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

Annual Report for 1977

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INTRODUCTION

The Pennsylvania Power and Light Company (PP&L) has contracted Ichthyological Associates, Inc. (IA) since 1971 to conduct ecological studies near the Susquehanna Steam Electric Station (Susquehanna SES). This is the seventh annual progress report on these studies which has been done as part of the preinvestigative ecological monitoring program at the Susquehanna SES. The Susquehanna River has been under investigation since the beginning of the studies, whereas terrestrial investigations of the Station site were initiated in 1972, discontinued in 1975, and reinitiated in the spring of 1977.

Since 1971, the overall objective of the ecological studies has been to establish a baseline of existing conditions in the River and on the site before the Susquehanna SES begins operation. When completed the Station will consist of two, nuclear-powered units, each with a generating capacity of 1,050 megawatts. Commerical operation of Unit 1 is scheduled to begin in February 1981 and Unit 2 in May 1982.

Throughout 1977, data on water chemistry, algae, macroinvertebrates, and larval and adult fishes were gathered to describe and evaluate the River ecosystem. Terrestrial studies were conducted to obtain information about the flora, vegetation, and birds found on the site. Descriptions of sampling procedures and analyses of results, including detailed tabulation of data, are presented in this report.

Most of the aquatic studies were conducted near the intake structure and discharge diffuser of the Susquehanna SES. In this area, the slope of the River bed is about 0.3 m/km, the maximum depth is 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 pools, some of which are several kilometers long. In times of high flow the River level commonly increases 3 m or more, and its flow characteristics resembles an open channel. 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 at the site (Gale et al. 1976).

Terrestrial studies were done on the 435.0-ha site of the Station 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 this area 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.

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PHYSICOCHEMICAL ANALYSES

by

Walter J. Soya and Theodore V. Jacobsen

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ABSTRACT

In 1977, physicochemical data were collected from the Susquehanna River near the Susquehanna SES. 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 -0.1 C to 30.8 C (the highest recorded at the site since 1971). River flow was calculated with the formula: $River\ flow = 215.8 + 322.3\ (River\ level - 149) + 106.4\ (River\ level - 149)^2$. River flow and level ranged from 49 m^3/s and 148.34 m above msl to 3,422 m^3/s and 153.18 m above msl, respectively.

Statistical analyses of the physicochemical data from 1973 through 1977 showed improved water quality. The pH ($P<0.001$), dissolved oxygen ($P<0.01$), and alkalinity ($P<0.05$) increased, whereas total iron ($P<0.01$), dissolved iron ($P<0.01$), turbidity ($P<0.01$), and specific conductance ($P<0.05$) decreased. There are indications, however, that this trend may be leveling off.

INTRODUCTION

This report presents physicochemical data collected from the Susquehanna River near the Susquehanna SES in 1977. The objective since 1971 has been to establish a baseline of water quality parameters for evaluation of possible effects on the River as a result of the operation of the Susquehanna SES. Records of similar physicochemical data are in annual reports from 1971 through 1976 (Ichthyological Associates 1972, 1973, 1974; Smith and Soya 1976; Jacobsen and Soya 1976, 1977).

Near the Susquehanna SES, the River is polluted by coal mine drainages (Gale et al. 1976) which enter upriver through several seeps, boreholes, and creeks. However, the River's water quality improved from 1973 through 1976 when total iron, sulfate, specific conductance, and turbidity decreased and pH and dissolved oxygen increased at the site (Jacobsen and Soya 1977).

PROCEDURES

Throughout 1977, physicochemical data were collected at the IA Laboratory and the SSES-A sampling station (Fig. A-1). The Laboratory is located on the River's west bank, 1,220 m east of the Susquehanna SES. SSES-A is 270 m downstream from the Laboratory, about 40 m from the west bank.

River temperature and depth were recorded continuously on seven-day graphs at the Laboratory (Table A-1). Sensors for both recorders were located on the River bottom within 30 m of the shore. River temperature (C) was read directly from the graph, whereas River depth (ft) was converted to River level (m) above mean sea level (msl). River level data were used to calculate the River flow (m^3/s) past the Laboratory (Table A-1). Daily means of the temperaure and level recordings were determined by averaging hourly values from 0100 through 2400 h. 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 recorded.

At SSES-A, a 3.8-liter surface grab sample of water was collected twice per week during April, May, June, July, August, and September, and twice per month for the remainder of the year. Samples were collected at 1300 ± 1 h. With each grab sample, air and surface water temperatures and Secchi disc depth were determined and a 300-ml surface dissolved oxygen sample was collected (Table A-1). Prevailing weather conditions were also recorded.

Surface grab samples were usually taken from a boat as it drifted over the station. However, both of the January samples and the first February sample were obtained through ice which covered the station. Prior to collection a hole was bored through the ice layer and cleared (to a depth of 0.5 m) of slush ice and flocculent ferric precipitates which filled the water column. Samples were obtained after most flocculent matter settled out.

Samples were immediately transported to the Laboratory and analyzed for dissolved oxygen, pH, alkalinity, turbidity, sulfate, specific conductance, and total, fixed total, nonfiltrable, and fixed nonfiltrable residues (Table A-1). Each laboratory analysis was performed at least twice and the value recorded was a mean of the determinations. All calculations were maintained in bound notebooks. Portions of the grab sample were fixed for total and dissolved iron analyses (Table A-1) which were determined by personnel from the Pennsylvania Power and Light (PP&L) Water Laboratory, Hazleton, Pennsylvania. All analyses were conducted within the holding time interval recommended by the U.S. Environmental Protection Agency (EPA 1974).

The 1977 physicochemical data at SSES-A were compared with those obtained at the site in previous years. Nonparametric statistics were used to determine if: 1) year to year changes had occurred in each parameter, and 2) 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 complete sampling years (1973-77) were used.

Quality control cross-checks of water samples collected at SSES-A were conducted quarterly. During each cross-check, triplicate surface grab samples were collected at the same time the routine sample was taken. Analyses of the cross-check samples were begun within 24 h at the Schuylkill River Ecological Study (SRES) Laboratory, Pottstown, Pennsylvania. Eight parameters were analyzed in each of the three samples according to EPA approved procedures. The mean of the three determinations was recorded.

Physicochemical data were also collected in conjunction with algal and fisheries studies. These data are presented in the Algae, Electrofishing of Fishes, and Seining of Fishes sections of this report.

Once each month, personnel from the PP&L Water Laboratory collected physicochemical data from the River at the IA boat ramp (Fig. A-1). No sample was collected in January because ice covered the sampling location. Water temperature and dissolved oxygen were measured in the field; all other determinations were made at the PP&L Laboratory according to Standard Methods (APHA 1975) or Methods for Chemical Analysis of Water and Wastes (EPA 1974). Analyses for total and dissolved nickel were initiated in July.

RESULTS AND DISCUSSION

River temperature ranged from -0.1 C, recorded at various times from 27 through 30 December, to 30.8 C on 21 July at 1500 h (Table A-2). This maximum was the highest recorded at the site since sampling began in 1971. The minimum daily mean temperature (also -0.1 C) occurred on 28 December and the maximum daily mean temperature (29.0 C) on 21 July. The daily mean temperature varied least (Standard Error = 0.03) in January and most (SE = 0.78) in May. The minimum monthly mean temperature (0.6 C) occurred in January and February and the maximum (25.5 C) in July.

Daily water temperature ranges of 0.5 C or greater occurred in each month except January (Table A-2). These fluctuations occurred 93% of the days from April through September. The maximum daily fluctuation in each of these months was 3.0, 2.2, 3.9, 3.8, 3.2, and 3.1 C, respectively. These maxima were more numerous and greater in range than those recorded in 1975 and 1976 (Jacobsen and Soya 1976, 1977).

The River level at the site ranged from 148.34 m above msl for the period 1000-0600 h on 15 and 16 September to 153.18 m above msl at 0100 h on 27 September (Table A-3). The minimum daily mean River level (148.35 m above msl) occurred on 15 September and the maximum (152.94 m above msl) on 15 March. The daily mean River level varied least in June (SE = 0.012) and most in September (SE = 0.272). The lowest monthly mean level (148.55 m above msl) occurred in July and the highest (151.18 m above msl) in March.

River flow (m^3/s) at the IA Laboratory was calculated with the formula:

$$River\ flow = 215.8 + 322.3\,(River\ level - 149) + 106.4\,(River\ level - 149)^2.$$

This polynomial regression equation was based on mean daily River flow and level data (Fig. A-2) collected from July 1973, when the continuous monitoring of River level was initiated, through December 1976 (Ichthyological Associates 1974; Smith and Soya 1976; Jacobsen and Soya 1976, 1977). The equation was found to be the best empirical fit since it explained 99.5% of flow variation. Both instantaneous and mean daily flows were calculated with the polynomial regression equation; in past years only mean daily flows could be calculated from U. S. Geological Survey data with a formula (Ichthyological Associates 1974) provided by Mr. O. D. White, National Weather Service, Harrisburg, Pennsylvania.

In 1977, River flow ranged from 49 m^3/s on 15 and 16 September to 3,422 m^3/s on 27 September (calculated from the minimum and maximum River level). Daily mean flow was least (51 m^3/s) on 15 September and greatest (3,137 m^3/s) on 15 March (Table A-4). The daily mean flow varied least (SE = 3.0) in June and most (SE = 158.0) in September. The monthly mean flow was lowest (93 m^3/s) in July and highest (1,480 m^3/s) in March.

Surface water grab samples were collected at River levels from 148.37 to 152.70 m above msl and River flows of 55 to 2,860 m^3/s. The surface water temperautre at collection time ranged from 0.0 to 29.0 C (Tables A-5 through A-8).

The limit of visibility of River water, determined with a Secchi disc, ranged from 8 cm on 28 February, 15 March, 27 September, and 16 December to 138 cm on 17 May (Tables A-5 through A-8). The Secchi disc

depth was not measured for either of the January samples or the first February sample because of ice cover.

Turbidity ranged from 6.4 NTU on 16 February to 270 NTU on 15 March (Tables A-5 through A-8). Water clarity was greatest in May when the monthly mean Secchi disc depth and turbidity were 113 cm and 9.8 NTU, respectively, and least ($\bar{x}$ = 12 cm and 165 NTU) in March.

Dissolved oxygen concentrations ranged from 7.05 mg/1 on 8 July to 14.95 mg/1 on 21 April (Tables A-5 through A-8). The concentration on 21 April was the highest recorded at the site since sampling began in 1971. The monthly mean concentration was lowest (8.69 mg/1) in September and highest (12.78 mg/1) in December. The percent saturation was lowest (82%) on 27 January and highest (153%) on 2 August.

Total alkalinity ranged from 20 mg/1 on 15 March to 72 mg/1 on 12 August (Tables A-5 through A-8). The minimum monthly mean concentration (22 mg/1) was recorded in March and the maximum (69 mg/1) in January. No phenolphthalein alkalinity was found.

River pH ranged from 7.2, recorded on numerous occasions throughout the year, to 8.1 on 17 June and 19 July (Tables A-5 through A-8). The minimum monthly mean pH (7.3) occurred in January, February, March, October, November, and December and the maximum (7.7) in July. Overall, the pH of the River was more alkaline than during any of the past sampling years (Fig. A-3).

Specific conductance ranged from 95 µmhos/cm on 15 March to 445 µmhos/cm on 29 July (Tables A-5 through A-8). The minimum monthly mean specific conductance (109 µmhos/cm) occurred in March and the maximum (396 µmhos/cm) in July.

Sulfate ranged from 16 mg/1 on 6 April and 23 September to 224 mg/1 on 22 July (Tables A-5 through A-8). The minimum monthly mean concentration (23 mg/1) occurred in December and the maximum (110 mg/1) in July.

Total iron concentrations ranged from 1.36 mg/1 on 13 May and 17 November to 12.9 mg/1 on 27 September (Tables A-5 through A-8). The minimum monthly mean concentration (1.64 mg/1) occurred in May and the maximum (5.94 mg/1) in December. The 1.5 mg/1 limit of total iron established for the River by the Pennsylvania Department of Environmental Resources (DER 1971) was exceeded in 60 of 64 samples.

The ranges of dissolved iron concentrations (0.02 mg/1 to 0.70 mg/1), monthly means (0.05 mg/1 to 0.44 mg/1), and percent compositions (1% to 43%) were the smallest recorded at the site since sampling began (Tables A-5 through A-8).

Maximum values for total (526 mg/1), fixed total (480 mg/1), nonfiltrable (497 mg/1), and fixed nonfiltrable (442 mg/1) residues occurred on 15 March (Tables A-5 through A-8). The minimum of total (104 mg/1), fixed total (77 mg/1), nonfiltrable (8 mg/1), and fixed nonfiltrable (4 mg/1) residues occurred on 5 December, 27 October, 16 February, and 22 and 25 August, respectively.

Statistical analyses of the physicochemical data from 1973 through 1977 showed improved water quality of the River similar to that observed from 1973 through 1976 (Jacobsen and Soya 1977). Using Friedman's test, significant differences were found in pH ($S = 23.083$, $DF = 4$, $P<0.001$), dissolved oxygen ($S = 14.183$, $DF = 4$, $P<0.01$), total iron ($S = 11.667$, $DF = 4$, $P<0.05$), and dissolved iron ($S = 13.367$, $DF = 4$, $P<0.01$). Page's test confirmed that pH ($L = 622.5$, $P<0.001$) and dissolved oxygen ($L = 587.0$, $P<0.01$) increased, whereas total iron ($L = 589.0$, $P<0.01$) and dissolved iron ($L = 591.0$, $P<0.01$) decreased. Also, alkalinity ($L = 319.0$, $P<0.05$) increased, and turbidity ($L = 589.5$, $P<0.01$) and specific conductance ($L = 579.0$, $P<0.05$) decreased, even though the Friedman analysis of these parameters could find no significant differences in the annual results (Figs. A-3, A-4).

These trends are associated with the termination of pumping mine water into the River after Tropical Storm Agnes in 1972. The amounts of acid, dissolved solids, iron, and sulfate in the River diminished as the volume of mine water decreased. Mine pollution has not completely ceased because some effluents continue to enter by gravity flow. The pH and alkalinity of the River increased as acid decreased. Dissolved oxygen also increased, at least partially because less dissolved iron was oxidized in the River. The specific conductance of the River decreased with the occurrence of fewer dissolved solids, and turbidity decreased due to the smaller amounts of suspended ferric precipitates.

There are indications in the data analyses that further improvements in water quality may not occur as rapidly in future years as during the past five or six years. Although Jacobsen and Soya (1977) showed that sulfate concentrations decreased significantly from 1972 through 1976 ($P<0.01$), high concentrations found in 1977 terminated the trend. Significant decreases ($P<0.01$) occurred in total iron concentrations during the periods 1973-76 and 1973-77, but the annual mean concentration increased in both 1976 and 1977. The decrease in specific conductance was statistically less significant in 1973-77 ($P<0.05$) than in 1973-76 ($P<0.001$).

The quality control cross-check values determined at the SRES Laboratory were similar to those obtained at the IA Laboratory in most instances (Table A-9). Differences in specific conductance, total iron, and nonfiltrable residue results on 16 February were probably caused by ferric precipitate contamination during sample collection through the River ice. Also, the turbidity result of the SRES Laboratory on 25 August was found to be in error because of a faulty meter. Minor discrepancies were attributed to transportation of the sample, the interval between collection and analysis, different instrumentation, and different methods of analysis.

A total of 50 water quality parameters was analyzed each month, except January, from samples collected at the IA boat ramp by personnel of the PP&L Water Laboratory (Table A-10). The high concentrations of iron, sulfate, aluminum, manganese, and magnesium indicated that coal mine drainage pollution persisted at the site. Total iron concentrations in 6 of the 11

samples exceeded the 1.5 mg/l limit established for the River by the DER (1971). Total manganese concentrations, however, did not surpass the DER limit of 1.0 mg/l in any month.

Calcium was the dominant cation in each sample ($\bar{x}$ = 1.28 me/l). Bicarbonate was the dominant anion in all samples ($\bar{x}$ = 0.89 me/l), except in June and July when sulfate was greatest.

Phenolphthalein alkalinity (5 mg/l), carbonate ions (6.0 mg/l), and calcium carbonate saturation (+0.34 pH units) were found in the July sample. These were not present in any sample since August 1975.

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Table A-1. Physicochemical parameters and methods of analyses, 1977.

Parameter	Method	Reference
River level (depth)	Seven-day continuous recordings from an ACCO Bristol, Model No. G500-15 bubbler-type water level gauge.	ACCO (1971)
River flow	River flow = 215.8 + 106.4 (river level -149) + 322.3 (river level -149)^2.	HP (1972)
River 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)
Air temperature	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 at 25 C.	EPA (1974)
Sulfate	Turbidimetric.	EPA (1974)
Total iron	Atomic absorption spectrophotometric determination of soluble iron.	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	Nephelometric.	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, 1977.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN						FEB					
1	0.7	0100	0.9	1300	0.8	1	0.5	0100	0.5	0100	0.5
2	0.8	0100	0.8	0100	0.8	2	0.4	2000	0.5	0100	0.5
3	0.8	0100	0.8	0100	0.8	3	0.4	0100	0.4	0100	0.4
4	0.8	0100	0.9	1300	0.8	4	0.4	0100	0.4	0100	0.4
5	0.8	0100	0.9	1400	0.8	5	0.4	0100	0.4	0100	0.4
6	0.8	0100	0.9	1300	0.8	6	0.4	0100	0.4	0100	0.4
7	0.8	0100	0.9	1300	0.8	7	0.4	0100	0.4	0100	0.4
8	0.7	1300	0.8	0100	0.8	8	0.4	0100	0.4	0100	0.4
9	0.7	0100	0.8	1300	0.8	9	0.4	0100	0.4	0100	0.4
10	0.7	1100	0.8	0100	0.8	10	0.4	0100	0.4	0100	0.4
11	0.8	0100	0.9	1300	0.8	11	0.4	0100	0.4	0100	0.4
12	0.8	0100	0.8	0100	0.8	12	0.4	0100	0.4	0100	0.4
13	0.8	0100	0.9	1200	0.8	13	0.4	0100	0.4	0100	0.4
14	0.7	0900	0.8	0100	0.7	14	0.4	0100	0.4	0100	0.4
15	0.6	1800	0.7	0100	0.7	15	0.4	0100	0.4	0100	0.4
16	0.6	0100	0.6	0100	0.6	16	0.4	0100	0.4	0100	0.4
17	0.6	0100	0.7	1300	0.6	17	0.4	0100	0.4	0100	0.4
18	0.7	0100	0.7	0100	0.7	18	0.4	0100	0.5	1200	0.5
19	0.7	0100	0.8	1200	0.8	19	0.5	0100	0.5	0100	0.5
20	0.4	0900	0.8	0100	0.6	20	0.5	0100	0.5	0100	0.5
21	0.4	0100	0.5	0900	0.5	21	0.5	0100	0.8	1500	0.6
22	0.4	0900	0.5	0100	0.4	22	0.4	0900	0.7	1900	0.6
23	0.4	0100	0.5	2400	0.4	23	0.7	0100	1.7	1900	1.1
24	0.5	0100	0.5	0100	0.5	24	1.7	0100	2.1	1300	1.9
25	0.5	0100	0.6	1300	0.5	25	0.7	2300	2.1	0100	1.7
26	0.5	0100	0.5	0100	0.5	26	0.6	0400	0.8	1600	0.7
27	0.4	0900	0.5	0100	0.4	27	0.8	0100	1.1	1400	0.9
28	0.4	0100	0.4	0100	0.4	28	1.0	0100	1.2	1200	1.1
29	0.4	0100	0.4	0100	0.4						
30	0.4	0100	0.4	0100	0.4						
31	0.4	0100	0.5	1200	0.5						
MEAN					0.6	MEAN					0.6
SE					0.03	SE					0.07
MAR						APR					
1	0.9	0800	1.1	0100	1.0	1	8.4	1000	9.1	0100	8.8
2	0.8	0900	1.1	2200	1.0	2	7.9	2200	8.8	0100	8.3
3	1.0	0800	1.7	2100	1.3	3	7.7	0500	8.2	1700	8.0
4	1.7	0100	2.3	2200	1.9	4	7.3	2000	8.2	0100	7.8
5	2.3	0100	3.0	1600	2.7	5	6.9	1200	7.3	0100	7.0
6	3.0	0100	3.1	1400	3.0	6	6.6	1800	6.9	0900	6.7
7	2.4	2400	3.1	0100	2.6	7	6.1	0600	6.5	0100	6.2
8	2.1	0600	2.8	2400	2.4	8	5.9	0900	6.3	1500	6.2
9	2.8	0100	3.8	2200	3.2	9	5.8	0500	6.3	0800	6.1
10	3.9	0100	5.1	2400	4.4	10	6.1	0500	7.1	1700	6.6
11	5.1	0100	6.2	1800	5.8	11	7.1	0100	8.8	2400	7.9
12	6.3	0100	6.7	2400	6.5	12	8.8	0100	10.9	2300	9.7
13	6.7	0100	6.8	2000	6.7	13	10.9	0100	12.9	2400	11.9
14	6.7	1800	6.9	0200	6.8	14	12.9	0100	13.4	1300	13.2
15	6.3	1100	6.7	0100	6.5	15	13.0	0600	13.8	1500	13.4
16	6.1	0800	6.6	1600	6.4	16	13.2	0600	14.2	1400	13.7
17	6.0	1000	6.5	0100	6.2	17	13.3	0500	14.3	1500	13.8
18	4.9	2300	6.1	0100	5.3	18	13.3	0600	14.7	1400	14.1
19	4.1	0800	4.8	0100	4.3	19	13.9	0500	14.6	1600	14.3
20	3.8	1900	4.3	0100	4.0	20	14.2	0100	15.3	1500	14.8
21	3.3	0700	3.8	1600	3.6	21	15.1	0100	16.1	1400	15.5
22	3.8	0100	3.9	1000	3.8	22	15.7	0200	17.3	1500	16.6
23	3.0	1400	3.7	0100	3.2	23	17.2	0100	18.4	1600	17.4
24	3.0	0100	3.2	1400	3.1	24	16.2	2400	18.0	0100	17.3
25	2.8	0700	3.2	0100	3.0	25	13.1	2200	16.1	0100	14.6
26	2.9	0600	3.4	1800	3.2	26	11.9	2400	13.1	0100	12.5
27	3.4	0100	4.4	2000	3.9	27	11.2	0700	11.8	0100	11.4
28	4.4	0100	5.0	1500	4.8	28	11.2	0600	11.9	1300	11.4
29	5.0	0100	7.0	2000	5.9	29	11.2	0500	11.8	1600	11.5
30	7.0	0100	8.2	2100	7.5	30	11.3	0800	12.4	2000	11.9
31	8.2	0100	9.1	1600	8.7						
MEAN					4.3	MEAN					11.3
SE					0.36	SE					0.66

