When finished, the petri dish and fish were transferred to a Bausch and Lomb StereoZoom 7 Microscope and detailed drawings were completed.

Dorsal and ventral illustrations of larvae were obtained with the aid of a specially made clear acrylic holder. The circular base of the holder was 0.32-cm thick and about 2.5 cm in diameter. Two 0.32 cm in diameter clear acrylic rods, 0.64-cm long, were cemented in the center and angled slightly to form a V. A fish was placed between the rods and held with dorsal or ventral side up. The holder was then positioned on the micro-projector stage and the projected image was traced and completed as previously explained.

The drawings which varied in size from 12 cm to 60 cm when inked were photographically reduced or enlarged.

RESULTS AND DISCUSSION

Northern Hog Sucker

Spawning

The northern hog sucker is restricted to fresh waters of eastern North America. It spawns in spring in riffles or near shallow sides of pools when the water temperature reaches 15.0 C (Scott and Crossman 1973). Females are found in the riffles only when ready to spawn and usually stay in nearby pools the remainder of the time. In spawning activities, vigorous vibrations by each fish result in a slight depression in which the eggs are deposited. During spawning a female is accompanied by one or more males. Each spawning act lasts about 2 seconds and is repeated every 4 to 7 minutes (Raney and Lachner 1946). The eggs are yellow in color, demersal, nonadhesive, and are abandoned. The mean egg diameter (preserved) of 10 fertilized eggs was 3.5 mm (Gale and Mohr unpublished).

Larval Development

Prolarvae -- Larvae of northern hog sucker hatched 10 days after fertilization at a mean temperature of 17.4 C. Newly hatched larvae ranged from 9.0 to 10.6 mm ($\bar{x}$ = 10.0 mm) total length (TL); urostyle length ranged from 8.7 to 10.1 mm ($\bar{x}$ = 9.6 mm). The yolk sac was bulbous anteriorly immediately after hatching with only small oil globules dispersed throughout. They were pigment free, had a slightly upturned urostyle, and as yolk was absorbed they became more cylindrical (Fig. D-1A). The dorsal fin fold originated about 30% TL behind the snout and was continuous with the caudal and ventral fin folds. The preanal length in the prolarvae was greater than the postanal length (Table D-1).

The eyes of larvae 12.0 mm TL were pigmented around the margin and the caudal fin rays began to develop (Fig. D-1B). No dorsal, ventral, or lateral pigment was evident. The mouth was open and pectoral fin rays began to develop at 12.6 mm TL (Fig. D-1C). Their eyes were more pigmented than the former, but the body remained relatively pigment free.

Postlarvae -- The postlarval stage began at 14.0 mm TL (Fig. D-1D). The dorsal fin started to develop and the swim bladder began to inflate. The only melanophores present were on the dorsal surface of the head. Larvae 15.0 mm TL (Fig. D-1E) became more densely pigmented on the dorsal surface of the head, along the dorsal section of the body, and on the swim bladder. In larvae 15.8 mm TL (Fig. D-1F) the dorsal fin rays began to develop, the dorsal body pigment was more dense that either the lateral or ventral pigment, and the overall pigmentation increased. The pigment on the dorsal surface of the head formed an almost triangular patch that was separated from the more anterior pigment by a pigment-free area between the eyes. Pelvic fins became apparent and formation of the anal fin began in postlarvae 16.8 mm TL (Fig. D-1G). Pigmentation increased on the lateral surface of the body, the swim bladder, and along the dorsal portion of the gut. Development of the pelvic and anal fin rays began in the postlarvae 17.8 mm TL (Fig. D-1H). It is probable however, that the anal fin rays developed earlier than pelvic fin rays.

Late Postlarvae -- The late postlarval stage began by 19.9 mm TL (Fig. D-1I). Melanophores were more dispersed and smaller along the dorsal and lateral surfaces of the body. The almost triangular patch of pigment, between the eyes was similar to that in the larvae 15.8 mm TL. The number of melanophores on the swim bladder and the dorsal and ventral portions of the gut increased and became more dispersed and were smaller. Ventrally, a row of small melanophores was evident on the gut. Saddle-like bands of pigment, similar to those found in juveniles and adults, were evident in larvae 20.2 mm TL (Fig. D-1J). Body depth was greatest in front of the dorsal fin and became tapered posteriorly. In larvae 22.0 mm TL (Fig. D-1K), development of all fin rays was nearly complete; pigmentation appeared at the base of the fins, and the saddle-like dorsal bands were more densely pigmented.

Juveniles -- In juveniles the body was fusiform (Fig. D-1L). The head was large and lacked scales. Head length was 19.8% TL (Table D-1). Maximum body depth occurred near the origin of the dorsal fin and was 15.5% TL. The mouth was protrusible and suctorial but less retractile than most suckers (Scott and Crossman 1973). The dorsal surface of the body had five, dark saddles; these were located near the head, anterior to the origin of the dorsal fin, at middorsal fin, over the anal fin, and on the caudal peduncle. Additional pigment was found in the juvenile between the saddles and at the base of the fins.

Shorthead Redhorse

Spawning

The shorthead redhorse is a widely distributed North American freshwater fish that migrates to riffles in streams and rivers in the spring to spawn when water temperature reaches 11.1 C. Males arrive at the spawning grounds first and establish territories. Spawning usually takes place at night or in early morning, although it may occur throughout the day (Mansueti and Hardy 1967). Eggs in the ovaries varied from 13,500 to 27,150 in females 30.5 to 45.7 cm in length. When spawned, the eggs are scattered and abandoned; no nest is built (Scott and Crossman 1973). In the Susquehanna River near Berwick, spawning began in mid-May and lasted about 2 weeks (Gale and Mohr 1976). Eggs are pale yellow and comparatively large; mean egg diameter (preserved) was 3.3 mm (Gale and Mohr 1976).

Larval Development

Prolarvae -- Eggs hatched 8 days after fertilization at a mean temperature of 15.6 C. The newly hatched larvae ranged from 9.3 to 10.4 mm TL ($\bar{x}$ = 10.0 mm); urostyle length ranged from 8.7 to 9.9 mm ($\bar{x}$ = 9.4 mm). They were cylindrical, pigment free, and had a slightly upturned urostyle (Fig. D-2A). Their mouth was incomplete, and pectoral fin buds were present. Small oil globules were dispersed throughout the yolk sac. The dorsal fin fold originated about 30% TL behind the snout and was continuous with the caudal and ventral fin folds (Fig. D-2B). The preanal length was greater than the postanal length (Table D-2).

The mouth opened, pigment on the dorsal surface of the head appeared, the eyes became pigmented, and development of the caudal fin began in larvae 12.9 mm TL (Fig. D-2C). The dorsal surface of the head had an almost triangular patch of pigment. Behind the head the pigment was scattered; no pigment was evident on lateral and ventral surfaces of the body (Fig. D-2C).

The dorsal fin was established and the swim bladder began to inflate in larvae 13.8 mm TL (Fig. D-2D). Dorsal body pigment began to increase posteriorly and development of the caudal fin rays was more complete.

Postlarvae -- The postlarval stage began at 15.1 mm TL (Fig. D-2E). By 15.8 mm TL the dorsal fin rays began to develop, the formation of the anal fin began, and the dorsal fin fold separated from the caudal fin fold (Fig. D-2F). Development of the pectoral fin rays began at 16.0 mm TL (Fig. D-2G) and anal fin rays began to develop at 16.7 mm TL (Fig. D-2H). Pelvic fin buds appeared at 16.7 mm TL.

Three distinct rows of pigmentation occurred on the body in the postlarval stage. A middorsal row was most dense on the head and caudal peduncle, a midlateral row was present along the lateral line, and a midventral row was most dense near the caudal peduncle (Figs. D-2E and D-2H). Internal pigmentation was present on the swim bladder and along the dorsal section of the gut. Pigmentation on the dorsal and caudal fins increased as the fish increased in size.

Late Postlarvae -- The late postlarval stage began by 18.8 mm TL (Fig. D-2I). Body pigmentation of these larvae remained similar to the postlarval stage, except the midlateral melanophores were more dispersed and smaller in size. Also, that on the dorsal and ventral surfaces of the caudal peduncle was less dense and it was sparse on the pectoral fins. The formation of the pelvic fins and development of the fin rays in all other fins neared completion in the 18.8 mm TL larvae.

Juvenile -- The juvenile stage began by 29.3 mm TL (Fig. D-2J). The body except the head, was covered with cycloid scales. Head length, as a percent of the total length, was larger in the juvenile (20.5%) than in the adult (17-19%). The mouth of the juvenile was small, inferior, and protrusible. Most of the body and the fins were covered with numerous small melanophores. The pigmentation on the caudal and dorsal fins was denser than that on the others.

Rock Bass

Spawning

The rock bass, found in the fresh waters of east-central North America, spawns in late spring and early summer when the water temperature reaches 15.6-21.1 C. Males dig and defend shallow nests up to 0.6 m in diameter. Spawning occurs at short intervals for one hour or more, but only a few adhesive eggs are laid at a time. More than one female may spawn in the same nest and one female may spawn in more than one nest.

Egg number in the ovaries varies from 3,000 to 11,000. The female leaves the nest after spawning, while the male guards and fans the eggs. The male later broods the young for a short period (Scott and Crossman 1973). Mean egg diameter (preserved) was 2.2 mm (Gale and Mohr 1976).

Larval Development

Prolarvae -- The newly hatched larva was pigment free, had an incomplete mouth, an ovoid yolk sac, a straight urostyle, and pectoral fin buds (Fig. D-3A). The mean total length and urostyle length of three newly hatched larvae was 5.6 and 5.5 mm, respectively. A single large oil globule was present in the posterior area of the yolk. Preanal length was less than the postanal length (Table D-3).

In larvae 6.8 mm TL, the eyes were pigmented, the swim bladder began to inflate, and the mouth was open (Fig. D-3B). Pigmentation had appeared on the dorsal, ventral, and lateral surfaces. Relatively large melanophores were present on the top of the head, on the swim bladder, and a few occurred on either side of the dorsal fin fold. Lateral and ventral pigment consisted of large melanophores on the body and yolk sac. In larvae 6.9 mm TL (Fig. D-3C) the lateral and ventral pigment was more dense and development of the caudal fin rays began.

Postlarvae -- The postlarval stage began by 8.6 mm (Fig. D-3D). At this size, development of the dorsal, anal, and pectoral fin rays started. The pigmentation on the dorsal surface of the head was more dense than that found in prolarvae and consisted of a concentration of large melanophores behind the eyes and a separate, more anterior patch, between the eyes. In larvae 9.1 mm TL (Fig. D-3E), development of the fin rays was more advanced; pigmentation was similar to the earlier postlarvae. Pigmentation on dorsal, lateral, and ventral surfaces was dense; the spinous dorsal fin began to form in larvae 10.3 mm TL (Fig. D-3F).

Late Postlarvae -- The late postlarval stage began by 13.5 mm (Fig. D-3G). At this size the pelvic fin rays developed; pigmentation on the dorsal, ventral, and lateral surfaces was more dense. Large melanophores were present on the coiled gut and the formation of saddle-like bands of pigment on the lateral body surface was evident.

Juvenile -- The body of the juvenile was relatively deep and laterally compressed; the greatest depth (37% of TL) occurred at the origin of the dorsal fin (Fig. D-3H). The eyes were large and located high, well in front of the center of the head. Head size was about 31% TL. The maxillary reached the middle or posterior edge of pupil and the base of the dorsal fin was twice as long as the anal fin base. The dorsal fin had 11 spines and the anal fin had 6. Several indistinct saddles of pigmentation occurred on the lateral surface, and each scale below the lateral line was marked with a black spot. The eyes of the juvenile were red and the opercular flap had a vague black spot. The dorsal and anal fin spines were darker than the interconnecting membranes.

Redbreast Sunfish

Spawning

The redbreast sunfish is a freshwater fish found in eastern North America that usually spawns in mid to late June when water temperature reaches 16.7-27.8 C. Males move first from deep water to the spawning grounds in shallow water. Nests are large, varying from 0.6 to 1.0 m in diameter. In streams, the nests are built in the current, usually on the downstream side of a rock. It sometimes spawns in nests of other centrarchids. The female leaves after the eggs are laid while the male guards the nest and fans the eggs (Scott and Crossman 1973). The eggs are moderate in size, yellow, and adhesive. Mean egg diameter (preserved) was 2.1 mm.

In two of three redbreast sunfish nests collected in 1974 and one in 1975, eggs of the swallowtail shiner were found. Utilization of the nest of one species by another in the same family (Raney 1940, Lachner 1952) or from different families including minnow-sunfish combinations (Kramer and Smith 1960, Hunter and Wisby 1961, and Hunter and Hasler 1965) has been documented. However, the redbreast sunfish-swallowtail shiner association was not found in the literature.

Larval Development

Prolarvae -- The newly hatched larva had an incomplete mouth, ovoid yolk sac, pectoral fin buds, and a straight urostyle (Fig. D-4A). A single large oil globule was found in the posterior area of the yolk. The total length ranged from 4.6 to 5.1 mm ($\bar{x}$ = 4.9 mm) and the urostyle length ranged from 4.5 to 5.0 mm ($\bar{x}$ = 4.8 mm). The preanal length was slightly less than postanal length (Table D-4).

At 6.0 mm TL the larvae had pigmented eyes, but lacked pigmentation on the dorsal, ventral, and lateral portions of the body (Fig. D-4B). In larvae 7.8 mm TL (Fig. D-4C), the swim bladder began to inflate, melanophores formed on the head, the mouth opened, and development of the caudal fin rays began. Also, the dorsal and anal fins began to form. No lateral or ventral pigment was found in 7.8 mm TL larvae, but a few melanophores were found on the dorsal surface of the head.

Postlarvae -- The postlarval stage began at 7.9 mm TL (Fig. D-4D). In larvae 8.0 mm TL (Fig. D-4E) lateral and ventral body pigment was present, dense pigment was found on the swim bladder, and the pigmented area on the dorsal surface of the head increased in size.

In larvae 8.1 mm TL (Fig. D-4F) dorsal, anal, and pectoral fin rays began to develop, and the pigmented area on the lateral and ventral surfaces of the body increased in size. In larvae 9.8 mm TL (Fig. D-4G) development of dorsal, pectoral, and anal fin rays was more advanced. Dorsal and ventral body pigment was more dense, formation of the spinous dorsal fin occurred, and pelvic fin buds were present in larvae 11.8 mm TL (Fig. D-4H).

Late Postlarvae -- The late postlarval stage began by 19.0 mm TL (Fig. D-4I). Pigmentation was dense on the dorsal body surface. Laterally, the pigmented area increased and the formation of bands of pigment was evident. Head size was 27% TL, while body depth was 26% TL.

Juvenile -- In the juvenile the body was deep and laterally compressed; greatest depth occurred at the origin of the dorsal fin (Fig. D-4J). The opercular flaps of the juvenile were black and shorter than in the adults. The large eyes of the juvenile were situated in front of the center of the head. The maxillary was short, and reached only to the anterior edge of the eye. The base of the dorsal fin was more than twice as long as the base of the anal fin. There was usually 10 or 11 dorsal spines and 3 or 4 anal spines. Pigmentation consisted of numerous small melanophores surrounding each scale. The fins were dusty to mottled,

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Table D-1. Morphometric and meristic characters of the northern hog sucker from the Susquehanna River, 1975 (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm)				Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number		
		Total	Urostyle	Postanal	Head					Preanal	Postanal	Total
20	$\bar{x}$	11.6	11.0	2.5	1.7	0.7	1.7	prolarvae	M	38	5	43
	R	9.0-14.2	8.7-13.2	1.5-3.5	1.0-2.3	0.5-0.8	1.4-1.9		R	36-38	5-7	41-44
20	$\bar{x}$	15.9	14.3	4.4	2.7	1.0	2.1	postlarvae	M	35	7	42
	R	13.9-18.0	12.9-15.8	3.5-5.1	2.1-3.5	0.9-1.2	1.5-2.7		R	34-36	7-8	41-44
20	$\bar{x}$	20.0	16.6	6.5	3.9	1.4	3.0	late postlarvae	M	34	7	41
	R	17.2-22.0	15.0-18.6	4.9-7.8	3.3-4.6	1.1-1.7	2.5-3.8		R	33-35	7-8	40-43
1		27.8	21.9	11.2	5.5	1.9	4.3	juvenile		--	--	--

Table D-2. Morphometric and meristic characters of the shorthead redhorse from the Susquehanna River, 1974 (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm)				Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number		
		Total	Urostyle	Postanal	Head					Preanal	Postanal	Total
20	$\bar{x}$	12.6	11.7	3.1	1.9	0.8	1.6	prolarvae	M	35	6	40,41
	R	10.2-13.8	9.7-12.9	2.2-3.8	1.3-2.3	0.6-0.9	1.5-1.8		R	34-35	5-7	40-41
20	$\bar{x}$	15.2	13.4	4.4	2.8	1.0	2.1	postlarvae	M	34	7	41
	R	13.4-16.6	12.4-14.4	3.4-5.1	2.3-3.3	0.9-1.2	1.6-2.6		R	33-35	6-7	39-41
20	$\bar{x}$	17.7	14.8	5.8	3.5	1.2	2.6	late postlarvae	M	32	7	38
	R	16.2-19.0	13.6-15.8	5.1-6.5	3.1-3.9	1.1-1.3	2.2-2.9		R	30-34	6-8	38-41
1		29.3	23.2	11.4	6.0	2.0	5.2	juvenile		--	--	--

Table D-3. Morphometric and meristic characters of the rock bass from the Susquehanna River, 1975 (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm)				Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number		
		Total	Urostyle	Postanal	Head					Preanal	Postanal	Total
10	$\bar{x}$	6.1	5.9	3.3	1.0	0.6	1.8	prolarvae	M	13	18	32
	R	5.2-6.9	5.1-6.6	2.7-3.8	0.7-1.6	0.4-0.7	1.6-2.0		R	12-14	17-19	30-32
10	$\bar{x}$	7.8	6.8	4.2	2.1	0.9	2.1	postlarvae	M	12,13	17	29
	R	6.8-9.1	6.0-7.7	3.6-4.8	1.8-2.6	0.8-1.0	1.7-2.4		R	12-13	17-18	29-31
5	$\bar{x}$	13.4	10.9	7.2	3.9	1.5	3.9	late	M	13	16	28,29
	R	12.6-13.8	10.2-11.3	6.9-7.4	3.5-4.2	1.4-1.5	3.5-4.1	postlarvae	R	12-13	16-17	28-30
1		30.6	24.2	17.8	9.5	3.3	11.2	juvenile		--	--	--

Table D-4. Morphometric and meristic characters of the redbreast sunfish from the Susquehanna River, 1976 (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Urostyle	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
10	$\bar{x}$	6.7	6.5	3.6	1.2	0.6	2.0	prolarvae	M	12	17	30
	R	5.0-7.9	4.9-7.7	2.4-4.2	0.7-1.7	0.5-0.7	1.5-2.5		R	12-14	16-18	28-31
10	$\bar{x}$	8.8	7.9	4.6	2.1	0.8	1.8	postlarvae	M	12	16	28
	R	7.9-11.8	7.1-9.9	4.3-5.8	1.8-3.3	0.7-1.1	1.5-2.9		R	12-14	14-18	27-30
5	$\bar{x}$	18.0	14.6	9.3	4.9	1.7	4.7	late postlarvae	M	12	16	28
	R	15.0-20.0	12.5-16.0	7.7-10.4	4.3-5.5	1.6-1.8	4.0-5.1		R	12-14	14-16	27-29
1		36.0	28.5	19.0	10.4	3.2	11.8	juvenile		--	--	--

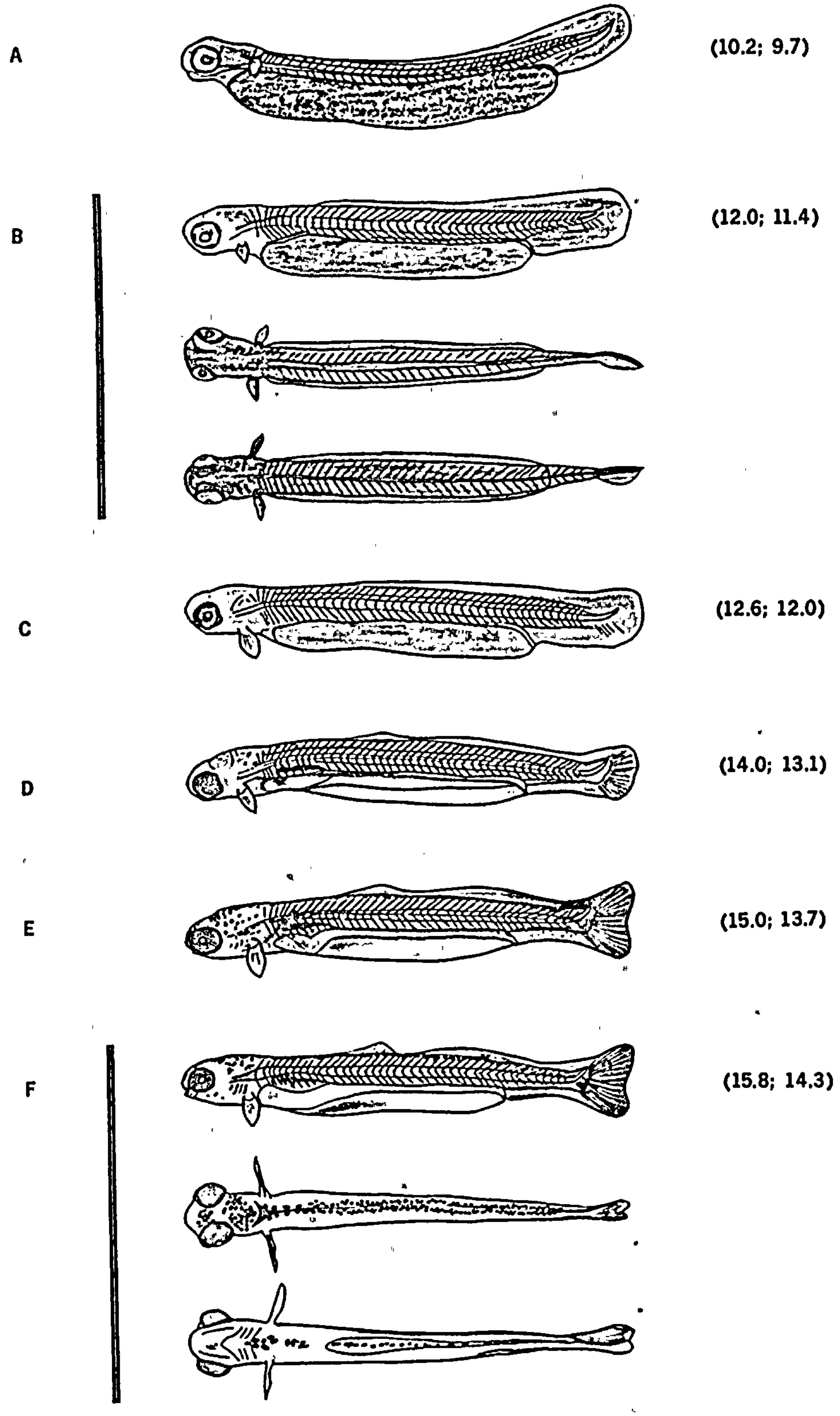

Fig. D-1. Development of the northern hog sucker. A-C. prolarvae. D-H. postlarvae. I-K. late postlarvae. L. juvenile. B, F, and I show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; urostyle).