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY						JUN					
1	12.1	0700	13.2	2200	12.7	1	20.9	0600	21.5	1900	21.1
2	13.2	0700	13.6	2400	13.3	2	20.8	0700	22.7	1500	21.6
3	13.2	0700	14.8	1700	14.0	3	20.1	0700	22.4	1500	21.2
4	14.0	2000	14.9	1100	14.3	4	20.2	0600	23.2	1500	21.7
5	13.8	0600	14.2	2300	14.0	5	21.1	0600	23.2	1500	22.0
6	14.1	0600	15.9	2400	14.8	6	20.1	2400	21.8	0100	21.0
7	15.4	1000	15.9	1800	15.7	7	18.9	2400	20.0	1100	19.6
8	15.1	0800	15.9	1600	15.6	8	17.9	0700	20.1	1400	19.0
9	13.5	2400	15.7	0100	14.7	9	17.2	2400	18.6	0100	18.0
10	12.1	2400	13.3	0100	12.7	10	16.8	2400	17.2	1700	17.1
11	12.0	0400	13.0	1700	12.5	11	16.2	0700	18.5	1600	17.4
12	12.3	0700	13.4	2400	12.9	12	17.8	0700	19.2	1600	18.4
13	13.3	0100	14.9	2400	14.2	13	18.2	0700	20.7	1600	19.5
14	14.8	0800	15.4	1700	15.0	14	19.9	2400	20.1	0100	20.0
15	15.1	0800	16.0	1600	15.6	15	19.7	0700	21.7	1600	20.6
16	15.7	0700	16.8	1700	16.2	16	20.1	0700	22.9	1500	21.6
17	16.0	0700	17.9	2100	16.9	17	22.0	0100	23.8	1500	22.5
18	17.3	0700	19.3	1500	18.3	18	22.0	0700	24.4	1600	23.1
19	18.3	0700	19.8	2100	19.1	19	22.8	0700	25.2	1500	24.0
20	19.2	0700	21.0	1900	20.2	20	22.8	0700	25.2	1500	23.9
21	20.4	0600	22.5	1800	21.5	21	22.9	2400	24.2	1600	23.4
22	21.6	0700	23.2	1600	22.4	22	22.0	0700	24.2	1400	23.1
23	22.2	0700	23.9	1500	23.2	23	21.9	0700	24.9	1500	23.3
24	23.0	0600	24.9	1500	23.8	24	22.8	0700	24.6	1600	23.6
25	23.4	0700	25.1	1500	24.3	25	23.1	0700	23.5	1900	23.2
26	23.3	0700	25.7	1500	24.3	26	22.3	0700	24.1	1500	23.2
27	22.9	0700	24.7	1600	23.9	27	22.1	0700	26.0	1600	23.9
28	23.3	0700	25.0	1600	24.2	28	23.3	0700	24.3	1500	23.8
29	23.1	0800	24.6	1500	23.8	29	23.7	0700	25.8	1500	24.5
30	22.3	2400	23.3	0100	22.9	30	23.3	0700	26.0	1500	24.7
31	21.1	2400	22.2	0100	21.6						
MEAN					18.0	MEAN					21.7
SE					0.78	SE					0.40
JUL						AUG					
1	24.2	0600	26.3	1600	25.1	1	23.7	0700	25.9	1500	24.7
2	23.9	0700	26.4	1500	25.0	2	24.0	0600	27.2	1600	25.3
3	23.3	0700	26.3	1500	24.8	3	23.9	0800	25.1	1600	24.6
4	24.1	0600	25.8	1600	24.9	4	24.0	0700	27.1	1600	25.3
5	24.1	0600	26.1	1800	25.1	5	24.1	0700	26.8	1700	25.4
6	24.3	2100	26.8	1400	25.1	6	24.3	0800	26.7	1700	25.5
7	23.6	2300	24.2	0100	24.1	7	24.9	0600	26.8	1800	25.7
8	23.2	0700	25.1	1500	24.2	8	24.9	0700	27.6	1600	26.1
9	23.8	0500	25.5	1600	24.7	9	25.7	0700	27.0	1400	26.3
10	24.8	0500	26.1	1500	25.5	10	25.9	0700	26.4	1400	26.1
11	24.9	2400	25.8	0100	25.3	11	25.7	0700	27.3	1500	26.3
12	24.3	0800	25.4	1700	24.9	12	25.9	0700	27.1	1500	26.3
13	24.3	0700	26.0	1500	25.1	13	25.3	0800	26.4	1500	25.8
14	24.4	0700	27.3	1500	25.8	14	24.8	2400	25.3	1700	25.0
15	25.3	0700	28.1	1600	25.8	15	24.1	0700	25.6	1400	24.8
16	25.9	0700	29.0	1600	26.3	16	24.2	0800	24.8	1700	24.6
17	26.2	0700	29.7	1700	27.6	17	23.8	2400	24.7	0100	24.2
18	26.9	0700	29.9	1600	28.1	18	23.0	0700	24.4	1500	23.6
19	27.2	0700	30.2	1600	28.3	19	22.4	0800	24.2	1500	23.3
20	27.3	0700	29.7	1600	28.3	20	22.1	0800	23.2	1500	22.6
21	27.9	0600	30.8	1500	29.0	21	21.4	1000	22.0	1400	21.8
22	26.4	2400	29.2	1400	27.8	22	21.4	0700	23.1	1500	22.2
23	25.4	0700	28.1	1400	26.7	23	21.7	0700	23.0	1500	22.2
24	25.0	0700	28.4	1500	26.7	24	21.3	2400	22.3	1300	22.0
25	24.8	2400	26.3	0100	25.6	25	20.9	0500	23.1	1500	21.6
26	23.2	0600	26.1	1600	24.5	26	20.8	0900	22.8	1500	21.6
27	21.6	0700	25.3	1700	23.5	27	21.0	0700	22.3	1600	21.6
28	21.2	0700	25.0	1500	23.1	28	21.7	0700	24.3	1500	22.9
29	21.6	0700	24.4	1400	23.0	29	23.1	0700	25.0	1300	24.1
30	22.8	0800	24.1	1400	23.3	30	24.1	0500	26.0	1500	24.9
31	22.9	0400	26.0	1700	24.2	31	24.3	0900	25.3	1500	24.9
MEAN					25.5	MEAN					24.2
SE					0.29	SE					0.29

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP.						OCT					
1	24.6	2400	25.7	1700	25.0	1	14.1	0700	14.4	0100	14.1
2	24.1	0700	26.7	1700	25.2	2	14.0	2400	14.3	0900	14.2
3	--	--	--	--	--	3	13.2	2400	14.0	0100	13.7
4	--	--	--	--	--	4	12.9	0700	13.2	0100	13.1
5	--	--	--	--	--	5	12.4	0800	12.9	0100	12.8
6	--	--	--	--	--	6	12.4	0800	12.8	1700	12.6
7	23.5	0800	25.9	1500	24.5	7	12.2	0800	12.7	1900	12.5
8	23.3	0800	24.4	1300	23.9	8	12.1	0700	12.3	0100	12.1
9	22.4	0800	24.9	1500	23.5	9	12.0	0100	12.2	1600	12.1
10	22.7	2400	24.9	1600	23.4	10	11.8	0800	12.0	0100	11.9
11	20.9	2400	23.3	1500	22.1	11	11.7	0700	12.0	1700	11.9
12	20.0	0800	23.1	1700	21.4	12	11.8	0800	12.0	1500	11.9
13	20.2	0900	21.1	1600	20.7	13	11.6	0800	11.9	0100	11.8
14	19.8	2400	21.9	1700	20.9	14	10.8	2400	11.6	0100	11.1
15	18.6	0700	20.9	1600	19.6	15	10.3	1000	10.8	0100	10.6
16	19.0	0600	19.8	0100	19.4	16	9.9	2400	10.7	0100	10.2
17	19.1	0200	19.9	1500	19.5	17	9.1	2400	10.5	0300	9.8
18	19.2	2400	19.7	0100	19.6	18	8.7	2400	9.0	0100	8.8
19	18.8	0800	19.2	1700	19.0	19	8.3	0700	8.7	2400	8.5
20	19.0	0800	19.8	2200	19.3	20	8.5	0700	9.0	1600	8.8
21	18.9	2400	19:4	0100	19.1	21	8.8	0700	9.1	1700	9.0
22	18.2	2400	18.9	0100	18.7	22	9.1	0100	10.0	1800	9.5
23	17.4	2100	18.2	0100	17.8	23	9.9	0800	10.1	1800	10.0
24	16.9	2400	17.4	0100	17.1	24	9.9	0800	10.1	0100	10.0
25	15.8	2400	16.9	0100	16.3	25	9.9	0700	10.1	1600	10.0
26	15.0	2400	15.8	0100	15.2	26	10.2	0100	10.8	1400	10.5
27	14.9	0800	15.2	1700	15.1	27	10.8	0100	11.9	2400	11.3
28	15.0	0800	15.4	1800	15.2	28	11.9	0100	12.4	1600	12.1
29	15.0	0700	15.7	2000	15.3	29	11.8	0900	12.1	0100	12.0
30	15.1	0800	15.7	2000	15.4	30	11.8	0900	12.0	1500	11.9
						31	11.3	0900	11.8	0100	11.5
MEAN					19.7	MEAN					11.3
SE					0.63	SE					0.28
NOV						DEC					
1	10.1	0900	10.6	1400	10.4	1	3.6	0100	4.3	2300	4.0
2	10.5	0100	11.0	2300	10.7	2	4.3	0200	4.7	1700	4.5
3	11.0	0100	11.8	2300	11.3	3	4.7	0100	4.7	0100	4.7
4	11.8	0100	12.8	2100	12.4	4	4.2	2200	4.7	0100	4.4
5	12.9	0100	13.9	1600	13.5	5	3.1	1800	4.2	0100	3.6
6	13.4	1200	13.9	0100	13.7	6	2.3	2400	3.1	0100	2.8
7	13.1	2400	13.8	0100	13.4	7	1.2	2400	2.3	0100	1.8
8	12.2	2400	13.1	0100	12.7	8	0.9	1400	1.2	0100	1.0
9	12.1	0400	12.2	0100	12.1	9	0.1	2000	0.9	0100	0.5
10	11.9	2400	12.1	0100	12.0	10	0.1	0100	0.3	1300	0.2
11	10.5	2400	11.9	0100	11.2	11	0.0	1900	0.1	0100	0.1
12	8.9	2400	10.3	0100	9.7	12	0.0	0100	0.2	2400	0.1
13	7.3	2400	8.8	0100	8.0	13	0.2	0100	0.4	1400	0.3
14	6.5	1900	7.2	0100	6.7	14	0.2	0600	0.3	0100	0.3
15	6.1	0700	6.5	0100	6.3	15	0.1	0700	0.3	2300	0.2
16	6.2	0700	6.8	2200	6.5	16	0.3	0100	0.9	2400	0.6
17	6.8	0100	7.6	2000	7.2	17	1.0	0100	1.7	2000	1.4
18	7.2	0800	7.6	0100	7.3	18	1.7	0100	2.0	2200	1.8
19	6.9	2400	7.3	1500	7.1	19	1.7	0600	2.3	2400	2.0
20	6.9	0100	7.1	1600	7.0	20	2.3	0100	2.5	2200	2.4
21	6.8	0700	7.0	0100	6.8	21	2.4	0800	2.5	0100	2.5
22	6.8	0100	6.9	0800	6.8	22	1.8	2000	2.4	0100	2.1
23	6.7	1400	6.9	0100	6.8	23	1.7	0900	1.9	0100	1.8
24	6.7	0100	6.8	1400	6.7	24	1.6	0900	2.1	2400	1.8
25	6.1	2400	6.8	0100	6.5	25	2.0	0100	2.5	1500	2.2
26	5.1	2400	6.0	0100	5.8	26	1.0	2300	2.0	0100	1.3
27	4.2	2300	5.0	0100	4.7	27	-0.1	1900	0.9	0100	0.2
28	3.8	2300	4.2	0100	4.0	28	-0.1	0100	0.0	1400	-0.1
29	3.3	0800	3.8	0100	3.5	29	-0.1	1800	0.0	2400	0.0
30	3.4	0800	3.7	2400	3.4	30	-0.1	2200	0.1	0100	0.0
						31	0.0	1800	0.1	0100	0.1
MEAN					8.5	MEAN					1.6
SE					0.58	SE					0.27

Table A-3. Daily minimum, maximum, and mean level (m above msl) of the Susquehanna River at Ichthyological Associates Laboratory, 1977.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN						FEB					
1	148.74	1800	148.86	0100	148.80	1	149.23	0900	149.26	0100	149.23
2	148.77	1000	148.93	1900	148.83	2	149.20	2000	149.23	0100	149.23
3	148.77	1800	148.83	1000	148.80	3	149.17	0600	149.20	0100	149.17
4	148.77	0100	148.80	0700	148.77	4	149.14	1500	149.17	0100	149.17
5	148.80	0100	148.86	1200	148.83	5	149.14	0100	149.17	1800	149.14
6	148.80	1500	148.83	0100	148.83	6	149.14	0100	149.14	0100	149.14
7	148.80	0100	148.86	2300	148.80	7	149.14	1800	149.17	0100	149.17
8	148.83	1800	148.93	0700	148.89	8	149.14	1500	149.17	0100	149.17
9	148.80	1600	148.89	0700	148.83	9	149.11	1600	149.14	0100	149.14
10	148.77	0400	148.93	2400	148.80	10	149.08	1800	149.11	0100	149.11
11	148.96	0100	149.11	1200	149.02	11	149.08	0100	149.08	0100	149.08
12	148.99	1600	149.11	0800	149.05	12	149.08	0100	149.08	0100	149.08
13	148.86	1800	149.08	0100	148.99	13	149.08	0100	149.14	1900	149.11
14	148.83	1800	148.96	0100	148.89	14	149.17	0100	149.23	2000	149.20
15	148.86	0100	148.93	1000	148.89	15	149.23	0100	149.50	2400	149.35
16	148.93	1700	148.99	1200	148.96	16	149.50	0100	149.63	1900	149.57
17	148.99	0100	149.11	2400	149.02	17	149.63	0100	149.53	0900	149.57
18	149.11	0100	149.20	2200	149.14	18	149.41	0900	149.53	0100	149.44
19	149.14	1700	149.23	0100	149.20	19	149.35	1600	149.41	0100	149.38
20	148.89	1800	149.17	0100	149.05	20	149.32	1800	149.35	0100	149.35
21	149.05	1800	149.11	1000	149.08	21	149.29	0600	149.32	0100	149.29
22	149.08	1800	149.11	0100	149.11	22	149.23	0800	149.29	0100	149.23
23	149.11	0100	149.14	0700	149.14	23	149.17	2300	149.23	0100	149.20
24	149.29	0900	149.29	0900	149.29	24	149.08	1300	149.17	0100	149.11
25	149.26	1800	149.29	0100	149.29	25	149.17	0100	151.36	2400	149.81
26	149.23	1800	149.29	0700	149.26	26	150.96	2400	151.46	0300	151.17
27	149.23	0100	149.29	1200	149.23	27	150.78	0800	150.93	0100	150.84
28	149.23	1300	149.26	0100	149.26	28	150.78	0100	151.26	2200	151.02
29	149.20	0700	149.23	0100	149.23						
30	149.26	0100	149.29	2100	149.26						
31	149.26	0600	149.29	0100	149.26						
MEAN					149.03	MEAN					149.45
SE					0.033	SE					0.109
MAR						APR					
1	151.26	0100	151.38	1000	151.32	1	151.93	0500	151.96	0100	151.96
2	150.71	2400	151.23	0100	150.99	2	151.81	1300	151.93	0100	151.84
3	150.32	2400	150.71	0100	150.50	3	151.87	0100	152.12	1200	152.02
4	150.26	0600	150.59	2400	150.32	4	151.48	2300	151.87	0100	151.66
5	150.65	0100	151.66	2400	151.29	5	151.14	2200	151.45	0100	151.26
6	151.72	0100	151.87	0900	151.81	6	150.96	2200	151.14	0100	151.02
7	151.38	2400	151.72	0100	151.60	7	150.71	2200	150.93	0100	150.81
8	150.87	2300	151.35	0100	151.11	8	150.50	2400	150.68	0100	150.59
9	150.53	2200	150.84	0100	150.68	9	150.29	2200	150.50	0100	150.38
10	150.44	1300	150.50	0100	150.47	10	150.07	2200	150.29	0100	150.17
11	150.44	0100	150.81	2400	150.53	11	149.92	1900	150.04	0100	149.95
12	150.81	0100	151.08	1700	150.99	12	149.80	2200	149.89	0100	149.86
13	151.08	0100	151.63	2400	151.26	13	149.74	1700	149.80	0100	149.77
14	151.69	0600	153.00	2400	152.45	14	149.59	2400	149.74	0100	149.68
15	152.79	2300	153.03	0300	152.94	15	149.50	2400	149.59	0100	149.56
16	152.42	2200	152.76	0100	152.57	16	149.40	1900	149.50	0100	149.46
17	152.02	2400	152.39	0100	152.24	17	149.34	1500	149.40	0100	149.37
18	151.42	2400	151.99	0100	151.69	18	149.28	1900	149.34	0100	149.31
19	150.96	2400	151.38	0100	151.17	19	149.22	1400	149.28	0100	149.25
20	150.65	2400	150.93	0100	150.78	20	149.16	1100	149.19	0100	149.16
21	150.50	2100	150.65	0100	150.56	21	149.10	2000	149.16	0100	149.13
22	150.47	0300	150.93	2400	150.59	22	149.04	1700	149.10	0100	149.07
23	150.96	0100	151.20	1400	151.14	23	149.01	0700	149.04	0100	149.01
24	150.96	2400	151.20	0100	151.11	24	149.04	0100	149.53	2400	149.22
25	150.59	2300	151.93	0100	150.78	25	149.59	0100	151.20	2400	150.55
26	150.38	2100	150.59	0100	150.47	26	151.20	0100	151.32	1000	151.29
27	150.23	1900	150.35	0100	150.29	27	150.99	2400	151.26	0100	151.14
28	150.23	0100	150.47	2400	150.32	28	150.53	2300	150.96	0100	150.74
29	150.47	0100	151.35	2400	150.84	29	150.17	2400	150.50	0100	150.32
30	151.42	0100	152.02	2400	151.87	30	149.92	2200	150.14	0100	150.01
31	151.96	2300	152.09	0800	152.02						
MEAN					151.18	MEAN					150.25
SE					0.129	SE					0.173

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY						JUN					
1	149.74	2400	149.89	0100	149.80	1	148.67	2400	148.73	0100	148.70
2	149.59	2400	149.71	0100	149.65	2	148.61	2400	148.67	0100	148.64
3	149.53	2400	149.59	0100	149.56	3	148.58	2400	148.61	0100	148.61
4	149.43	2400	149.53	0100	149.46	4	148.55	2400	148.58	0100	148.58
5	149.43	0100	149.53	2400	149.46	5	148.55	0100	148.55	0100	148.55
6	149.53	0100	150.17	2400	149.77	6	148.55	0100	148.58	2400	148.58
7	150.07	2400	150.29	0700	150.20	7	148.58	0100	148.61	2400	148.61
8	149.83	2400	150.07	0100	149.92	8	148.58	2400	148.61	0100	148.61
9	149.65	2400	149.80	0100	149.71	9	148.58	0100	148.61	2400	148.61
10	149.65	0100	149.65	0100	149.65	10	148.64	0100	148.73	2400	148.67
11	149.65	0100	149.77	2400	149.71	11	148.73	0100	148.79	0900	148.76
12	149.80	0100	149.86	1200	149.83	12	148.70	2400	148.76	0100	148.73
13	149.77	2400	149.83	0100	149.77	13	148.67	1200	148.70	0100	148.70
14	149.68	2400	149.77	0100	149.71	14	148.67	2400	148.70	0100	148.67
15	149.56	2400	149.68	0100	149.62	15	148.67	0100	148.67	0100	148.67
16	149.46	2400	149.56	0100	149.50	16	148.58	2400	148.67	0100	148.61
17	149.34	2400	149.46	0100	149.40	17	148.55	2400	148.58	0100	148.55
18	149.25	2400	149.34	0100	149.28	18	148.52	2300	148.55	0100	148.52
19	149.16	2400	149.25	0100	149.19	19	148.55	2400	148.64	0600	148.58
20	149.10	2400	149.16	0100	149.13	20	148.55	0100	148.55	0100	148.55
21	149.07	2400	149.10	0100	149.07	21	148.55	0100	148.55	0100	148.55
22	149.07	0100	149.07	0100	149.07	22	148.55	0100	148.61	2400	148.58
23	149.01	2400	149.07	0100	149.04	23	148.58	2400	148.61	0100	148.61
24	148.95	2400	149.01	0100	148.98	24	148.55	2400	148.58	0100	148.58
25	148.92	2400	148.95	0100	148.92	25	148.52	2400	148.55	0100	148.52
26	148.85	0900	148.92	0100	148.89	26	148.52	0100	148.52	0100	148.52
27	148.82	1500	148.92	0100	148.85	27	148.49	0600	148.52	0100	148.49
28	148.89	0100	148.95	1200	148.92	28	148.49	0600	148.52	2400	148.49
29	148.82	2400	148.92	0100	148.85	29	148.52	0100	148.61	1500	148.58
30	148.76	1200	148.82	0100	148.79	30	148.58	2400	148.61	0100	148.58
31	148.70	2400	148.76	0100	148.73						
MEAN					149.37	MEAN					148.60
SE					0.072	SE					0.012

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL						AUG					
1	148.55	0900	148.58	0100	148.55	1	148.43	0100	148.43	0100	148.43
2	148.55	0100	148.58	1000	148.58	2	148.46	0100	148.46	0100	148.46
3	148.52	2100	148.58	0100	148.55	3	148.46	0100	148.52	1800	148.49
4	148.49	1500	148.52	0100	148.52	4	148.43	1800	148.52	0100	148.47
5	148.49	0100	148.52	1900	148.49	5	148.40	0900	148.43	0100	148.41
6	148.49	0100	148.49	0100	148.49	6	148.40	0100	148.40	0100	148.40
7	148.52	0100	148.58	2400	148.55	7	148.40	0100	148.43	1200	148.42
8	148.61	0100	148.70	2100	148.67	8	148.43	0100	148.46	1000	148.45
9	148.70	0100	148.82	2400	148.73	9	148.46	0100	148.82	1800	148.66
10	148.85	0100	149.07	1200	149.01	10	148.73	1900	148.82	0100	148.77
11	148.79	2000	148.98	2000	148.85	11	148.58	2100	148.73	0100	148.65
12	148.70	0100	148.76	1500	148.73	12	148.52	1800	148.58	0100	148.55
13	148.64	2200	148.79	0700	148.73	13	148.49	0100	148.49	0100	148.49
14	148.55	2200	148.64	0100	148.61	14	148.49	0100	148.55	2400	148.50
15	148.49	2100	148.55	0100	148.52	15	148.58	0100	148.73	1500	148.68
16	148.49	0100	148.49	0100	148.49	16	148.70	0100	148.70	0100	148.70
17	148.49	0100	148.49	0100	148.49	17	148.73	0100	148.79	2100	148.76
18	148.49	0100	148.49	0100	148.49	18	148.79	0100	148.82	1200	148.80
19	148.49	0100	148.49	0100	148.49	19	148.61	2100	148.76	0100	148.68
20	148.49	0100	148.49	0100	148.49	20	148.61	0100	148.85	2400	148.70
21	148.49	0100	148.49	0100	148.49	21	148.82	2000	148.89	0400	148.86
22	148.49	0100	148.49	0100	148.49	22	148.70	2100	148.79	0100	148.74
23	148.43	2400	148.49	0100	148.46	23	148.61	1800	148.70	0100	148.65
24	148.43	0100	148.43	0100	148.43	24	148.58	1300	148.61	0100	148.60
25	148.43	0100	148.43	0100	148.43	25	148.55	0900	148.61	2400	148.57
26	148.43	0100	148.46	0300	148.43	26	148.58	2000	148.61	0100	148.61
27	148.40	2100	148.43	0100	148.43	27	148.58	0100	148.58	0100	148.58
28	148.40	0100	148.40	0100	148.40	28	148.58	0100	148.58	0100	148.58
29	148.40	0100	148.46	2400	148.43	29	148.55	0600	148.58	0100	148.56
30	148.46	0100	148.46	0100	148.46	30	148.52	1800	148.58	0900	148.54
31	148.43	0600	148.46	0100	148.43	31	148.52	0100	148.55	1500	148.53
MEAN					148.55	MEAN					148.59
SE					0.025	SE					0.022

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP.						OCT					
1	148.46	1600	148.52	0100	148.48	1	150.47	2400	150.71	0100	150.56
2	148.43	0600	148.46	0100	148.44	2	150.47	0100	150.56	2400	150.51
3	148.43	0100	148.49	1800	148.46	3	150.56	0100	150.78	1600	150.71
4	148.49	0100	148.49	0100	148.49	4	150.74	0100	150.74	0100	150.74
5	148.49	0100	148.49	0100	148.49	5	150.56	2400	150.74	0100	150.66
6	148.49	0100	148.49	0100	148.49	6	150.29	2400	150.53	0100	150.40
7	148.49	0100	148.49	0100	148.49	7	150.14	2400	150.29	0100	150.20
8	148.43	1800	148.49	0100	148.46	8	149.95	2400	150.14	0100	150.03
9	148.43	0100	148.43	0100	148.43	9	149.89	1200	149.95	0100	149.90
10	148.40	0700	148.43	0100	148.41	10	149.89	0100	150.01	2400	149.93
11	148.37	1000	148.40	0100	148.38	11	150.01	0100	150.38	2000	150.25
12	148.37	0100	148.37	0100	148.37	12	150.20	2400	150.35	0100	150.30
13	148.37	0100	148.37	0100	148.37	13	149.98	2400	150.20	0100	150.07
14	148.37	0100	148.37	0100	148.37	14	149.83	1800	149.98	0100	149.88
15	148.34	1000	148.37	0100	148.35	15	149.89	0100	150.44	2400	150.11
16	148.34	0100	149.13	2400	148.61	16	150.38	1300	150.65	2400	150.45
17	149.04	1900	149.16	0200	149.09	17	150.68	0100	152.33	2400	151.51
18	149.07	0100	150.26	2400	149.73	18	152.39	0100	153.06	1700	152.88
19	150.10	2400	150.26	0100	150.20	19	152.63	2200	153.03	0100	152.79
20	150.07	0100	150.68	2400	150.23	20	152.63	0100	152.88	1900	152.76
21	150.74	0100	151.38	2400	151.05	21	152.42	2400	152.85	0100	152.70
22	151.38	2400	151.54	1000	151.47	22	151.60	2400	152.39	0100	151.99
23	151.11	2400	151.38	0100	151.25	23	151.02	2300	151.57	0100	151.26
24	150.74	2400	151.11	0100	150.95	24	150.68	2400	150.99	0100	150.84
25	150.68	1000	151.38	2400	150.84	25	150.44	2300	150.68	0100	150.56
26	151.48	0100	153.15	2400	152.49	26	150.26	2400	150.44	0100	150.35
27	152.39	2400	153.18	0100	152.81	27	150.10	2400	150.26	0100	150.19
28	151.78	2400	152.39	0100	152.13	28	149.92	2300	150.10	0100	150.02
29	151.20	2400	151.78	0100	151.47	29	149.71	2400	149.92	0100	149.81
30	150.74	2400	151.20	0100	150.96	30	149.59	2200	149.71	0100	149.64
						31	149.50	2200	149.59	0100	149.56
MEAN					149.66	MEAN					150.70
SE					0.272	SE					0.174
NOV						DEC					
1	149.43	1900	149.50	0100	149.46	1	149.56	0100	150.17	2400	149.77
2	149.34	1900	149.43	0100	149.38	2	150.23	0100	151.08	2400	150.76
3	149.28	1900	149.34	0100	149.31	3	151.05	2000	151.11	0100	151.09
4	149.25	1100	149.28	0100	149.26	4	150.84	2300	151.05	0100	150.95
5	149.19	1200	149.53	2400	149.23	5	150.56	2300	150.84	0100	150.68
6	149.71	0100	150.47	1500	150.33	6	150.32	2300	150.56	0100	150.43
7	149.98	2100	150.38	0100	150.12	7	150.17	2100	150.32	0100	150.24
8	149.98	0100	150.99	2400	150.31	8	149.98	2100	150.17	0100	150.07
9	151.08	0100	151.72	1600	151.56	9	149.92	1400	149.98	0100	149.95
10	151.14	2100	151.63	0100	151.33	10	149.83	1600	150.01	0400	149.93
11	151.14	0100	151.87	2400	151.45	11	149.74	1800	149.89	0100	149.82
12	151.90	0100	152.24	1300	152.12	12	149.40	1600	149.74	0100	149.57
13	151.35	2400	151.96	0100	151.63	13	149.34	1300	149.77	1800	149.47
14	150.93	2300	151.35	0100	151.14	14	149.40	0400	149.68	2000	149.47
15	150.53	2200	150.90	0100	150.69	15	149.71	0100	151.81	2400	150.75
16	150.29	2200	150.53	0100	150.39	16	151.90	0100	152.42	1100	152.28
17	150.17	2400	150.29	0100	150.21	17	151.63	2400	152.24	0100	151.92
18	150.10	1000	150.17	0100	150.14	18	151.23	2300	151.63	0100	151.40
19	150.17	0100	150.26	1200	150.21	19	151.14	0900	151.20	0100	151.16
20	150.04	2200	150.17	0100	150.10	20	150.96	2400	151.20	0300	151.11
21	149.92	2100	150.04	0100	149.98	21	150.84	1100	150.93	0100	150.88
22	149.83	2000	149.92	0100	149.87	22	150.68	2300	150.84	0100	150.78
23	149.74	2100	149.83	0100	149.78	23	150.50	2300	150.68	0100	150.59
24	149.71	1200	149.74	0100	149.72	24	150.29	2200	150.50	0100	150.39
25	149.62	2000	149.71	0100	149.66	25	150.26	0300	150.41	2400	150.30
26	149.62	0100	149.65	0300	149.65	26	150.44	0100	150.68	2400	150.59
27	149.62	0900	149.65	0100	149.63	27	150.29	2400	150.68	0100	150.51
28	149.62	0100	149.62	0100	149.62	28	150.17	1800	150.32	0800	150.24
29	149.56	1500	149.59	0100	149.58	29	149.89	1700	150.17	0100	150.00
30	149.53	1500	149.56	0100	149.55	30	149.68	1800	149.89	0100	149.77
						31	149.62	1800	149.68	0100	149.65
MEAN					150.18	MEAN					150.47
SE					0.144	SE					0.124

Table A-4. Daily flow (m^3/s) of the Susquehanna River at Ichthyological Associates Laboratory, 1977.

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	156	296	1536	2102	542	129	92	67	77	978	387	527
2	164	296	1279	1989	470	114	99	73	69	945	354	1113
3	156	274	939	2160	430	106	92	79	73	1078	326	1354
4	147	274	827	1826	387	99	86	75	79	1099	307	1249
5	164	263	1512	1488	387	92	79	63	79	1044	296	1058
6	164	263	1962	1301	527	99	79	61	79	876	833	894
7	156	274	1773	1148	756	106	92	65	79	756	710	779
8	182	274	1370	997	602	106	121	71	73	661	821	682
9	164	263	1058	863	498	106	137	119	67	592	1738	618
10	156	253	920	739	470	121	219	147	63	608	1544	608
11	222	242	958	618	498	145	170	116	57	785	1644	552
12	232	242	1279	572	557	137	137	92	55	815	2257	434
13	213	253	1488	527	527	129	137	79	55	682	1799	391
14	182	285	2594	484	498	121	106	81	55	582	1393	391
15	182	342	3137	430	457	121	86	124	51	705	1064	1106
16	203	434	2722	387	404	106	79	129	106	907	869	2418
17	222	434	2377	350	362	92	79	145	246	1695	762	2064
18	263	378	1853	326	314	86	79	156	508	3068	721	1602
19	285	354	1416	303	281	99	79	124	756	2966	762	1408
20	232	342	1127	270	259	92	79	129	773	2932	699	1370
21	242	318	978	259	239	92	79	173	1324	2865	634	1198
22	253	296	997	239	239	99	79	139	1661	2131	577	1127
23	263	285	1393	219	229	106	73	116	1480	1488	532	997
24	318	253	1370	292	209	99	67	104	1249	1169	503	869
25	318	547	1127	971	191	86	67	97	1169	978	475	815
26	307	1416	920	1512	182	86	67	106	2637	845	470	997
27	296	1169	809	1393	170	79	67	99	2988	750	461	945
28	307	1301	827	1099	191	79	61	99	2267	655	457	779
29	296		1169	827	170	99	67	95	1661	547	439	645
30	307		2017	650	153	99	73	90	1256	466	425	527
31	307		2160		137		67	88		430		470
MEAN	228	415	1480	878	366	104	93	103	703	1164	809	967
SE	10.8	60.5	109.6	109.6	29.0	3.0	6.3	5.3	158.0	141.2	94.5	85.0

Table A-5. Physicochemical data collected at SSES-A on the Susquehanna River, January, February, and March 1977.

DATE	14 JAN	27 JAN		
TIME	1230	1330		
RIVER LEVEL(M ABOVE MSL)	148.93	149.26		
DISCHARGE(M3/S)	194	307		
TEMPERATURE(C)				
AIR	-2.0	-3.0		
WATER	0.0	0.0		
WEATHER	OVERCAST	SUNNY	MEAN	SE
TURBIDITY(NTU)	12	8.0	10	1.6
OXYGEN				
DISSOLVED(MG/L)	13.32	12.10	12.71	0.498
PERCENT SATURATION	91	82	87	3.7
ALKALINITY(MG/L)	69	68	69	0.4
PH	7.3	7.2	7.3	0.04
SPECIFIC CONDUCTANCE				
AT 25 C(UMHOS/CM)	395	370	383	10.2
SULFATE(MG/L)	82	71	77	4.5
IRON(MG/L)				
TOTAL	3.20	2.72	2.96	0.196
DISSOLVED	0.04	0.05	0.05	0.004
PERCENT DISSOLVED	1	2	2	0.4
RESIDUE(MG/L)				
TOTAL	257	236	247	8.6
FIXED TOTAL	184	186	185	0.8
NONFILTRABLE	11	10	11	0.4
FIXED NONFILTRABLE	8	7	8	0.4

DATE	16 FEB	28 FEB		
TIME	1240	1315		
RIVER LEVEL(M ABOVE MSL)	149.53	151.05		
DISCHARGE(M3/S)	417	1320		
TEMPERATURE(C)				
AIR	-2.0	5.0		
WATER	0.0	1.0		
WEATHER	P.CLOUDY	P.CLOUDY	MEAN	SE
SECCHI DISC(CM)	--	8	8	--
TURBIDITY(NTU)	6.4	77	42	28.8
OXYGEN				
DISSOLVED(MG/L)	12.20	12.70	12.45	0.204
PERCENT SATURATION	84	89	87	2.0
ALKALINITY(MG/L)	66	26	46	16.3
PH	7.4	7.2	7.3	0.08
SPECIFIC CONDUCTANCE				
AT 25 C(UMHOS/CM)	420	143	282	113.1
SULFATE(MG/L)	78	21	50	23.3
IRON(MG/L)				
TOTAL	2.24[a]	2.08	2.16	0.057
DISSOLVED	0.12	0.08	0.10	0.016
PERCENT DISSOLVED	5	4	5	0.5
RESIDUE(MG/L)				
TOTAL	252	220	236	13.1
FIXED TOTAL	194	184	189	4.1
NONFILTRABLE	8	121	65	46.1
FIXED NONFILTRABLE	6	112	59	43.3

DATE	15 MAR	30 MAR		
TIME	1330	1340		
RIVER LEVEL(M ABOVE MSL)	152.00	151.96		
DISCHARGE(M3/S)	3140	2100		
TEMPERATURE(C)				
AIR	12.0	21.0		
WATER	6.0	7.0		
WEATHER	SUNNY	SUNNY	MEAN	SE
SECCHI DISC(CM)	8	16	12	3.3
TURBIDITY(NTU)	270	60	165	85.7
OXYGEN				
DISSOLVED(MG/L)	11.40	13.45	12.43	0.837
PERCENT SATURATION	91	110	101	7.8
ALKALINITY(MG/L)	20	24	22	1.6
PH	7.2	7.3	7.3	0.04
SPECIFIC CONDUCTANCE				
AT 25 C(UMHOS/CM)	95	122	109	11.0
SULFATE(MG/L)	21	74	48	21.6
IRON(MG/L)				
TOTAL	5.38	4.56	4.97	0.335
DISSOLVED	0.07	0.04	0.06	0.012
PERCENT DISSOLVED	1	1	1	0.0
RESIDUE(MG/L)				
TOTAL	526	230	378	120.8
FIXED TOTAL	480	198	339	115.1
NONFILTRABLE	497	163	330	136.4
FIXED NONFILTRABLE	442	151	297	118.8

[a]Mean of 3 quality control cross-check values. Our determination (15.3 mg/l) was not used because of suspected contamination during sample collection.

Table A-6. Physicochemical data collected at SSES-A on the Susquehanna River, April, May, and June 1977.

DATE	6 APR	8 APR	12 APR	15 APR	19 APR	21 APR	26 APR	28 APR		
TIME	1315	1200	1330	1350	1315	1350	1340	1330		
RIVER LEVEL(M ABOVE MSL)	151.02	150.59	149.83	149.56	149.02	149.13	151.35	150.71		
DISCHARGE(M3/S)	1300	997	557	430	222	259	1560	1080		
TEMPERATURE(C)										
AIR	5.5	6.0	22.0	14.0	18.0	24.0	15.0	18.0		
WATER	5.5	5.0	9.5	13.0	14.5	16.0	13.0	12.0		
WEATHER	P.CLOUDY	SUNNY	SUNNY	SUNNY	OVERCAST	SUNNY	P.CLOUDY	OVERCAST	MEAN	SE
SECCHI DISC(CM)	28	89	111	111	89	78	19	33	70	12.5
TURBIDITY(NTU)	26	14	11	12	17	18	44	24	21	3.6
OXYGEN										
DISSOLVED(MG/L)	13.05	13.60	12.90	11.30	13.55	14.95	10.85	11.45	12.71	0.467
PERCENT SATURATION	103	107	114	107	132	151	102	106	115	5.8
ALKALINITY(MG/L)	30	34	39	46	53	56	38	28	41	3.4
PH	7.3	7.3	7.2	7.3	7.4	7.8	7.5	7.3	7.4	0.06
SPECIFIC CONDUCTANCE										
AT 25 C(µMHOS/CM)	134	150	200	231	254	294	161	119	193	20.8
SULFATE(MG/L)	16	39	52	67	69	76	21	27	46	7.8
IRON(MG/L)										
TOTAL	2.63	1.86	1.98	2.23	2.74	2.77	3.78	2.17	2.52	0.205
DISSOLVED	0.39	0.53	0.54	0.16	0.05	0.03	0.11	0.24	0.26	0.069
PERCENT DISSOLVED	15	28	27	7	2	1	3	11	12	3.6
RESIDUE(MG/L)										
TOTAL	140	127	143	164	184	199	202	128	161	10.3
FIXED TOTAL	108	100	78	122	146	146	161	102	120	9.5
NONFILTRABLE	45	22	14	16	21	24	100	38	35	9.4
FIXED NONFILTRABLE	37	21	11	14	14	18	92	34	30	8.9

DATE	3 MAY	6 MAY	10 MAY	13 MAY	17 MAY	19 MAY	24 MAY	26 MAY	31 MAY		
TIME	1335	1335	1355	1315	1355	1355	1350	1325	1340		
RIVER LEVEL(M ABOVE MSL)	149.56	149.80	149.62	149.77	149.40	149.19	148.95	148.85	148.73		
DISCHARGE(M3/S)	430	542	457	527	362	281	200	170	137		
TEMPERATURE(C)											
AIR	17.0	25.0	16.0	23.0	24.0	29.0	25.0	23.5	21.0		
WATER	10.0	16.0	13.0	15.0	17.0	20.0	24.0	25.0	22.0		
WEATHER	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY	SUNNY	P.CLOUDY	P.CLOUDY	SUNNY	OVERCAST	MEAN	SE
SECCHI DISC(CM)	128	128	118	130	138	103	97	94	80	113	6.3
TURBIDITY(NTU)	8.1	10	9.3	7.8	8.7	11	11	9.6	13	9.8	0.5
OXYGEN											
DISSOLVED(MG/L)	10.60	10.70	10.40	11.20	12.20	11.00	10.40	11.60	9.60	10.86	0.240
PERCENT SATURATION	95	106	97	109	126	131	124	138	110	115	4.8
ALKALINITY(MG/L)	40	46	45	40	48	50	58	58	66	50	2.8
PH	7.4	7.4	7.4	7.5	7.9	7.8	7.8	7.8	7.6	7.6	0.06
SPECIFIC CONDUCTANCE											
AT 25 C(µMHOS/CM)	200	216	191	198	211	225	289	300	339	241	17.0
SULFATE(MG/L)	55	48	48	113	54	80	44	66	162	74	12.4
IRON(MG/L)											
TOTAL	1.62	1.78	1.64	1.36	1.48	1.61	1.62	1.68	1.98	1.64	0.055
DISSOLVED	0.70	0.11	0.58	0.21	0.05	0.05	0.02	0.05	0.03	0.20	0.082
PERCENT DISSOLVED	43	6	35	15	3	3	1	3	2	12	5.0
RESIDUE(MG/L)											
TOTAL	133	123	116	135	144	148	180	190	220	154	11.0
FIXED TOTAL	100	104	96	103	100	106	133	138	154	115	6.6
NONFILTRABLE	12	16	17	12	10	12	16	13	14	14	0.7
FIXED NONFILTRABLE	8	12	12	8	8	8	10	8	8	9	0.6

DATE	3 JUN	7 JUN	10 JUN	14 JUN	17 JUN	21 JUN	24 JUN	28 JUN		
TIME	1345	1340	1340	1345	1350	1340	1325	1330		
RIVER LEVEL(M ABOVE MSL)	148.58	148.61	148.64	148.64	148.55	148.55	148.55	148.49		
DISCHARGE(M3/S)	99	106	114	114	92	92	92	79		
TEMPERATURE(C)										
AIR	16.0	18.0	16.0	18.0	26.0	21.0	23.0	23.0		
WATER	22.0	20.0	18.0	20.0	23.0	24.0	24.0	24.0		
WEATHER	SUNNY	OVERCAST	LT.RAIN	LT.RAIN	P.CLOUDY	P.CLOUDY	P.CLOUDY	OVERCAST	MEAN	SE
SECCHI DISC(CM)	86	78	73	44	34	46	40	45	56	6.6
TURBIDITY(NTU)	13	16	18	13	14	14	13	13	14	0.6
OXYGEN										
DISSOLVED(MG/L)	10.25	9.20	8.80	10.95	12.00	8.90	9.50	8.20	9.73	0.421
PERCENT SATURATION	117	99	93	116	139	105	113	97	110	4.9
ALKALINITY(MG/L)	66	68	66	64	68	60	65	60	65	1.1
PH	7.7	7.5	7.4	7.8	8.1	7.6	7.7	7.2	7.6	0.09
SPECIFIC CONDUCTANCE										
AT 25 C(µMHOS/CM)	353	391	376	344	378	382	390	400	377	6.4
SULFATE(MG/L)	89	93	95	78	90	77	75	105	88	3.5
IRON(MG/L)										
TOTAL	2.05	2.56	2.97	2.08	2.18	2.38	2.36	2.64	2.40	0.104
DISSOLVED	0.04	0.02	0.04	0.06	0.10	0.03	0.05	0.14	0.06	0.013
PERCENT DISSOLVED	2	1	1	3	5	1	2	5	3	0.6
RESIDUE(MG/L)										
TOTAL	232	260	274	255	262	274	261	277	262	4.8
FIXED TOTAL	164	186	194	166	200	204	187	206	188	5.4
NONFILTRABLE	14	14	13	16	20	14	14	15	15	0.7
FIXED NONFILTRABLE	8	10	10	9	10	8	7	7	9	0.4

Table A-7. Physicochemical data collected at SSES-A on the Susquehanna River, July, August, and September 1977.

DATE	1 JUL	5 JUL	8 JUL	12 JUL	15 JUL	19 JUL	22 JUL	26 JUL	29 JUL		
TIME	1345	1345	1330	1330	1330	1345	1315	1315	1315		
RIVER LEVEL(M ABOVE MSL)	148.55	148.49	148.64	148.73	148.52	148.49	148.52	148.46	148.43		
DISCHARGE(M3/S)	92	79	114	137	86	79	86	73	67		
TEMPERATURE(C)											
AIR	24.0	29.5	29.0	29.0	29.0	29.0	19.0	20.0	23.0		
WATER	25.0	25.0	24.0	24.5	26.0	29.0	27.5	25.0	24.0		
WEATHER	P.CLOUDY	OVERCAST	P.CLOUDY	OVERCAST	P.CLOUDY	SUNNY	SUNNY	SUNNY	OVERCAST	MEAN	SE
SECCHI DISC(CM)	44	40	42	40	35	30	35	40	30	37	1.6
TURBIDITY(NTU)	11	12	13	11	15	12	10	9.0	15	12	0.7
OXYGEN											
DISSOLVED(MG/L)	9.10	9.20	7.05	9.00	9.00	11.55	8.60	9.30	12.00	9.42	0.474
PERCENT SATURATION	108	110	83	107	111	149	108	111	142	114	6.2
ALKALINITY(MG/L)	66	68	62	68	54	60	58	60	57	61	1.6
PH	7.6	7.7	7.4	7.7	7.5	8.1	7.7	7.6	7.7	7.7	0.06
SPECIFIC CONDUCTANCE											
AT 25 C(µMHOS/CM)	385	412	385	355	345	400	400	435	445	396	10.5
SULFATE(MG/L)	91	123	86	71	77	93	224	107	114	110	14.6
IRON(MG/L)											
TOTAL	2.18	2.08	2.21	1.65	2.73	2.00	1.86	1.56	2.55	2.09	0.121
DISSOLVED	0.03	0.20	0.03	0.13	0.13	0.04	0.03	0.03	0.03	0.07	0.020
PERCENT DISSOLVED	1	10	1	8	5	2	2	2	1	4	1.1
RESIDUE(MG/L)											
TOTAL	276	291	185	241	231	272	269	317	310	266	13.1
FIXED TOTAL	196	210	127	170	173	200	204	226	238	194	10.5
NONFILTRABLE	17	15	15	16	15	16	14	14	22	16	0.8
FIXED NONFILTRABLE	7	7	8	12	12	10	8	12	12	10	0.7

DATE	2 AUG	5 AUG	9 AUG	12 AUG	15 AUG	19 AUG	22 AUG	25 AUG	30 AUG		
TIME	1330	1315	1330	1315	1315	1315	1315	1315	1315		
RIVER LEVEL(M ABOVE MSL)	148.46	148.40	148.40	148.55	148.73	148.67	148.73	148.55	148.55		
DISCHARGE(M3/S)	73	61	61	92	137	121	137	92	92		
TEMPERATURE(C)											
AIR	23.0	32.0	30.5	27.0	27.0	19.0	20.5	22.0	27.0		
WATER	26.0	26.0	27.0	26.0	25.0	23.5	22.5	23.0	25.0		
WEATHER	SUNNY	OVERCAST	P.CLOUDY	OVERCAST	SUNNY	P.CLOUDY	P.CLOUDY	P.CLOUDY	OVERCAST	MEAN	SE
SECCHI DISC(CM)	30	40	35	35	40	40	45	45	50	40	1.9
TURBIDITY(NTU)	13	11	16	11	15	11	10	11	9.0	12	0.7
OXYGEN											
DISSOLVED(MG/L)	12.45	9.40	8.80	8.90	7.80	9.80	9.80	10.70	8.55	9.58	0.432
PERCENT SATURATION	153	116	109	109	94	115	111	124	103	115	5.2
ALKALINITY(MG/L)	66	64	61	72	67	70	66	64	61	66	1.2
PH	7.8	7.6	7.4	7.8	7.4	7.5	7.6	7.4	7.5	7.6	0.05
SPECIFIC CONDUCTANCE											
AT 25 C(µMHOS/CM)	430	420	410	370	375	310	300	338	344	366	14.9
SULFATE(MG/L)	100	93	107	78	86	64	57	78	75	82	5.1
IRON(MG/L)											
TOTAL	2.37	1.96	3.00	2.16	3.05	2.02	1.78	2.13	1.81	2.25	0.150
DISSOLVED	0.02	0.03	0.03	0.04	0.04	0.04	0.03	0.23	0.03	0.05	0.021
PERCENT DISSOLVED	1	2	1	2	1	2	2	11	2	3	1.0
RESIDUE(MG/L)											
TOTAL	300	262	278	244	262	224	221	253	264	256	7.9
FIXED TOTAL	216	200	210	179	196	150	144	171	174	182	8.0
NONFILTRABLE	20	15	22	18	20	18	14	15	12	17	1.0
FIXED NONFILTRABLE	9	6	13	11	11	10	4	4	5	8	1.1

DATE	2 SEP	6 SEP	9 SEP	13 SEP	16 SEP	20 SEP	23 SEP	27 SEP	30 SEP		
TIME	1315	1315	1315	1345	1315	1330	1315	1330	1315		
RIVER LEVEL(M ABOVE MSL)	148.43	148.49	148.43	148.37	148.40	150.23	151.23	152.70	150.96		
DISCHARGE(M3/S)	67	79	67	55	61	773	1460	2860	1260		
TEMPERATURE(C)											
AIR	30.0	27.5	24.5	22.0	19.0	22.0	18.0	21.0	22.0		
WATER	25.5	25.5	24.5	21.0	20.0	19.0	18.0	15.0	15.0		
WEATHER	P.CLOUDY	OVERCAST	P.CLOUDY	OVERCAST	LT.RAIN	OVERCAST	OVERCAST	P.CLOUDY	P.CLOUDY	MEAN	SE
SECCHI DISC(CM)	72	50	50	50	40	28	20	8	25	38	6.2
TURBIDITY(NTU)	7.4	9.0	9.4	9.4	12	31	56	170	30	37	16.6
OXYGEN											
DISSOLVED(MG/L)	9.40	8.20	8.80	9.00	8.70	7.80	8.20	8.90	9.20	8.69	0.165
PERCENT SATURATION	114	99	105	100	96	83	87	87	90	96	3.2
ALKALINITY(MG/L)	68	63	67	67	64	40	31	25	30	51	5.9
PH	7.5	7.5	7.5	7.5	7.4	7.4	7.4	7.3	7.4	7.4	0.02
SPECIFIC CONDUCTANCE											
AT 25 C(µMHOS/CM)	376	380	405	435	440	165	120	105	130	284	46.9
SULFATE(MG/L)	86	86	93	93	100	22	16	20	24	60	11.9
IRON(MG/L)											
TOTAL	1.57	1.80	1.66	1.80	2.26	3.60	5.20	12.90	2.55	3.70	1.152
DISSOLVED	0.03	0.07	0.04	0.02	0.03	0.16	0.24	0.08	0.22	0.10	0.027
PERCENT DISSOLVED	2	4	2	1	1	4	5	1	9	3	0.8
RESIDUE(MG/L)											
TOTAL	268	260	280	294	311	184	210	382	146	259	22.5
FIXED TOTAL	187	191	184	222	235	135	170	338	114	197	20.5
NONFILTRABLE	10	14	12	13	20	76	124	298	54	69	29.8
FIXED NONFILTRABLE	6	8	6	6	11	69	112	249	41	56	25.6

Table A-8. Physicochemical data collected at SSES-A on the Susquehanna River, October, November, and December 1977.

DATE	12 OCT	27 OCT		
TIME	1315	1330		
RIVER LEVEL(M ABOVE MSL)	150.29	150.20		
DISCHARGE(M3/S)	809	756		
TEMPERATURE(C)				
AIR	14.0	18.0		
WATER	12.0	11.0		
WEATHER	P.CLOUDY	SUNNY	MEAN	SE
SECCHI DISC(CM)	40	94	67	22.0
TURBIDITY(NTU)	17	6.8	12	4.2
OXYGEN				
DISSOLVED(MG/L)	9.90	10.40	10.15	0.204
PERCENT SATURATION	92	94	93	0.8
ALKALINITY(MG/L)	47	37	42	4.1
PH	7.3	7.2	7.3	0.04
SPECIFIC CONDUCTANCE				
AT 25 C(µMHOS/CM)	180	182	181	0.8
SULFATE(MG/L)	25	36	31	4.5
IRON(MG/L)				
TOTAL	7.70	1.51	4.61	2.527
DISSOLVED	0.25	0.62	0.44	0.151
PERCENT DISSOLVED	3	41	22	15.5
RESIDUE(MG/L)				
TOTAL	149	116	133	13.5
FIXED TOTAL	118	77	98	16.7
NONFILTRABLE	37	12	25	10.2
FIXED NONFILTRABLE	30	8	19	9.0

DATE	9 NOV	17 NOV		
TIME	1315	1230		
RIVER LEVEL(M ABOVE MSL)	151.69	150.20		
DISCHARGE(M3/S)	1853	756		
TEMPERATURE(C)				
AIR	13.5	11.0		
WATER	12.0	7.5		
WEATHER	OVERCAST	P.CLOUDY	MEAN	SE
SECCHI DISC(CM)	15	90	53	30.6
TURBIDITY(NTU)	84	7.8	46	31.1
OXYGEN				
DISSOLVED(MG/L)	9.60	11.60	10.60	0.816
PERCENT SATURATION	92	95	94	1.2
ALKALINITY(MG/L)	34	39	37	2.0
PH	7.4	7.2	7.3	0.08
SPECIFIC CONDUCTANCE				
AT 25 C(UMHOS/CM)	132	160	146	11.4
SULFATE(MG/L)	20	31	26	4.5
IRON(MG/L)				
TOTAL	2.07	1.36	1.72	0.290
DISSOLVED	0.09	0.58	0.34	0.200
PERCENT DISSOLVED	4	43	24	15.9
RESIDUE(MG/L)				
TOTAL	304	118	211	75.9
FIXED TOTAL	264	90	177	71.0
NONFILTRABLE	208	12	110	80.0
FIXED NONFILTRABLE	196	8	102	76.8

DATE	5 DEC	16 DEC		
TIME	1300	1230		
RIVER LEVEL(M ABOVE MSL)	150.65	152.39		
DISCHARGE(M3/S)	1037	2530		
TEMPERATURE(C)				
AIR	0.0	7.0		
WATER	4.0	0.5		
WEATHER	SNOW	SUNNY	MEAN	SE
SECCHI DISC(CM)	60	8	34	21.2
TURBIDITY(NTU)	11	110	61	40.4
OXYGEN				
DISSOLVED(MG/L)	12.40	13.15	12.78	0.306
PERCENT SATURATION	94	92	93	0.8
ALKALINITY(MG/L)	42	45	44	1.2
PH	7.2	7.3	7.3	0.04
SPECIFIC CONDUCTANCE				
AT 25 C(UMHOS/CM)	124	130	127	2.4
SULFATE(MG/L)	25	21	23	1.6
IRON(MG/L)				
TOTAL	1.38	10.50	5.94	3.723
DISSOLVED	0.47	0.08	0.28	0.159
PERCENT DISSOLVED	34	1	18	13.5
RESIDUE(MG/L)				
TOTAL	104	382	243	113.5
FIXED TOTAL	81	346	214	108.2
NONFILTRABLE	19	319	169	122.5
FIXED NONFILTRABLE	16	287	152	110.6

Table A-9. Quality control comparison of physicochemical data from water samples collected quarterly at SSES-A on the Susquehanna River, 1977.