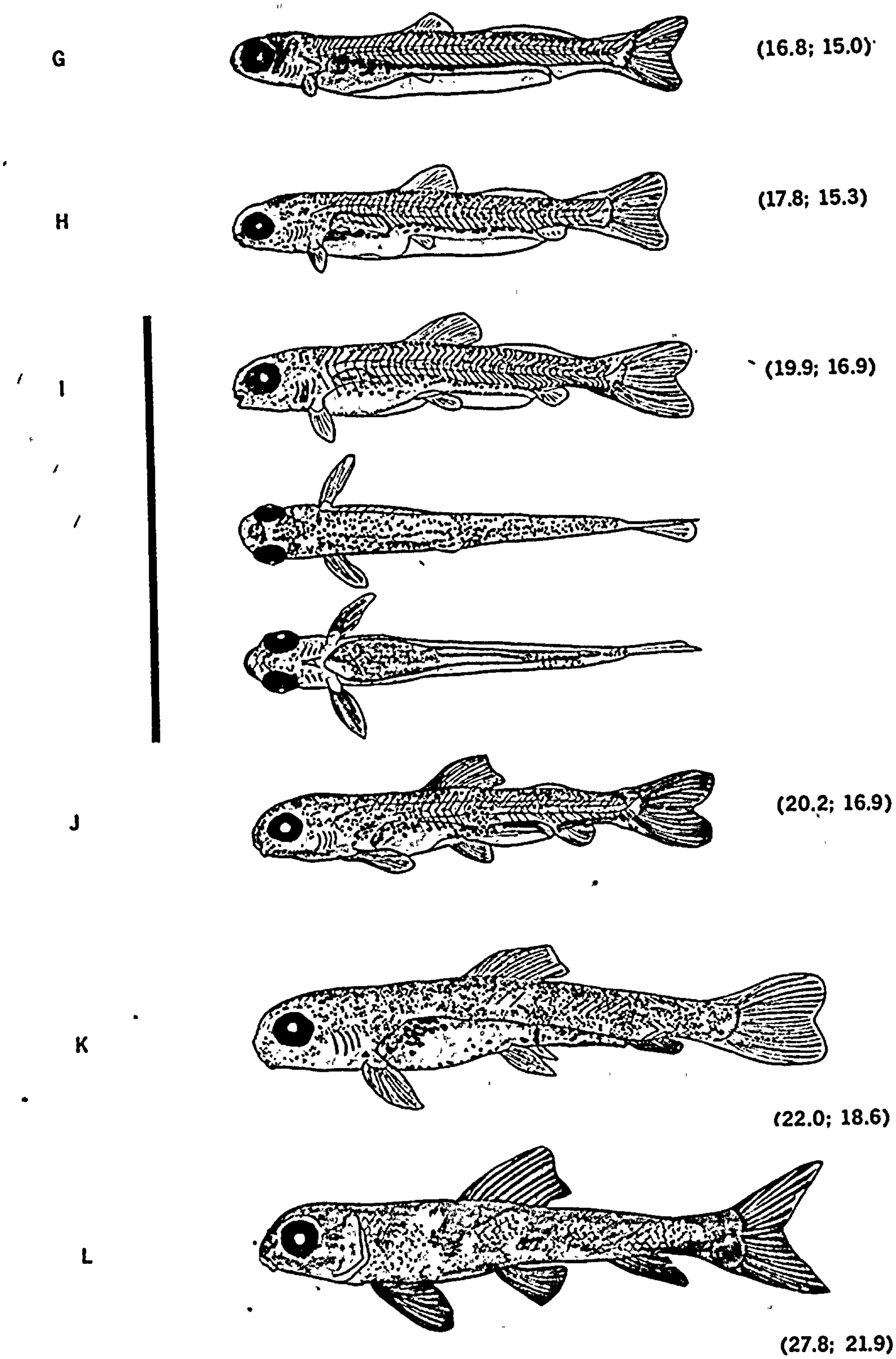

Fig. D-1 (cont.)

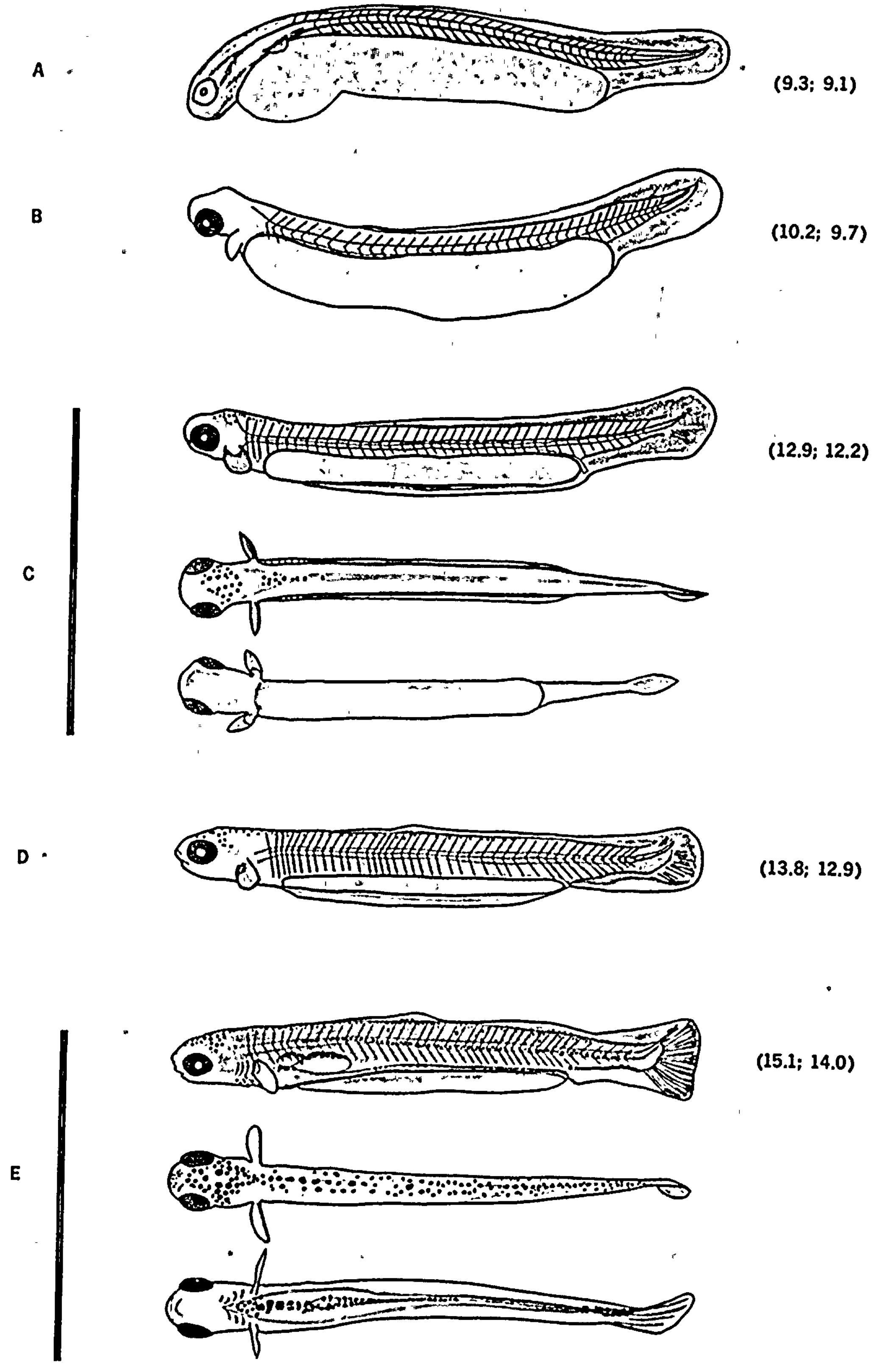

Fig. D-2. Development of the shorthead redhorse. A-D. prolarvae. E-H. postlarvae. I. late postlarvae. J. juvenile. C, E, and H show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; urostyle).

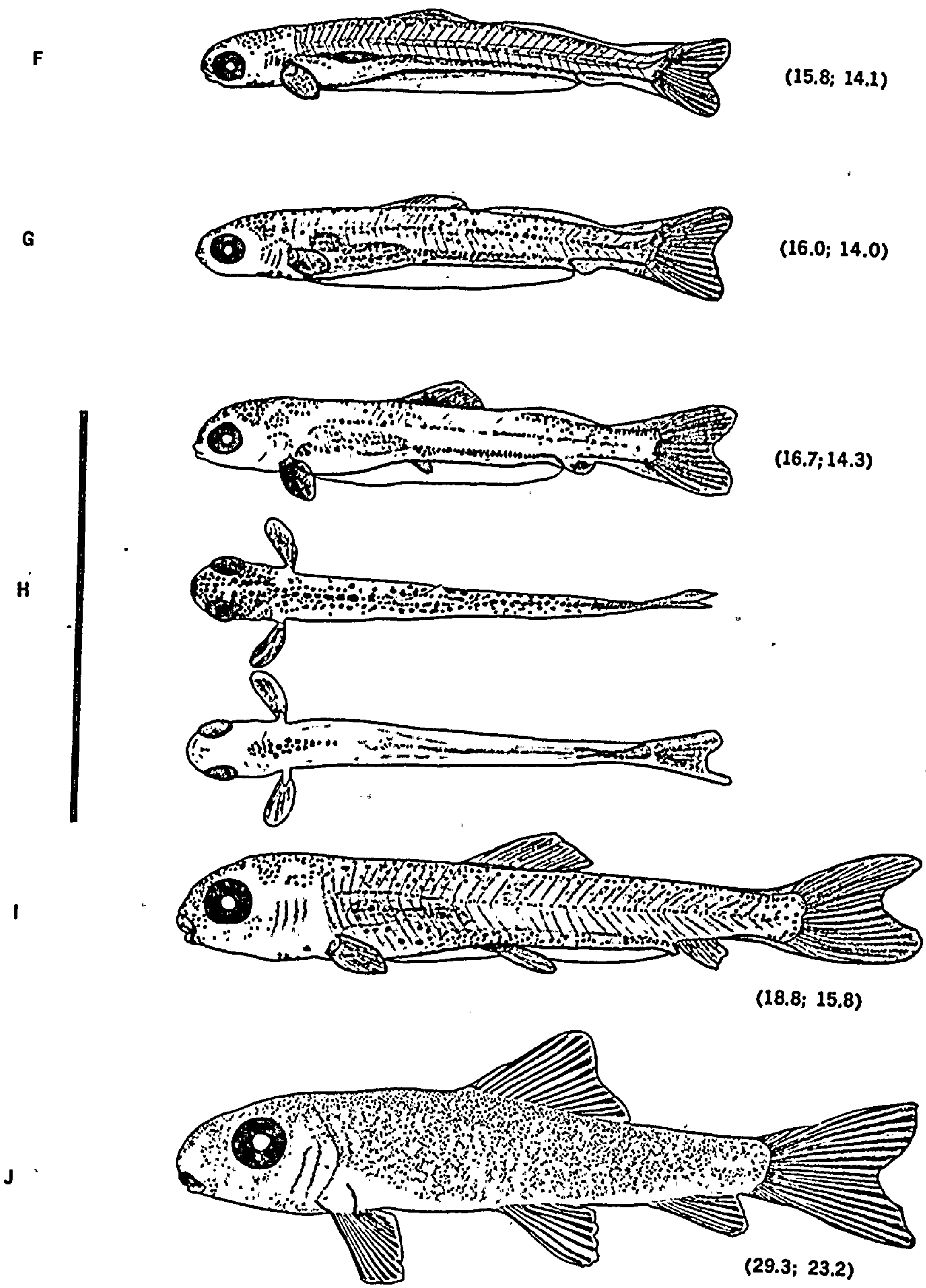

Fig. D-2 (cont.)

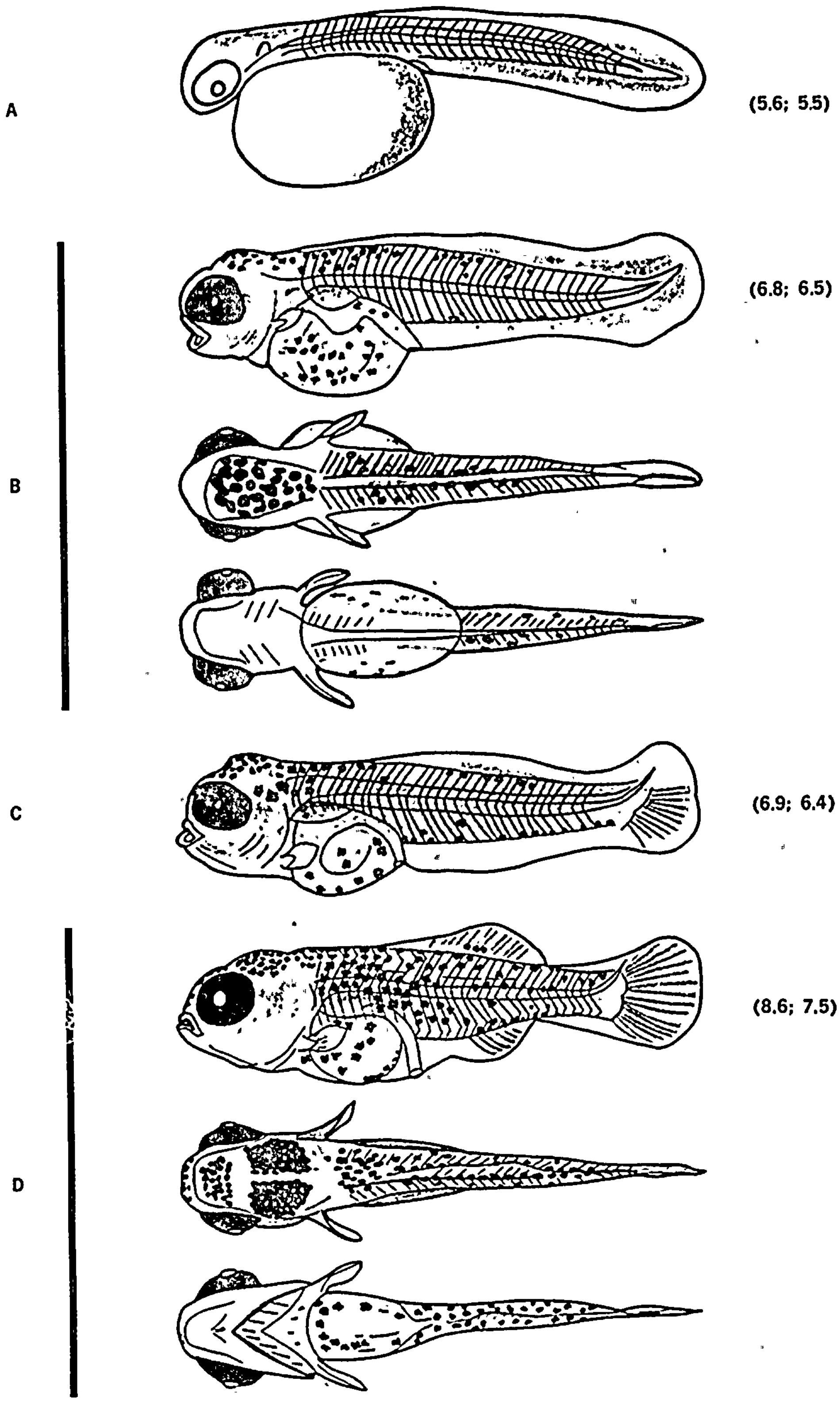

Fig. D-3. Development of the rock bass. A-C. prolarvae. D-F. postlarvae. G. late postlarvae. H. juvenile. B, D, and G show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; urostyle).

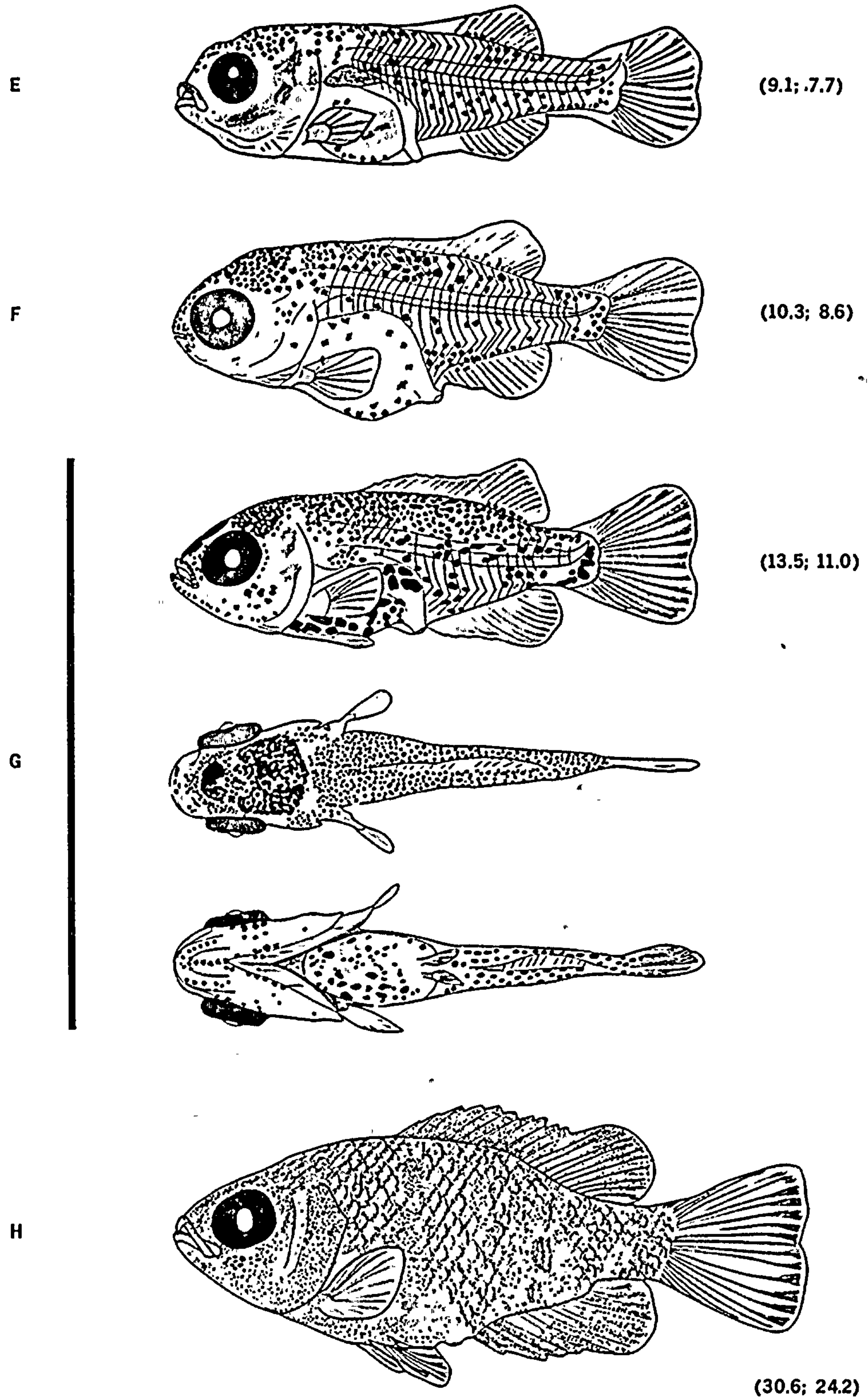

Fig. D-3 (cont.)