Parameter	16 Feb		26 May		25 Aug		17 Nov	
	IA[a]	SRES[b]	IA	SRES	IA	SRES	IA	SRES
Turbidity (NTU)	6.4	6.5	9.6	11	11	--	7.8	7.6
Total Alkalinity (mg/l)	66	68	58	61	64	58	39	43
Specific conductance at 25 C (µmhos/cm)	420	352	300	294	338	357	160	173
Sulfate (mg/l)	78	75.4	66	59.2	78	75.3	31	32.0
Total iron (mg/l)	15.3	2.24	1.68	1.73	2.13	2.00	1.36	1.36
Total residue (mg/l)	252	259	190	209	253	243	118	137
Fixed total residue (mg/l)	194	188	138	136	171	191	90	82
Nonfiltrable residue (mg/l)	8	1	13	10	15	15	12	6

[a]Ichthyological Associates grab sample results (Tables A-5, A-6, A-7, and A-8).

[b]Schuylkill River Ecological Study cross-check results.

Table A-10. Physicochemical data collected monthly at Ichthyological Associates boat ramp on the Susquehanna River, 1977. Samples were collected and analyzed by the Pennsylvania Power and Light Company, Hazleton, Pennsylvania.[a]

Sample Number	164	165	166	167	168	169	170	171	172	173	174
Date	16 Feb	28 Mar	12 Apr	16 May	14 Jun	18 Jul	10 Aug	28 Sep	24 Oct	28 Nov	12 Dec
Time	1425	1445	1440	1419	1453	1428	1445	1400	1452	1445	1400
River temperature (F)	32.0	40.1	50.0	62.2	67.0	85.1	78.8	58.1	46.4	37.4	30.2
Color (Pt-Co units)	16.2	37.8	37.8	14.9	74.3	9.5	10.8	35.1	27.0	39.2	35.1
Turbidity (FTU)	7.7	9.8	11.0	7.5	12.0	8.0	8.2	62.0	9.6	6.7	6.0
pH at 25 C	7.40	7.30	7.30	7.90	7.80	8.65	7.80	7.40	7.30	7.55	7.45
Specific conductance at 25 C (μmhos/cm)	325	180	195	200	325	365	340	125	150	210	215
Analysis (mg/l)											
Suspended matter	7.3	16.2	21.1	12.9	20.0	9.9	8.4	127.6	11.8	10.5	6.1
Ammonia nitrogen (as N)	0.81	0.37	0.21	0.12	0.32	0.28	0.11	0.20	0.13	0.24	0.34
Nitrate nitrogen (as N)	1.58	0.81	0.87	0.37	0.67	0.40	0.59	0.56	0.52	0.84	0.89
Phenolphthalein alkalinity (as $CaCO_3$)	--	--	--	--	--	5	--	--	--	--	--
Methyl orange alkalinity (as $CaCO_3$)	68	35	40	47	63	57	70	29	37	52	47
Hardness (as $CaCO_3$)	121.5	67.0	77.5	80.5	131.5	148.1	131.0	47.1	62.2	88.5	84.0
Total dissolved solids at 103 C.	199.2	110.6	121.8	123.4	208.4	249.2	220.8	85.6	100.6	134.2	131.6
Loss on ignition	63.6	36.8	36.8	38.0	61.2	68.8	70.4	27.6	34.6	39.6	32.4
Silicon dioxide (SiO_2)	2.80	4.63	4.17	0.91	0.91	0.46	1.94	5.54	5.82	4.97	5.37
Calcium (Ca)	38.8	20.4	23.2	61.0	38.8	40.0	36.6	14.4	18.8	26.2	24.7
Magnesium (Mg)	6.0	3.9	4.7	19.5	8.4	11.7	9.6	2.7	3.7	5.6	5.4
Sodium (Na)	14.7	7.1	6.1	6.5	11.4	13.6	15.0	4.8	4.3	6.7	6.8
Potassium (K)	2.0	1.5	1.4	1.5	0.5	2.6	2.3	2.2	1.7	2.25	1.70
Carbonate (CO_3)	--	--	--	--	--	6.0	--	--	--	--	--
Bicarbonate (HCO_3)	83.0	42.7	48.8	57.3	76.9	57.3	85.4	35.4	45.1	63.4	57.3
Sulfate (SO_4)	46.0	28.1	34.7	31.3	63.6	92.5	54.0	20.5	25.0	33.0	38.4
Chloride (Cl)	21.8	9.7	7.9	8.5	16.4	17.0	21.8	5.5	4.8	8.5	9.7
Nitrate (NO_3)	7.00	3.60	3.86	1.64	2.96	1.76	2.64	2.48	2.30	3.72	3.94
Phosphate (PO_4)	0.31	0.18	0.15	0.13	0.16	0.23	0.28	0.43	0.18	0.05	0.06
Total mineral solids	222.4	121.6	134.9	136.8	220.1	243.1	229.6	93.9	111.8	154.3	153.4
Dissolved oxygen (O_2)	13.2	12.1	11.4	10.8	11.0	12.8	8.6	9.1	11.4	13.0	15+
Ion Analysis (me/l)											
Positive ions											
Calcium (Ca)	1.94	1.02	1.16	1.22	1.94	2.00	1.83	0.72	0.94	1.31	1.23
Magnesium (Mg)	0.49	0.32	0.39	0.39	0.69	0.96	0.79	0.22	0.30	0.46	0.44
Sodium (Na)	0.64	0.31	0.27	0.28	0.49	0.59	0.65	0.21	0.19	0.29	0.30
Potassium (K)	0.05	0.04	0.04	0.04	0.01	0.07	0.06	0.06	0.04	0.06	0.04
Total	3.12	1.69	1.86	1.93	3.13	3.62	3.33	1.21	1.47	2.12	2.01
Negative ions											
Carbonate (CO_3)	--	--	--	--	--	0.20	--	--	--	--	--
Bicarbonate (HCO_3)	1.36	0.70	0.80	0.94	1.26	0.94	1.40	0.58	0.74	1.04	0.94
Sulfate (SO_4)	0.96	0.58	0.72	0.65	1.32	1.92	1.12	0.43	0.52	0.69	0.80
Chloride (Cl)	0.61	0.27	0.22	0.24	0.46	0.48	0.61	0.15	0.14	0.24	0.27
Nitrate (NO_3)	0.11	0.06	0.06	0.03	0.05	0.03	0.04	0.04	0.04	0.06	0.06
Phosphate (PO_4)	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00
Total	3.05	1.62	1.80	1.86	3.09	3.58	3.18	1.21	1.45	2.03	2.07
Trace Metal Analysis (mg/l)											
Iron (Fe), total	2.08	1.40	1.64	1.96	1.54	1.09	1.42	3.58	1.18	1.55	1.38
Iron (Fe), dissolved	0.58	0.67	0.60	0.07	0.03	0.02	0.02	0.23	0.38	0.68	0.71
Aluminum (Al), total	0.35	0.73	0.50	0.87	0.45	0.45	0.42	2.1	0.4	0.2	0.2
Aluminum (Al), dissolved	0.03	0.10	0.09	0.02	0.12	0.24	0.07	0.3	0.0	0.1	0.05
Manganese (Mn), total	0.33	0.17	0.20	0.23	0.40	0.30	0.31	0.21	0.13	0.24	0.25
Manganese (Mn), dissolved	0.00	0.15	0.03	0.01	0.27	0.14	0.16	0.05	0.13	0.26	0.25
Copper (Cu), total	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01
Copper (Cu), dissolved	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01
Zinc (Zn), total	0.00	0.01	0.02	0.04	0.03	0.10	0.01	0.04	0.01	0.01	0.04
Zinc (Zn), dissolved	0.00	0.00	0.01	0.01	trace	0.01	0.01	0.02	0.01	0.03	0.02
Nickel (Ni), total	--	--	--	--	--	0.04	0.03	0.02	0.00	0.01	0.02
Nickel (Ni), dissolved	--	--	--	--	--	0.04	0.02	0.00	0.00	0.01	0.02

[a]No sample was collected in January because ice covered the sampling location.

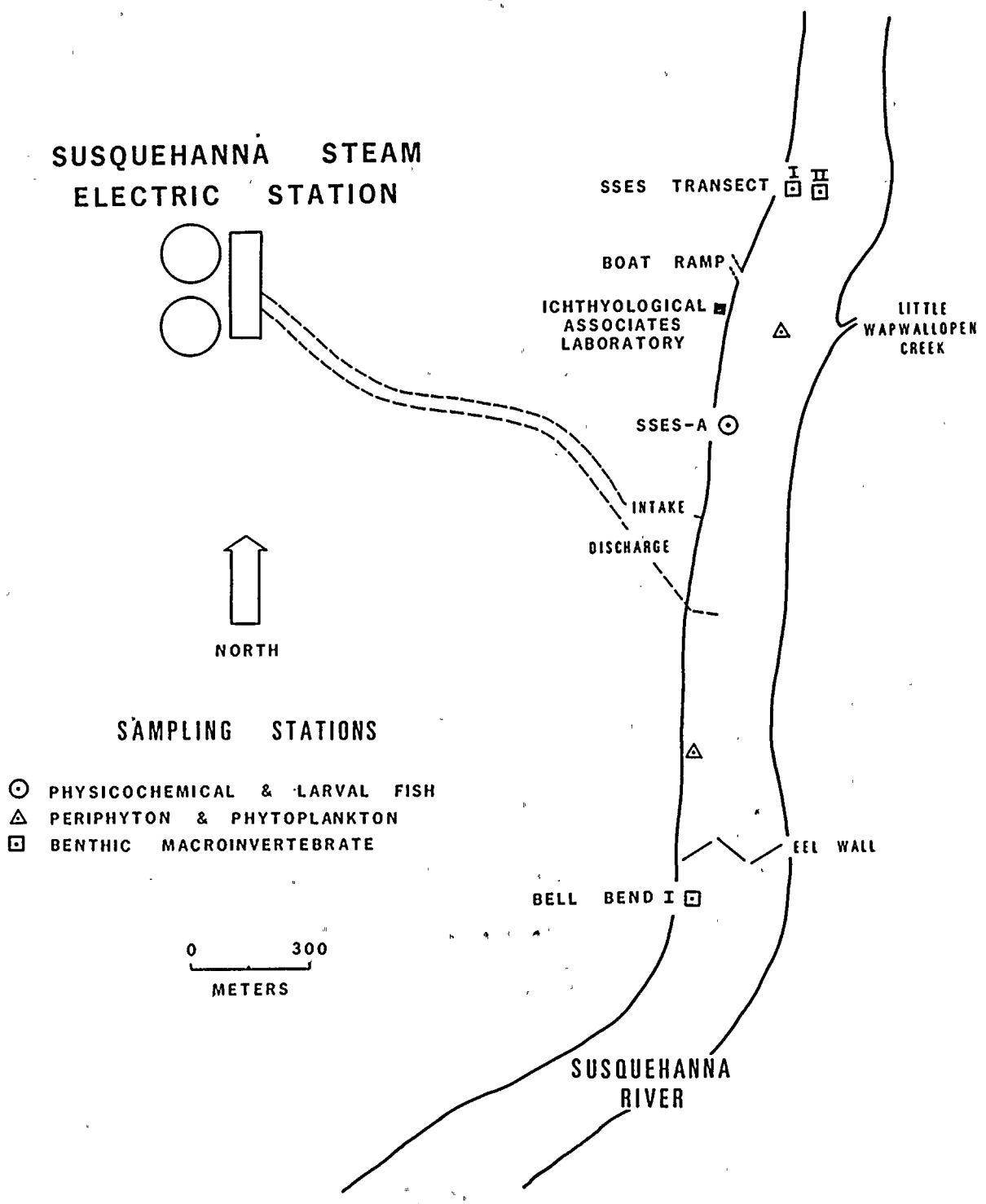

Fig. A-1. Sampling stations on the Susquehanna River near the Susquehanna SES, 1977.

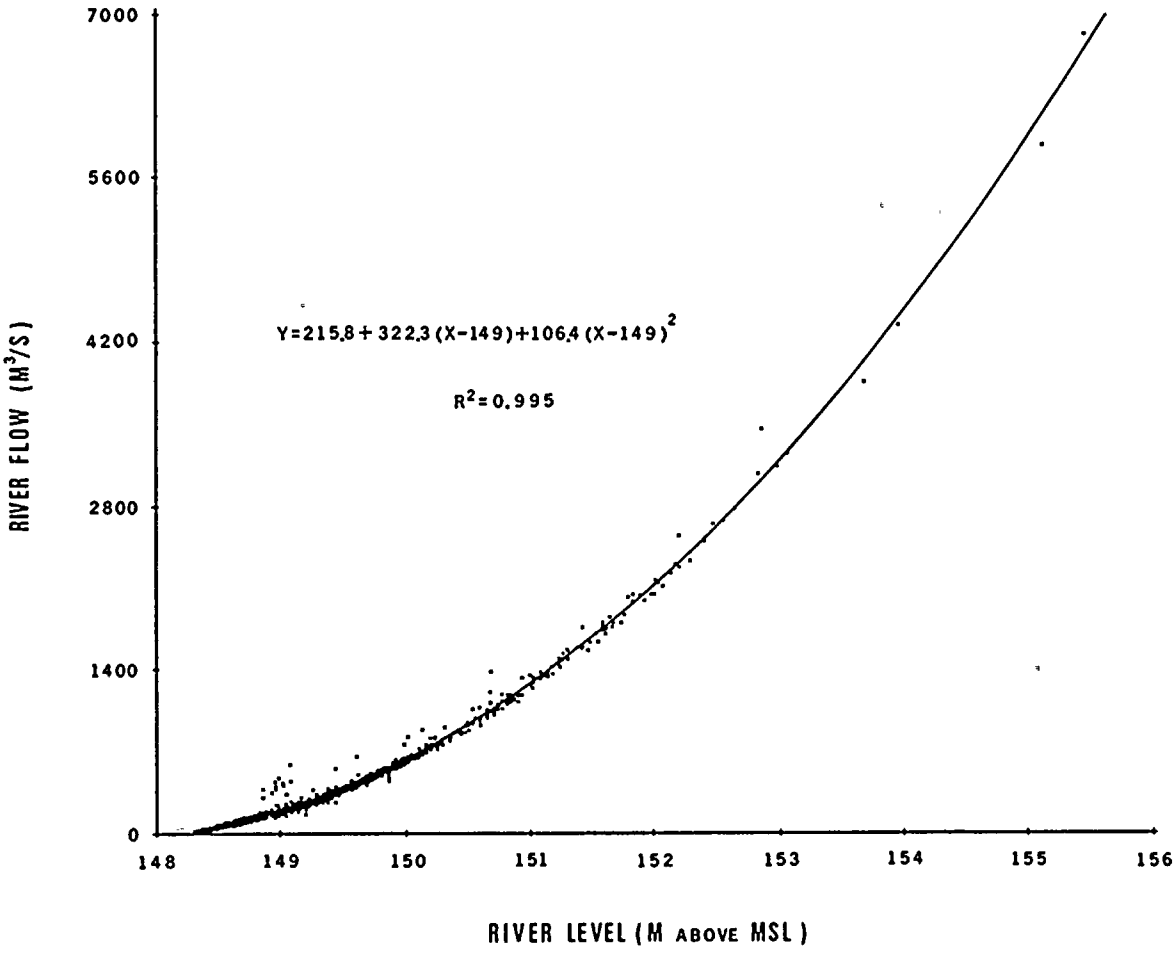

Fig. A-2. The relationship between flow (m^3/s) and level (m above msl) of the Susquehanna River at Ichthyological Associates Laboratory from July 1973 through December 1976.

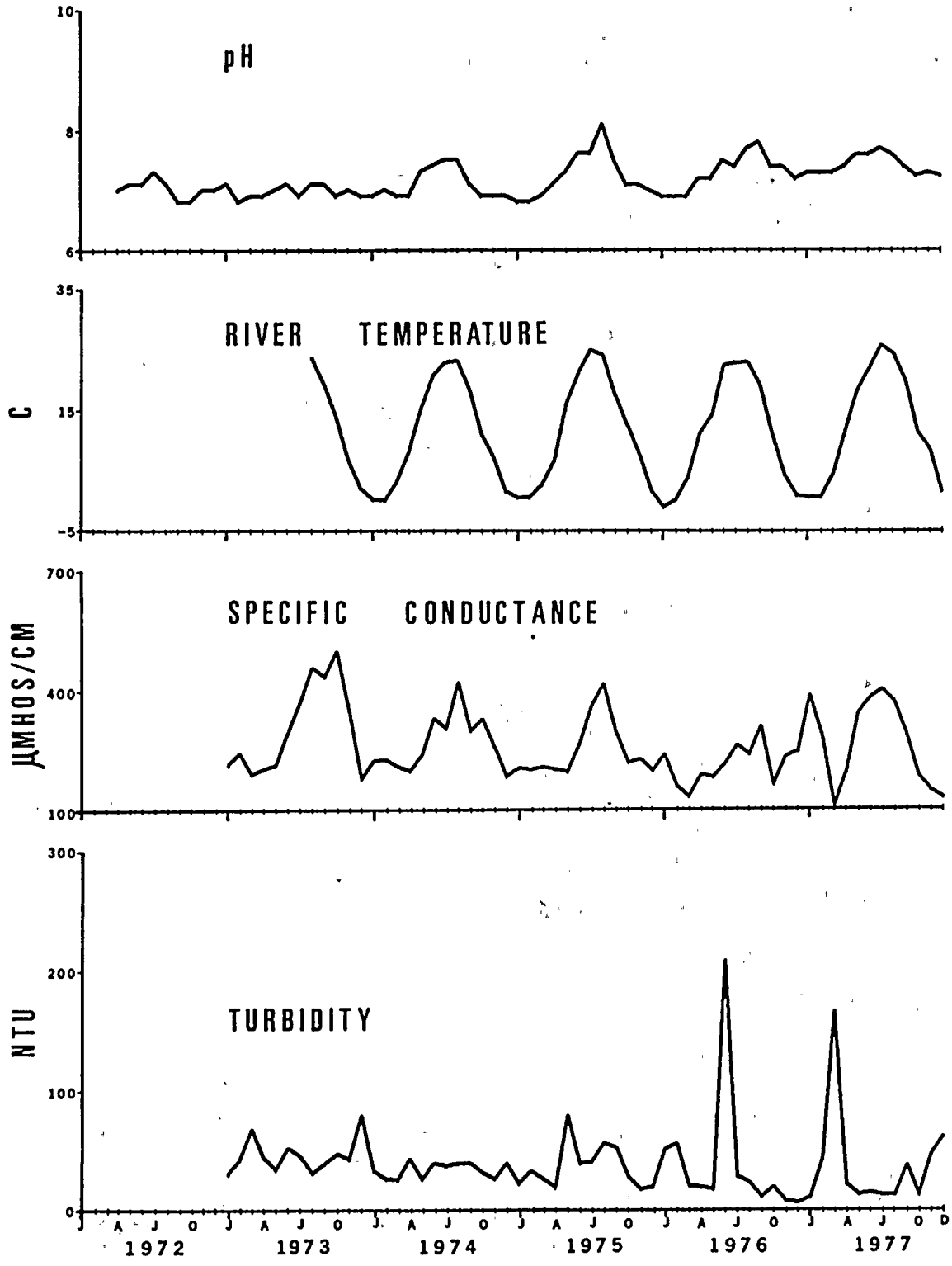

Fig. A-3. Trends in monthly mean values of pH, River temperature, specific conductance, and turbidity in the Susquehanna River near the Susquehanna SES from 1972 through 1977.

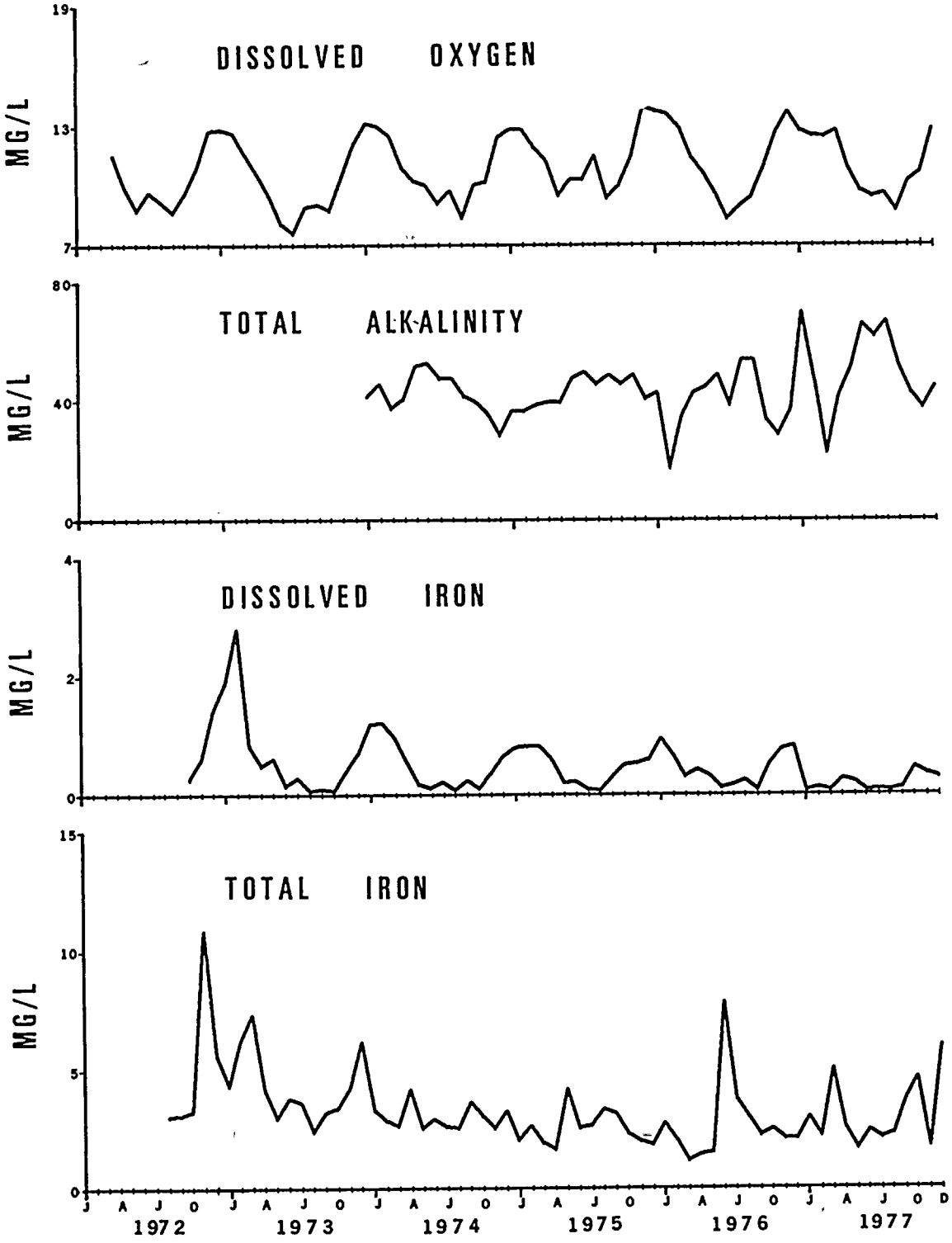

Fig. A-4. Trends in monthly mean concentrations of dissolved oxygen, total alkalinity, dissolved iron, and total iron in the Susquehanna River near the Susquehanna SES from 1972 through 1977.

ALGAE

by

Andrew J. Gurzynski and William F. Gale

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ABSTRACT

Periphyton and phytoplankton samples were collected upriver from the Susquehanna SES intake structure and downriver from the discharge diffuser throughout 1977. Diatoms composed 63% of the algae collected and were most abundant in April (phytoplankton) and June (periphyton). Green algae were second in abundance. Standing crops of algae peaked in April (29,321,000 phytoplankton units/liter) and in June (2,855 periphyton units/mm^2 on bimonthly plates). Standing crops of algae were extremely low in winter and colonization rates of periphyton averaged only 61 and 190 units/mm^2/month in October and December on bimonthly and cumulative plates, respectively. At both stations there was an average of 106,900 and 128,100 phytoplankton units/liter in October and December, respectively.

INTRODUCTION

Numbers of algae in periphyton samples from Susquehanna River stones varied widely in 1973 (Ichthyological Associates 1974) and subsequently, artificial substrates were used to reduce sample variability. The artificial substrates provided a more homogeneous surface than River stones for algae to colonize. Five kinds of substrates were tested in 1974 and frosted acrylic was found to be the most desirable (Gale and Gurzynski 1976).

The primary objective in the 1977 study was to describe seasonal changes in the periphyton community colonizing frosted (sandblasted) acrylic plates at two stations near the Susquehanna SES (Fig. A-1). One station was 463 m upriver from the Susquehanna SES intake structure, 135 m from the west bank; the other was 397 m downriver from the discharge diffuser, 30 m from the west bank.

PROCEDURES

Acrylic plates (22 x 30 cm) were fastened by brass pins to an acrylic holder (Fig. B-1) on the River bottom. The holder lacked projections that would catch drifting detritus. The plates faced upstream at 5^{o} from horizontal so that they offered little resistance to the current. The holder was situated near the channel where minimum and maximum water depths ranged from about 2.5 to 6.0 m, respectively. The concrete-filled holder was too bulky for a scuba diver to handle in the strong current and had to be lowered to the River bottom on a submersible raft (Gale and Thompson 1974). It was fastened in position with steel stakes driven into the substrate. The front of the holder and the stakes were covered with small stones to keep detritus from catching on them.

Eight plates were placed in the holders at each station on 16 December 1976. Three plates were randomly selected for sampling at two-month intervals at each station. One of the three plates was a spare that could be sampled if a plate was lost. Three replicate samples were taken from each plate. Slots where plates were removed were filled with clean plates that would be sampled the following month. The remaining five plates provided cumulative samples of 2 to 12 months duration. Plates removed for cumulative samples were replaced by clean ones to maintain a constant current pattern.

A scuba diver collected samples from the plates with a bar-clamp sampler (Gale 1975). The sampler included a collecting cup which delimited a circular sampling area (415 mm^2) and prevented loss of cells while the plate was retrieved and while it was processed in the Laboratory.

Samples were cleaned by vibration (Gale 1975) with an ultrasonic dental cleaning probe. Almost all cells were loosened within a few minutes vibration. Dislodged cells were flushed into a collecting jar with "cooling" water sprayed inside the collecting cup by the dental cleaning probe. Vibration was continued for a total of 10 minutes to reduce the chances of missing some cells. After 10 minutes vibration, the surface of the plate had a "fresh" appearance where the sample was taken. Some cells may have been damaged by vibration, but tests in which samples were cleaned by: 1) scraping and brushing, and 2) scraping and vibration, more cells/unit area were obtained by the second method (Gale 1975). Samples were then preserved with formalin and, after settling 10 days, were concentrated to 50 ml by decanting. One half of the concentrate was sent to Dr. Rex L. Lowe, Department of Biology, Bowling Green State University, Bowling Green, Ohio, for identification and enumeration. The remainder was placed in our reference collection.

One phytoplankton sample (1 liter) was collected near the River surface at each periphyton sampling station on the same day periphyton samples were collected. The samples were preserved, concentrated, and processed in the same manner as the periphyton samples.

Algal cells in periphyton and phytoplankton samples that contained chloroplasts were enumerated in terms of units (Gale and Lowe 1971). In most instances, at least 1,500 units were enumerated and identified in each sample (about 500/each of 3 subsamples). Extremely low algal densities in some subsamples made it impractical to count 500 units. Counts were made using a Palmer counting cell at 430 X magnification. Higher magnification,

including electron microscopy, was used for some identifications. Periphyton was identified to genus and the more abundant forms to species using keys by Hustedt (1930) and Prescott (1962).

Physicochemical data were collected on 25 August both up- and downriver from the Susquehanna SES sewage effluent to determine if the effluent affected the periphyton communities. The effluent enters the River between the Station's intake structure and discharge diffuser. Grab samples of surface water were collected at SSES-A, upriver from the sewage effluent. Both surface and bottom samples were taken at the periphyton station, downriver from the sewage effluent. The bottom sample was collected with a bilge pump.

Water temperatures, nonfiltrable and fixed nonfiltrable residues, pH, dissolved oxygen, turbidity, and Secchi disc were determined according to methods in Table A-1. Free and total residual chlorine were determined by the DPD method of analysis (APHA 1975). Nitrate nitrogen and orthophosphate phosphorus were determined using the automated method in Methods for Chemical Analysis of Water and Wastes (EPA 1974). River current was measured with a direct reading current meter, Gurley (Price) Model No. 665, suspended to 0.6 total depth. The current was a mean of readings at 5-s intervals for 2 minutes.

RESULTS AND DISCUSSION

Raw data tables (B-4 through B-28) have been presented last because there are many of them and they are needed infrequently in this discussion. Numbers of algal units/mm^2 and units/liter can be determined in periphyton and phytoplankton tables by multiplying the total number of units in subsamples A, B, and C, by the conversion value listed for the sample.

A total of 60 genera of algae was collected in 33 samples from acrylic plates above the intake; 64 genera were collected in 30 samples taken below the discharge (Tables B-4 through B-28).

Twenty-seven species of algae were identified that composed 5% or more of the total units counted in samples from the two sampling stations (Table B-1). As in 1972 and 1973, diatoms were more abundant below the discharge than other forms. Green algae were more abundant than diatoms in samples taken above the intake. Three species of diatoms that composed over 5% of the total units counted above the intake composed less than 5% of the total below the discharge (Table B-1). Blue green algae were relatively scarce at both stations but sometimes composed over 5% of the total units counted. Only two species of blue greens, Phormidium geniculata and Schizothrix calcicola were identified.

Most of the algae found were "clean water" forms and only four of the abundant species were listed by Palmer (1969) in the top 10 species of those tolerating much organic pollution. Included were Nitzschia palea, Synedra ulna, Scenedesmus quadricauda, and Ankistrodesmus falcatus. Only 1 of 18 species of abundant diatoms (Table B-1) were rated as acidophilous by Lowe (1974). Some of the others were rated "indifferent" but most were alkaliphilous.

Colonization of Bimonthly and Cumulative Acrylic Plates

It is obvious from Fig. B-2 that algal colonization of clean substrates at both stations was extremely slow in winter as it was at Falls and SSES in 1972-73. Diatoms rapidly colonized substrates between April and June as

the River warmed. The colonization rate remained high between June and August but dropped sharply in October and remained low in December.

Colonization rates on cumulative plates followed trends observed on bimonthly plates. Cumulative acrylic plates, which were placed in the River in winter, when colonization was slow, had not been heavily colonized by mid-April at either station (Fig. B-2). Colonization increased sharply between April and June, and remained high into August. Colonization rates fell to near zero by October and remained low through December.

Density of Algae on Bimonthly and Cumulative Plates

There was an average of 340 algal units/mm^2 on bimonthly acrylic plates and 372 units/mm^2 on cumulative acrylic plates above the intake. Densities below the discharge were much higher with an average of 1,795 algal units/mm^2 on bimonthly plates and 1,401 units/mm^2 on cumulative plates.

The higher standing crop below the discharge may have been a result of organic enrichment that entered the River from the Susquehanna SES sewage treatment facility. Physicochemical conditions, however, at the two sites were similar when they were measured on 25 August (Table B-2). The major differences were the greater depth and current velocity at the site above the intake. Orthophosphate and nitrate concentrations were only slightly higher at the site below the discharge.

Standing crops of algae at both stations were much lower than those encountered in the cleaner water at Falls in earlier studies (Gale and Gurzynski 1976). Iron from mine drainage seems to impair the development of the periphyton community by: 1) shading the water and reducing light

penetration; 2) coating River stones so that cells could not attach to them and were lost when iron was scoured away during periods of increased River discharge.

It is of interest that the standing crop of algae on bimonthly plates exceeded the standing crop of algae on cumulative plates in June and August. The plates seemed to become less suitable for colonization after prolonged exposure to the water. The plates may have become coated with silt and miscellaneous detritus which deterred colonization. Patrick et al. (1954) indicated that such accumulations make a surface a "less favorable habitat for diatoms." The difference in standing crop might also have been due to a greater number of macroinvertebrates on cumulative plates. Macroinvertebrates may reduce algal density by grazing, drifting, molting, and by other activities. Grazing in some systems has been shown to reduce the standing crop of periphyton and to lower production (Elwood and Nelson 1972). Also, fish may have selected the cumulative plate for feeding, because of a greater abundance of macroinvertebrates on it, and removed algae while feeding.

Phytoplankton in samples collected upriver from the intake structure was nearly identical to that in samples taken downriver from the discharge diffuser (Fig. B-3). There was a total of 50 genera of algae in 6 samples from above the intake and 55 genera in 6 samples taken below the discharge (Tables B-24 through B-28).

Twenty species of algae were identified that composed 5% or more of the total units counted in samples from the two sampling stations (Table B-3). Overall, diatoms were the most abundant form at both stations. Three species

of diatoms that composed over 5% of the total units above the intake composed less than 5% of the total below the discharge (Table B-3).

In June and August green algae was abundant at both sites (Fig. B-3). Similar trends were observed in summer, 1972-73 (Ichthyological Associates 1974).

Most of the algae found were "clean water" forms and only three of the abundant species were listed by Palmer (1969) in the top 10 species of those tolerating much organic pollution. Included were Nitzschia palea, Scenedesmus quadricauda, and Synedra ulna. None of the species of abundant diatoms (Table B-4) were rated as acidophilous by Lowe (1974). Some were rated "indifferent" but most were alkaliphilous.

Standing crops of phytoplankton were low in February but increased by about 24-fold to the season's high in April when there were about 28,000,000 phytoplankton units/liter above the intake and 30,700,000 phytoplankton units/liter below the discharge. The standing crop at both stations dropped sharply in June and continued to decline through December.

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Table B-1. Periphyton species composing at least 5% of the total units counted in samples at two stations on the Susquehanna River, 1977. Numbers following diatoms indicate the species affinity for pH as rated by Lowe (1974): 1 = alkaliphilous; 2 = acidophilous; 3 = indifferent to pH; and 4 = unknown.

Species		Above Intake	Below Discharge
CHLOROPHYTA			
Actinastrum hantzschii		Jun	Jun
Ankistrodesmus falcatus		Jun, Aug	Jun
Cerasterias actinastroides		Jun	
C. staurastroides		Jun	Jun
Chodatella quadriseta		Jun	Jun
Dictyosphaerium pulchellum		Jun	
Scenedesmus quadricauda		Jun, Aug, Oct	Jun, Aug
BACILLARIOPHYTA			
Cyclotella atomus	(4)	Jun, Aug, Oct	Jun, Aug
C. meneghiniana	(1)	Oct	
C. pseudostelligera	(1,3)	Jun	Jun
Fragilaria vaucheriae	(1)	Feb	Feb
Gomphonema olivaceum	(1)	Feb	Feb, Dec
G. simus	(4)		Dec
Melosira granulata	(1)	Oct	Oct
M. varians	(1)	Oct	
Meridion circulare	(1)	Dec	Feb
Navicula cryptocephala	(1)	Dec	Dec
N. cryptocephala var. veneta	(1)	Feb	
N. gregaria	(4)		Dec
N. salinarum var. intermedia	(4)	Oct	
N. viridula	(1,2)	Jun	Jun, Dec
Nitzschia dissipata	(1)	Dec	Dec
N. palea	(1,3)	Feb, Oct	Feb, Aug, Oct, Dec
Stephanodiscus invisitatus	(4)	Apr, Jun	Apr, Jun, Aug
Synedra ulna	(1)		Dec
Thalassiosira pseudonana	(3)		Jun
CYANOPHYTA			
Phormidium geniculata		Feb	Feb
Schizothrix calcicola		Jun, Aug, Oct, Dec	Apr, Oct, Dec
RHODOPHYTA			
Rhodochorton sp.		Oct	

Table B-2. Physicochemical analyses of River water collected upriver from the Susquehanna SES intake structure and downriver from the discharge diffuser, 25 August 1977.

Parameter	Above Intake	Below Discharge
River depth (m)	3.75	2.50
Temperature (C)	23.0[a]	22.0
	-- [b]	22.0
Velocity (m/s)	0.57	0.20
Secchi disc (cm)	45	--
Turbidity (NTU)	10	10
	--	12
Dissolved oxygen (mg/l)	10.7	9.3
	--	8.8
pH	7.5	7.4
	--	7.4
Residue (mg/l)		
Nonfiltrable	7	10
	--	13
Fixed nonfiltrable	3	3
	--	7
Nitrate nitrogen (mg/l)	0.68	0.70
	--	0.60
Orthophosphate phosphorus (mg/l)	0.00	0.01
	--	0.01
Chlorine (mg/l)		
Free	0.00	0.00
	--	0.00
Total residual	0.35	0.35
	--	0.35

[a] Surface

[b] Bottom

Table B-3. Phytoplankton species composing at least 5% of the total units counted in samples at two stations on the Susquehanna River, 1977. Numbers following diatoms indicate the species affinity for pH as rated by Lowe (1974): 1 = alkaliphilous; 2 - acidophilous; 3 = indifferent to pH; and 4 = unknown.

Species		Above Intake	Below Discharge
CHLOROPHYTA			
Actinastrum hantzschii		Jun	Jun
Chodatella quadriseta			Jun
Coelastrum sphaericum			Aug
Dictyosphaerium pulchellum		Aug	
Kirchneriella subsolitaria		Aug	
Scenedesmus quadricauda		Jun, Aug	Jun, Aug
BACILLARIOPHYTA			
Asterionella formosa	(1)	Dec	
Cymbella ventricosa	(3)	Feb	
Cyclotella atomus	(4)	Jun, Aug, Oct	Jun, Aug
C. pseudostelligera	(1,3)	Jun	Aug
Fragilaria crotonensis	(1)		Feb, Dec
F. vaucheriae	(1)	Feb	Feb
Gomphonema olivaceum	(1)	Feb, Dec	Feb, Dec
Melosira granulata	(1)		Aug
Navicula cryptocephala	(1)	Dec	Dec
N. dissipata	(1)	Dec	Dec
Nitzschia acicularis	(1)	Oct	Aug
N. palea	(1,3)	Oct, Dec	Aug, Dec
Stephanodiscus invisitatus	(4)	Apr, Jun	Apr, Jun
Synedra ulna	(1)	Feb	
CYANOPHYTA			
Phormidium sp.		Feb	Feb

Table B-4. Units of periphytic algae in three replicate samples from bimonthly acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	24 FEB			24 FEB			24 FEB		
REPLICATE	1			2			3		
CONVERSION FACTOR	0.40			0.40			0.40		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
CRUCIGENIA	1	0	0	0	0	0	0	0	0
SCENEDESMUS	1	0	0	0	0	0	0	0	0
STIGEOCLONIUM	0	0	0	0	0	0	0	1	0
BACILLARIOPHYTA									
ASTERIONELLA	0	0	0	0	0	1	0	0	1
CYMBELLA	0	0	0	3	0	0	1	1	4
DIATOMA	0	0	0	0	3	2	0	5	3
FRAGILARIA	3	7	6	8	16	10	33	64	87
GOMPHONEMA	2	3	1	8	5	8	11	27	29
HANNAEA	0	0	0	0	0	0	0	1	0
MELOSIRA	0	0	0	0	2	0	0	0	4
MERIDION	0	0	1	0	0	0	4	1	5
NAVICULA	1	2	2	1	3	2	3	4	7
NITZSCHIA	1	1	1	3	6	3	6	13	16
STEPHANODISCUS	0	0	0	0	0	0	1	0	0
SURIRELLA	0	0	0	0	1	2	0	0	1
SYNEDRA	0	0	0	0	0	0	0	4	2
CYANOPHYTA									
PHORMIDIUM	0	0	10	10	2	13	5	26	15
CHRYSOPHYTA									
DINOBYRON	0	0	0	1	0	0	0	0	1
TOTAL	9	13	21	34	38	41	64	147	175

Table B-5. Units of periphytic algae in three replicate samples from bimonthly acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	25 FEB			25 FEB			25 FEB		
REPLICATE	1			2			3		
CONVERSION FACTOR	0.40			0.40			0.40		
TAXON	A	B	C	A	B	C	A	B	C
BACILLARIOPHYTA									
CYMATOPLEURA	0	0	0	0	0	0	0	1	0
CYMBELLA	1	2	0	2	1	0	1	0	0
DIATOMA	2	1	0	2	6	3	0	0	0
EUNOTIA	0	0	1	0	0	1	0	0	0
FRAGILARIA	11	15	11	25	24	26	6	2	6
GOMPHONEMA	6	12	8	10	11	10	2	0	1
MERIDION	2	0	1	4	0	6	0	1	0
NAVICULA	1	1	1	4	3	4	1	0	1
NITZSCHIA	2	4	3	7	6	8	1	0	2
RHOICOSPHENIA	0	0	0	1	0	0	0	0	0
SURIRELLA	0	0	0	0	0	1	0	0	0
SYNEDRA	0	4	0	0	1	1	2	0	1
CYANOPHYTA									
PHORMIDIUM	0	0	1	5	4	6	0	0	0
TOTAL	25	39	26	60	56	66	13	4	11

Table B-6. Units of periphytic algae in three replicate samples from bimonthly acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	18 APR			18 APR			18 APR		
REPLICATE	1			2			3		
CONVERSION FACTOR	0.59			0.59			0.59		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ANKISTRODESMUS	1	2	0	3	2	0	0	0	0
CHLAMYDOMONAS	2	0	1	4	1	3	2	1	1
SCHROEDERIA	0	0	0	0	0	0	1	0	0
TETRASTRUM	0	0	1	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	3	5	3	1	0	0	0	1	2
BACILLARIOPHYTA									
ACHNANTHES	1	0	0	1	1	0	0	0	0
COCCONEIS	1	0	1	1	0	0	1	1	0
CYMBELLA	1	2	1	1	6	0	1	0	0
DIATOMA	0	0	0	0	0	0	0	0	1
EUNOTIA	0	0	0	0	1	0	0	0	0
FRAGILARIA	3	0	3	0	0	0	2	1	0
GOMPHONEMA	3	5	1	3	3	4	4	4	6
GYROSIGMA	0	0	0	1	0	0	0	0	0
MELOSIRA	3	0	0	0	2	6	0	4	14
MERIDION	2	1	1	1	0	2	0	0	1
NAVICULA	1	3	3	2	2	2	2	1	4
NITZSCHIA	10	6	2	4	0	3	4	1	6
STEPHANODISCUS	88	96	111	91	80	84	57	86	62
SURIRELLA	0	0	0	1	0	0	1	0	0
SYNEDRA	1	1	4	1	1	1	1	3	6
THALASSIOSIRA	4	4	4	4	4	4	2	3	2
CYANOPHYTA									
CHROOCOCCUS	0	3	0	2	4	0	0	0	0
SCHIZOTHRIX	0	0	0	0	0	0	3	0	1
EUGLENOPHYTA									
TRACHELOMONAS	0	0	0	0	0	0	0	0	1
TOTAL	124	128	136	121	107	109	81	106	107

Table B-7. Units of periphytic algae in three replicate samples from bimonthly acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	15 JUN			15 JUN			15 JUN		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			3.09			2.36		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	3	5	3	32	19	23	10	11	6
ANKISTRODESMUS	1	3	1	19	16	17	6	8	12
CERASTERIAS	5	7	9	0	0	0	16	21	22
CHLAMYDOMONAS	5	2	3	6	7	5	14	9	11
CHODATELLA	0	1	1	24	11	18	2	14	9
CLOSTERIOPSIS	0	0	0	0	0	0	1	0	0
DICTYOSPHAERIUM	0	6	6	1	7	1	8	9	9
GOLENKINIA	0	0	0	0	0	0	0	1	1
KIRCHNERIELLA	0	0	0	1	2	0	2	0	2
MICRACTINIUM	0	0	0	6	6	3	3	1	1
OOCYSTIS	0	0	0	1	0	0	0	0	0
PHACOTUS	0	0	0	0	1	0	0	0	0
SCENEDESMUS	2	1	1	11	13	17	8	2	10
SCHROEDERIA	0	0	0	1	0	0	1	0	0
TETRAEDRON	0	0	0	0	0	0	0	1	0
TETRASTRUM	1	0	0	0	1	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	0	0	1	14	12	13	4	4	8
BACILLARIOPHYTA									
AMPHORA	0	0	0	0	0	0	0	0	1
CYCLOTELLA	1	2	2	20	24	21	21	13	21
CYMBELLA	0	0	0	1	1	2	0	0	1
DIATOMA	0	0	0	1	0	0	0	0	0
GOMPHONEMA	0	1	0	1	0	0	2	0	0
MELOSIRA	0	0	1	0	1	1	0	0	0
NAVICULA	1	4	5	6	6	6	5	9	7
NITZSCHIA	1	2	1	8	13	14	7	5	5
STEPHANODISCUS	1	2	3	12	13	12	13	8	13
SYNEDRA	0	0	0	2	7	2	3	4	2
TABELLARIA	0	0	0	4	5	5	0	0	0
THALASSIOSIRA	0	0	0	0	0	0	6	4	7
CYANOPHYTA									
CHROOCOCCUS	0	2	1	7	6	1	3	3	4
SCHIZOTHRIX	0	1	0	19	20	18	6	4	3
TOTAL	21	39	38	197	191	179	141	131	155

Table B-8. Units of periphytic algae in three replicate samples from bimonthly acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	16 JUN			16 JUN			16 JUN		
REPLICATE	1			2			3		
CONVERSION FACTOR	4.46			8.61			6.02		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	16	10	13	3	5	17	10	4	16
ANKISTRODESMUS	8	25	24	1	16	13	6	12	15
CERASTERIAS	27	35	27	13	18	22	21	16	34
CHLAMYDOMONAS	20	12	20	3	5	5	11	11	11
CHODATELLA	19	4	16	5	4	3	21	19	15
CLOSTERIOPSIS	0	0	1	1	0	0	0	1	1
COSMARIUM	0	1	0	0	0	2	0	0	0
DICTYOSPHAERIUM	4	10	10	1	3	7	5	4	5
ELAKATOTHRIX	0	0	0	0	1	0	0	0	0
GOLENKINIA	0	1	0	0	0	0	0	0	0
KIRCHNERIELLA	0	1	2	0	1	0	0	6	2
MICRACTINIUM	4	0	5	0	0	0	2	3	0
PEDIASTRUM	0	0	0	1	0	0	0	0	0
SCENEDESMUS	28	21	28	12	25	26	23	27	37
SCHROEDERIA	2	0	0	0	0	0	1	0	0
SELENASTRUM	0	1	0	0	0	0	0	2	0
STAURASTRUM	0	1	0	0	0	0	0	0	0
TETRAEDRON	1	0	2	0	0	0	0	1	0
TREUBARIA	0	1	0	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	11	12	16	9	14	11	8	6	10
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	0	1	0	0	0	0
COCCONEIS	1	3	0	4	0	1	2	0	0
CYCLOTELLA	15	17	21	22	27	25	30	23	26
CYMBELLA	1	1	3	7	10	4	6	2	3
DIATOMA	0	0	1	2	0	0	1	0	0
EPITHEMIA	1	0	0	0	0	0	0	0	0
EUNOTIA	0	0	0	0	1	0	0	0	0
FRAGILARIA	0	0	2	0	0	2	2	0	0
GOMPHONEMA	1	0	2	1	1	2	4	1	1
MELOSIRA	2	0	4	2	4	2	3	0	0
NAVICULA	10	14	10	32	23	21	19	25	17
NITZSCHIA	7	16	18	7	9	8	8	11	1
RHOICOSPHENIA	0	0	0	1	0	0	0	0	0
STEPHANODISCUS	43	48	60	51	60	58	30	23	26
SURIRELLA	1	1	0	1	0	0	0	1	1
SYNEDRA	8	3	3	5	19	8	4	4	10
THALASSIOSIRA	5	5	7	7	7	8	24	18	21
CYANOPHYTA									
APHANOTHECE	0	0	2	0	0	0	0	0	0
CHROOCOCCUS	13	6	15	2	2	5	8	5	6
MICROCYSTIS	1	0	0	0	0	0	0	0	0
OSCILLATORIA	0	2	2	0	0	0	0	0	0
SCHIZOTHRIX	1	1	3	0	0	1	2	0	1
EUGLENOPHYTA									
EUGLENA	0	0	0	0	0	0	1	0	0
TRACHELOMONAS	2	0	1	0	0	1	0	1	0
TOTAL	252	252	318	193	256	252	252	226	259