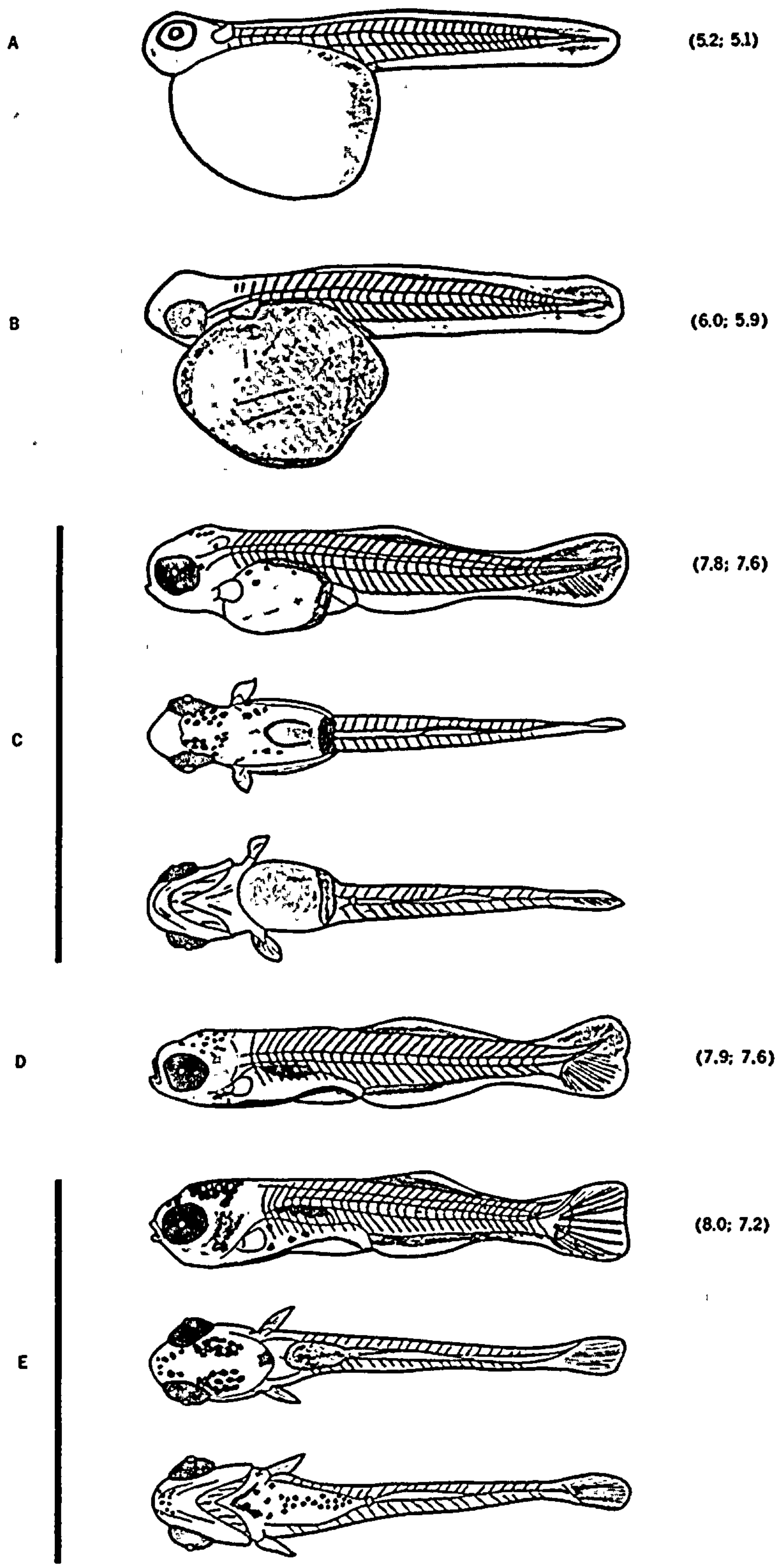

Fig. D-4. Development of the redbreast sunfish. A-C. prolarvae. D-H. postlarvae. I. late postlarvae. J. juvenile. C, E, and H show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; urostyle).

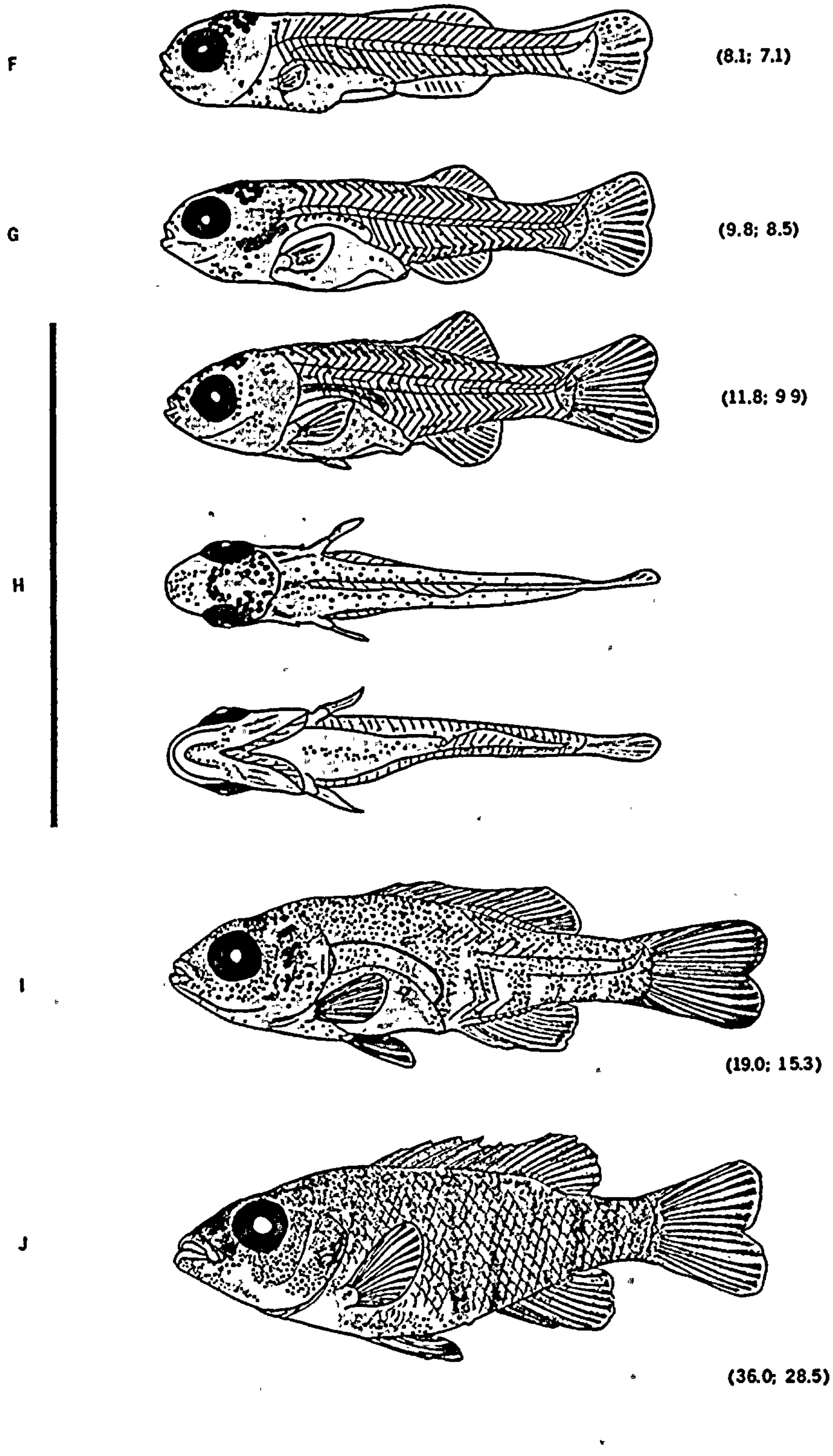

Fig. D-4 (cont.)

LARVAL FISHES

by

Gerard L. Buynak and Harold W. Mohr, Jr.

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ABSTRACT

In 1976 a total of 1,019 larvae of at least 9 fishes was collected at SSES-A from 6 May through 18 August. Quillback composed 40% of the total catch and were the most abundant larvae collected. Mean larval fish density was almost twice as great near the surface (7.9 fish/10 m^3) as near bottom (4.6 fish/10 m^3). Mean density at night (9.6 fish/10 m^3) was more than threefold greater than during the day (2.9 fish/10 m^3). About 98% of the overall catch were prolarvae; of these 63% were collected near the surface.

INTRODUCTION

Samples were collected in 1976 to monitor the relative abundance and density of larval fishes drifting downriver in the vicinity of the Susquehanna SES. Data analyzed are from 144 collections taken at SSES-A (Fig. A-2).

PROCEDURES

Larval fish were sampled from early May through mid-August 1976. Three replicate surface and bottom samples were taken at 0900 and 2100 h at SSES-A on 6, 12, 20, and 28 May; 2, 8, 16, and 25 June; 7 and 20 July; and 5 and 18 August. Samples were collected with a high-capacity, gasoline-powered trash pump mounted on a pontoon boat (Gale and Mohr 1976a). The pump intake was positioned upriver and could be lowered to the bottom of the River and raised by a hand winch.

Pumping rate was approximately 2,500 liters/min. The volume of water sampled was determined by multiplying pumping duration (5 min) by pumping rate. This was considered one unit of effort. Pumping rate was determined in May by twice filling a 1,280-liter trough. In June-August, a hand-held tachometer (Stewart-Warner Model 757-W) was used to estimate pumping rate. A reading of about 2,900 revolutions/min resulted in the pumping of 11.3 m^3 of water/5 min. This rate was constant throughout the remainder of the sampling program.

Larvae were collected by filtering the water through a No. 76 mesh (216 μ opening) net attached on the back of the boat. Samples were preserved with 10% formalin containing rose bengal stain.

In the laboratory, all larvae were sorted, identified, and stored in vials of 10% buffered formalin. Prolarvae were defined as fish with yolk, and postlarvae were those without yolk until scalation began (Hubbs 1943). Larval fish were identified by comparing them to laboratory-reared specimens in reference series and by using keys of Fish (1932), Norden (1961), Mansueti (1964), Mansueti and Hardy (1967), May and Gasaway (1967), Taber (1969), Meyer (1970), and Lippson and Moran (1974).

RESULTS

A total of 1,019 larvae of at least 9 fishes (Table E-1) was collected from 6 May through 18 August at SSES-A in 1976 (Tables E-2 through E-7). Walleye and minnow prolarvae were the first collected (Table E-2). On 12 May quillback prolarvae, white sucker pro- and postlarvae, and tesselated darter prolarvae were first taken (Table E-2). Carp and shorthead redhorse prolarvae were collected on 28 May (Table E-3) and 2 June (Table E-4), respectively. Shorthead redhorse and minnow postlarvae were first captured on 8 June (Table E-4). Quillback postlarvae were first collected on 16 June and spottail shiner and spotfin shiner postlarvae were first taken on 26 June (Table E-5). Spottail shiner, spotfin shiner, and probably other minnows were present earlier but could not be positively identified and were tabulated as "unidentified minnows." By the 7 July sample, larvae of carp and suckers were no longer collected (Table E-6). On 18 August, 1 channel catfish postlarvae was taken (Table E-7).

As was found in 1975 (Buynak and Mohr 1976), three families of fish composed over 99% of the total catch. Suckers were the most abundant (42%), followed by minnows and carps (37%), and perches (20%). Overall, the catch/unit effort was similar in 1975 and 1976 at SSES-A (Fig. E-1). In both years it peaked between 20 May and 20 June. After 1 July very few larvae/unit effort were captured. The peaks in the number of larvae captured in 1975 and 1976 occurred when large numbers of minnows, quillback, and tessellated darter were captured. In 1975 a second peak occurred near the end of June when carp, unidentified minnows, and tessellated darter were abundant (Buynak and Mohr 1976).

The mean densities of larval fish collected increased from less than 0.3 fish/10 m^3 on 6 May (Table E-2) to a maximum of over 27.0 fish/10 m^3 on 16 June (Table E-5) when carp, unidentified minnows, quillback, and tessellated darter were the most abundant. Mean densities then decreased to 0.7 fish/10 m^3 or less from 25 June through 18 August.

In 1976 quillback were the most abundant larvae collected, as in 1974 (Gale and Mohr 1976b) and 1975 (Buynak and Mohr 1976). Quillback composed 40% of the total catch in 1976; almost 80% were caught at night and nearly 85% were taken near the surface. Unidentified minnows were next in abundance (33%) followed by tessellated darter (20%), and carp (3%). Maximum densities of unidentified minnows were present on 8 June when over 10.0 fish/10 m^3 were collected (Table E-4). Maximum densities of quillback were present on 16 June when more than 11.0 fish/ 10 m^3 were collected (Table E-5). Carp and tessellated darter also reached maximum densities on 16 June, when over 2.0 and 5.0 fish/10 m^3 were collected, respectively (Table E-5).

Of the total number of larvae collected in 1976, 63% were taken near the surface of the River. The mean larval fish density was nearly twice as large near the surface (7.9 fish/10 m^3) as near the bottom (4.6 fish/ 10 m^3). Most of the quillback (84%), tessellated darter (76%), and carp (71%) were collected near the surface, while cyprinids other than carp were most frequently collected near the bottom (70%).

Prolarvae were collected more frequently and composed 98% of the total catch. Prolarvae (63%) and postlarvae (68%) were more frequently collected near the surface than near bottom.

In 1976, most (77%) of the larvae were taken at night. Mean density at night (9.6 fish/10 m^3) was over threefold more than during the day (2.9 fish/10 m^3). Most of the tessellated darter (94%), quillback (79%), carp (74%), and unidentified minnows (65%) were captured at night.

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Table E-1. Species of larval fish collected at SSES-A on the Susquehanna River, 1976. Names and order of listing conform to Bailey et al. (1970).

Cyprinidae - Minnows and Carps
- *Cyprinus carpio* - carp
- *Notropis hudsonius* - spottail shiner
- *N. spilopterus* - spotfin shiner
- Unidentified Cyprinidae - unidentified minnows

Catostomidae - Suckers
- *Carpiodes cyprinus* - quillback
- *Catostomus commersoni* - white sucker
- *Moxostoma macrolepidotum* - shorthead redhorse

Ictaluridae - Freshwater Catfishes
- *Ictalurus punctatus* - channel catfish

Percidae - Perches
- *Etheostoma olmstedi* - tessellated darter
- *Stizostedion vitreum* - walleye

Table E-2. Mean density of larval fishes/10 m^3 in 5-min pump samples (3 surface and 3 bottom replicates/sampling period) at SSES-A on the Susquehanna River, 6 and 12 May 1976.

	6 May				12 May			
Sampling period	0902-0938		2100-2136		0900-0935		2108-2143	
Location	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Collection No. HWM-76-	001 002 003	004 005 006	007 008 009	010 011 012	013 014 015	016 017 018	019 020 021	022 023 024
Species								
Unidentified minnows								
prolarva	0	0	0.3	0	0.3	0.3	0	0.3
postlarva	0	0	0	0	0	0	0	0
Quillback								
prolarva	0	0	0	0	0	0.3	1.8	0
postlarva	0	0	0	0	0	0	0	0
White sucker								
prolarva	0	0	0	0	0.3	0	0	0
postlarva	0	0	0	0	0.6	0	0.6	0
Tessellated darter								
prolarva	0	0	0	0	0	0	2.4	0.6
postlarva	0	0	0	0	0	0	0	0
Walleye								
prolarva	0	0.3	0.3	0	0	0	0	0
postlarva	0	0	0	0	0	0	0	0

Table E-3. Mean density of larval fishes/10 m^3 in 5-min pump samples (3 surface and 3 bottom replicates/sampling period) at SSES-A on the Susquehanna River, 20 and 28 May 1976.

	20 May				28 May			
Sampling period	0900-0936		2100-2135		0900-0937		2108-2144	
Location	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Collection No. HWM-76-	025	028	031	034	037	040	043	046
	026	029	032	035	038	041	044	047
	027	030	033	036	039	042	045	048
Species								
Carp								
prolarva	0	0	0	0	0	0	0	0.3
postlarva	0	0	0	0	0	0	0	0
Unidentified minnows								
prolarva	3.8	2.1	0.3	2.1	0.3	2.4	2.4	1.2
postlarva	0	0	0	0	0	0	0	0
Quillback								
prolarva	2.9	0.6	2.1	0.9	3.2	4.7	13.6	0.6
postlarva	0	0	0	0	0	0	0	0
White sucker								
prolarva	0	0	0.3	0	0	0	0	0
postlarva	0	0	1.2	0.6	0	0	0.6	0
Tessellated darter								
prolarva	0.9	0.9	0.3	0	0	0	3.2	1.5
postlarva	0	0	0	0	0	0	0	0
Unidentifiable	0	0	0.6	0	0	0.6	0.3	0

Table E-4. Mean density of larval fishes/10 m^3 in 5-min pump samples (3 surface and 3 bottom replicates/sampling period) at SSES-A on the Susquehanna River, 2 and 8 June 1976.

	2 June				8 June			
Sampling period	0859-0934		2100-2137		0901-0935		2059-2135	
Location	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Collection No. HWM-76-	049	052	055	058	069	072	075	078
	050	053	056	059	070	073	076	079
	051	054	057	060	071	074	077	080
Species								
Carp								
prolarva	0	0	0	0	0	0	0.3	0
postlarva	0	0	0	0	0	0	0	0
Unidentified minnows								
prolarva	0.9	2.1	1.2	2.1	1.5	5.6	8.6	25.1
postlarva	0	0	0	0	0	0	0	0.3
Quillback								
prolarva	1.2	5.0	17.7	2.1	3.2	2.9	10.0	1.5
postlarva	0	0	0	0	0	0	0	0
Shorthead redhorse								
prolarva	0	0.6	0	0	0	0	0.6	0.6
postlarva	0	0	0	0	0	0	0.3	0
Tessellated darter								
prolarva	0	0.9	5.6	0.9	0	1.2	12.7	4.1
postlarva	0	0	0	0	0	0	0	0
Unidentifiable	0	0	0	0	0	0	0.3	0.3

Table E-5. Mean density of larval fishes/10 m^3 in 5-min pump samples (3 surface and 3 bottom replicates/sampling period) at SSES-A on the Susquehanna River, 16 and 25 June 1976.

	16 June				25 June			
Sampling period	0905-0945		2103-2145		0901-0935		2100-2135	
Location	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Collection No. HWM-76-	216	219	222	225	309	312	315	318
	217	220	223	226	310	313	316	319
	218	221	224	227	311	314	317	320
Species								
Carp								
prolarva	2.7	0	4.1	2.7	0	0	0	0
postlarva	0	0	0	0	0	0	0	0
Spottail shiner								
prolarva	0	0	0	0	0	0	0	0
postlarva	0	0	0	0	0	0	0	0.3
Spotfin shiner								
prolarva	0	0	0	0	0	0	0	0
postlarva	0	0	0	0	0.3	0	0	0
Unidentified minnows								
prolarva	1.2	11.5	7.7	11.2	0.3	0.9	0.3	0
postlarva	0	0	0	0	0	0	0	0
Quillback								
prolarva	0.3	0.3	44.2	0.6	0	0	0.3	0
postlarva	0	0.3	0.3	0	0	0	0	0
Tessellated darter								
prolarva	0	0	19.2	4.1	0	0	0.6	0
postlarva	0	0	0	0	0	0	0	0

Table E-6. Mean density of larval fishes/10 m^3 in 5-min pump samples (3 surface and 3 bottom replicates/sampling period) at SSES-A on the Susquehanna River, 7 and 20 July 1976.