Table B-9. Units of periphytic algae in three replicate samples from bimonthly acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	15 AUG			15 AUG			15 AUG		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			2.36			2.36		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	0	0	0	0	0	1	0	1
ANKISTRODESMUS	3	6	3	12	6	7	1	2	9
CERASTERIAS	0	0	0	1	0	0	0	0	1
CHLAMYDOMONAS	0	1	0	0	0	2	0	0	0
CHODATELLA	0	0	0	5	0	0	0	0	0
COELASTRUM	3	1	1	0	1	5	2	0	1
COSMARIUM	0	0	0	0	0	0	0	1	0
CRUCIGENIA	0	0	0	0	0	0	3	0	0
DICTYOSPHAERIUM	4	1	4	1	4	2	2	2	6
KIRCHNERIELLA	0	4	2	2	1	3	1	3	2
MICRACTINIUM	0	0	0	1	0	1	0	0	0
OOCYSTIS	1	0	0	1	0	0	0	0	0
PEDIASTRUM	0	1	0	1	1	0	1	1	2
SCENEDESMUS	34	31	28	32	41	35	24	21	28
TETRAEDRON	0	1	1	0	0	0	0	0	0
TETRASTRUM	0	0	2	0	0	1	0	0	0
TREUBARIA	0	2	0	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	7	10	5	6	5	6	3	8	6
BACILLARIOPHYTA									
COCCONEIS	0	0	1	1	0	1	1	0	0
CYCLOTELLA	13	22	17	19	18	18	16	17	20
CYMBELLA	0	0	0	1	0	0	0	0	0
MELOSIRA	0	0	0	0	0	3	2	0	2
NAVICULA	3	4	0	0	4	5	4	2	8
NITZSCHIA	2	5	2	3	3	1	4	2	1
STEPHANODISCUS	2	4	3	0	0	0	1	2	2
THALASSIOSIRA	1	1	1	3	3	3	0	0	0
UNIDENTIFIED BACILLARIOPHYTA	0	0	0	0	0	0	0	1	0
CYANOPHYTA									
CHROOCOCCUS	0	0	0	1	0	1	0	0	0
MERISMOPEDIA	1	1	0	0	0	0	0	0	0
MICROCYSTIS	0	0	0	0	0	1	0	0	0
SCHIZOTHRIX	9	23	14	10	13	8	6	13	15
EUGLENOPHYTA									
TRACHELOMONAS	0	0	0	0	0	1	0	0	0
PYRRHOPHYTA									
PERIDINIUM	1	0	0	0	0	0	2	0	0
TOTAL	84	118	84	100	100	104	74	75	104

Table B-10. Units of periphytic algae in three replicate samples from bimonthly acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	16 AUG			16 AUG			16 AUG		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			7.09			7.09		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	1	0	0	1	0	0	0	1
ANKISTRODESMUS	5	3	9	1	3	5	6	8	6
CHLAMYDOMONAS	1	0	0	0	0	0	1	2	0
CHODATELLA	0	0	0	0	0	0	0	0	4
COELASTRUM	0	0	2	2	4	5	6	7	4
COSMARIUM	0	0	0	0	0	1	0	1	0
CRUCIGENIA	4	0	0	0	0	0	0	0	0
DICTYOSPHAERIUM	1	3	3	0	0	0	3	2	2
FRANCEIA	0	2	0	0	0	0	0	0	0
KIRCHNERIELLA	2	4	2	4	4	2	3	3	2
OOCYSTIS	0	1	1	0	0	1	0	2	2
PEDIASTRUM	4	6	2	3	5	3	3	3	1
SCENEDESMUS	48	82	58	71	67	83	79	57	70
STAURASTRUM	0	0	2	0	0	1	0	0	0
TETRAEDRON	0	1	0	0	1	0	0	1	0
TETRASTRUM	1	0	0	0	0	0	0	0	1
TREUBARIA	1	0	0	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	19	11	6	11	6	4	6	8	2
BACILLARIOPHYTA									
AMPHORA	0	0	0	0	2	0	0	0	0
COCCONEIS	1	4	4	0	3	1	4	1	1
CYCLOTELLA	90	105	89	106	90	111	120	112	92
CYMBELLA	1	1	2	0	0	3	1	3	0
EUNOTIA	0	0	1	0	0	0	0	0	0
GOMPHONEMA	1	1	0	0	2	0	1	2	2
MELOSIRA	10	5	5	2	3	0	0	1	1
MERIDION	0	0	0	0	0	1	0	0	0
NAVICULA	5	4	6	4	8	3	7	7	4
NITZSCHIA	13	7	11	17	14	8	9	6	9
RHOICOSPHENIA	0	1	0	0	0	0	0	0	0
STEPHANODISCUS	8	10	8	20	18	23	17	16	13
SURIRELLA	1	0	0	0	0	0	0	0	0
THALASSIOSIRA	4	4	4	5	5	5	6	5	4
CYANOPHYTA									
CHROOCOCCUS	0	1	1	0	0	1	0	0	0
MERISMOPEDIA	0	0	0	0	0	0	2	1	1
OSCILLATORIA	0	0	0	2	0	0	0	0	0
SCHIZOTHRIX	2	4	4	1	1	1	0	1	0
PYRRHOPHYTA									
GLENODINIUM	0	0	0	0	0	0	0	1	0
CRYPTOPHYTA									
CRYPTOMONAS	1	0	0	0	0	0	0	0	0
TOTAL	223	261	220	249	237	262	274	250	222

Table B-11. Units of periphytic algae in three replicate samples from bimonthly acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	14 OCT			14 OCT			14 OCT		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			1.18			1.18		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	0	0	0	0	0	0	0	1
ANKISTRODESMUS	1	0	0	0	0	0	0	0	1
SCENEDESMUS	1	0	1	3	0	1	3	4	1
UNIDENTIFIED CHLOROPHYTA	0	0	0	2	0	1	1	1	0
BACILLARIOPHYTA									
ACHNANTHES	0	0	2	1	0	1	0	1	1
AMPHORA	0	0	0	1	0	0	0	0	0
COCCONEIS	0	0	1	4	0	2	1	0	0
CYCLOTELLA	2	2	1	3	3	4	3	3	3
CYMBELLA	0	0	0	2	0	0	0	0	0
GOMPHONEMA	0	0	0	1	0	1	0	2	1
MELOSIRA	0	0	0	1	0	16	0	4	0
MERIDION	0	0	0	1	0	0	0	0	0
NAVICULA	1	2	3	7	3	6	3	4	2
NITZSCHIA	2	1	3	2	3	0	3	1	0
PINNULARIA	0	0	0	0	0	0	0	1	1
RHOICOSPHENIA	0	0	0	0	0	0	1	0	0
STEPHANODISCUS	0	1	0	0	0	2	1	1	1
SYNEDRA	1	0	0	4	3	1	1	2	1
CYANOPHYTA									
APHANOCAPSA	0	0	0	0	0	0	0	0	1
SCHIZOTHRIX	6	2	2	2	6	2	5	0	5
CHRYSOPHYTA									
DINOBYRON	0	0	0	0	0	4	0	0	0
EUGLENOPHYTA									
UNIDENTIFIED EUGLENOPHYTA	0	0	0	0	0	0	0	1	0
RHODOPHYTA									
RHODOCHORTON	0	0	0	10	0	0	0	0	0
TOTAL	14	8	13	44	18	41	22	25	19

Table B-12. Units of periphytic algae in three replicate samples from bimonthly acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	14 OCT			14 OCT			14 OCT		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			1.18			1.18		
TAXON	A	B	C	A	B	C	A	B	C
BACILLARIOPHYTA									
ACHNANTHES	0	1	0	0	0	0	0	0	0
AMPHORA	1	0	0	0	0	0	0	0	0
CYCLOTELLA	0	1	2	0	0	0	1	1	0
CYMBELLA	1	0	1	0	0	0	0	0	0
GOMPHONEMA	1	1	1	0	0	0	0	0	0
MELOSIRA	0	0	0	0	2	2	0	0	0
NAVICULA	1	3	2	1	0	0	0	0	0
NITZSCHIA	4	1	2	0	0	1	0	0	0
CYANOPHYTA									
SCHIZOTHRIX	4	2	3	0	1	3	2	3	2
TOTAL	12	9	11	1	3	6	3	4	2

Table B-13. Units of periphytic algae in three replicate samples from bimonthly acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	13 DEC			13 DEC			13 DEC		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			1.18			1.18		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
UNIDENTIFIED CHLOROPHYTA	1	0	0	0	0	0	0	0	0
BACILLARIOPHYTA									
GOMPHONEMA	0	1	0	0	0	0	0	0	0
MERIDION	0	0	0	0	0	0	0	1	0
NAVICULA	2	3	2	0	0	0	0	0	0
NITZSCHIA	2	2	0	0	0	0	0	0	0
SYNEDRA	1	0	0	0	0	0	0	0	0
CYANOPHYTA									
SCHIZOTHRIX	0	2	1	2	1	2	1	0	2
TOTAL	6	8	3	2	1	2	1	1	2

Table B-14. Units of periphytic algae in three replicate samples from bimonthly acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	13 DEC			13 DEC			13 DEC		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			1.18			1.18		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
SCENEDESMUS	0	0	0	0	0	1	0	0	0
ULOTHRIX	0	2	0	0	0	0	0	0	0
BACILLARIOPHYTA									
ACHNANTHES	1	1	2	0	0	1	1	2	0
ASTERIONELLA	0	2	0	0	3	0	0	0	0
COCCONEIS	0	0	0	0	0	0	1	1	0
CYCLOTELLA	0	0	0	0	0	1	0	1	0
CYMBELLA	1	2	1	1	2	2	2	2	0
DIATOMA	2	0	1	1	0	0	0	0	2
FRAGILARIA	0	2	0	0	0	0	0	0	0
GOMPHONEMA	6	4	2	9	4	4	2	5	3
MELOSIRA	0	0	0	2	0	2	0	0	0
MERIDION	1	0	0	0	1	1	0	0	0
NAVICULA	22	13	15	13	9	6	6	9	8
NITZSCHIA	5	5	5	4	14	9	1	11	8
SURIRELLA	0	2	1	1	1	0	0	1	3
SYNEDRA	5	2	1	0	1	4	5	0	4
CYANOPHYTA									
OSCILLATORIA	0	0	0	0	4	0	0	0	0
SCHIZOTHRIX	1	1	3	1	2	1	0	0	0
CHRYSOPHYTA									
DINOBYRON	0	1	0	0	1	0	0	0	1
TOTAL	44	37	31	32	42	32	18	32	29

Table B-15. Units of periphytic algae in three replicate samples from cumulative acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	18 APR			18 APR			18 APR		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			0.59			0.59		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
UNIDENTIFIED CHLOROPHYTA	2	0	0	0	2	1	1	1	0
BACILLARIOPHYTA									
COCCONEIS	0	0	0	0	0	0	1	1	0
CYMBELLA	0	0	2	0	0	2	0	0	0
DIATOMA	0	0	0	0	0	0	0	1	0
FRAGILARIA	0	0	2	0	0	2	0	0	3
GOMPHONEMA	0	1	1	1	0	2	4	1	0
MELOSIRA	0	0	0	0	0	0	0	2	0
MERIDION	0	0	0	0	0	1	0	0	0
NAVICULA	1	1	2	2	1	0	2	1	1
NITZSCHIA	2	0	0	2	1	0	3	1	1
STEPHANODISCUS	48	46	54	39	53	44	24	29	29
SURIRELLA	1	0	0	0	0	0	0	0	0
SYNEDRA	0	2	0	0	0	0	1	4	0
THALASSIOSIRA	2	2	2	2	2	2	1	1	1
CYANOPHYTA									
CHROOCOCCUS	0	0	0	0	1	1	0	0	0
SCHIZOTHRIX	0	0	0	0	4	0	0	1	0
PYRRHOPHYTA									
GLENODINIUM	0	0	0	0	0	0	0	1	0
TOTAL	56	52	63	46	64	55	37	44	35

Table B-16. Units of periphytic algae in three replicate samples from cumulative acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	18 APR			18 APR			18 APR		
REPLICATE	1			2			3		
CONVERSION FACTOR	0.59			0.59			0.59		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ANKISTRODESMUS	0	1	0	0	0	0	0	0	0
CHLAMYDOMONAS	0	0	0	1	0	0	2	0	0
UNIDENTIFIED CHLOROPHYTA	3	0	3	1	3	4	4	5	1
BACILLARIOPHYTA									
ACHNANTHES	2	0	0	0	0	0	0	0	0
COCCONEIS	2	1	4	1	1	5	2	1	0
CYMBELLA	3	4	1	2	4	2	1	0	1
DIATOMA	2	0	1	1	0	0	0	0	1
EUNOTIA	1	1	0	0	0	0	0	0	0
FRAGILARIA	2	6	2	0	0	4	0	2	2
GOMPHONEMA	12	4	2	6	8	3	3	6	1
MELOSIRA	9	0	0	0	0	1	2	0	0
MERIDION	0	2	0	1	0	0	0	1	0
NAVICULA	13	6	11	11	10	7	9	4	1
NITZSCHIA	7	3	2	1	1	3	3	0	3
RHOICOSPHENIA	1	1	1	0	0	0	1	0	1
STEPHANODISCUS	40	32	23	62	40	36	43	52	54
SURIRELLA	0	1	0	1	3	0	0	0	2
SYNEDRA	2	3	1	2	1	0	4	1	1
TABELLARIA	0	0	1	0	0	0	0	0	0
THALASSIOSIRA	2	1	1	2	2	1	2	2	2
CYANOPHYTA									
SCHIZOTHRIX	46	71	69	170	170	189	9	9	8
TOTAL	147	137	122	262	243	255	85	83	78

Table B-17. Units of periphytic algae in three replicate samples from cumulative acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	15 JUN			15 JUN			15 JUN		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			2.36			2.36		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	13	7	8	9	20	15	8	8	11
ANKISTRODESMUS	5	4	8	10	13	17	12	5	17
CERASTERIAS	23	18	24	19	22	31	23	15	21
CHLAMYDOMONAS	9	7	15	14	13	17	11	20	13
CHODATELLA	8	6	3	14	8	12	14	19	14
CLOSTERIOPSIS	0	0	0	0	0	0	0	2	1
DICTYOSPHAERIUM	3	3	4	10	10	6	7	4	2
GOLENKINIA	0	2	0	0	1	0	3	2	5
KIRCHNERIELLA	0	1	2	2	4	0	2	4	2
MICRACTINIUM	1	3	1	4	2	6	2	2	1
OOCYSTIS	0	0	0	0	0	0	1	1	0
PEDIASTRUM	0	0	0	1	0	0	0	0	0
SCENEDESMUS	7	6	11	9	19	11	15	20	17
SCHROEDERIA	1	0	0	2	0	0	0	0	0
SELENASTRUM	0	1	0	0	0	2	0	0	1
TETRAEDRON	1	1	0	0	0	1	3	2	1
TETRASTRUM	0	0	0	0	3	2	0	0	0
TREUBARIA	0	0	0	0	0	0	0	0	1
UNIDENTIFIED CHLOROPHYTA	7	5	10	8	11	13	12	8	8
BACILLARIOPHYTA									
ACHNANTHES	0	0	1	0	0	0	0	1	1
CYCLOTELLA	8	7	8	11	18	15	20	24	27
CYMBELLA	0	0	0	0	0	1	0	1	1
GOMPHONEMA	0	0	1	0	0	0	0	0	0
NAVICULA	2	7	3	14	7	10	5	4	8
NITZSCHIA	2	4	2	11	11	7	6	2	7
RHOICOSPHENIA	0	0	0	1	0	0	0	0	0
STEPHANODISCUS	20	18	22	18	28	23	12	15	16
SYNEDRA	3	1	0	4	3	0	3	3	4
THALASSIOSIRA	4	3	4	7	10	9	6	7	8
CYANOPHYTA									
APHANOTHECE	0	2	0	1	4	1	2	1	3
CHROOCOCCUS	5	4	11	3	7	7	8	8	15
MICROCYSTIS	0	0	0	1	0	0	0	0	0
SCHIZOTHRIX	1	3	3	3	2	5	7	7	12
EUGLENOPHYTA									
TRACHELOMONAS	1	0	1	0	0	0	0	0	0
TOTAL	124	113	142	176	216	211	182	185	217

Table B-18. Units of periphytic algae in three replicate samples from cumulative acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	16 JUN			16 JUN			16 JUN		
REPLICATE	1			2			3		
CONVERSION FACTOR	6.02			6.02			2.36		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	6	6	9	15	9	20	8	5	9
ANKISTRODESMUS	8	18	23	14	20	24	14	12	7
CERASTERIAS	5	10	9	13	20	18	18	14	16
CHLAMYDOMONAS	1	0	8	5	6	6	3	9	10
CHODATELLA	2	4	3	3	1	2	10	17	8
CLOSTERIOPSIS	0	0	0	1	2	0	0	0	0
CRUCIGENIA	2	0	0	0	0	0	0	0	0
DICTYOSPHAERIUM	1	4	3	1	1	1	6	6	2
GOLENKINIA	0	0	0	0	1	0	0	1	0
KIRCHNERIELLA	0	4	0	1	2	2	0	1	0
MICRACTINIUM	0	0	0	2	0	0	0	1	1
OOCYSTIS	0	2	1	0	0	0	1	0	1
PEDIASTRUM	0	0	0	1	0	0	0	0	0
SCENEDESMUS	30	16	24	26	29	24	36	26	20
SCHROEDERIA	0	0	0	0	0	0	1	0	0
TETRAEDRON	0	0	0	1	2	1	1	0	1
TETRASTRUM	3	4	2	0	0	0	3	1	1
TREUBARIA	0	0	0	1	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	3	4	3	5	7	12	6	3	8
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	1	0	0	0	0	0
COCCONEIS	0	1	1	1	1	5	1	0	0
CYCLOTELLA	22	26	20	28	27	28	13	20	16
CYMBELLA	11	5	6	5	5	12	4	5	3
DIATOMA	1	0	0	1	0	0	2	1	0
FRAGILARIA	20	0	0	0	0	0	0	0	0
GOMPHONEMA	2	5	3	3	5	0	1	0	0
HANNAEA	0	0	0	0	1	0	0	0	0
MELOSIRA	0	12	7	0	7	0	3	4	2
MERIDION	0	0	0	1	0	0	0	0	0
NAVICULA	37	27	31	29	37	48	27	16	18
NITZSCHIA	23	20	19	11	19	22	17	19	9
RHOICOSPHENIA	0	0	0	0	0	0	0	1	0
STEPHANODISCUS	33	41	30	52	50	53	27	45	35
SURIRELLA	1	0	0	1	1	0	1	0	0
SYNEDRA	15	12	14	14	8	13	13	16	16
THALASSIOSIRA	22	26	20	6	7	8	13	20	16
CYANOPHYTA									
CHROOCOCCUS	3	5	3	6	3	5	5	11	12
LYNGBYA	1	0	0	0	0	0	0	1	0
OSCILLATORIA	0	0	0	0	0	2	0	1	0
SCHIZOTHRIX	0	0	1	3	0	0	0	0	0
EUGLENOPHYTA									
PHACUS	0	0	0	0	0	0	1	0	0
TRACHELOMONAS	0	1	0	1	1	1	0	0	0
TOTAL	252	253	240	252	272	307	235	256	211

Table B-19. Units of periphytic algae in three replicate samples from cumulative acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	15 AUG			15 AUG			15 AUG		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			2.36			2.36		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	1	0	0	0	0	0	0	0
ANKISTRODESMUS	2	3	12	3	2	4	4	3	3
CHLAMYDOMONAS	0	0	0	0	1	0	0	0	0
CHODATELLA	4	0	0	0	0	0	0	0	0
COELASTRUM	8	2	3	1	2	2	1	0	0
COSMARIUM	0	0	0	0	0	0	0	1	0
CRUCIGENIA	0	0	1	11	3	0	0	0	4
DICTYOSPHAERIUM	0	1	4	2	4	2	2	2	0
KIRCHNERIELLA	4	3	2	0	2	0	3	0	1
OOCYSTIS	0	0	0	0	1	0	0	0	0
PEDIASTRUM	1	1	1	0	0	2	4	2	2
SCENEDESMUS	31	32	49	28	23	30	22	26	27
TETRAEDRON	1	1	0	0	0	1	0	0	0
TETRASTRUM	0	0	0	1	0	2	0	1	1
UNIDENTIFIED CHLOROPHYTA	8	8	11	3	11	8	3	2	4
BACILLARIOPHYTA									
ACHNANTHES	1	0	0	0	0	2	0	0	0
COCCONEIS	0	0	0	0	0	1	1	0	0
CYCLOTELLA	26	29	26	12	14	17	11	14	13
FRAGILARIA	0	0	0	0	0	2	0	0	0
FRUSTULIA	0	0	1	0	0	0	0	0	0
GOMPHONEMA	1	0	0	0	0	0	0	0	1
MELOSIRA	5	1	0	0	2	1	0	0	0
NAVICULA	0	2	4	0	5	1	0	1	1
NITZSCHIA	2	5	4	4	3	6	3	1	1
STEPHANODISCUS	1	1	1	1	1	2	1	1	1
THALASSIOSIRA	0	0	0	1	1	2	0	0	0
CYANOPHYTA									
CHROOCOCCUS	1	2	1	2	0	1	0	0	0
SCHIZOTHRIX	4	13	10	4	8	8	7	2	6
PYRRHOPHYTA									
PERIDINIUM	0	1	0	0	0	1	0	0	0
TOTAL	100	106	130	73	83	95	62	56	65

Table B-20. Units of periphytic algae in three replicate samples from cumulative acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	16 AUG			16 AUG			16 AUG		
REPLICATE	1			2			3		
CONVERSION FACTOR	7.09			6.02			4.46		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	0	0	0	0	0	1	0	0
ANKISTRODESMUS	3	9	10	7	2	4	10	9	12
CHLAMYDOMONAS	0	0	0	0	0	0	0	1	0
COELASTRUM	3	5	3	2	3	4	3	0	2
COSMARIUM	0	0	0	0	0	0	0	1	1
CRUCIGENIA	0	1	0	0	0	0	0	0	1
DICTYOSPHAERIUM	0	0	4	2	5	0	3	1	3
KIRCHNERIELLA	1	4	4	3	3	7	2	0	2
OOCYSTIS	0	0	0	1	1	0	3	0	0
PEDIASTRUM	2	1	2	3	6	3	5	4	1
SCENEDESMUS	48	40	51	78	88	83	65	58	81
SELENASTRUM	1	0	0	0	0	0	0	0	0
STAURASTRUM	0	0	1	1	0	0	1	0	1
TETRAEDRON	1	0	0	2	1	0	4	0	1
TETRASTRUM	1	2	3	1	1	3	0	0	1
TREUBARIA	0	0	1	1	0	1	0	1	1
UNIDENTIFIED CHLOROPHYTA	10	13	8	11	0	14	14	10	10
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	0	1	0	0	1	1
AMPHORA	0	0	0	0	0	0	0	0	1
COCCONEIS	2	1	0	1	1	1	0	0	3
CYCLOTELLA	71	75	65	102	96	87	96	83	91
CYMBELLA	0	1	1	0	0	1	1	2	0
FRAGILARIA	0	0	0	0	0	2	0	0	0
FRUSTULIA	0	0	0	0	0	0	1	0	0
GOMPHONEMA	2	0	0	1	0	1	0	2	1
MELOSIRA	2	0	0	0	0	0	4	1	2
NAVICULA	6	8	7	2	3	3	12	6	12
NITZSCHIA	8	9	4	10	7	14	9	10	14
RHOICOSPHENIA	0	1	0	0	0	2	0	0	0
STEPHANODISCUS	14	14	12	14	13	12	8	7	8
SYNEDRA	0	0	1	0	0	0	0	0	0
TABELLARIA	0	0	0	0	0	0	1	0	0
THALASSIOSIRA	0	0	0	0	0	0	5	4	4
CYANOPHYTA									
CHROOCOCCUS	1	1	0	0	1	0	0	0	0
MERISMOPEDIA	0	1	0	0	0	0	0	0	0
MICROCYSTIS	0	1	0	0	0	0	0	0	0
SCHIZOTHRIX	3	1	2	1	4	2	8	8	5
PYRRHOPHYTA									
PERIDINIUM	0	0	0	1	0	0	0	0	0
TOTAL	179	188	179	244	236	244	256	209	259

Table B-21. Units of periphytic algae in three replicate samples from cumulative acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	14 OCT			14 OCT			14 OCT		
REPLICATE	1			2			3		
CONVERSION FACTOR	2.36			2.36			2.36		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
COSMARIUM	0	0	0	0	0	1	0	0	0
KIRCHNERIELLA	0	0	0	0	1	0	0	0	0
OOCYSTIS	0	1	0	0	0	0	0	0	0
PEDIASTRUM	0	0	0	0	0	1	0	1	0
SCENEDESMUS	1	0	1	3	4	3	0	2	2
SELENASTRUM	0	0	0	1	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	0	1	0	0	1	2	2	0	0
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	0	0	1	0	0	0
COCCONEIS	0	1	0	0	1	0	0	0	0
CYCLOTELLA	3	5	3	0	7	8	2	2	3
CYMBELLA	0	0	1	0	0	1	0	1	0
GOMPHONEMA	1	0	0	1	0	1	0	1	3
MELOSIRA	0	0	0	4	3	0	2	4	3
MERIDION	0	0	0	0	0	4	0	0	0
NAVICULA	1	4	4	2	3	2	3	2	4
NITZSCHIA	3	1	3	5	0	5	0	2	4
STEPHANODISCUS	0	1	0	0	0	0	0	0	0
SYNEDRA	1	1	1	0	0	1	0	1	2
CYANOPHYTA									
OSCILLATORIA	0	0	0	0	1	0	0	0	0
SCHIZOTHRIX	3	1	2	24	24	22	6	2	2
RHODOPHYTA									
RHODOCHORTON	0	0	0	0	0	0	0	0	3
TOTAL	13	16	15	40	45	52	15	18	26

Table B-22. Units of periphytic algae in three replicate samples from cumulative acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	14 OCT			14 OCT			14 OCT		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			2.36			1.18		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
SCENEDESMUS	1	1	0	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	0	0	0	0	0	2	0	0	0
BACILLARIOPHYTA									
COCCONEIS	1	0	0	0	0	0	0	0	0
GOMPHONEMA	0	0	1	0	0	0	0	0	0
MELOSIRA	0	4	0	0	0	4	8	0	0
NAVICULA	2	2	1	1	0	1	0	0	0
NITZSCHIA	1	2	2	3	1	0	0	0	0
SYNEDRA	0	0	1	0	0	0	0	0	0
CYANOPHYTA									
SCHIZOTHRIX	22	25	26	152	156	140	3	1	2
TOTAL	27	34	31	156	157	147	11	1	2

Table B-23. Units of periphytic algae in three replicate samples from cumulative acrylic plates upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	13 DEC			13 DEC			13 DEC		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			1.18			1.18		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
SCENEDESMUS	0	0	0	0	0	0	0	1	0
BACILLARIOPHYTA									
CYMBELLA	0	0	0	0	0	0	0	1	0
GOMPHONEMA	0	0	0	0	0	0	0	0	1
NAVICULA	1	1	0	3	0	0	0	0	0
NITZSCHIA	1	0	1	0	0	2	0	0	1
SYNEDRA	0	0	0	1	0	0	0	0	0
CYANOPHYTA									
SCHIZOTHRIX	2	3	1	2	1	1	4	2	3
TOTAL	4	4	2	6	1	3	4	4	5

Table B-24. Units of periphytic algae in three replicate samples from cumulative acrylic plates downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	13 DEC			13 DEC			13 DEC		
REPLICATE	1			2			3		
CONVERSION FACTOR	1.18			1.18			1.18		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ANKISTRODESMUS	0	0	0	1	0	0	0	0	0
PEDIASTRUM	0	0	0	0	0	1	0	0	0
SCENEDESMUS	1	1	0	0	0	0	1	0	0
ULOTHRIX	0	0	0	0	0	0	3	0	0
UNIDENTIFIED									
CHLOROPHYTA	0	1	0	0	0	0	0	0	0
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	0	1	1	1	0	0
ASTERIONELLA	0	0	0	0	0	2	0	0	0
COCCONEIS	0	2	1	0	0	0	0	0	0
CYCLOTELLA	2	0	2	2	0	0	0	0	1
CYMBELLA	0	2	1	0	1	0	1	1	0
DIATOMA	0	0	0	0	0	0	0	0	1
FRAGILARIA	0	0	0	0	7	0	0	2	0
GOMPHONEMA	2	3	1	1	3	3	4	6	2
MELOSIRA	0	0	1	0	0	0	0	1	0
MERIDION	0	0	0	0	0	0	0	1	2
NAVICULA	18	13	26	10	10	10	20	34	26
NITZSCHIA	10	15	11	5	5	10	9	9	10
STEPHANODISCUS	0	0	0	0	0	0	0	0	1
SYNEDRA	4	2	3	0	1	1	3	6	2
CYANOPHYTA									
OSCILLATORIA	0	0	0	4	0	0	0	0	0
SCHIZOTHRIX	11	8	4	3	2	3	3	4	6
EUGLENOPHYTA									
UNIDENTIFIED									
EUGLENOPHYTA	0	0	0	0	0	0	0	0	1
TOTAL	48	47	50	26	30	31	45	64	52

Table B-25. Units of phytoplankton in three subsamples collected bimonthly upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	24 FEB			18 APR			15 JUN		
CONVERSION FACTOR	1961			35714			11905		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	0	0	0	0	0	83	87	72
ANKISTRODESMUS	0	0	0	0	0	0	15	13	11
CHLAMYDOMONAS	1	3	1	2	4	4	32	29	19
CHODATELLA	0	0	0	0	0	0	18	12	25
CRUCIGENIA	0	0	0	0	0	0	0	0	1
DICTYOSPHAERIUM	0	0	0	0	0	0	19	18	18
GOLENKINIA	0	0	0	0	0	0	2	1	3
KIRCHNERIELLA	0	0	0	0	0	0	2	3	5
MICRACTINIUM	0	0	0	0	0	0	29	12	12
OEDOGONIUM	0	0	0	0	3	0	0	0	0
OOCYSTIS	0	0	0	0	0	0	1	0	1
PEDIASTRUM	0	0	0	0	0	0	1	0	0
SCENEDESMUS	0	2	0	1	0	0	21	29	23
SCHROEDERIA	0	0	0	0	0	0	0	0	1
SELENASTRUM	0	0	0	0	0	0	2	5	2
TETRAEDRON	0	0	0	0	0	0	1	1	1
TETRASTRUM	0	0	0	0	0	0	1	5	0
TREUBARIA	0	0	0	0	0	0	0	1	1
UNIDENTIFIED CHLOROPHYTA	0	0	2	5	1	1	5	9	10
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	0	0	1	0	0	0
CYCLOTELLA	0	0	0	9	10	10	38	39	48
CYMBELLA	10	1	5	1	0	0	0	1	0
DIATOMA	1	1	1	0	0	0	0	0	0
EUNOTIA	0	0	0	0	1	0	0	0	0
FRAGILARIA	29	20	33	18	0	0	0	0	0
GOMPHONEMA	23	20	16	0	2	1	0	0	0
HANNAEA	1	0	0	0	0	0	0	0	0
MELOSIRA	0	0	0	0	0	2	0	3	0
MERIDION	2	1	1	1	0	0	0	0	0
NAVICULA	2	2	3	0	0	2	0	1	1
NITZSCHIA	6	4	7	4	1	3	1	2	2
RHOICOSPHENIA	0	0	0	0	1	0	0	0	0
STEPHANODISCUS	0	1	0	222	237	236	36	36	44
SURIRELLA	0	0	2	0	0	0	0	0	0
SYNEDRA	8	6	4	0	0	1	1	1	2
CYANOPHYTA									
CHROOCOCCUS	0	0	0	0	0	0	29	17	17
PHORMIDIUM	13	16	15	0	0	0	0	0	0
CHRYSOPHYTA									
DINOBYRON	0	0	6	0	0	0	0	0	0
TOTAL	96	77	96	263	260	261	337	325	319

Table B-26. Units of phytoplankton in three subsamples collected bimonthly downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	25 FEB			18 APR			16 JUN		
CONVERSION FACTOR	2564			35714			11905		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	0	0	0	0	0	0	79	78	74
ANKISTRODESMUS	3	1	1	0	0	1	12	14	12
CARTERIA	0	0	0	0	0	0	0	1	0
CHLAMYDOMONAS	0	0	0	5	2	4	31	39	38
CHODATELLA	0	0	0	0	0	0	42	27	68
CLOSTERIOPSIS	0	0	0	0	1	0	0	0	0
DICTYOSPHAERIUM	0	0	0	0	0	0	9	22	21
ELAKATOTHRIX	0	0	0	0	0	0	0	0	1
FRANCEIA	0	0	0	0	0	0	3	1	0
GOLENKINIA	0	0	0	0	0	0	0	1	0
KIRCHNERIELLA	2	0	0	0	0	0	2	2	4
MICRACTINIUM	0	0	0	0	0	0	10	10	14
SCENEDESMUS	4	1	0	0	0	0	23	29	18
SELENASTRUM	0	0	0	0	0	0	0	3	0
TETRAEDRON	0	0	0	0	0	0	0	2	3
TETRASTRUM	0	0	0	0	0	0	1	1	0
TREUBARIA	0	0	0	0	0	0	0	1	0
UNIDENTIFIED CHLOROPHYTA	0	0	1	4	1	0	15	13	6
BACILLARIOPHYTA									
ACHNANTHES	2	1	0	0	0	0	0	0	0
AMPHORA	1	1	0	0	0	0	0	0	0
ASTERIONELLA	0	0	0	0	1	0	0	0	0
COCCONEIS	2	0	2	0	0	1	0	0	0
CYCLOTELLA	0	0	0	10	10	11	30	31	29
CYMBELLA	2	13	7	1	0	2	0	1	0
DIATOMA	3	4	2	0	0	0	0	0	0
EUNOTIA	1	1	0	0	0	0	0	0	0
FRAGILARIA	87	147	121	0	0	0	0	0	0
GOMPHONEMA	33	36	28	3	1	0	0	0	0
HANNAEA	0	1	0	0	0	0	0	0	0
MELOSIRA	0	0	0	3	14	1	0	0	0
MERIDION	3	4	1	0	0	0	0	0	0
NAVICULA	16	27	11	1	0	0	1	1	0
NITZSCHIA	20	24	15	2	2	1	1	4	3
RHOICOSPHENIA	1	1	1	0	0	0	0	0	0
STEPHANODISCUS	6	2	3	243	256	267	35	37	35
SURIRELLA	0	1	5	0	0	0	0	0	0
SYNEDRA	9	15	13	2	4	2	1	4	0
THALASSIOSIRA	0	0	0	0	0	0	3	3	3
CYANOPHYTA									
CYANARCUS	4	1	1	0	0	0	0	0	0
PHORMIDIUM	13	24	22	0	0	0	0	0	0
UNIDENTIFIED CYANOPHYTA	0	0	0	0	0	0	10	5	3
CHRYSOPHYTA									
DINOBYRON	0	0	0	1	0	1	0	0	0
EUGLENOPHYTA									
TRACHELOMONAS	0	0	0	0	0	0	0	0	1
PYRRHOPHYTA									
UNIDENTIFIED PYRRHOPHYTA	0	0	0	0	1	0	0	0	0
TOTAL	212	305	234	275	293	291	308	330	333

Table B-27. Units of phytoplankton in three subsamples collected bimonthly upriver from the Susquehanna SES intake structure on the Susquehanna River, 1977.

DATE	15 AUG			14 OCT			13 DEC		
CONVERSION FACTOR	11905			1961			490		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ACTINASTRUM	1	4	0	0	0	1	0	0	0
ANKISTRODESMUS	7	5	3	0	0	2	0	0	0
CHLAMYDOMONAS	1	1	1	0	0	0	0	0	2
COELASTRUM	7	7	10	0	0	0	0	0	0
CRUCIGENIA	5	1	0	0	0	0	0	0	0
DICTYOSPHAERIUM	11	14	13	0	1	0	0	0	0
GOLENKINIA	0	0	1	0	0	0	0	0	0
KIRCHNERIELLA	20	11	18	0	0	0	0	0	0
OOCYSTIS	1	1	4	0	0	0	0	0	0
PANDORINA	1	0	0	0	0	0	0	0	0
PEDIASTRUM	1	1	0	0	2	0	0	0	0
SCENEDESMUS	52	52	52	0	2	2	0	0	2
SELENASTRUM	1	0	0	0	0	0	0	0	0
TETRAEDRON	3	2	1	0	0	0	0	0	0
TETRASTRUM	1	2	2	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	18	19	23	3	1	1	2	2	2
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	0	0	0	1	1	5
AMPHORA	0	0	0	0	1	0	2	0	0
ASTERIONELLA	0	0	0	1	0	0	5	3	2
COCCONEIS	0	0	0	2	2	0	1	1	1
CYCLOTELLA	87	75	60	2	3	6	2	3	4
CYMBELLA	0	0	0	2	0	0	3	6	4
DIATOMA	0	0	0	0	0	0	0	0	1
FRAGILARIA	0	0	0	0	0	0	2	0	0
GOMPHONEMA	0	0	0	3	0	2	7	8	10
MELOSIRA	0	0	4	2	3	3	4	0	2
MERIDION	0	0	0	0	0	0	1	0	2
NAVICULA	1	0	1	3	4	9	8	19	16
NITZSCHIA	3	4	6	7	11	7	17	15	11
STEPHANODISCUS	4	4	3	0	1	0	0	0	1
SURIRELLA	0	0	0	0	0	0	0	2	0
SYNEDRA	0	0	0	0	0	2	0	6	0
THALASSIOSIRA	0	0	0	0	0	3	0	0	0
CYANOPHYTA									
ANABAENA	0	0	0	0	0	0	0	0	5
CHROOCOCCUS	2	1	4	0	0	1	0	0	0
MERISMOPEDIA	3	2	0	0	0	0	0	0	0
OSCILLATORIA	0	0	0	0	0	0	2	0	0
SCHIZOTHRIX	0	0	0	0	0	0	4	1	0
CHRYSOPHYTA									
DINOBYRON	0	0	0	2	0	0	4	0	0
MALLOMONAS	0	0	0	0	0	0	0	0	2
SYNURA	0	0	0	0	1	0	0	1	1
PYRRHOPHYTA									
GLENODINIUM	0	1	0	0	0	0	0	0	0
TOTAL	230	207	206	27	32	39	65	68	73

Table B-28. Units of phytoplankton in three subsamples collected bimonthly downriver from the Susquehanna SES discharge diffuser on the Susquehanna River, 1977.

DATE	16 AUG			14 OCT			13 DEC		
CONVERSION FACTOR	11905			1961			490		
TAXON	A	B	C	A	B	C	A	B	C
CHLOROPHYTA									
ANKISTRODESMUS	3	5	2	1	1	0	0	0	0
CHLAMYDOMONAS	0	3	1	0	0	1	0	0	1
COELASTRUM	21	14	11	0	0	0	0	0	0
COSMARIUM	1	3	0	0	0	0	0	0	0
DICTYOSPHAERIUM	6	6	17	0	0	0	0	0	0
FRANCEIA	0	1	0	0	0	0	0	0	0
KIRCHNERIELLA	15	6	8	0	0	0	0	0	0
PEDIASTRUM	1	1	0	0	0	0	0	0	0
SCENEDESMUS	33	49	48	2	1	1	0	2	1
TETRAEDRON	0	1	5	0	0	0	0	0	0
TREUBARIA	0	2	0	0	0	0	0	0	0
UNIDENTIFIED CHLOROPHYTA	11	9	12	2	0	0	1	5	2
BACILLARIOPHYTA									
ACHNANTHES	0	0	0	1	1	1	3	2	8
ASTERIONELLA	0	0	0	0	0	0	3	8	4
COCCONEIS	0	0	0	1	0	0	1	0	3
CYCLOTELLA	149	141	133	8	7	9	6	7	1
CYMBELLA	0	0	0	2	1	2	2	4	7
DIATOMA	0	0	0	0	0	0	1	1	0
DIPLONEIS	0	0	0	0	0	0	0	1	0
FRAGILARIA	0	0	0	0	4	2	0	17	0
GOMPHONEMA	0	0	0	1	1	0	12	10	8
HANTZSCHIA	0	0	0	0	0	0	0	0	1
MELOSIRA	2	8	0	30	9	0	1	0	9
MERIDION	0	0	0	1	0	0	0	2	0
NAVICULA	1	0	0	6	4	7	23	25	20
NITZSCHIA	2	1	9	6	9	6	25	24	21
STEPHANODISCUS	8	7	7	0	1	0	0	1	0
SURIRELLA	0	0	0	1	0	0	0	1	1
SYNEDRA	0	0	0	1	1	2	6	4	4
TABELLARIA	0	0	0	0	0	0	1	0	0
THALASSIOSIRA	0	0	0	1	0	0	0	0	0
CYANOPHYTA									
ANABAENA	0	0	0	0	0	0	1	0	0
CHROOCOCCUS	7	2	0	0	0	0	0	0	0
MERISMOPEDIA	3	3	2	0	0	0	0	0	0
OSCILLATORIA	0	0	0	0	0	0	4	3	8
SCHIZOTHRIX	1	0	0	0	0	0	1	1	1
CHRYSOPHYTA									
DINOBYRON	0	0	0	0	1	8	4	2	2
MALLOMONAS	0	0	0	0	0	0	0	1	0
SYNURA	0	0	0	0	1	0	0	0	2
CRYPTOPHYTA									
CRYPTOMONAS	0	0	0	1	0	0	0	0	0
TOTAL	264	262	255	65	42	39	95	121	104

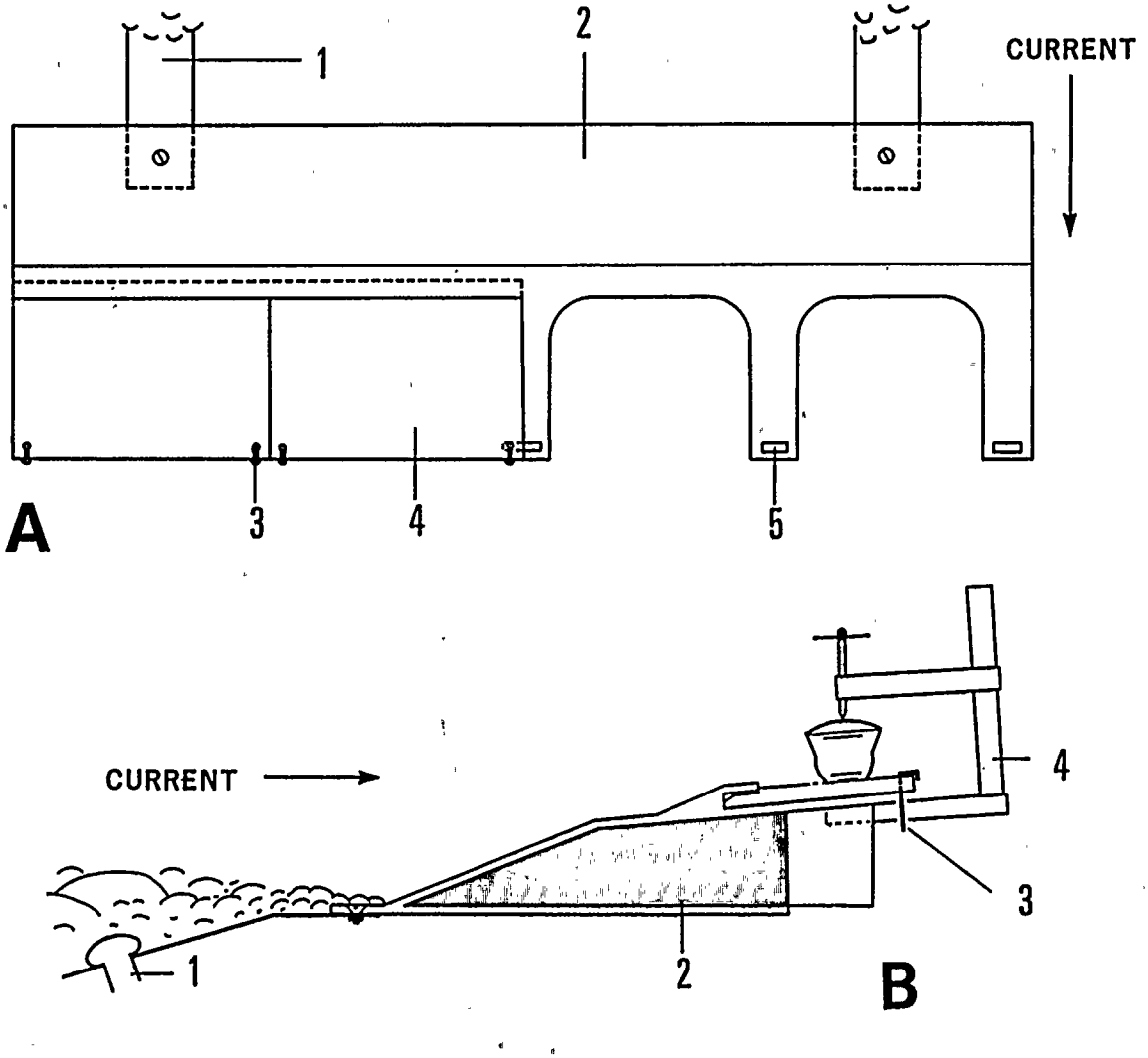

Fig. B-1. Detritus-free apparatus for periphytic algae studies.
A. Acrylic holder with two plates removed (top view):
1) metal retaining strap; 2) deflecting shield, acrylic;
3) brass pin; 4) acrylic plate; 5) pin retaining slot.
B. Acrylic holder (end view) with sampler in place:
1) steel strap (buried); 2) concrete ballast; 3) brass
pin; 4) bar-clamp sampler.

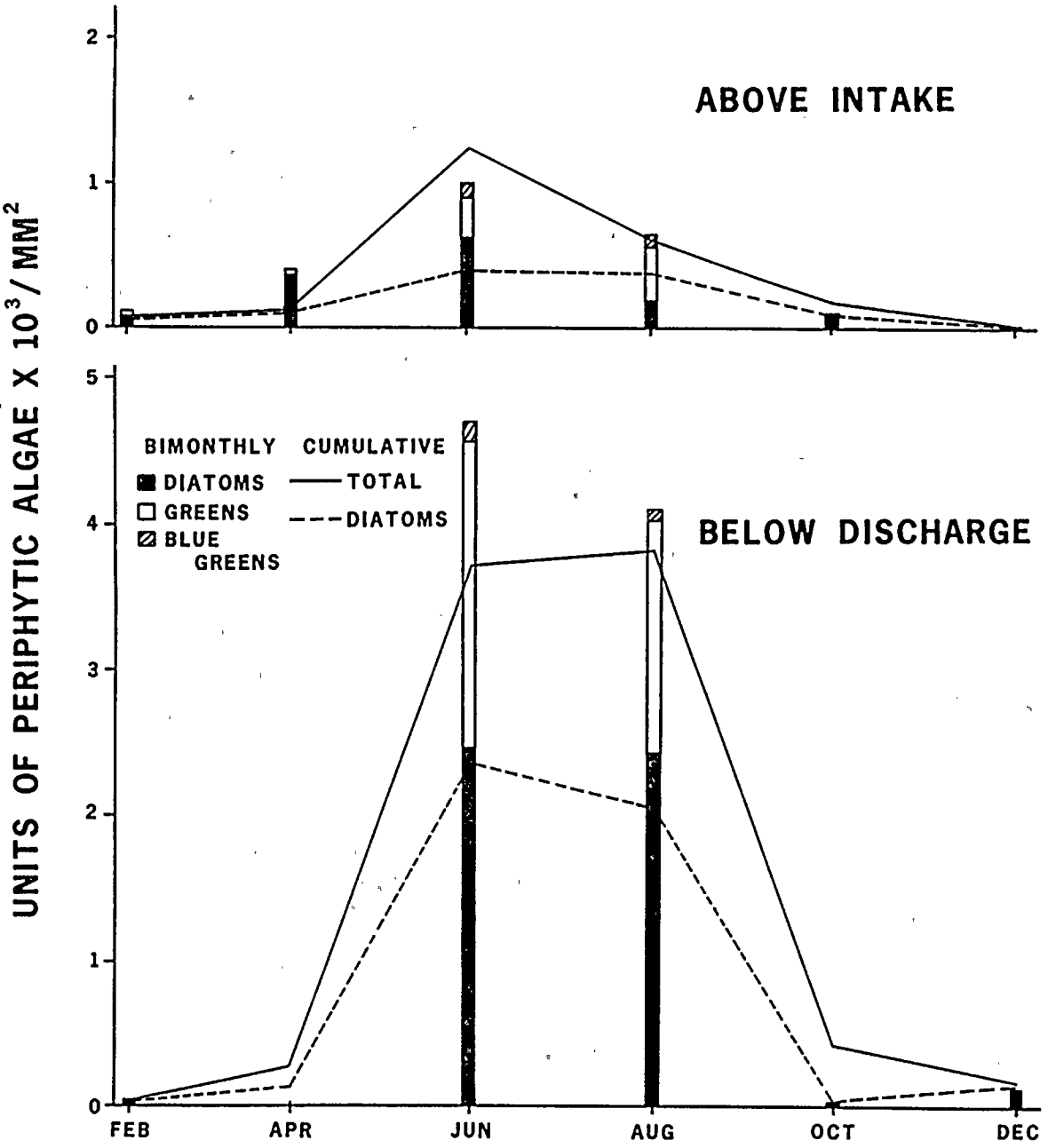

Fig. B-2. Standing crop of algae (units/mm^2) on bimonthly and cumulative acrylic plates upriver from the intake structure and downriver from the discharge diffuser of the Susquehanna SES on the Susquehanna River, 1977 (the bimonthly plate below the discharge was lost in April).

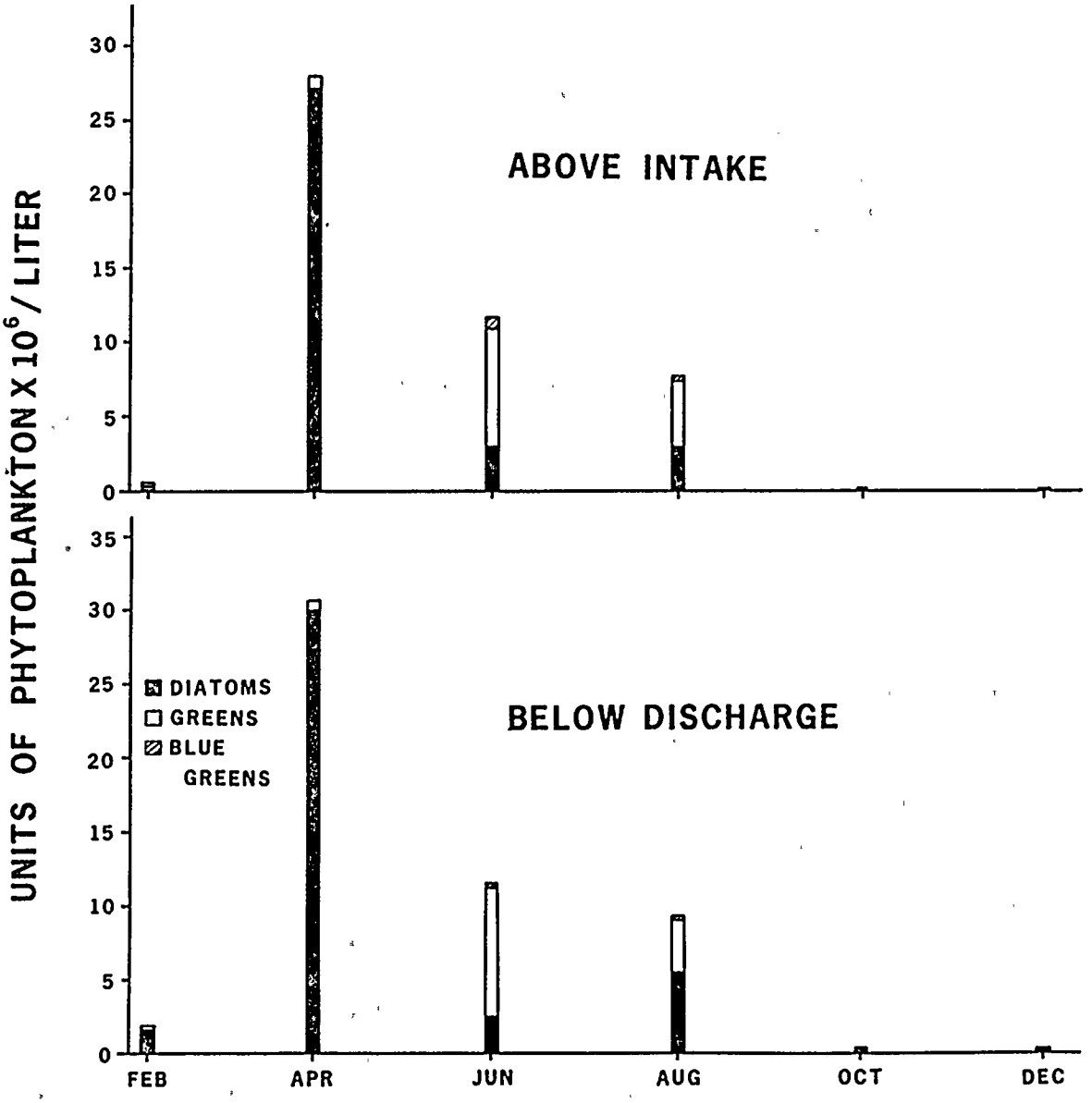

Fig. B-3. Standing crop of algae (units/liter) from bimonthly samples taken upriver from the intake structure and downriver from the discharge diffuser of the Susquehanna SES on the Susquehanna River, 1977.