	7 July				20 July			
Sampling period	0901-0936		2102-2137		0859-0933		2100-2134	
Location	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Collection No. HWM-76-	321	324	327	330	333	336	339	342
	322	325	328	331	334	337	340	343
	323	326	329	332	335	338	341	344
Species								
Spotfin shiner								
prolarva	0	0	0	0	0	0	0	0
postlarva	0	0	0	0	0	0	0.3	0
Unidentified minnows								
prolarva	0	1.2	0.3	0	0	0.3	0	0
postlarva	0	0	0	0	0	0	0	0
Tessellated darter								
prolarva	0	0	0.6	0	0	0	0	0
postlarva	0	0	0	0	0	0	0	0

Table E-7. Mean density of larval fishes/10 m^3 in 5-min pump samples (3 surface and 3 bottom replicates/sampling period) at SSES-A on the Susquehanna River, 5 and 18 August 1976.

	5 August				18 August			
Sampling period	0853-0933		2104-2138		0855-0930		2100-2138	
Location	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Collection No. HWM-76-	345	348	351	354	357	360	363	366
	346	349	352	355	358	361	364	367
	347	350	353	356	359	362	365	368
Species								
Spotfin shiner								
prolarva	0	0	0	0	0	0	0	0
postlarva	0	0.3	0.3	0	0	0	0	0
Unidentified minnows								
prolarva	0	0.6	0.9	0.6	0	0	0	0
postlarva	0	0	0	0	0	0	0	0
Channel catfish								
prolarva	0	0	0	0	0	0	0	0
postlarva	0	0	0	0	0	0	0	0.3

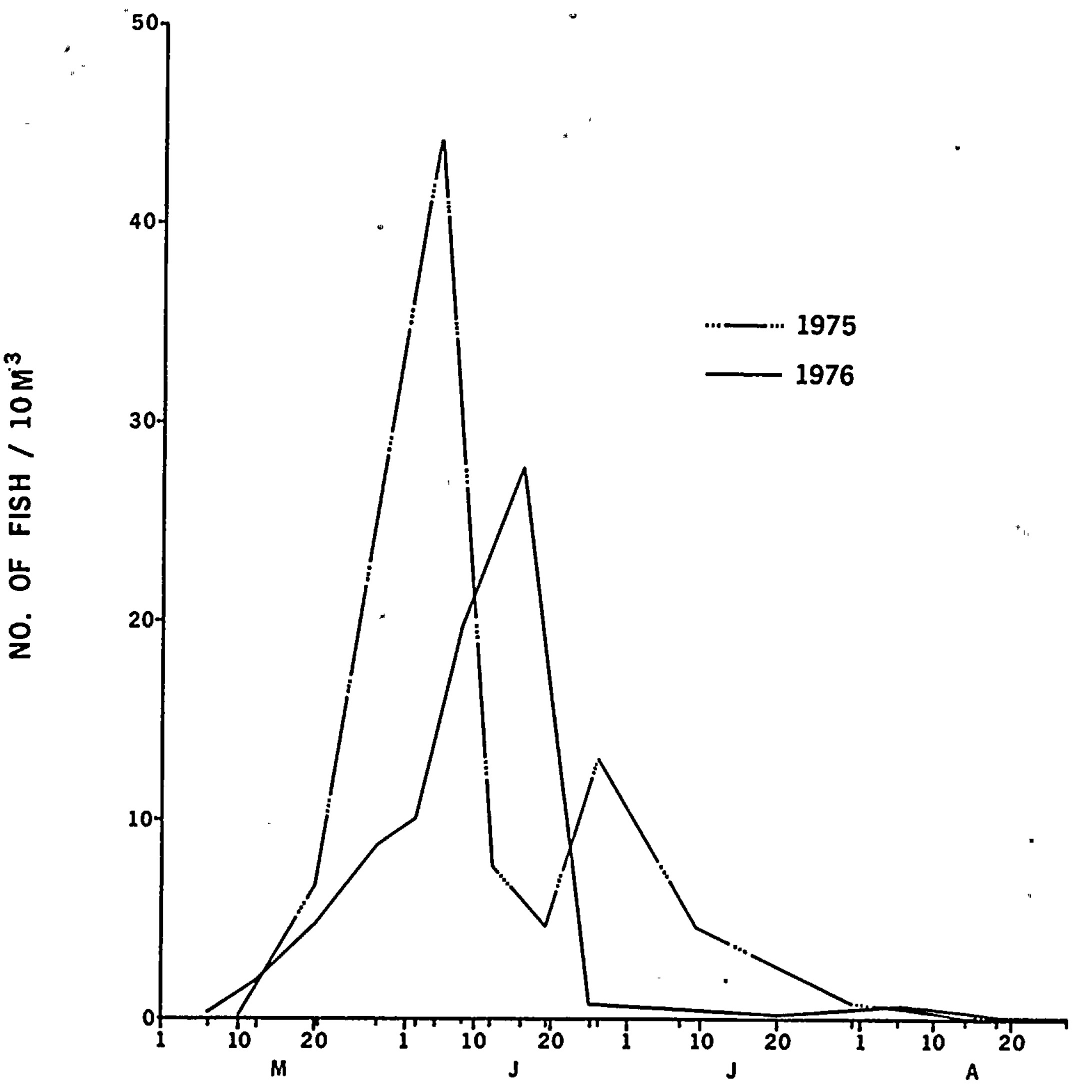

Fig. E-1. Mean density of larvae captured during each sampling period on the Susquehanna River, 1975 and 1976.

ELECTROFISHING OF FISHES

by

Gerard L. Buynak and Andrew J. Gurzynski

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ABSTRACT

At SSES and Bell Bend a total of 4,332 specimens of at least 26 fishes was observed. Quillback, white sucker, northern hog sucker, shorthead redhorse, smallmouth bass, and walleye composed 77% of the specimens observed. The white sucker was the most abundant specimen observed at both stations. Significantly more specimens ($P<0.05$, $n = 34$) were observed/unit effort at Bell Bend than at SSES. The Bell Bend east site yielded a greater catch/effort ($P<0.01$, $n = 17$) than the west site. More specimens/unit effort ($P<0.05$, $n = 16$) were observed at night at Bell Bend than during the day. At SSES, no significant differences in the catch were observed at either the east and west site, or during the day and night.

INTRODUCTION

Electrofishing was conducted in 1976 to determine species composition and relative abundance of large fish near the Susquehanna SES. Included here are data gathered from SSES and Bell Bend in 68 electrofishing collections. These baseline data will be used to asses the environmental impact of construction and operation of the Susquehanna SES on large fish.

PROCEDURES

Electrofishing was conducted once per month from March through November at SSES and Bell Bend (two 1,000-m runs each) using a DC electrofisher. The two sites at SSES were upriver from the proposed intake and discharge structures and the two at Bell Bend were downriver from them (Table F-1; Fig. F-1). The electrofisher has been used to sample large fish since 1972. The major components are a 4-KW Onan generator, a variable voltage pulsator (Power Control Corporation, Pittsburgh, Pennsylvania), and an 18-ft flat-bottomed boat. A more detailed description of the electrofisher is given by Ichthyological Associates (1973).

Each site was electrofished once during the morning and once at night. Each run was considered one unit of effort. Night sampling was started one hour after sunset starting in April. On a run, the electrofishing boat was driven slowly downriver, parallel to and from 1 to 15 m from shore. Stunned fish, excluding cyprinids except carp and large fallfish, were identified to species and counted by two observers on the bow or by the boat operator when the fish surfaced in the water behind the observers. These data were recorded on a cassette tape recorder (Craig No. 8108) by one of the observers on the bow of the boat. Fish which could not be positively identified in the water were captured for closer examination; those that escaped were recorded as unidentified.

Dissolved oxygen concentration, pH, air and water temperatures, and Secchi disc readings were measured at the surface near midriver at each station at the end of the daylight runs. The same parameters, except Secchi disc reading, were determined at night. Dissolved oxygen concentrations and water temperature were measured with a Yellow Springs Instrument Company (Model 54) oxygen meter. The pH was determined using a Leeds and Northrup (Model 7417) pH meter. Air temperature was measured with a Sybron Corporation (Taylor) field thermometer and the limit of visibility was measured with a Secchi disc.

All data were analyzed using a "nonparametric sign test" (Siegel 1956) to determine if there were significant differences in the numbers of fish captured at the various sites.

RESULTS

In 1976 a total of 1,965 specimens of at least 22 fishes was observed at SSES by electrofishing from March through November (Tables F-2 and F-3). Six fishes composed 78% of the catch at SSES (Table F-3). The white sucker was the most abundant fish observed and composed 23.8% of the total catch. It was followed in abundance by shorthead redhorse (16.8%), smallmouth bass (15.4%), quillback (7.7%), walleye (7.2%), and northern hog sucker (7.1%). The percent composition of the total catch of northern hog sucker, smallmouth bass, and walleye at SSES increased from 23.4% in 1975 (Buynak and Gurzynski 1976) to 29.6% in 1976. This increase might be due to improved water quality near the Susquehanna SES site (Fig. A-3).

The number of species observed per month at SSES decreased from April through July, increased in August and September, and decreased in October. The largest number of fishes was taken in April and September at SSES (Table F-3). White sucker, shorthead redhorse, smallmouth bass, and walleye were the only fishes observed in all months. Quillback were observed in 8 out of 9 months sampled. Most fish were observed in May. The catch/unit effort increased from March through May, decreased through July, increased through September, and was low in October and November.

At SSES, no significant differences were found in the total numbers of fish observed at the east (853) and west (1,112) sites. Twenty of the 22 fishes taken were observed at both sites.

The numbers and kinds of fishes observed during the day and night were similar. Totals of 927 specimens of at least 22 fishes were observed during the day and 1,038 specimens of at least 21 fishes were observed at night (Tables F-4 through F-12). Of the 22 fishes observed at SSES, only the yellow bullhead was taken during the day and not at night.

In 1976 the catch/unit effort at Bell Bend was significantly greater ($P<0.01$, $n = 34$) than at SSES when a total of 2,367 specimens of at least 27 fishes were observed at Bell Bend from March through November (Table F-13). The same six species that were the most abundant at SSES were also the most abundant at Bell Bend. At Bell Bend they composed 76% of the total catch. White sucker, the most abundant species observed, composed 26.0% of the catch at Bell Bend. Smallmouth bass was the next most abundant species observed (20.5%), followed by shorthead redhorse (9.7%), quillback (9.5%), walleye (5.5%), and northern hog sucker (4.7%). As at SSES, the percent composition of the total catch of northern hog sucker, smallmouth bass, and walleye increased from 19.3% in 1975 (Buynak and Gurzynski 1976) to 30.7% in 1976.

The number of fishes observed per month at Bell Bend remained high (16-18 fishes) from April through September and was low in March (9), October (10), and November (11) (Table F-13). White sucker, northern hog sucker, shorthead redhorse, smallmouth bass, and walleye were observed in all months sampled. The largest number of fish was observed in May.

A cisco, and, for the first time, a "tiger" muskellunge were observed at Bell Bend. The cisco probably migrated out of Harvey's Lake (Luzerne County) where the Pennsylvania Fish Commission stocked them from 1969 to 1972 (Denoncourt et al. 1975). The tiger muskellunge may have migrated out of Francis Slocum Lake (Luzere Co.), upriver from the Susquehanna SES. They were stocked in the Lake in the early 1970's as fingerlings (personal communication, Pennsylvania Fish Commission, 20 January 1977).

As was found in 1975, a significantly larger ($P<0.01$, $n = 17$) catch/unit effort was observed at the east site at Bell Bend. Totals of 1,303 specimens of at least 22 fishes and 1,064 specimens of at least 21 fishes were observed at the east and west sites at Bell Bend, respectively (Tables F-4 through F-12). Brown trout, river chub, and white catfish were taken only at the Bell Bend east site; redbreast sunfish and yellow perch were taken only at the Bell Bend west site. More fish were observed at the east site because they probably tended to congregate near the mouth of Wapwallopen Creek.

At Bell Bend significantly more ($P<0.01$, $n = 16$) fish/unit effort were observed at night than during the day. Totals of 873 specimens of at least 22 fishes and 1,494 specimens of at least 24 fishes were observed during the day and night, respectively (Tables F-4 through F-12). The river chub and redbreast sunfish were taken only during the day. Cisco, brown trout, golden shiner, and white catfish were observed only at night.

At SSES and Bell Bend a combined total of 4,332 specimens of at least 26 fishes was observed (Tables F-3 and F-13). Of the 26 fishes, 6 (quillback, white sucker, northern hog sucker, shorthead redhorse, smallmouth bass, and walleye) composed 77% of the total. Cisco, tiger muskellunge, river chub, golden shiner, and white catifsh were observed at Bell Bend, but not at SSES; all fish taken at SSES were taken at Bell Bend.

The percent total composition of 6 fishes observed at SSES and Bell Bend (combined total) continued to increase in 1976 compared to 1975 and 1974. The percentage of brown trout, muskellunge, chain pickerel, smallmouth and largemouth bass, and walleye increased from 10% of the total catch in 1974, to 22% of the catch in 1975, and to 27% in 1976 (Buynak and Gurzynski 1976). Pan fish however, decreased from 22% in 1974, to 10% in 1975, and 7% in 1976. A combination of the remaining species composed a similar percentage of the catch from 1974 through 1976.

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Table F-1. Description of electrofishing runs on the Susquehanna River, 1976.

Station	Run	Location
SSES	EL 1	East bank from gas-line crossing to approximately 250 m below Ichthyological Associates dock.
SSES	EL 2	West bank from gas-line crossing to approximately 230 m below mouth of Little Wapwallopen Creek.
Bell Bend	EL 3	East bank from 225 m above eel wall to 200 m above Wapwallopen Creek.
Bell Bend	EL 4	West bank from 275 m above eel wall to 175 m above small stream directly across from Wapwallopen Creek.

Table F-2. List of fishes collected or observed at SSES and Bell Bend on the Susquehanna River, 1976. Names and order of listing conform to Bailey et al. (1970).

Salmonidae - Trouts
- Coregonus artedii - cisco
- Salmo trutta - brown trout

Esocidae - Pikes
- Esox masquinongy - muskellunge
- E. niger - chain pickerel
- E. lucius x E. masquinongy - tiger muskellungd

Cyprinidae - Minnows and Carps
- Cyprinus carpio - carp
- Nocomis micropogon - river chub
- Notemigonus crysoleucas - golden shiner
- Notropis amoenus - comely shiner
- N. cornutus - common shiner
- N. hudsonius - spottail shiner
- N. procne - swallowtail shiner
- N. spilopterus - spotfin shiner
- Pimephales notatus - bluntnose minnow
- Rhinichthys atratulus - blacknose dace
- Semotilus corporalis - fallfish

Catostomidae - Suckers
- Carpiodes cyprinus - quillback
- Catostomus commersoni - white sucker
- Hypentelium nigricans - northern hog sucker
- Moxostoma macrolepidotum - shorthead redhorse

Ictaluridae - Freshwater Catfishes
- Ictalurus catus - white catfish
- I. natalis - yellow bullhead
- I. nebulosus - brown bullhead
- I. punctatus - channel catfish

Centrarchidae - Sunfishes
- Ambloplites rupestris - rock bass
- Lepomis auritus - redbreast sunfish
- L. cyanellus - green sunfish
- L. gibbosus - pumpkinseed
- L. macrochirus - bluegill
- Lepomis spp. - sunfish spp.
- Micropterus dolomieui - smallmouth bass
- M. salmoides - largemouth bass
- Pomoxis annularis - white crappie
- P. nigromaculatus - black crappie

Percidae - Perches
- Etheostoma olmstedi - tessellated darter
- Perca flavescens - yellow perch
- Stizostedion vitreum - walleye

Cottidae - Sculpins
- Cottus bairdi - mottled sculpin

Table F-3. Frequency of occurrence and species composition (percent) of fish captured using a DC electrofisher at SSES on the Susquehanna River, 1976.

Species	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	% Total
Brown trout	1	4	1	0	0	0	0	0	0	6	0.31
Muskellunge	0	4	2	1	3	1	1	4	0	16	0.81
Chain pickerel	0	1	0	0	0	1	0	0	0	2	0.10
Carp	15	10	12	11	13	11	4	0	0	76	3.86
Fallfish	0	9	11	0	0	0	3	0	0	23	1.17
Quillback	9	36	27	12	21	38	7	1	0	151	7.68
White sucker	32	70	60	68	14	64	100	24	37	469	23.84
Northern hog sucker	0	14	30	3	0	5	82	0	5	139	7.07
Shorthead redhorse	7	30	183	20	24	48	15	1	1	329	16.83
Yellow bullhead	0	1	0	0	0	0	0	0	0	1	0.05
Brown bullhead	2	3	8	1	1	7	3	0	0	25	1.27
Channel catfish	0	0	0	5	0	2	5	0	0	12	0.61
Rock bass	0	11	12	14	3	10	11	0	3	64	3.25
Redbreast sunfish	0	1	0	0	0	0	2	0	0	3	0.15
Pumpkinseed	0	0	0	2	0	2	3	0	0	7	0.36
Bluegill	0	1	0	0	0	1	5	0	0	7	0.36
Sunfish spp.	0	0	0	0	0	0	2	0	0	2	0.10
Smallmouth bass	1	5	47	90	45	39	71	2	3	303	15.40
Largemouth bass	2	12	2	1	0	3	1	0	0	21	1.07
White crappie	0	21	12	1	0	0	1	0	0	35	1.78
Black crappie	1	11	8	0	0	2	2	0	0	24	1.22
Crappie spp.	2	10	4	2	0	0	0	0	2	20	1.02
Yellow perch	0	0	1	0	1	0	3	0	0	5	0.25
Walleye	5	4	34	22	13	16	12	16	20	142	7.22
Unidentified	4	0	5	20	17	0	20	6	11	83	4.22
Total	81	258	459	273	155	250	353	54	82	1,965	100.00

Table F-4. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 29 March 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-001		GLB-76-002			GLB-76-003		GLB-76-004		
Time	0905-0928		0935-0955			1040-1105		1005-1030		
Air temperature (C)	17.0		17.0			17.0		17.0		
Water temperature (C)	8.5		8.5			8.5		8.5		
Dissolved oxygen (mg/l)	9.3		9.3			8.3		8.3		
pH	7.2		7.2			7.2		7.2		
Secchi disc (cm)	70		70			73		73		
Species					Total					Total
Brown trout	0	No sample	1	No sample	1	0	No sample	0	No sample	0
Muskellunge	0		0		0	1		0		1
Carp	7		8		15	4		6		10
Quillback	2		7		9	3		4		7
White sucker	11		21		32	25		40		65
Northern hog sucker	0		0		0	3		2		5
Shorthead redhorse	1		6		7	1		0		1
Brown bullhead	2		0		2	0		0		0
Smallmouth bass	1		0		1	1		0		1
Largemouth bass	2		0		2	0		0		0
Black crappie	1		0		1	4		0		4
Crappie spp.	2		0		2	0		0		0
Walleye	2		3		5	2		1		3
Unidentified	1		3		4	1		2		3
Total	32		49		81	45		55		100

Table F-5. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 14 April 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-013	GLB-76-017	GLB-76-014	GLB-76-018		GLB-76-016	GLB-76-020	GLB-76-015	GLB-76-019	
Time	0835-0850	1955-2010	0855-0932	2020-2045		1017-1045	2130-2155	0940-1005	2055-2115	
Air temperature (C)	11.0	15.0	10.0	10.0		20.0	11.0	21.0	11.0	
Water temperature (C)	8.0	9.0	8.0	9.0		8.0	9.0	8.0	9.0	
Dissolved oxygen (mg/l)	10.8	9.0	10.4	9.0		9.7	7.5	9.0	8.5	
pH	7.4	7.4	7.2	7.2		7.2	7.2	7.2	7.2	
Secchi disc (cm)	145	--	151	--		153	--	143	--	
Species					**Total**					**Total**
Brown trout	0	1	1	2	4	0	0	0	0	0
Muskellunge	0	0	1	3	4	0	0	2	0	2
Tiger muskellunge	0	0	0	0	0	0	0	1	0	1
Chain pickerel	0	1	0	0	1	2	0	1	1	4
Carp	0	1	1	8	10	0	6	0	2	8
Fallfish	0	5	1	3	9	1	15	0	8	24
Quillback	1	19	0	16	36	0	6	1	82	89
White sucker	9	20	13	28	70	8	23	6	36	73
Northern hog sucker	4	5	1	4	14	2	4	1	7	14
Shorthead redhorse	1	19	1	9	30	1	11	2	18	32
Yellow bullhead	1	0	0	0	1	0	1	0	0	1
Brown bullhead	1	1	0	1	3	4	2	0	1	7
Rock bass	0	3	0	8	11	0	7	1	5	13
Redbreast sunfish	0	1	0	0	1	0	0	0	0	0
Bluegill	1	0	0	0	1	1	0	0	0	1
Smallmouth bass	1	0	1	3	5	3	0	0	1	4
Largemouth bass	1	0	11	0	12	1	0	0	0	1
White crappie	10	9	1	1	21	4	0	0	1	5
Black crappie	10	1	0	0	11	4	0	0	0	4
Crappie spp.	2	8	0	0	10	0	0	0	0	0
Walleye	0	3	1	0	4	0	6	0	0	6
Unidentified	0	0	0	0	0	1	1	1	10	13
Total	42	97	33	86	258	32	82	16	172	302

Table F-6. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 12-13 May 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-023	GLB-76-027	GLB-76-024	GLB-76-028		GLB-76-021	GLB-76-026	GLB-76-022	GLB-76-025	
Time	1020-1045	2345-0008	1100-1125	0021-0038		0910-0935	2245-2320	0950-1015	2210-2240	
Air temperature (C)	17.0	12.0	17.0	12.0		17.0	12.5	17.0	16.5	
Water temperature (C)	13.5	13.5	13.5	13.5		13.5	13.5	13.5	13.5	
Dissolved oxygen (mg/l)	10.1	10.2	10.8	10.2		10.3	10.2	10.2	10.6	
pH	7.6	7.5	7.4	7.6		7.6	7.4	7.5	7.6	
Secchi disc (cm)	125	--	125	--		125	--	125	--	
Species					**Total**					**Total**
Brown trout	0	0	0	1	1	0	0	0	0	0
	0	0	0	2	2	1	0	1	0	2
Chain pickerel	0	0	0	0	0	0	0	0	1	1
Carp	3	3	2	4	12	0	6	2	1	9
Golden shiner	0	0	0	0	0	0	0	0	1	1
Fallfish	1	0	2	8	11	1	3	2	2	8
Quillback	8	6	10	3	27	2	2	6	8	18
White sucker	13	15	7	25	60	20	54	13	29	116
Northern hog sucker	9	7	6	8	30	13	0	3	4	20
Shorthead redhorse	0	7	129	47	183	1	9	12	6	28
Yellow bullhead	0	0	0	0	0	0	1	0	0	1
Brown bullhead	1	4	2	1	8	5	10	1	6	22
Rock bass	2	5	3	2	12	1	24	3	5	33
Smallmouth bass	11	16	8	12	47	22	72	9	36	139
Largemouth bass	1	0	1	0	2	2	1	0	0	3
White crappie	3	1	8	0	12	1	0	2	1	4
Black crappie	2	1	5	0	8	0	3	1	0	4
Crappie spp.	2	2	0	0	4	1	0	0	0	1
Yellow perch	0	1	0	0	1	1	0	1	0	2
Walleye	3	9	10	12	34	1	12	5	15	33
Unidentified	1	2	2	0	5	1	0	2	4	7
Total	60	79	195	125	459	73	197	63	119	452

Table F-7. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 29 June 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-045	GLB-76-051	GLB-76-046	GLB-76-052		GLB-76-048	GLB-76-049	GLB-76-047	GLB-76-050	
Time	0930-0955	2302-2325	1015-1033	2338-2405		1115-1139	2100-2125	1041-1101	2130-2155	
Air temperature (C)	28.0	24.0	35.0	24.0		39.0	26.0	37.0	26.0	
Water temperature (C)	25.0	25.0	25.0	25.0		25.5	25.0	25.5	25.0	
Dissolved oxygen (mg/l)	8.4	10.2	8.6	9.8		8.7	9.8	8.7	8.8	
pH	7.6	--	7.6	--		7.4	--	7.5	--	
Secchi disc (cm)	30	--	30	--		40	--	40	--	
Species					**Total**					**Total**
Muskellunge	0	1	0	0	1	1	0	0	0	1
Chain pickerel	0	0	0	0	0	1	0	0	0	1
Carp	5	4	1	1	11	6	5	3	3	17
Fallfish	0	0	0	0	0	0	0	1	0	1
Quillback	1	6	3	2	12	0	2	6	12	20
White sucker	2	28	10	28	68	14	46	7	36	103
Northern hog sucker	1	1	1	0	3	0	0	2	5	7
Shorthead redhorse	0	8	4	8	20	6	10	4	5	25
Yellow bullhead	0	0	0	0	0	0	1	0	1	2
Brown bullhead	0	1	0	0	1	7	2	1	3	13
Channel catfish	1	2	0	2	5	0	1	0	0	1
Rock bass	0	5	2	7	14	6	8	1	7	22
Pumpkinseed	0	0	2	0	2	3	0	0	1	4
Smallmouth bass	25	25	14	26	90	21	79	21	38	159
Largemouth bass	1	0	0	0	1	0	0	0	0	0
White crappie	1	0	0	0	1	1	0	0	0	1
Black crappie	0	0	0	0	0	1	2	0	0	3
Crappie spp.	0	1	1	0	2	0	1	0	0	1
Yellow perch	0	0	0	0	0	0	0	1	0	1
Walleye	2	8	6	6	22	4	10	1	5	20
Unidentified	4	4	8	4	20	18	11	6	5	40
Total	43	94	52	84	273	89	178	54	121	442

Table F-8. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 14 July 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-055	GLB-76-057	GLB-76-056	GLB-76-058		GLB-76-054	GLB-76-060	GLB-76-053	GLB-76-059	
Time	0950-1010	2135-2200	1021-1042	2210-2232		0905-0926	2311-2334	0830-0852	2236-2258	
Air temperature (C)	25.0	22.0	27.0	22.0		22.0	22.0	21.0	23.0	
Water temperature (C)	21.0	20.5	21.5	20.5		21.0	20.5	21.5	20.5	
Dissolved oxygen (mg/l)	8.6	7.0	8.8	7.2		8.4	8.2	8.0	7.3	
pH	--	--	--	--		--	--	--	--	
Secchi disc (cm)	43	--	20	--		42	--	21	--	
Species					Total					Total
Muskellunge	1	1	1	0	3	1	2	0	0	3
Chain pickerel	0	0	0	0	0	0	0	0	1	1
Carp	3	4	6	0	13	3	7	7	0	17
Quillback	4	2	6	9	21	4	2	7	5	18
White sucker	4	0	5	5	14	6	5	9	6	26
Northern hog sucker	0	0	0	0	0	0	0	4	0	4
Shorthead redhorse	1	9	7	7	24	6	8	7	13	34
White catfish	0	0	0	0	0	0	1	0	0	1
Yellow bullhead	0	0	0	0	0	1	0	0	0	1
Brown bullhead	0	0	1	0	1	1	2	0	1	4
Rock bass	1	0	2	0	3	2	0	0	0	2
Pumpkinseed	0	0	0	0	0	2	3	0	0	5
Bluegill	0	0	0	0	0	1	0	0	0	1
Smallmouth bass	14	5	14	12	45	8	30	15	11	64
Largemouth bass	0	0	0	0	0	1	0	0	0	1
Black crappie	0	0	0	0	0	0	1	0	0	1
Crappie spp.	0	0	0	0	0	1	0	0	0	1
Yellow perch	0	1	0	0	1	0	0	0	0	0
Walleye	0	1	3	9	13	3	2	3	3	11
Unidentified	3	14	0	0	17	7	15	0	12	34
Total	31	37	45	42	155	47	78	52	52	229

Table F-9. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 19 August 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-069	GLB-76-075	GLB-76-070	GLB-76-076		GLB-76-071	GLB-76-074	GLB-76-072	GLB-76-073	
Time	0900-0925	2210-2223	0935-1000	2235-2305		1010-1030	2130-2159	1041-1109	2105-2126	
Air temperature (C)	23.0	21.0	23.0	20.0		24.0	21.0	24.0	20.0	
Water temperature (C)	23.0	23.0	23.0	23.0		23.0	23.0	23.0	23.0	
Dissolved oxygen (mg/l)	--	--	--	--		--	--	--	--	
pH	7.2	7.4	7.4	7.2		7.4	7.2	7.3	7.2	
Secchi disc (cm)	40	--	45	--		30	--	35	--	
Species					**Total**					**Total**
Muskellunge	0	0	1	0	1	1	1	1	0	3
Chain pickerel	0	0	1	0	1	1	0	0	0	1
Carp	3	1	3	4	11	4	6	2	3	15
Quillback	5	7	11	15	38	5	11	5	7	28
White sucker	17	13	15	19	64	10	16	7	15	48
Northern hog sucker	3	1	1	0	5	2	1	2	3	8
Shorthead redhorse	6	11	19	12	48	15	9	16	17	57
Yellow bullhead	0	0	0	0	0	2	1	0	0	3
Brown bullhead	3	1	1	2	7	3	4	2	3	12
Channel catfish	0	2	0	0	2	3	1	0	1	5
Rock bass	2	3	2	3	10	4	2	2	6	14
Pumpkinseed	1	0	1	0	2	2	0	0	1	3
Bluegill	0	0	1	0	1	0	0	0	2	2
Smallmouth bass	11	7	9	12	39	10	16	10	7	43
Largemouth bass	1	1	0	1	3	1	0	0	1	2
Black crappie	1	1	0	0	2	1	0	0	0	1
Walleye	5	4	3	4	16	7	6	12	5	30
Total	58	52	68	72	250	71	74	59	71	275

Table F-10. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 22 September 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-085	GLB-76-091	GLB-76-086	GLB-76-092		GLB-76-088	GLB-76-090	GLB-76-087	GLB-76-089	
Time	0940-1005	2200-2225	1037-1100	2233-2250		1155-1219	2045-2110	1125-1145	2010-2035	
Air temperature (C)	13.0	11.0	13.0	9.0		16.0	13.0	18.0	12.0	
Water temperature (C)	18.0	17.5	19.0	17.0		19.0	17.5	19.0	17.5	
Dissolved oxygen (mg/l)	7.4	8.5	7.1	8.4		7.6	8.9	7.1	8.3	
pH	7.2	--	--	--		7.0	--	--	--	
Secchi disc (cm)	72	--	69	--		76	--	72	--	
Species					**Total**					**Total**
Muskellunge	0	0	0	1	1	0	0	0	0	0
Chain pickerel	0	0	0	0	0	1	0	0	0	1
Carp	1	1	1	1	4	4	4	2	2	12
River chub	0	0	0	0	0	1	0	0	0	1
Fallfish	0	0	3	0	3	0	0	0	1	1
Quillback	3	3	0	1	7	13	17	5	7	42
White sucker	29	11	29	31	100	23	34	17	16	90
Northern hog sucker	14	10	55	3	82	22	3	10	2	37
Shorthead redhorse	0	10	3	2	15	14	16	10	8	48
Brown bullhead	0	1	1	1	3	0	2	0	0	2
Channel catfish	0	3	0	2	5	0	2	0	0	2
Rock bass	0	3	2	6	11	1	7	1	4	13
Redbreast sunfish	2	0	0	0	2	0	0	2	0	2
Pumpkinseed	1	0	1	1	3	1	0	4	0	5
Bluegill	1	1	1	2	5	1	3	0	0	4
Sunfish spp.	2	0	0	0	2	0	6	0	1	7
Smallmouth bass	12	11	19	29	71	7	29	16	15	67
Largemouth bass	0	0	0	1	1	0	0	0	0	0
White crappie	0	0	0	1	1	0	0	0	0	0
Black crappie	0	2	0	0	2	0	0	0	0	0
Yellow perch	2	1	0	0	3	0	0	0	1	1
Walleye	1	3	0	8	12	1	10	0	9	20
Unidentified	2	3	4	11	20	4	11	5	8	28
Total	70	63	119	101	353	93	144	72	74	383

Table F-11. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on the Susquehanna River, 28 October 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-103	GLB-76-105	GLB-76-104	GLB-76-106		GLB-76-102	GLB-76-108	GLB-76-101	GLB-76-107	
Time	1106-1124	1928-1950	1148-1205	2005-2025		0947-1006	2100-2123	0910-0932	2030-2050	
Air temperature (C)	4.0	1.0	8.0	--		1.0	-2.0	0.0	4.0	
Water temperature (C)	5.0	6.0	5.0	5.5		5.0	5.0	5.5	5.5	
Dissolved oxygen (mg/l)	10.0	8.9	10.2	8.5		10.2	9.4	8.9	8.9	
pH	7.3	7.3	7.1	7.2		7.1	7.3	7.3	7.2	
Secchi disc (cm)	53	--	42	--		45	--	45	--	
Species					Total					Total
Cisco	0	0	0	0	0	0	1	0	0	1
Brown trout	0	0	0	0	0	0	1	0	0	1
Muskellunge	3	0	1	0	4	2	0	0	2	4
Chain pickerel	0	0	0	0	0	3	0	0	0	3
Quillback	0	1	0	0	1	0	1	0	1	2
White sucker	6	12	5	1	24	11	3	5	22	41
Northern hog sucker	0	0	0	0	0	0	0	0	1	1
Shorthead redhorse	0	0	0	1	1	0	0	1	3	4
Smallmouth bass	1	0	0	1	2	0	0	2	4	6
Walleye	0	5	0	11	16	0	0	0	1	1
Unidentified	3	3	0	0	6	0	0	0	3	3
Total	13	21	6	14	54	16	6	8	37	67

Table F-12. Number of fish captured or observed in day and night runs (1000 m) using a DC electrofisher at SSES and Bell Bend on tne Susquehanna River, 16 November 1976.

Station	SSES					BELL BEND				
Site	EL 1 East		EL 2 West			EL 3 East		EL 4 West		
Collection No.	GLB-76-117	GLB-76-121	GLB-76-118	GLB-76-122		GLB-76-120	GLB-76-124	GLB-76-119	GLB-76-123	
Time	0934-0954	1844-1915	1003-1021	1927-1957		1106-1129	2035-2100	1037-1055	2005-2025	
Air temperature (C)	3.5	0.0	6.0	0.0		5.0	0.0	5.0	0.0	
Water temperature (C)	2.5	2.0	3.0	3.0		3.0	2.0	3.0	2.0	
Dissolved oxygen (mg/l)	13.7	13.0	13.2	13.0		13.7	12.7	13.7	12.5	
pH	7.2	7.4	7.3	7.5		7.2	7.4	7.2	7.4	
Secchi disc (cm)	159	--	120	--		133	--	133	--	
Species					**Total**					**Total**
Muskellunge	0	0	0	0	0	0	1	0	0	1
Chain pickerel	0	0	0	0	0	1	7	2	0	10
Fallfish	0	0	0	0	0	1	6	0	1	-8
White sucker	5	22	2	8	37	4	35	1	14	54
Northern hog sucker	1	1	0	3	5	5	2	7	2	16
Shorthead redhorse	0	1	0	0	1	0	0	0	1	1
Brown bullhead	0	0	0	0	0	0	1	0	0	1
Rock bass	0	2	0	1	3	0	4	0	0	4
Pumpkinseed	0	0	0	0	0	0	1	0	0	1
Smallmouth bass	1	1	0	1	3	3	0	0	0	3
Black crappie	0	0	0	0	0	0	1	0	0	1
Crappie spp.	0	2	0	0	2	0	0	0	0	0
Walleye	0	18	0	2	20	0	4	0	2	6
Unidentified	2	5	0	4	11	2	0	2	7	11
Total	9	52	2	19	82	16	62	12	27	117

Table F-13. Frequency of occurrence and species composition (percent) of fish captured using a DC electrofisher at Bell Bend on the Susquehanna River, 1976.

Species	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	% Total
Cisco	0	0	0	0	0	0	0	1	0	1	0.04
Brown trout	0	0	0	0	0	0	0	1	0	1	0.04
Muskellunge	1	2	2	1	3	3	0	4	1	17	0.72
Tiger muskellunge	0	1	0	0	0	0	0	0	0	1	0.04
Chain pickerel	0	4	1	1	1	1	1	3	10	22	0.93
Carp	10	8	9	17	17	15	12	0	0	88	3.72
River chub	0	0	0	0	0	0	1	0	0	1	0.04
Golden shiner	0	0	1	0	0	0	0	0	0	1	0.04
Fallfish	0	24	8	1	0	0	1	0	8	42	1.77
Quillback	7	89	18	20	18	28	42	2	0	224	9.46
White sucker	65	73	116	103	26	48	90	41	54	616	26.01
Northern hog sucker	5	14	20	7	4	8	37	1	16	112	4.73
Shorthead-redhorse	1	32	28	25	34	57	48	4	1	230	9.71
White catfish	0	0	0	0	1	0	0	0	0	1	0.04
Yellow bullhead	0	1	1	2	1	3	0	0	0	8	0.34
Brown bullhead	0	7	22	13	4	12	2	0	1	61	2.58
Channel catfish	0	0	0	1	0	5	2	0	0	8	0.34
Rock bass	0	13	33	22	2	14	13	0	4	101	4.27
Redbreast sunfish	0	0	0	0	0	0	2	0	0	2	0.08
Pumpkinseed	0.	0	0	4	5	3	5	0	1	18	0.76
Bluegill	0	1	0	0	1	2	4	0	0	8	0.34
Sunfish spp.	0	0	0	0	0	0	7	0	0	7	0.30
Smallmouth bass	1	4	139	159	64	43	67	6	3	486	20.48
Largemouth bass	0	1	3	0	1	2	0	0	0	7	0.30
White crappie	0	5	4	1	0	0	0	0	0	10	0.42
Black crappie	4	4	4	3	1	1	0	0	1	18	0.76
Crappie spp.	0	0	1	1	1	0	0	0	0	3	0.21
Yellow perch	0	0	2	1	0	0	1	0	0	4	0.17
Walleye	3	6	33	20	11	30	20	1	6	130	5.49
Unidentified	3	13	7	40	34.	0	28	3	11	139	5.87
Total	100	302	452	442	229	275	383	67	117	2,367	100.00

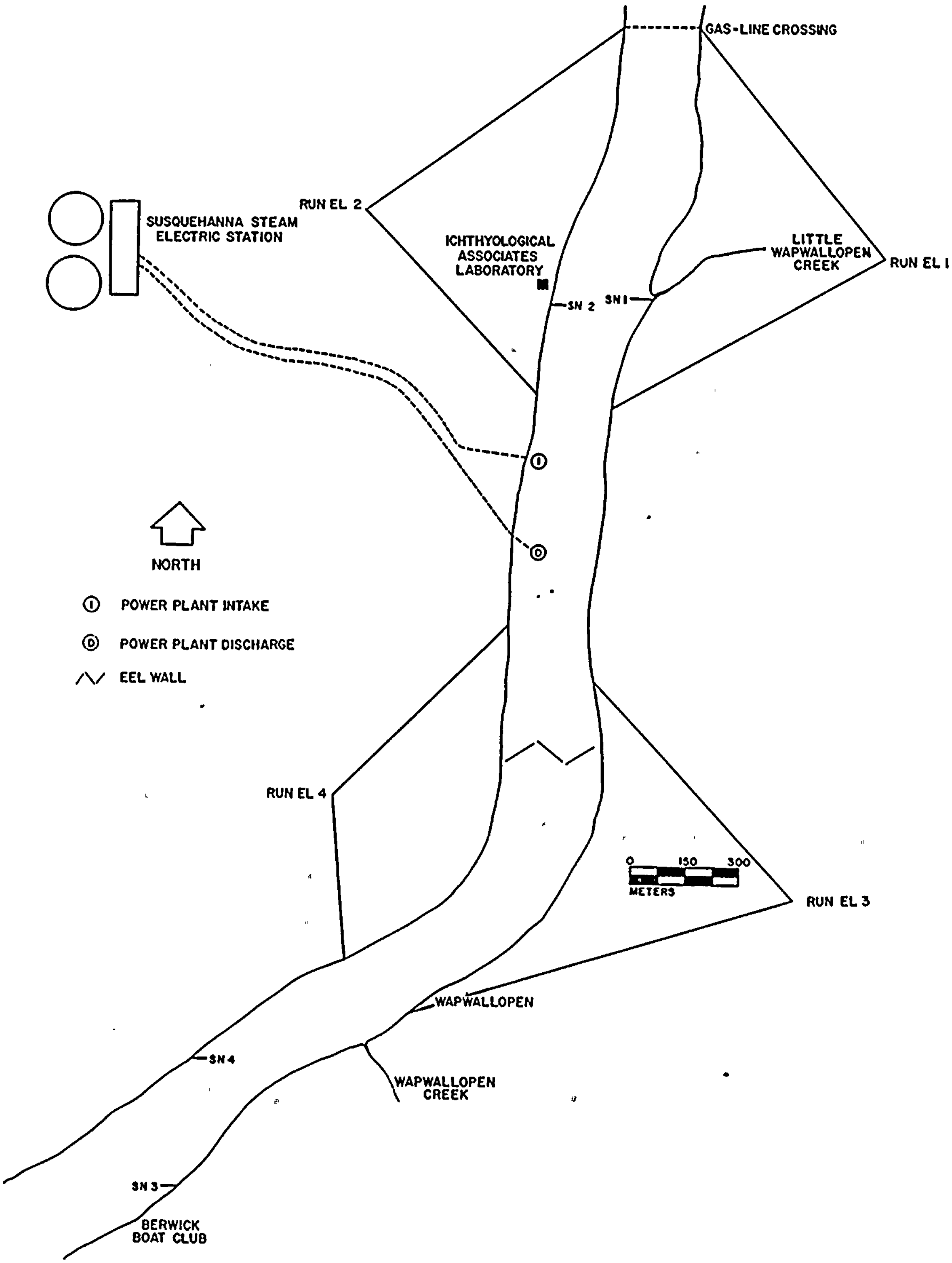

Fig. F-1. Sampling stations for electrofishing (EL) and seining (SN) on the Susquehanna River at the Susquehanna SES site, 1976.

SEINING OF FISHES

by

Gerard L. Buynak and Andrew J. Gurzynski

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ABSTRACT

At SSES and Bell Bend a combined total of 1,101 specimens of 18 fishes was captured by seine. Of the 18 fishes caught the spotfin shiner was the most abundant specimen taken at both SSES and Bell Bend. No significant differences in the catch/unit effort were found within and between sampling sites at SSES and Bell Bend.

INTRODUCTION

The seining program in 1976 was conducted to determine species composition and relative abundance of small fish near the Susquehanna SES. Included here are data gathered from the SSES and Bell Bend stations in 56 seining collections. These baseline data will help to assess the env: onmental impact on small fish due to construction and operation of the Susquehanna SES.

PROCEDURES

A 7.6-m bag seine with 0.64-cm mesh, was used once per month from April through November (except October) at SSES and Bell Bend (two sites each). Both sites at SSES were upriver from the proposed intake and discharge structures and the two sites at Bell Bend were downriver from them (Table G-1; Fig. F-1). Sites were selected in areas free of obstructions that might decrease sampling efficiency. Seining began about one hour after sunset. At each site, a unit of seining effort consisted of two onshore hauls, one immediately after the other. During an onshore haul, one person stood on the River bank holding a brail while another person waded into the River with the other brail to a distance of about 6.0 m or to a depth of 1.3 m. The seine was pulled slowly upriver about 7.6 m before pulling it to shore. Specimens were preserved in 10% formalin in the field. The dissolved oxygen concentration, pH, and air and water temperatures were also measured at each site (Table A-1).

In the laboratory, all specimens were identified and stored in vials containing 10% buffered formalin. Specimens were identified using keys of Eddy (1969), Pflieger (1968), and Scott and Crossman (1973).

All data were analyzed using a "nonparametric sign test" (Siegel 1956) to determine if there were significant differences in the numbers of specimens captured at the various sites.

RESULTS

In 1976, a total of 515 specimens of 14 fishes was captured at SSES by seine (Tables F-2 and G-2 through G-8). Five fishes composed 93.4% of the total catch. As in 1975, the spotfin shiner was the most abundant specimen taken (Buynák and Gurzynski 1976); in 1976 it composed 60.0% of the catch (Table G-9). Others were the spottail shiner (18.3%), swallowtail shiner (7.2%), bluntnose minnow (4.5%), and comely shiner (3.5%).

The number of fishes captured per month at SSES seine sites was highest in May (11) and lowest in November (3) (Table G-9). The most specimens were captured in August and the least in November. Spotfin shiner was the only specimen taken in all months sampled.

No significant differences were found in the number of specimens captured/unit effort at the east and west sites at SSES. Totals of 215 specimens of 12 fishes and 300 specimens of 11 fishes were captured at the east and west sites, respectively (Tables G-2 through G-8). Bluegill, white crappie, and yellow perch were taken only at the east site and yellow bullhead and smallmouth bass only at the west site.

At Bell Bend, 586 specimens of 14 fishes were captured by seine (Tables F-2 and G-2 through G-8). Four fishes composed 94.5% of the total catch. The spotfin shiner was the most abundant specimen captured and composed 83.3% of the total catch. It was followed in abundance by the spottail shiner (5.6%), comely shiner (3.9%), and white sucker (1.7%) (Table G-10).

The greatest numbers of fishes were taken in April (8), June (8), and May (6); the least was taken in August (2) (Table G-10). The most fish were taken in June and the least in November. Spotfin and spottail shiner were collected in all months sampled at Bell Bend.

In 1976, no significant differences in the number of specimens captured/unit effort were observed at SSES and Bell Bend. These results differed from those found in 1975, when three times the number of specimens were taken at Bell Bend than at SSES (Buynak and Gurzynski 1976). The greater similarity between stations observed in 1976 probably occurred because the SSES west seining site was moved to a more ideal location. Yellow bullhead, bluegill, white crappie, and yellow perch were taken only at SSES; whereas common shiner, blacknose dace, and green sunfish were taken only at Bell Bend in 1976.

In general, more specimens were captured at the SSES and Bell Bend east sites. The greater abundance probably resulted because fish congregate below the mouth of Little Wapwallopen and Wapwallopen Creeks. In 1975, 65% more specimens were collected at the east site at Bell Bend (Buynak and Gurzynski 1976). In 1976, 88% more specimens were taken at the east site; totals of 385 specimens of 10 fishes and 201 specimens of 11 fishes were captured at the east and west sites, respectively (Tables G-2 through G-8). Although 88% more specimens were captured at the east site, differences in the number of specimens captured between the two sites were not significant.

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Table G-1. Descriptions of seining stations on the Susquehanna River, 1976.

Station	Site	Location	Substrate Type[a]	Vegetation
SSES	SN 1	East bank 15 m downriver from Little Wapwallopen Creek.	fine sand and clay	none
SSES	SN 2	West bank 75 m downriver from the dock at Ichthyological Associates Laboratory.	pebble and gravel	moderate quantity of emergent
Bell Bend	SN 3	East bank directly downriver from launching ramp at Berwick Boat Club.	coarse and medium sand	moderate quantity of emergent
Bell Bend	SN 4	West bank 300 m upriver from mouth of small stream directly opposite Wapwallopen Creek.	pebble and gravel	none

[a]Classification modified from Cummins (1962).

Table G-2. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 13 April 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-009	GLB-76-010	GLB-76-011	GLB-76-012		GLB-76-005	GLB-76-006	GLB-76-007	GLB-76-008	
Time	2040	2045	2105	2110		2000	2005	2025	2030	
Air temperature (C)	8.0		8.0			10.0		10.0		
Water temperautre (C)	7.0		7.1			7.5		7.5		
Dissolved oxygen (mg/l)	10.4		10.3			10.8		11.3		
pH	7.3		7.2			7.3		7.2		
Species					Total					Total
Comely shiner	0	0	3	3	6	0	2	0	0	2
Spottail shiner	0	0	0	0	0	2	0	0	0	2
Swallowtail shiner	0	0	22	1	23	1	0	0	0	1
Spotfin shiner	8	1	8	0	17	97	22	1	0	120
Bluntnose minnow	2	0	4	1	7	0	1	1	1	3
Fallfish	0	0	0	0	0	1	1	0	0	2
Rock bass	0	0	2	0	2	0	0	0	0	0
Tessellated darter	0	0	0	0	0	0	0	1	0	1
Mottled sculpin	0	0	0	0	0	0	1	0	0	1
Total	10	1	39	5	55	101	27	3	1	132

Table G-3. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 28 May 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-033	GLB-76-034	GLB-76-035	GLB-76-036		GLB-76-031	GLB-76-032	GLB-76-029	GLB-76-030	
Time	2240	2250	2310	2315		2215	2222	2200	2205	
Air temperature (C)	15.0		13.5			15.0		15.0		
Water temperature (C)	14.0		14.0			14.0		14.0		
Dissolved oxygen (mg/l)	9.0		10.0			10.4		10.0		
pH	7.5		7.5			7.5		7.4		
Species					Total					Total
Comely shiner	1	0	0	0	1	4	5	2	1	12
Spottail shiner	7	16	0	0	23	1	1	0	0	2
Swallowtail shiner	0	0	0	1	1	0	2	0	0	2
Spotfin shiner	0	0	2	9	11	18	41	2	2	63
Bluntnose minnow	0	0	1	1	2	3	1	0	0	4
Fallfish	0	0	1	0	1	0	0	0	0	0
White sucker	0	0	1	0	1	0	0	0	0	0
Rock bass	1	0	0	0	1	0	0	0	1	1
Bluegill	5	2	0	0	7	0	0	0	0	0
White crappie	1	2	0	0	3	0	0	0	0	0
Yellow perch	0	2	0	0	2	0	0	0	0	0
Total	15	22	5	11	53	26	50	4	4	84

Table G-4. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 17 June 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-037	GLB-76-038	GLB-76-039	GLB-76-040		GLB-76-043	GLB-76-044	GLB-76-041	GLB-76-042	
Time	2145	2155	2208	2215		2245	2250	2229	2235	
Air temperature (C)	20.0		20.0			18.0		19.5		
Water temperature (C)	23.0		24.0			22.0		24.0		
Dissolved oxygen (mg/l)	8.8		8.4			8.8		8.6		
pH	7.7		7.9			7.8		7.8		
Species					**Total**					**Total**
Comely shiner	0	0	0	0	0	0	0	0	1	1
Spottail shiner	0	0	0	0	0	0	1	16	0	17
Swallowtail shiner	0	0	5	1	6	1	1	3	0	5
Spotfin shiner	1	2	51	20	74	75	24	29	26	154
Bluntnose minnow	0	0	2	3	5	0	0	0	0	0
Blacknose dace	0	0	0	0	0	0	0	1	0	1
White sucker	0	1	1	1	3	1	1	4	3	9
Rock bass	0	0	0	0	0	0	2	0	0	2
Tessellated darter	0	0	0	3	3	1	0	1	2	4
Total	1	3	59	28	91	78	29	54	32	193

Table G-5. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 20 July 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-067	GLB-76-068	GLB-76-065	GLB-76-066		GLB-76-061	GLB-76-062	GLB-76-063	GLB-76-064	
Time	2235	2242	2218	2224		2139	2143	2158	2203	
Air temperature (C)	--		--			--		--		
Water temperature (C)	21.0		23.0			22.5		23.0		
Dissolved oxygen (mg/1)	9.4		10.2			10.0		10.2		
pH	7.3		7.5			7.8		7.5		
Species					Total					Total
Comely shiner	0	0	0	0	0	0	2	0	0	2
Spottail shiner	4	1	18	6	29	0	0	2	3	5
Spotfin shiner	5	12	33	5	55	8	15	40	20	83
Fallfish	0	1	0	0	1	0	0	0	0	0
White sucker	1	0	1	0	2	0	0	0	1	1
Yellow bullhead	0	0	0	1	1	0	0	0	0	0
Rock bass	1	0	0	0	1	0	0	0	0	0
Green sunfish	0	0	0	0	0	0	0	0	1	1
Smallmouth bass	0	0	1	0	1	0	0	1	0	1
Crappie spp.	0	1	0	1	2	0	0	0	0	0
Total	11	15	53	13	92	8	17	43	25	93

Table G-6. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 24 August 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-077	GLB-76-078	GLB-76-079	GLB-76-080		GLB-76-081	GLB-76-082	GLB-76-083	GLB-76-084	
Time	2100	2106	2117	2122		2152	2156	2135	2140	
Air temperature (C)	21.0		21.0			20.0		21.0		
Water temperature (C)	23.5		25.0			24.0		25.0		
Dissolved oxygen (mg/l)	9.7		9.8			9.7		9.8		
pH	7.2		7.2			7.3		7.3		
Species					Total					Total
Spottail shiner	16	7	1	1	25	3	0	0	0	3
Swallowtail shiner	7	0	1	0	8	0	0	0	0	0
Spotfin shiner	79	12	46	5	142	10	12	14	13	49
Bluntnose minnow	2	1	4	0	7	0	0	0	0	0
Tessellated darter	2	0	0	0	2	0	0	0	0	0
Total	106	20	52	6	184	13	12	14	13	52

Table G-7. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 27 September 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-099	GLB-76-100	GLB-76-097	GLB-76-098		GLB-76-093	GLB-76-094	GLB-76-095	GLB-76-096	
Time	2100	2106	2045	2051		2010	2017	2032	2036	
Air temperature (C)	17.0		17.0			17.0		17.0		
Water temperature (C)	15.5		16.0			15.0		16.0		
Dissolved oxygen (mg/l)	8.6		8.6			8.2		8.2		
pH	7.2		7.2			7.0		7.4		
Species					Total					Total
Spottail shiner	5	0	8	1	14	1	1	3	0	5
Spotfin shiner	1	0	6	1	8	3	6	3	0	12
Bluntnose minnow	1	0	1	0	2	0	0	0	0	0
Smallmouth bass	0	0	0	0	0	0	0	0	1	1
Tessellated darter	0	0	1	0	1	0	0	0	0	0
Total	7	0	16	2	25	4	7	6	1	18

Table G-8. Number of fish captured with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 12 November 1976.

Station	SSES					BELL BEND				
Site	SN 1 East		SN 2 West			SN 3 East		SN 4 West		
Haul	1	2	1	2		1	2	1	2	
Collection No.	GLB-76-109	GLB-76-110	GLB-76-111	GLB-76-112		GLB-76-115	GLB-76-116	GLB-76-113	GLB-76-114	
Time	1820	1825	1833	1840		1915	1920	1900	1905	
Air temperature (C)	-2.0		-2.0			-5.0		-3.0		
Water temperature (C)	2.0		2.0			2.0		3.0		
Dissolved oxygen (mg/l)	11.2		10.3			10.8		10.4		
pH	6.5		7.2			6.8		7.2		
Species					**Total**					**Total**
Comely shiner	2	2	3	4	11	5	0	1	0	6
Spottail shiner	0	0	0	2	2	0	1	0	0	1
Spotfin shiner	0	0	0	2	2	4	3	0	0	7
Total	2	2	3	8	15	9	4	1	0	14

Table G-9. Frequency of occurrence and species composition (percent) of fish captured with a 7.6-m bag seine at SSES on the Susquehanna River, 1976.

Species	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	% Total
Comely shiner	6	1	0	0	0	0		11	18	3.50
Spottail shiner	0	23	0	29	25	14		2	94	18.25
Swallowtail shiner	23	1	6	0	8	0		0	37	7.18
Spotfin shiner	17	11	74	55	142	8		2	309	60.00
Bluntnose minnow	7	2	5	0	7	2		0	23	4.47
Fallfish	0	1	0	1	0	0		0	2	0.39
White sucker	0	1	3	2	0	0		0	6	1.17
Yellow bullhead	0	0	0	1	0	0		0	1	0.19
Rock bass	2	1	0	1	0	0		0	4	0.78
Bluegill	0	7	0	0	0	0	No sample	0	7	1.36
Smallmouth bass	0	0	0	1	0	0		0	1	0.19
White crappie	0	3	0	0	0	0		0	3	0.58
Crappie spp.	0	0	0	2	0	0		0	2	0.39
Tessellated darter	0	0	3	0	2	1		0	6	1.17
Yellow perch	0	2	0	0	0	0		0	2	0.39
Total	55	53	91	92	184	25		15	515	100.01

Table G-10. Frequency or occurrence and species composition (percent) of fish captured with a 7.6-m bag seine at Bell Bend on the Susquehanna River, 1976.

Species	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	% Total
Comely shiner	2	12	1	2	0	0		6	23	3.92
Common shiner	0	0	0	0	0	0		0	2	0.34
Spottail shiner	2	2	17	5	3	5		1	33	5.63
Swallowtail shiner	1	2	5	0	0	0		0	8	1.37
Spotfin shiner	120	63	154	83	49	12		7	488	83.28
Bluntnose minnow	3	4	0	0	0	0		0	7	1.19
Blacknose dace	0	0	1	0	0	0	No sample	0	1	0.17
Fallfish	2	0	0	0	0	0		0	2	0.34
White sucker	0	0	9	1	0	0		0	10	1.71
Rock bass	0	1	2	0	0	0		0	3	0.51
Green sunfish	0	0	0	1	0	0		0	1	0.17
Smallmouth bass	0	0	0	1	0	1		0	2	0.34
Tessellated darter	1	0	4	0	0	0		0	5	0.85
Mottled sculpin	1	0	0	0	0	0		0	1	0.17
Total	132	84	193	93	52	18		14	586	100.00

TAGGING OF FISHES

by

Gerard L. Buynak and Andrew J. Gurzynski

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ABSTRACT

Tags from 63 walleye, 3 muskellunge, and 1 brown trout were returned by anglers and electrofishing in 1976. Most were recaptured in August and October. Of the recaptured walleye, 49% were taken downriver and 22% upriver from the tagging site; the remainder were recaptured in the tagging area.

INTRODUCTION

The purpose of the tagging program was to describe the movements of fish above and below the intake and discharge structures of the Susquehanna SES. Included here are data from tagged fish recaptured by angling and electrofishing. Tagging of fish was terminated in December 1975.

PROCEDURES

From 1972 through 1975, selected fishes captured during monthly monitor sampling at SSES and Bell Bend were tagged. Fish were anesthetized and tagged with Monel metal jaw tags (Salt Lake Stamp Company, Salt Lake City, Utah). Each tag was inscribed with the message. "Reward - I.A. Research, Berwick, Pa." After each fish was tagged, weighed (nearest gram), and measured (nearest millimeter fork length), scales were taken for age and growth studies. The date and location of capture were recorded and fish were released in the capture area.

Anglers who returned tags were given a fishing lure and a chance in a drawing for a $50.00 gift certificate. Each was sent a letter that explained the tagging program, along with a questionnaire that requested information about his or her fishing habits.

RESULTS

From 1972 through 1975, 21 fishes were tagged in the Susquehanna River (Table H-1). In 1976, no additional fish were tagged. However, 67 tags from three species (63 walleye, 3 muskellunge, and 1 brown trout) were returned in 1976.

Of the walleye, 49% were taken downriver, 28% were taken in the same area, and 22% were taken upriver from the area where they were tagged. In 1976, a 21% increase over 1975 was observed in the number of walleye taken downriver, a 22% decrease in the number taken upriver, and a 9% decrease in the number recaptured in the same area. The maximum distances traveled were 240 km upriver and 113 km downriver (Table H-2; Fig. H-1). The upriver migrant, tagged on 14 November 1973 at Sunbury, Pennsylvania, was caught by an angler at Johnson City, New York, in March 1976. The downriver migrant, tagged on 20 February 1975 at Wapwallopen, Pennsylvania, was caught by an angler at Millersburg, Pennsylvania, in July 1976.

Of the three muskellunge that were recaptured by angling, two were taken downriver; one moved 0.8 km and the other 15.0 km. The third muskellunge, tagged near Shickshinny, Pennsylvania, was caught in a farm pond in Brandonville, Pennsylvania. This fish was probably caught in the River and stocked into the farm pond without the tag being noticed until it was recaptured in the pond.

Tagged specimens were recaptured in all months, except April and December, throughout 1976 (Table H-2). Most walleye were recaptured in May, August, October, and November.

Table H-1. Number of fish tagged and percentage recovered by angling and electrofishing on the Susquehanna River, 1972 through 1976.

Species	No. Tagged 1972	1973	1974	1975	1976	Total No. Tagged	Total No. Recovered	Percent Recovered
American eel	1	2	0	0	0	3	0	0
Brown trout	1	2	1	12	0	16	3	18.8
Rainbow trout	0	2	0	0	0	2	0	0
Northern pike	3	1	1	1	0	6	3	50.0
Muskellunge	8	23	19	15	0	65	21	32.3
Chain pickerel	4	0	1	0	0	5	2	40.0
Carp	19	0	0	0	0	19	2	10.5
Quillback	3	0	0	0	0	3	0	0
White sucker	2	0	0	0	0	2	0	0
Shorthead redhorse	10	0	0	0	0	10	0	0
White catfish	15	0	0	0	0	15	0	0
Yellow bullhead	5	0	0	0	0	5	1	20.0
Brown bullhead	113	0	0	0	0	113	7	6.2
Channel catfish	16	0	0	0	0	16	1	6.3
Rock bass	7	0	2	0	0	9	3	33.3
Smallmouth bass	14	4	1	1	0	20	5	25.0
Largemouth bass	24	3	7	2	0	36	9	25.0
White crappie	7	0	0	0	0	7	2	28.6
Black crappie	25	0	0	0	0	25	0	0
Yellow perch	2	0	0	0	0	2	0	0
Walleye	172	231	204	132	0	739	308	41.7
Total	451	268	236	163	0	1,118	367	32.8

Table H-2. Tag and recovery data for fish recaptured in 1976.

Species	Recaptured		Tagged	
	Date	Location	Date	Location
	1976			
Brown trout	13 Feb	Mouth of Wapwallopen Creek	20 Feb 1975	SSES
Muskellunge	1 Mar	Mifflinville	20 Nov 1975	Wapwallopen
Muskellunge	16 May	Mouth of Wapwallopen Creek	27 Jan 1975	SSES
Muskellunge	11 Aug	Farm pond, Brandonville	6 Jun 1973	Shickshinny
Walleye	1 Jan	Wapwallopen	30 Dec 1974	Wapwallopen
Walleye	4 Jan	Smithboro, NY	19 Nov 1973	Sunbury
Walleye	4 Jan	Towanda	19 Nov 1974	Wapwallopen
Walleye	21 Jan	Towanda	17 Sep 1975	Wapwallopen
Walleye	13 Feb	SSES	17 Dec 1975	SSES
Walleye	15 Feb	West Nanticoke	7 Nov 1974	Hummels Wharf
Walleye	18 Feb	Tunkhannock	15 Mar 1975	Wapwallopen
Walleye	27 Feb	SSES	16 Nov 1975	SSES
Walleye	-- Mar	West Nanticoke	17 Oct 1974	Wapwallopen
Walleye	-- Mar	West Nanticoke	7 Nov 1974	Hummels Wharf
Walleye	-- Mar	Johnson City, NY	14 Nov 1973	Sunbury
Walleye	2 May	SSES	26 Nov 1975	SSES
Walleye	6 May	Wapwallopen	20 Feb 1975	Wapwallopen
Walleye	12 May	Lewisburg	6 Nov 1974	Wapwallopen
Walleye	15 May	Mouth of Wapwallopen Creek	27 Jun 1975	Wapwallopen
Walleye	16 May	Johnson City, NY	30 Oct 1975	Wapwallopen
Walleye	22 May	Sunbury	20 Nov 1975	Wapwallopen
Walleye	31 May	Allenwood	4 Dec 1973	SSES
Walleye	-- May	Allenwood	19 Nov 1974	Wapwallopen
Walleye	1 Jun	Beach Haven	30 Oct 1975	SSES
Walleye	9 Jun	Muncy	15 Jan 1974	SSES
Walleye	12 Jun	Tunkhannock	30 Oct 1975	Wapwallopen
Walleye	13 Jun	Liverpool	7 Nov 1974	Hummels Wharf
Walleye	23 Jul	Meshoppen	4 Mar 1974	Wapwallopen
Walleye	-- Jul	Millersburg	20 Feb 1975	Wapwallopen
Walleye	1 Aug	West Nanticoke	5 Nov 1974	Wapwallopen
Walleye	7 Aug	Catawissa	19 Nov 1974	Wapwallopen
Walleye	10 Aug	Wapwallopen	27 Jun 1975	Wapwallopen
Walleye	14 Aug	Watsontown	20 Feb 1975	SSES
Walleye	16 Aug	Wapwallopen	17 Sep 1975	Wapwallopen
Walleye	17 Aug	Wapwallopen	19 Nov 1974	Wapwallopen
Walleye	19 Aug	SSES	30 Jan 1975	SSES
Walleye	19 Aug	Wapwallopen	17 Sep 1975	Wapwallopen
Walleye	19 Aug	Wapwallopen	17 Sep 1975	Wapwallopen
Walleye	24 Aug	Watsontown	17 Dec 1975	SSES
Walleye	31 Aug	Lewisburg	20 Nov 1975	SSES
Walleye	3 Sep	Selinsgrove	30 Oct 1975	SSES
Walleye	4 Sep	Sunbury	30 Oct 1975	SSES
Walleye	6 Sep	Nescopeck	20 Feb 1975	SSES
Walleye	11 Sep	Selinsgrove	19 Nov 1973	Sunbury
Walleye	17 Sep	Millersburg	30 Oct 1975	SSES
Walleye	3 Oct	Wapwallopen	16 Jan 1974	SSES
Walleye	3 Oct	Wapwallopen	16 Nov 1975	Wapwallopen
Walleye	4 Oct	Hummels Wharf	19 Nov 1973	Sunbury
Walleye	5 Oct	Lime Ridge	5 Nov 1974	Wapwallopen
Walleye	5 Oct	Wapwallopen	3 Mar 1973	SSES
Walleye	7 Oct	Wapwallopen	19 Nov 1974	Wapwallopen
Walleye	15 Oct	Wapwallopen	20 Feb 1975	Wapwallopen
Walleye	17 Oct	Berwick	17 Dec 1975	SSES
Walleye	17 Oct	Sunbury	17 Dec 1975	SSES
Walleye	18 Oct	Sunbury	7 Nov 1974	Hummels Wharf
Walleye	25 Oct	Berwick	20 Feb 1975	SSES
Walleye	31 Oct	Lime Ridge	27 Dec 1974	SSES
Walleye	1 Nov	Sunbury	7 Nov 1974	Hummels Wharf
Walleye	1 Nov	Sunbury	7 Nov 1974	Hummels Wharf
Walleye	4 Nov	Wapwallopen	5 Nov 1974	Wapwallopen
Walleye	6 Nov	Sunbury	7 Nov 1974	Hummels Wharf
Walleye	8 Nov	Sunbury	7 Nov 1974	Hummels Wharf
Walleye	13 Nov	Sunbury	17 Dec 1975	SSES
Walleye	20 Nov	SSES	30 Jan 1975	SSES
Walleye	21 Nov	SSES	30 Oct 1975	SSES
Walleye	21 Nov	Sunbury	17 Dec 1975	Wapwallopen
Walleye	25 Nov	Wapwallopen	27 Dec 1974	Wapwallopen

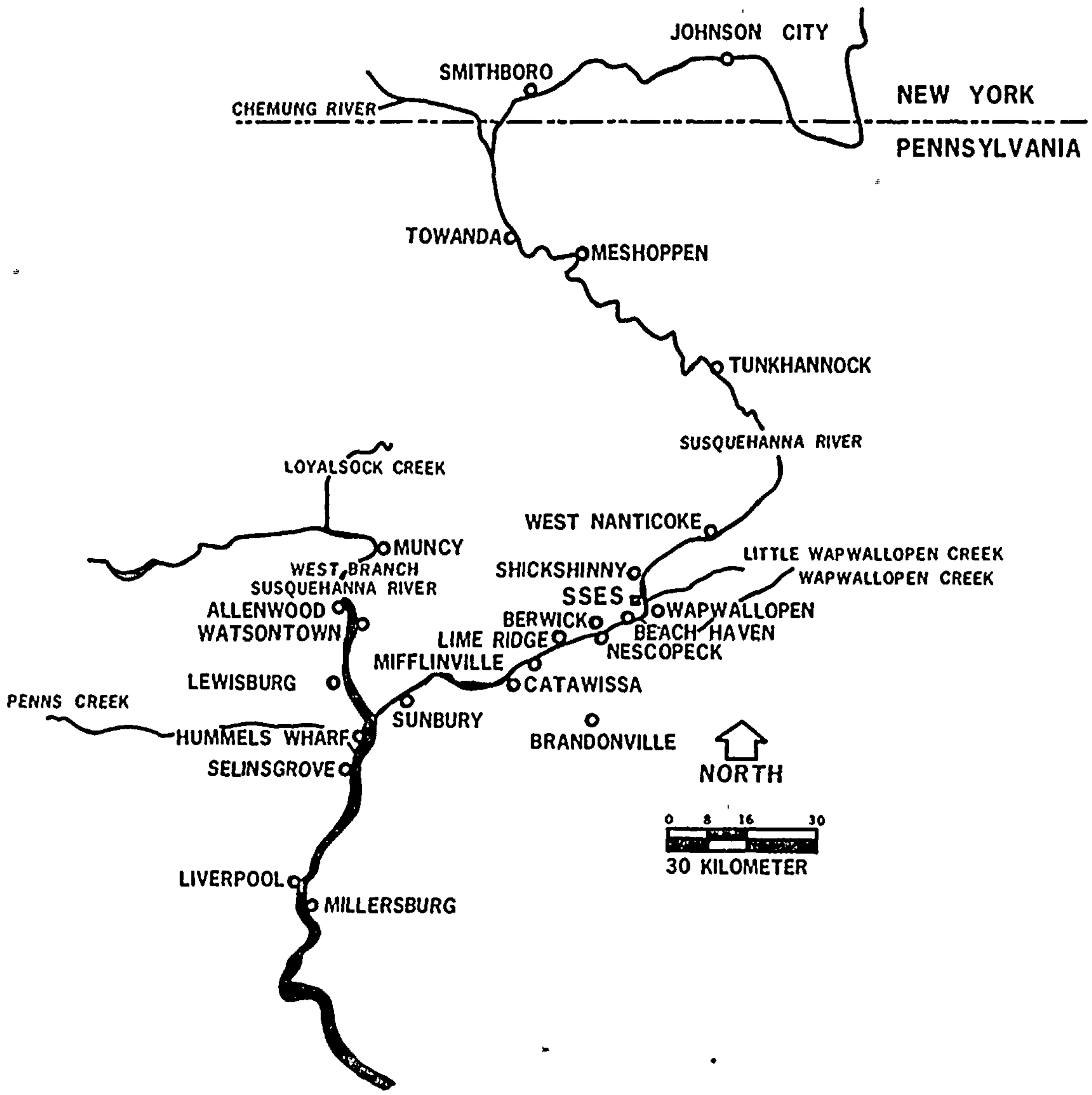

Fig. H-1. Tagging and recapture locations in 1976 (refer to Table H-2).

AGE AND GROWTH OF FISHES

by

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ABSTRACT

The purposes of the age and growth program were to obtain data on the growth rates of muskellunge, white sucker, northern hog sucker, and shorthead redhorse in the Susquehanna River and to compare their growth to that in other bodies of water.

Most muskellunge were four years old or older, and 50% of the fish were of legal size. Muskellunge entered the fishery at 762 mm in the fifth year of life and averaged 2,950 g in weight. Few young muskellunge were collected in the River.

Of the suckers, the northern hog sucker was the slowest growing, while the shorthead redhorse grew to the largest size. The white sucker and the northern hog sucker grew more during the first year, but with the shorthead redhorse it was in the second year. Overall, growth of these four fishes in the River was similar to that found elsewhere.

INTRODUCTION

Age and growth of the muskellunge, white sucker, shorthead redhorse, and northern hog sucker were studied in 1976. The objectives were to describe the age and growth of these fishes in the Susquehanna River in the vicinity of the Susquehanna SES near Berwick, Pennsylvania, and to compare growth rates with that of other bodies of water.

PROCEDURES

From 1972 through 1976, 94 muskellunge, 268 white sucker, and 253 shorthead redhorse were collected for age and growth studies near the Susquehanna SES with a boat-mounted AC-DC electrofisher, seines, and trapnets. In addition, 145 northern hog sucker were collected by electrofishing upriver from the Susquehanna SES at Falls, Pennsylvania (Fig. A-1). Fork length (mm) and weight (g) of each fish were measured and sex was determined externally when possible. Scales of suckers were removed from the left side, below the lateral line, and near the tip of the extended pectoral fin. Those of muskellunge were removed from the dorsal body surface behind the dorsal fin.

Scales (3 to 6) were pressed on cellulose acetate slides with a flat rolling mill (No. 191-1, William Dixon, Inc.). Impressions were read at 24X with a Bausch and Lomb Tri-Simplex Micro-Projector. Annuli were recognized by criteria described by Lagler (1961). Age was read as the number of annuli along the longitudinal anterior axis through the focus. Impressions were read at least twice. When the two readings differed, they were read a third time. If no agreement was found, results from that fish were removed from the sample. Anterior scale radius, growth fields within annuli, fork length, and weight were recorded separately for each fish.

Body-scale and length-weight relationships were determined for each species. The body-scale relationships for muskellunge, white sucker, and northern hog sucker were derived by fitting a straight line by the least square method to the length of the fish and the projected scale radius (Ricker 1971). The general formula used was: *fish length* $= C + B$ *(scale radius)* (B = slope of the line; C = the intercept of the length axis). The method proved inadequate for the shorthead redhorse data and the following formula was used: $l_n = \frac{S_n}{S} l$ where l_n = length of fish when annulus 'n' was formed, l = length of fish at time scale sample was obtained, S_n = radius of annulus 'n' (at length 'l_n'), S = total scale radius (Ricker 1971). Length-weight relationships were calculated by fitting a straight line by the least square method to logarithms of the length and weight of each fish. The resulting formula was: $\log w = \log a + b (\log l)$, where w = weight of the fish, l = length of the fish, a = the intercept on the weight axis, and b = the slope of the line.

RESULTS AND DISCUSSION

Muskellunge

The equations for the body-scale and length-weight relationships derived from the 94 muskellunge were: $l = 168.0639 + 5.2677S$ and $\log w = 4.9591 + 2.9588 \log l$, respectively.

The growth in length of muskellunge was relatively fast during the first four years and then slowed (Table I-1). However, the mean calculated increment in weight between annuli increased progressively from 196 g between age 0 and I to a maximum of 1,955 g between age V and VI.

Upon the basis of scale samples it was found that most (77%) of the muskellunge captured were four years old or older (Table I-1). The oldest individuals taken were seven years old. Muskellunge in the River entered the Pennsylvania fishery (legal length limit of 762 mm) during their fifth year and averaged 2,950 g in weight.

Calculated growth in length of the muskellunge in the Susquehanna River was less at each annulus than that in several lakes and rivers in Pennsylvania (Table I-2). Susquehanna River muskellunge grew as fast at all ages as those in the St. Lawrence River, but from age II to IV they grew slower than those in Kawartha Lakes and the Georgian Bay in Canada. In Lake of the Woods, Canada, muskellunge from age VI to VIII were smaller than those in the Susquehanna River.

White Sucker

The equations for the body-scale and length-weight relationships of the 268 white sucker were: $l = 118.6372 + 2.0674S$ and $\log w = -4.4073 + 2.8382 \log l$, respectively.

Their greatest calculated growth in length of white sucker occurred during the first year (148 mm) after which the growth decreased from 88 mm between age I and II to 27 mm between age VI and VII (Table I-3). Increases in the weight were substantial during the first five years and they reached a maximum of 176 g at age V.

Based on scale samples, most (80%) of the white sucker captured belong to age groups II, III, and IV. The oldest fish taken were seven years old.

Growth of white sucker in the Susquehanna River was similar to that found in the Missouri River. Susquehanna River white sucker grew faster than those in Lake Superior and the Big Blue River, Kansas (Table I-4). However, white sucker in Great Slave Lake, Canada, grew faster than those in the Susquehanna River after age V. Overall, white sucker in the Susquehanna River did not live as long as those in the Lakes.

Northern Hog Sucker

The body-scale and length-weight equations for northern hog sucker at Falls were: $l = 67.1243 + 1.7705S$ and $\log w = -5.0793 + 3.1746 \log l$ for 20 female; $l = 23.9628 + 2.1105S$ and $\log w = -.19868 + 1.8330 \log l$ for 30 male; and $l = 60.0841 + 1.9541S$ and $\log w = -3.7842 + 2.5910 \log l$ for 145 specimens (both sexes combined), respectively.

The greatest increase in the calculated growth increment, irrespective of sex, occurred during the first year (Table I-5). Growth of the northern hog sucker was slower than the white sucker and shorthead redhorse. After age I the growth increment decreased from 63 mm between age I and II to 27 mm between age V and VI. The calculated weight interval, however, increased from 24 g at age I to 131 g at age V. Females were usually longer and heavier at each annulus than males (Tables I-6 and I-7).

Most (85%) of the northern hog sucker captured were three years old or less. Most males were three years old; the oldest was six years. The majority of the females were three or four years old; the oldest was five years.

The growth of the northern hog sucker was greater in the Susquehanna River than in the Roanoke River, Virginia, and Genesee River, New York, but it was considerably less than in the Illinois River (Table I-8).

Shorthead Redhorse

The body-scale and length-weight relationships of 253 shorthead redhorse were determined by the direct proportion method using Lea's 1910 formula because a low coefficient of determination was obtained when the Fraser (1916) modification of the direct proportion formula was used.

Of the three species of sucker studied in the River, the shorthead redhorse grew to the largest size in both weight and length. Its calculated growth increment for both sexes combined increased from 57 mm between age 0 and I to 102 mm between age I and II (Table I-9).

The calculated weight increased from 39 g between age 0 and I to 254 g between age II and III (Table I-9). After age III the growth in both length and weight decreased. Males and females were similar in length at each annulus; however, females weighed more than the males at each annulus (Tables I-10 and I-11).

Most (93%) of the shorthead redhorse captured were between four and six years old. The oldest taken was an eight-year-old female. The oldest males were six years old. Fish younger than three years were not captured.

The absence of age groups I through II in the catch is difficult to explain. Part of the reason might be the selectivity of electrofishing for larger fish; however, very few young shorthead redhorse were captured with seines or trapnets near shore. The most likely explanation is that younger shorthead redhorse do not usually inhabit shallow waters near shore. They are probably in deeper water where sampling by electrofishing, seining, and trapnetting is often not efficient.

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Table I-1. Mean calculated fork length (mm) and weight (g) at each annulus for 94 muskellunge from the Susquehanna River in the vicinity of the Susquehanna SES, 1973-75.

Age Group	Number of Fish	Fork Length at Each Annulus						
		1	2	3	4	5	6	7
I	4	258						
II	6	340	406					
III	12	283	385	493				
IV	25	287	410	514	612			
V	24	276	390	513	649	725		
VI	18	271	399	531	651	761	848	
VII	5	243	377	489	591	687	784	875
Number of fish		94	90	84	72	47	23	5
Calculated fork length		280	395	508	626	724	816	875
Length increment		280	116	116	116	91	89	91
Calculated weight		196	529	1143	2073	2950	4545	5570
Weight increment		196	327	633	919	793	1955	1550

Table I-2. Calculated total length (mm) of muskellunge at each annulus in the Susquehanna River compared with those from four other waters.

Body of Water	Calculated Total Length at Each Annulus							
	1	2	3	4	5	6	7	8
Susquehanna River[a] (present study)	305	431	553	682	789	889	953	
Rivers & Lakes in Pennsylvania (Pennsylvania Fish Comm. 1970)	198	437	622	754	862	958	1036	1105
Lake of the Woods (Hourston 1952)	--	--	--	--	--	673	769	745
Kawartha Lakes & Georgian Bay (Hourston 1952)	--	472	567	714	725	772	778	938
St. Lawrence River (Hourston 1952)	--	467	587	692	798	824	876	956

[a]Fork lengths converted to total lengths (Carlander 1969).

Table I-3. Mean calculated fork length (mm) and weight (g) at each annulus for 268 white sucker from the Susquehanna River in the vicinity of the Susquehanna SES, 1973-75.

Age Group	Number of Fish	Fork Length at Each Annulus						
		1	2	3	4	5	6	7
I	4	138						
II	41	149	188					
III	78	147	229	278				
IV	96	150	223	268	309			
V	37	144	196	240	278	324		
VI	10	150	193	246	290	328	358	
VII	2	155	195	233	268	302	329	356
Number of fish		268	264	223	145	49	12	2
Calculated fork length		148	204	253	286	318	344	356
Length increment		148	88	59	41	44	30	27
Calculated weight		56	143	260	371	497	593	683
Weight increment		56	134	159	141	176	102	137

Table I-4. Calculated total lengths (mm) of white sucker at each annulus in the Susquehanna River compared with those from four other waters.

Body of Water	Calculated Total Length at Each Annulus											
	1	2	3	4	5	6	7	8	9	10	11	12
Susquehanna River[a] (present study)	156	217	269	304	338	341	369					
Lake Superior (Bean 1936)	51	89	89	190	229	279	305	343	368	406		
Missouri River (Kathrein 1951)	142	188	277	302	340	381	378	406				
Great Slave Lake (Rawson 1951)	--	--	--	262	315	386	445	465	505	544	589	599
Big Blue River (Minckley 1959)	71	99	208									

[a]Fork lengths converted to total lengths (Carlander 1969).

Table I-5. Mean calculated fork length (mm) and weight (g) at each annulus for 145 northern hog sucker from the Susquehanna River at Falls, Pennsylvania, 1973-75.

Age Group	Number of Fish	Fork Length at Each Annulus 1	2	3	4	5	6
I	5	100					
II	50	106	169				
III	68	108	170	227			
IV	16	100	167	231	280		
V	5	94	151	203	246	288	
VI	1	71	145	185	218	269	296
Number of fish		145	140	90	22	6	1
Calculated fork length		97	160	212	248	279	296
Length increment		97	63	58	47	44	27
Calculated weight		24	86	177	269	357	416
Weight increment		24	67	110	129	131	91

Table I-6. Mean calculated fork length (mm) and weight (g) at each annulus for 20 female northern hog sucker from the Susquehanna River at Falls, Pennsylvania, 1973-75.

Age Group	Number of Females	Fork Length at Each Annulus				
		1	2	3	4	5
I	0	--				
II	1	116	191			
III	7	105	166	209		
IV	9	106	170	240	291	
V	3	99	156	196	242	281
Number of fish		20	20	19	12	3
Calculated fork length		106	171	215	267	281
Length increment		106	47	55	50	39
Calculated weight		23	104	217	430	495
Weight increment		23	74	144	227	187

Table I-7. Mean calculated fork length (mm) and weight (g) at each annulus for 30 male northern hog sucker from the Susquehanna River at Falls, Pennsylvania, 1973-75.

Age Group	Number of Males	Fork Length at Each Annulus					
		1	2	3	4	5	6
I	1	73					
II	8	76	142				
III	18	76	150	204			
IV	2	78	143	186	244		
V	0	--	--	--	--	--	
VI	1	71	145	185	218	269	296
Number of fish		30	29	21	3	1	1
Calculated fork length		75	145	192	231	269	296
Length increment		75	70	52	50	51	27
Calculated weight		29	95	158	223	294	350
Weight increment		29	68	70	82	94	56

Table I-8. Calculated total length (mm) of northern hog sucker at each annulus in the Susquehanna River compared with those from three other waters.

Body of Water	Calculated Total Length at Each Annulus								
	1	2	3	4	5	6	7	8	9
Susquehanna River[a] (present study)	114	187	248	290	326	346			
Genesee River (Raney and Lachner 1946)	43	99	142	190	239	251	274	287	351
Roanoke River (Raney and Lachner 1947)	79	145	--	--	216	241	279		
Illinois River (Jenkins et al. 1952)	196	287	353	373					

[a]Fork lengths converted to total lengths using formula TL ÷ 1.17 FL.

Table I-9. Mean calculated fork length (mm) and weight (g) at each annulus for 252 shorthead redhorse from the Susquehanna River in the vicinity of the Susquehanna SES, 1973-76.

Age Group	Number of Fish	Fork Length at Each Annulus 1	2	3	4	5	6	7	8
I	0	--							
II	0	--	--						
III	2	59	180	248					
IV	74	58	170	273	331				
V	115	57	156	242	312	361			
VI	46	59	156	245	308	355	388		
VII	14	50	134	184	253	307	349	376	
VIII	1	58	148	198	264	304	333	358	391
Number of fish		252	252	252	250	176	61	15	1
Calculated fork length		57	157	232	294	332	357	367	391
Length increment		57	102	90	65	49	35	27	33
Calculated weight		39	169	425	668	939	1142	1424	1624
Weight increment		39	141	254	240	174	125	135	114

Table I-10. Mean calculated fork length (mm) and weight (g) at each annulus for 35 male shorthead redhorse from the Susquehanna River in the vicinity of the Susquehanna SES, 1973-76.

Age Group	Number of Males	Fork Length at Each Annulus					
		1	2	3	4	5	6
I	0	--					
II	0	--	--				
III	2	55	176	257			
IV	18	51	152	236	293		
V	12	58	150	229	290	324	
VI	3	57	147	201	269	309	346
Number of fish		35	35	35	33	15	3
Calculated fork length		55	156	231	284	317	346
Length increment		55	98	80	59	35	37
Calculated weight		37	104	404	619	899	1027
Weight increment		37	70	268	214	136	111

Table I-11. Mean calculated fork length (mm) and weight (g) at each annulus for 59 female shorthead redhorse from the Susquehanna River in the vicinity of the Susquehanna SES, 1973-76.

Age Group	Number of Females	Fork Length at Each Annulus							
		1	2	3	4	5	6	7	8
I	0	--							
II	0	--	--						
III	0	--	--	--					
IV	7	55	166	252	315				
V	29	51	149	237	297	336			
VI	18	64	165	250	294	329	362		
VII	4	50	149	232	285	321	341	372	
VIII	1	58	148	198	264	304	333	358	391
Number of fish		59	59	59	59	52	23	5	1
Calculated fork length		56	155	234	291	323	345	365	391
Length increment		56	100	86	55	37	31	30	33
Calculated weight		40	196	484	768	1011	1205	1443	1608
Weight increment		40	169	299	288	209	163	140	120

PARASITES OF FISHES

by

William G. Deutsch

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ABSTRACT

From June through November 1973, 274 fish from the Susquehanna River were examined for parasites. About 85% were infected with one or more of 40 species of parasites. Most parasites were species specific and were most abundant in the spring and fall. No gross differences were found in the incidence of parasites at unpolluted and polluted (acid mine drainage) River sites. Infections were sometimes limited to, and were often greater in larger fish. New host records included digentic trematodes *Rhipidocotyle septpapillata* (in white sucker and black crappie), *Lissorchis gullaris* (quillback), and *Ptychogonimus fontanus* (walleye); a nematode *Hedruris* sp. (smallmouth bass); a copepod *Lernaea cyprinacea* (chain pickerel); a branchiuran *Argulus* sp. (quillback); and a leech *Actinobdella inequiannulata* (quillback).

INTRODUCTION

Literature pertaining to the parasites of fishes in Pennsylvania is scarce. Fried et al. (1964) conducted an intestinal helminth study of the white sucker in Northampton County. Mackiewicz (1965) surveyed caryophyllid tapeworms of the white sucker from Potter, Forest, and Union Counties and Mackiewicz and Deutsch (1976) described two genera of caryophyllids which infected the quillback from Luzerne and Wyoming Counties. Little parasitological work has been done with the quillback, particularly in the northern part of its North American range, and only five species of parasites have been previously reported from this host (Mackiewicz and Deutsch 1976, Hoffman 1970, Kritsky et al. 1972, and Whitaker and Schlueter 1975).

The purpose of this study was to determine the incidence and infection intensity of helminths and parasitic copepods of selected fishes from a polluted and unpolluted site on the Susquehanna River.

PROCEDURES

From June through November 1973, 274 fish from the Susquehanna River were examined for parasites (Deutsch 1974). Species were selected on the basis of availability and variety of food habits. Efforts were made to capture fish of several sizes. They included chain pickerel (20-44 cm fork length); white sucker (7-47 cm); quillback (29-47 cm); smallmouth bass (7-31 cm); black crappie (8-24 cm); and walleye (18-50 cm). A boat-mounted, AC electrofisher, Oneida-style trapnet, or seine was used to collect fish from "unpolluted" water at Falls, Pennsylvania (Wyoming Co.), and from polluted water (acid mine drainage) near Berwick, Pennsylvania (Luzerne Co.). Specimens that could not be examined immediately were either kept in a live box (for up to 24 h), or dissected and refrigerated. The fins, body surface, gills, stomach, cecae (when present), and intestine were examined, and parasites were prepared for identification by standard methods (Hoffman 1970, Humason 1967, and Klemm 1972). Identifications were verified by the following specialists: Dr. Jacob H. Fischthal, State University of New York at Binghamton (helminths); Dr. Donald J. Klemm, U.S. Environmental Protection Agency, Cincinnati (leeches); and Dr. John S. Mackiewicz, State University of New York at Albany (carophyllid cestodes).

RESULTS AND DISCUSSION

A total of 234 of 274 fish examined were infected with one or more of 40 species of parasites (Table J-1). The incidence of parasitism (85.4%) was similar to that found in Wisconsin and south-central New York streams (Fischthal 1956), and in the Genesee River in New York (Deutsch 1972).

Smallmouth bass were infected with greater numbers and more species (18) of parasites than other fishes. One seemingly healthy bass hosted 185 parasites of seven species. The copepod *Lernaea cyprinacea* was the one parasite which infected all fishes, and it was especially common on white sucker and quillback. Immature *L. cyprinacea* were the only parasites which were most numerous in summer. In general, helminths were more abundant in late spring and fall. Only eight species of parasites infected more than one species of fish, and four were ectoparasites. Skin lesions and inflammation were often associated with copepod infections, but most parasites did not produce notable pathogenic symptoms in fish.

No gross differences were found in the incidence of parasites at unpolluted and polluted River sites. But some helminths, such as the trematode *Crepidostomum cornutum* and nematode *Spinitectus gracilis* which were found in about half the bass from Falls, were absent in fish taken near Berwick. The absence of these parasites may be indirectly related to pollution and substrate type. Earlier macroinvertebrate sampling revealed that crayfish (Orconectes spp.), the intermediate hosts of C. cornutum, and mayflies, the intermediate hosts of S. gracilis, were much more numerous on the cleaner, coarser substrate at Falls (Ichthyological Associates, Inc. 1974, Deutsch 1976) than near Berwick. Low densities of crayfish and mayflies near Berwick may disrupt the life cycle of parasites which use them as intermediate hosts. Van Cleave and Mueller (1934) reported that C. cornutum infections in Oneida Lake were "invariably" found in fish taken from gravel bottom areas, and suggested that this was due to a more favorable habitat for the intermediate host.

Many parasites were more numerous in large fish than in small fish of the same species, and some were only found in adults. A regression analysis revealed that there was a significant linear relationship (correlation coefficient = .86; DF = 4; $P < .05$) between size class of walleye and the intensity of infection of the acanthocephalan Neoechinorhynchus cylindratus, implying accumulation of parasites over time.

Only smallmouth bass larger than 18 cm were infected with the trematode C. cornutum. Food habit studies near Berwick indicated that bass smaller than 15 cm did not eat crayfish, the intermediate host of C. cornutum, whereas much smaller bass consumed fish (Ichthyological Associates, Inc. 1973). Lagler (1972) noted that juvenile smallmouth bass are generally piscivorous, whereas adults eat large numbers of crayfish. Unlike C. cornutum, the trematode Rhipidocotyle septpapillata, which uses fish for an intermediate host, was found in young-of-the-year bass only 7 cm long.

Eight new host records were established. The occurrence of *Ptychogonimus fontanus* in stomach of walleye was of particular interest. This trematode is usually found in the stomach of sharks, and has been reported in fresh water only in yellow perch and brook trout (Hoffman 1970). The digentic trematode *Lissorchis gullaris*, which was common in the intestine of quillback in this study, has been found in buffalo fishes, *Ictiobus* spp., from Lake Texoma, Oklahoma (Self and Campbell 1956).

Immature nematodes *Hedruris* sp. were found in the intestine and stomach of smallmouth bass, and immature specimens of the digenetic trematode *R. septpapillata* were found in the intestines of both the white sucker and black crappie. These infections could have been incidental and the parasites may not reach sexual maturity in these hosts.

Copepodids of *L. cyprinacea* were found on the gills of chain pickerel, but no adult paraistes were observed on this host. Hoffman (1970) suggested that *L. cyprinacea* is unspecific and probably infects "all freshwater fishes." The branchiuran *Argulus* sp. was collected from the body surface of several quillback. Like *L. cyprinacea*, it infects numerous fishes.

The leech *Actinobdella inequiannulata* was found on the gills of a quillback. It also occurs on the white sucker; webug sucker, *Catostomus fecundus*; largescale sucker, *C. macrocheilus*; and the yellow perch, and seems to have a "predilection" for suckers (Dr. Donald J. Klemm, personal communication).

Single specimens of Anonchohaptor muelleri were found on the gills of two adult quillback. The range of this recently described monogenetic trematode is thus extended from North and South Dakota and Illinois (Kritsky et al. 1972), to Pennsylvania.

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Table J-1. Parasites of six fishes from the Susquehanna River with percent of fish infected (%), mean number of parasites per host ($\bar{x}$), and infection site (B, body surface; C, cecae; F, fins; G, gills; I, intestine; S, stomach).

Parasite	Chain Pickerel (8,6)[a]			White Sucker (98,87)			Quillback (69,55)			Smallmouth Bass (39,35)			Black Crappie (25,18)			Walleye (35,33)		
	%	$\bar{x}$	site	%	$\bar{x}$	site	%	$\bar{x}$	site	%	$\bar{x}$	site	%	$\bar{x}$	site	%	$\bar{x}$	site
Monogenetic Trematodes																		
Anonchohaptor muelleri							3	3	(G)									
Actinocleidus fusiformis										14	2	(G)						
Cleidodiscus banghami										25	2	(G)						
Cleidodiscus capax													20	2	(G)			
Octomacrum lanceatum				4	1	(G)												
Digenetic Trematodes																		
Crepidostomum cornutum										15	81	(C,S,I)						
Bucephaloides pusillus																45	15	(C,S,I)
Lissorchis attenuatus				19	3	(I)												
Lissorchis gullaris							30[b]	7	(I)									
Macroderoides flavus	14	19	(S,I)															
Ptychogonimus fontanus																6[b]	1	(S)
Rhipidocotyle septpapillata				1[b,c]	1	(I)				31	11	(C,I)	4[b,c]	1	(I)			
Cestodes																		
Biacetabulum biloculoides				1	3	(I)												
Biacetabulum macrocephalum				1	1	(I)												
Bothrocephalus claviceps										3	--	(I)						
Bothrocephalus cuspidatus										3	2	(C)				40	3	(C,S,I)
Glaridacris laruei				14	11	(I)												
Hunterella nodulosa				9	6	(I)												
Isoglaridacris bulbocirrus				5	2	(I)												
Janiszewskella fortobothria							30	12	(I)									
Proteocephalus ambloplitis										28	2	(C,S,I)						
Proteocephalus pearsei										26	2	(I)						
Proteocephalus pinguis	13	2	(I)															
Rowardleus pennensis							34	2	(I)									
Nematodes																		
Camallanus oxycephalus										3	4	(C,I)	64	8	(C,S,I)			
Capillaria catenata				1	1	(I)												
Hedruris sp.[c]										10[b]	6	(S,I)						
Rhabdochona cascadilla				2	1	(I)												
Rhabdochona sp.[c]							6	4	(I)									
Spinitectus gracilis										21	3	(S,I)						
Spiroxys sp.[c]										3	4	(I)						
Acanthocephalans																		
Leptorhynchoides thecatus										3	2	(C)						
Neoechinorhynchus cylindratus				2	1	(I)				63	6	(S,I)				74	7	(I)
Neoechinorhynchus tenellus	50	2	(I)															
Branchiurans																		
Argulus sp.				24	2	(G,F,B)	7[b]	1	(B)	3	1	(B)				3	1	(B)
Copepods																		
Achtheres sp.										8	2	(G)						
Ergasilus sp.																4	2	(G)
Lernaea cyprinacea (copepodid)	38[b]	10	(G)	45	10	(G)	20	2	(G)							6	1	(G)
(adult)				40	4	(G,F,B)	10	1	(G)	3	1	(B)	4	1	(F)			
Leeches																		
Actinobdella inequiannulata				1	1	(G)	1[b]	1	(G)									
Myzobdella lugubris										7	1	(F)				3	1	(F)

[a] Number of fish examined, number of fish infected.

[b] New host record.

[c] Immature specimens.

LYMPHOCYSTIS IN WALLEYE

by

Gerard L. Buynak and Andrew J. Gurzynski

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ABSTRACT

Seasonal variation in the incidence of lymphocystis tumors in 272 walleye from the Susquehanna River was investigated in 1975 and 1976. The incidence of infection was significantly higher ($P<0.01$) during the winter and the highest incidence (31%) occurred in February. Most tumors (53%) were on the body below the spinous dorsal fin. Lymphocystis did not occur in fish younger than three years old.

INTRODUCTION

Lymphocystis is a highly infectious disease caused by an intracellular virus. It is characterized by the formation of tumors or "warts" on the body and fins of both fresh and salt water fishes (Nigrelli and Ruggieri 1965). Although lymphocystis is generally considered nonlethal, it may partially immobilize the host and decrease its chance of survival.

Although lymphocystis has been studied in the laboratory (annotated bibliography, Nigrelli and Ruggieri 1965), information concerning the disease in nature is sparse. The purposes of this study were to determine the seasonal occurrence and rates of infection of the disease in walleye from the Susquehanna River.

PROCEDURES

Monthly from December 1975 through November 1976 (no sample was taken in January), a total of 272 walleye was collected from a 3.0-km section of the Susquehanna River near Berwick, Pennsylvania. All fish were weighed, measured, and examined for location of lymphocystis tumors. Scales for age determination were removed from the left side of each fish at the tip of the extended pectoral fin.

RESULTS AND DISCUSSION

Seasonal Variation in Occurrence of Lymphocystis

The percent infection of walleye with lymphocystis varied; it was low from March through July, increased in August, and then decreased in September and October. It increased again in November and remained high throughout the winter (Fig. K-1). A chi-square analysis (Siegel 1956) revealed that there was a significant difference ($P<0.01$) in the rate of infection seasonally. The highest rate occurred in February when 31% of the fish were infected. Percent infection in August was high in comparison to those of July, September, and October. However, lymphocystis tumors may appear and disappear within a few days (Nigrelli 1954) and the sudden change in August is probably not unusual.

In the literature there are conflicting reports regarding seasonal occurrence of the disease. In Lake of the Ozarks, Missouri, Witt (1957) observed the highest incidence of infection in summer (10.7%) and the lowest in winter and early spring (1.4%) for white crappie. In walleye from Nipigon River, Ontario, Ryder (1961) observed the highest incidence of the disease during and immediately following spawning in early spring and infected fish that were tagged showed no trace of the disease in summer, fall, and winter. Hansen (1951) observed a low incidence of the disease in spring of 1942 in two Illinois lakes and an extremely high incidence in fall of 1943 in a third lake.

The differences in the time of year for maximum occurrence of lymphocystis differed not only in the various fishes but also in the same species from different bodies of water. This suggests that the disease is controlled by more than one factor. Environmental conditions, such as temperature, may play an important part in its occurrence, but other factors such as stress caused by changing environmental conditions, removal of the mucous coat through spawning activities, and injuries might reduce the fishes' resistance to the disease. Once started the disease may spread throughout the population irrespective of the season.

Sites of Infection

In the walleye examined, the number of tumors varied from 1 to over 50, and covered up to about 8% of the total body surface. The body beneath the spinous dorsal fin contained 53% of all the infections; followed by the operculum with 34%; the caudal peduncle, 6%; and the body under the soft dorsal, 3% (Table K-1). The fins, which were the main sites of infection for Centrarchids (Weissenberg 1945), were infected only 3%.

Age Class vs. Incidence of Infection

Some age classes of walleye were more infected with lymphocystis than others. None of the 122 walleye in age classes I and II were infected, but from 11 to 44% of the individuals in the remaining groups of age classes were infected (Table K-2). Similar results were found in white crappie (Witt 1957); bluegill (Petty and Magnuson 1974); and blennioid fishes, genus *Hypoblennius* (McCosker 1969).

The difference in the rate of infection between the year classes might result from differences in behavior. Ryder (1961) attributed the increase in infected walleye in spring to spawning. Walleye may lose a portion of their mucous coat when spawning in riffles, thereby becoming more vulnerable to infection; the chance of infection may also be increased by crowded conditions on the spawning grounds. Walleye less than three years old, which usually do not spawn, would be less likely to become infected.

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Table K-1. Location of lymphocystis tumors found on walleye from the Susquehanna River.

Area[a]	Incidences of Infection	% of Occurrence
Operculum	11	34
Fins	1	3
Body under spinous dorsal	17	53
Body under soft dorsal	1	3
Caudal peduncle	2	6

[a] More than one area may be infected at the same time.

Table K-2. Percent infection of lymphocystis for combined age classes of walleye in the Susquehanna River.

Age Classes	No. Fish	No. Infected	% Infection
I & II	122	0	0
III & IV	97	12	12
V & VI	44	5	11
VII & VIII	9	4	44

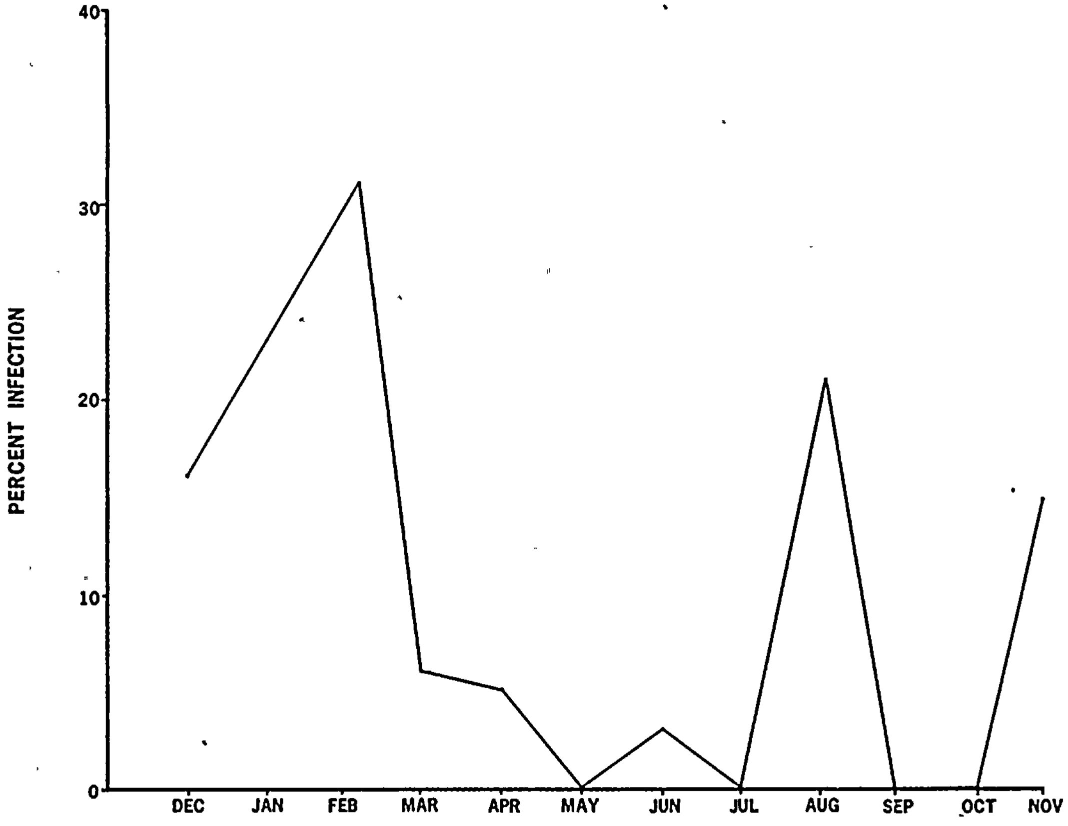

Fig. K-1. Seasonal variation in the percent infection of lymphocystis in 272 walleye collected in the Susquehanna River, 1975 and 1976. Walleye were collected in all months except January.

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