BENTHIC MACROINVERTEBRATES

by

William G. Deutsch

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ABSTRACT

The benthic macroinvertebrate community that inhabits the Susquehanna River near the Susquehanna SES was sampled at three sites in April, June, and October 1977. Two sites were on a transect upriver from the intake structure, and the other was below the discharge diffuser. Overall mean density of macroinvertebrates at sites above the intake was 3,350 organisms/m^2, and below the diffuser it was 5,108 org/m^2. Oligochaetes (especially Nais spp. and Limnodrilus sp.), mayflies (Isonychia sp. and Stenonema spp.), caddisflies (Cheumatopsyche sp. and Hydropsyche phalerata), and chironomids (Nanocladius sp. and Rheotanytarsus sp.) composed more than 93% of the total number of macroinvertebrates at all sites. There were 3-fold fewer macroinvertebrates collected in 1977 than in 1976, primarily due to smaller populations of naidid worms, and the chironomids Rheotanytarsus sp. and Cricotopus spp.

Chironomids from 121 basket samples collected at five stations on the Susquehanna River in 1972 were identified to genus or species, and populations of them were described. Of the 116,240 chironomids collected, Rheotanytarsus sp. composed about 70%. Only four other taxa (Polypedilum sp., Conchapelopia grp., Nanocladius sp., and Cricotopus bicinctus) of the 38 collected, composed more than 2% of the total number.

INTRODUCTION

Benthic macroinvertebrates are one of the most useful groups of organisms for the study of aquatic environments. In recent studies of European rivers (Clarke et al. 1977), they were the most frequently used community in biological classification. Because populations of macroinvertebrates are often large and relatively sessile, they are useful in the detection of pollution sources (Gaufin 1958, Goodnight 1973). Certain species are highly selective in their choice of habitat, and are, therefore, important indicators of both environmental quality and change (Paine and Gaufin 1956).

Environmental evaluations have been made by identification of macroinvertebrates to order or family (Mackenthum and Ingram 1967), but it has been shown that species within these groups have wide ranges of physicochemical tolerances (Resh and Unzicker 1975). For this reason, the trend has been toward species identifications for accurate interpretation of macroinvertebrate data. Lack of taxonomic keys (especially for immature insect stages) was a problem. However, a recent influx of new literature (Lewis 1974; Beck 1976; Edmunds et al. 1976; Resh 1976; Saether 1976, 1977a, 1977b; Wiggins 1977) has been helpful, not only for identification purposes, but also for the study of the distribution, ecology, and pollution tolerances of many species.

The objective of this study was to monitor seasonal changes in the benthic macroinvertebrate community of the Susquehanna River near the Susquehanna SES. In addition to the collection and analyses of 1977 data,

chironomids (Diptera: Chironomidae) collected in 1972 basket samples were identified to genus or species and populations of them were described.

PROCEDURES

Benthic macroinvertebrates were collected at three sites near the Susquehanna SES. Two sites (SSES I and SSES II) were on a transect upriver from the intake structure, and the other (Bell Bend I) was below the discharge diffuser (Fig. A-1). The location of these stations was unchanged from 1976. Stations were remeasured in 1977 with a Watts Microptic Alidade (Model SA 100TS) and are described in Table C-1.

Three replicate dome suction samples (Gale and Thompson 1975) were collected at each site on 12-13 April, 6-8 June, and 26 October 1977. After the dome sampler was lowered from a boat to the River bottom, a scuba diver moved it upriver or laterally to the first undisturbed area encountered, where an adequate seal between the sampler band and the substrate could be established. The area (0.163 m^2) enclosed by the sampler 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 nylon net (216-μ mesh); larger stones were carefully vacuumed and discarded. When all three replicates were collected, they were 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 immediately

after it was collected (Deutsch 1976). Damp weights were determined after freshly-sorted organisms were centrifuged on screens (3,200 rpm for 15 s), and dry weights were determined after organisms were dehydrated at 100 C for at least 12 h.

The other two replicates were washed, sieved, 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 dissecting microscope (30 X), 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/sample. Number/square meter was determined by multiplying the total number of organisms/sample by 6.135. All data were stored in and processed with a Hewlett-Packard 9830A computer. Organisms were identified with the keys of Ross (1944), Pennak (1953), Parrish (1968), Hilsenhoff (1970), Lewis (1974), Beck (1976), and Resh (1976).

To more thoroughly describe chironomid populations of the River, specimens collected in 121 basket samples at five stations (Table C-2; Fig. C-1) from April through December 1972 (Ichthyological Associates 1973) were identified to genus or species. Both cement spheres and stones were used as artificial substrates in the baskets, but a non-parametric sign test revealed no significant difference in either the number of taxa or the total abundance of organisms which colonized the

two substrates. Therefore, data from all basket samples were combined for analysis. Large samples, which contained up to 11,000 organisms, were randomly subsampled before they were sorted.

Mature chironomid larvae of some genera could be identified at 70 X magnification, but others had to be dissected and examined with a compound microscope at 100-400 X. The head capsule of those in the latter group was dissected from the body with "minuten nadeln" probes (size 000 insect pins) and mounted ventral-side up in polyvinyl lactophenol on microscope slides. Enough pressure was applied to the coverslip to partially squash the head capsule and spread apart the mouthparts which are needed for identification.

RESULTS AND DISCUSSION

Macroinvertebrates from 1977 Dome Samples

Overall mean density of macroinvertebrates was higher at Bell Bend I (5,108 org/m^2) than at SSES I (3,039 org/m^2) or SSES II (3,661 org/m^2). Macroinvertebrates were most abundant in June at SSES I ($\bar{x}$ = 8,141 org/m^2) and Bell Bend I ($\bar{x}$ = 9,518 org/m^2), and densities of them at SSES II were highest in October ($\bar{x}$ = 5,899 org/m^2). Minimum macroinvertebrate densities were found at all sites in April (Tables C-3 through C-11). Oligochaetes (especially Nais spp. and Limnodrilus spp.), mayflies (Isonychia sp. and Stenonema spp.), caddisflies (Cheumatopsyche sp. and Hydropsyche phalerata), and chironomids (Nanocladius sp., and Rheotanytarsus sp.) composed more than 93% of the total number of macroinvertebrates at

all sites (Table C-12). A total of 61 macroinvertebrate taxa was found at Bell Bend I, 59 at SSES II, and 50 at SSES I.

Macroinvertebrate densities in April 1977 were much lower than in April 1976. The 11-fold reduction was primarily due to smaller numbers of naidid worms and the chironomids, Rheotanytarsus sp., Cricotopus spp., and Nanocladius sp. (Table C-13). Caddisflies (especially Cheumatopsyche sp. and Hydropsyche phalerata) composed from 39% to 62% of the total number of organisms at all sites (Tables C-3, C-6, C-9).

Between April and June, there was a sharp increase in densities of naidid worms, mayflies, and chironomids at all sites (Tables C-4, C-7, C-10). Mayflies were particularly abundant (2,322 org/m^2) at SSES I, and 10 species of 7 families were collected. The most common mayflies were Isonychia sp., immature Stenonema spp., and Caenis sp.. Of the chironomids, numbers of Nanocladius sp., Rheotanytarsus sp., and Cricotopus spp. increased the most (Table C-13). Nanocladius sp. composed more than half the number of chironomids at SSES II and Bell Bend I, and densities of it reached 1,770 org/m^2 at the latter station.

By October, numbers of macroinvertebrates declined to much lower levels than those of 1976, especially at SSES I where there was a 30-fold reduction. The chironomid, Nanocladius sp., which was abundant in June, was absent from SSES I and SSES II, and scarce at Bell Bend I (12 org/m^2), probably due to the emergence of the adults. Whereas densities of most macroinvertebrates decreased, those of Cheumatopysche sp. increased from 2- to 4-fold at SSES II and Bell Bend I (Tables C-8, C-11).

There were 26 additions to the 1976 macroinvertebrate species list (Table C-14). Most of these organisms had been collected in previous years but were more specifically identified in 1977. Identifications of 16 additional chironomids were verified by Mr. William M. Beck (Florida A & M University). Because of revisions in taxonomy, names of three chironomids from previous species lists were changed:

1. Psectrocladius now is Nanocladius
2. Chironomus attenuatus now is C. decorus
3. Lobodiamesa sp. now is Diamesa sp. #4

Four species of heptageniid mayflies were identified in 1977 and verified by Dr. Philip A. Lewis (National Environmental Research Center, Cincinnati). This resulted in three revisions of previous lists:

1. Stenonema sp. #1 now is S. nepotellum
2. Stenonema sp. #2 now is S. interpunctatum
3. Stenonema sp. #3 now is S. rubrum

The community indices of percent similarity and coefficient of community (Whittaker and Fairbanks 1958) were generally higher between SSES II and Bell Bend I, than between SSES I and other sites (Tables C-15, C-16). There is a finer substrate at SSES I than at SSES II or Bell Bend I, and this difference may be reflected in the macroinvertebrate communities at these sites. Rheotanytarsus sp. seemingly preferred the gravel-pebble substrate of SSES I, and densities of it there were from 2- to 5-fold greater than at SSES II or Bell Bend I in 1975-76 (Deutsch 1976, 1977). In 1977, late instar Cheumatopsyche sp. seemed to prefer the coarser, pebble-cobble substrate of SSES II. Buscemi (1964) noted that optimum

habitats for filter-feeding caddisflies, like Cheumatopsyche, may be in crevices with low current velocities.

Overall mean damp weight of macroinvertebrates was greater at SSES II (44.7 kg/ha) than at SSES I (10.5 kg/ha) or Bell Bend I (28.6 kg/ha). Damp weight was greatest at SSES II (47.9 kg/ha) and Bell Bend I (45.2 kg/ha) in April, when density of macroinvertebrates was lowest. Greatest damp weight was found at SSES I (18.9 kg/ha) in June (Tables C-17 through C-25). Hydropsychid caddisflies, heptageniid mayflies, and oligochaetes composed from 62% (SSES I) to 73% (Bell Bend I) of the total damp weight at all sites, although late instar Isonychia sp. and Potamanthus sp. composed a large portion of the June biomass. At SSES I and Bell Bend I, biomass was from 2- to 5-fold less than in 1976, but at SSES II, a 25% increase in damp weight of hydropsychids resulted in a greater mean biomass than in 1976. Dry weights were from 19% to 30% ($\bar{x}$ = 23%) of damp weights at all sites.

Chironomidae from 1972 Basket Samples

A total of 116,240 chironomids was collected from 121 basket samples (Tables C-26 through C-46). Of these, 19,655 were individually examined and identified; about 4,800 of them were mounted on microscope slides and placed in a permanent reference collection. Except Cricotopus, generic names were not counted as separate taxa if species within them were identified, and no family or subfamily names were counted as taxa. Data from all sites of the SSES station were combined for analysis.

Thirty-eight chironomid taxa were collected, and 13 identified to species (Table C-47). The subfamily Chironominae comprised the most taxa (20), followed by the Orthocladiinae (13), and Tanypodinae (5). The greatest variety of chironomids (29 taxa) was found at SSES, probably due to more intensive sampling there. Falls, Wilkes-Barre (2), and Nanticoke had a moderate number of taxa (18-24), and Nescopeck had the least (12 taxa).

Mine drainage and sewage pollution had a harmful effect on most chironomid populations. At Nanticoke, the most polluted station, total mean density of chironomids was only 8% of that at Falls and Wilkes-Barre (2), 20% of that at SSES, and 2% of that at Nescopeck (Tables C-48 through C-52). At Nescopeck, chironomids were extremely abundant in spite of pollution because of large amounts of filamentous algae which accumulated in the basket samplers. Chironomids were generally more sensitive to mine drainage and sewage pollution than oligochaetes, but less sensitive than mayflies and caddisflies (Table C-53). This difference in sensitivity was most obvious in late summer, when water quality was poorest.

Rheotanytarsus sp. composed about 70% of the chironomid populations (Table C-54), and it was the most abundant genus at Falls (62%), Wilkes-Barre (2) (29%), and Nescopeck (85%). Overall mean density ($\bar{x}$ = 14,798 org/m^2) of Rheotanytarsus sp. was highest at Nescopeck; Rheotanytarsus sp. was especially abundant there in September (45,089 org/m^2), when the largest amounts of the filamentous alga, Oedogonium sp., accumulated in the basket samplers. This abundant food supply, coupled with the

relatively shallow riffles of the station, seemed to make an ideal environment for this chironomid. Low diversity of other chironomids at Nescopeck was probably due to the success of Rheotanytarsus sp. as a competitor for food and space. In July, September, and October, when Rheotanytarsus sp. was most abundant, density of it was positively correlated with density of hydropsychid caddisflies; it was negatively correlated with oligochaete density and concentrations of total iron (Tables C-55 through C-57).

Only four other taxa composed more than 2% of the total number of chironomids (Table C-54). Included were Polypedilum sp. (8.8%), Conchapelopia grp. (6.7%), Cricotopus bicinctus (5.6%), and Nanocladius sp. (2.8%). Polypedilum sp. was the most abundant chironomid at SSES and composed 42.4% of the total number. In September, density of Polypedilum sp. reached a maximum at Wilkes-Barre (2) (2,265 org/m^2) and SSES (3,276 org/m^2) and exceeded those at Falls (516 org/m^2) and Nescopeck (1,991 org/m^2). The greater abundance of Polypedilum sp. at Wilkes-Barre (2) and SSES may have been due to less competition from Rheotanytarsus sp.

Conchapelopia grp. was the most abundant chironomid at Nanticoke, and composed 36.8% of the total number. In December, densities of it reached a maximum of 343 org/m^2. Conchapelopia grp. was one of the few predaceous chironomids collected, and its prey included water mites and four kinds of chironomids. Rheotanytarsus sp. was the most common chironomid prey (57%), followed by Cricotopus spp. (29%), Polypedilum sp.

(10%), and Nanocladius sp. (5%). These species occur in about the same percentages in natural populations, and Conchapelopia grp. seems to be a nonselective feeder. About 70% of all occurrences of predation were in September.

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Table C-1. Description and location of benthic macroinvertebrate sampling stations on the Susquehanna River, 1977 (see Fig. A-1).

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 the west bank, 1,467 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 C-2. Description and location of benthic macroinvertebrate sampling stations on the Susquehanna River, 1972.

Station	Distance (km) from SSES[a]	Depth[b] (m)	Substate Type[c]	Distance (m) from West Bank	East Bank
Falls	+64	2.3	cobble-boulder	90	
Wilkes-Barre (2)	+34	1.0	gravel-cobble		15
Nanticoke	+22	1.6	gravel-cobble	110	
SSES A	0	1.3	gravel-cobble	75	
B	0	2.2	gravel-cobble	110	
C	0	1.0	gravel-cobble	15	
D	0	1.0	mud-sand		7
E	0	1.3	mud		9
Nescopeck	-10	0.5	gravel-bedrock		50

[a]A plus (+) indicates upriver from SSES; a minus (-) indicates downriver from SSES.

[b]Station depths when River surface elevation is 148.9 m above msl at Ichthyological Associates Laboratory.

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

Table C-3. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 13 April 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TUBIFICIDAE	1	1	1.0	6.1
POTAMANTHUS	2	0	1.0	6.1
EPHEMERELLA	0	1	0.5	3.0
HEPTAGENIIDAE	0	1	0.5	3.0
STENONEMA	1	0	0.5	3.0
STENONEMA PULCHELLUM	1	0	0.5	3.0
POLYCENTROPUS	1	0	0.5	3.0
CHEUMATOPSYCHE	5	3	4.0	24.2
HYDROPSYCHE PHALERATA	3	1	2.0	12.1
PSEPHENUS HERRICKI	0	1	0.5	3.0
STENELMIS	3	0	1.5	9.1
EMPIDIDAE	0	1	0.5	3.0
CHIRONOMIDAE (PUPAE)	0	1	0.5	3.0
CONCHAPELOPIA GRP	2	2	2.0	12.1
POLYPEDILUM	1	0	0.5	3.0
UNIDENTIFIED TERRESTRIAL	1	0	0.5	3.0
TOTAL ORGANISMS	21	12	17	
ORGANISMS/M2	129	74	101	

Table C-4. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 6 June 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
PROSTOMA RUBRUM	0	6	3.0	0.2
NEMATODA	10	6	8.0	0.6
NAIDIDAE	446	345	395.5	29.8
TUBIFICIDAE	3	6	4.5	0.3
TAENIOPTERYX	0	1	0.5	0.0
NEOPERLA	7	3	5.0	0.4
EPHORON	7	10	8.5	0.6
POTAMANTHUS	12	2	7.0	0.5
CAENIS	86	37	61.5	4.6
EPHEMERELLA	17	1	9.0	0.7
EPHEMERELLA DEFICIENS	9	6	7.5	0.6
BAETIS	3	0	1.5	0.1
PSEUDOCLOEON	1	4	2.5	0.2
ISONYCHIA	180	35	107.5	8.1
HEPTAGENIIDAE	0	128	64.0	4.8
HEPTAGENIA	0	24	12.0	0.9
STENONEMA	185	3	94.0	7.1
STENONEMA NEPOTELLUM	2	1	1.5	0.1
STENONEMA PULCHELLUM	3	1	2.0	0.2
TRICHOPTERA (PUPAE)	0	3	1.5	0.1
HYDROPSYCHIDAE (PUPAE)	3	0	1.5	0.1
CHEUMATOPSYCHE	241	281	261.0	19.7
HYDROPSYCHE BIFIDA GRP	6	0	3.0	0.2
HYDROPSYCHE PHALERATA	22	1	11.5	0.9
HYDROPTILIDAE	12	12	12.0	0.9
CERACLEA	1	0	0.5	0.0
CERACLEA NEPHA	0	7	3.5	0.3
CERACLEA TARSIPUNCTATA	0	1	0.5	0.0
OECETIS	1	5	3.0	0.2
OECETIS CINERACENS	4	4	4.0	0.3
DUBIRAPHIA	0	1	0.5	0.0
STENELMIS	26	29	27.5	2.1
STENELMIS (ADULTS)	5	0	2.5	0.2
SIMULIIDAE	14	1	7.5	0.6
EMPIDIDAE	1	1	1.0	0.1
EMPIDIDAE (PUPAE)	1	0	0.5	0.0
CHIRONOMIDAE (PUPAE)	2	8	5.0	0.4
ABLABESMYIA MALLOCHI	0	2	1.0	0.1
CONCHAPELOPIA GRP	4	12	8.0	0.6
CRYPTOCHIRONOMUS FULVUS	0	1	0.5	0.0
GLYPTOTENDIPES	0	1	0.5	0.0
PARACHIRONOMUS PECTINATELLAE	17	57	37.0	2.8
POLYPEDILUM	1	16	8.5	0.6
RHEOTANYTARSUS	96	45	70.5	5.3
TANYTARSUS	0	3	1.5	0.1
ZAVRELIA	0	2	1.0	0.1
CRICOTOPUS	5	6	5.5	0.4
CRICOTOPUS BICINCTUS	1	0	0.5	0.0
EUKIEFFERIELLA SP#1	4	0	2.0	0.2
NANOCLADIUS	70	28	49.0	3.7
TOTAL ORGANISMS	1508	1146	1327	
ORGANISMS/M2	9252	7031	8141	

Table C-5. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 26 October 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	5	2	3.5	2.5
PROSTOMA RUBRUM	9	1	5.0	3.5
NEMATODA	5	1	3.0	2.1
NAIDIDAE	8	2	5.0	3.5
TUBIFICIDAE	19	14	16.5	11.6
POTAMANTHUS	6	4	5.0	3.5
ISONYCHIA	0	1	0.5	0.4
HEPTAGENIIDAE	4	2	3.0	2.1
RHITHROGENA	4	0	2.0	1.4
STENONEMA	3	0	1.5	1.1
STENONEMA FUSCUM	1	0	0.5	0.4
STENONEMA ITHACA	1	0	0.5	0.4
CHEUMATOPSYCHE	24	20	22.0	15.4
HYDROPSYCHE BIFIDA GRP	1	1	1.0	0.7
HYDROPSYCHE PHALERATA	3	5	4.0	2.8
STENELMIS	10	1	5.5	3.9
EMPIDIDAE	9	10	9.5	6.7
CHIRONOMIDAE (PUPAE)	1	0	0.5	0.4
CONCHAPELOPIA GRP	25	8	16.5	11.6
CRYPTOCHIRONOMUS FULVUS	5	7	6.0	4.2
DICROTENDIPES	4	0	2.0	1.4
GLYPTOTENDIPES	2	2	2.0	1.4
MICROTENDIPES	0	1	0.5	0.4
POLYPEDILUM	36	10	23.0	16.1
RHEOTANYTARSUS	1	6	3.5	2.5
EUKIEFFERIELLA COERULESCENS GRP SP#1	0	1	0.5	0.4
TOTAL ORGANISMS	186	99	143	
ORGANISMS/M2	1141	607	874	

Table C-6. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 13 April 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	1	1	1.0	0.5
NEMATODA	10	6	8.0	4.0
NAIDIDAE	4	4	4.0	2.0
TUBIFICIDAE	20	7	13.5	6.8
POTAMANTHUS	4	4	4.0	2.0
EPHEMERELLA	0	4	2.0	1.0
EPHEMERELLA BICOLOR	1	0	0.5	0.3
ISONYCHIA	1	0	0.5	0.3
HEPTAGENIIDAE	0	5	2.5	1.3
STENONEMA PULCHELLUM	0	4	2.0	1.0
CHEUMATOPSYCHE	63	140	101.5	51.3
HYDROPSYCHE BIFIDA GRP	1	3	2.0	1.0
HYDROPSYCHE PHALERATA	6	17	11.5	5.8
OECETIS CINERACENS	3	12	7.5	3.8
BEROSUS	1	0	0.5	0.3
ELMIDAE (ADULTS)	2	1	1.5	0.8
STENELMIS	2	6	4.0	2.0
EMPIDIDAE	24	10	17.0	8.6
CHIRONOMIDAE (PUPAE)	1	0	0.5	0.3
CONCHAPELOPIA GRP	8	2	5.0	2.5
DICROTENDIPES	1	0	0.5	0.3
RHEOTANYTARSUS	2	0	1.0	0.5
BRILLIA	0	1	0.5	0.3
CRICOTOPUS	2	0	1.0	0.5
EUKIEFFERIELLA SP#1	1	0	0.5	0.3
NANOCLADIUS	4	1	2.5	1.3
UNIDENTIFIED TERRESTRIAL	0	1	0.5	0.3
PISIDIUM	2	0	1.0	0.5
SPHAERIUM	3	0	1.5	0.8
TOTAL ORGANISMS	167	229	198	
ORGANISMS/M2	1025	1405	1215	

Table C-7. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 7 June 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	1	0	0.5	0.1
PROSTOMA RUBRUM	0	8	4.0	0.6
NEMATODA	5	10	7.5	1.2
NAIDIDAE	106	152	129.0	20.5
TUBIFICIDAE	8	25	16.5	2.6
TAENIOPTERYX	0	1	0.5	0.1
EPHORON	1	9	5.0	0.8
POTAMANTHUS	2	7	4.5	0.7
CAENIS	0	27	13.5	2.1
EPHEMERELLA DEFICIENS	0	1	0.5	0.1
BAETIS	1	0	0.5	0.1
ISONYCHIA	4	5	4.5	0.7
HEPTAGENIIDAE	0	26	13.0	2.1
STENONEMA	3	0	1.5	0.2
STENONEMA NEPOTELLUM	0	1	0.5	0.1
SIALIS	0	17	8.5	1.3
TRICHOPTERA (PUPAE)	4	5	4.5	0.7
PROTOPTILA	0	1	0.5	0.1
CHEUMATOPSYCHE	9	169	89.0	14.1
HYDROPSYCHE PHALERATA	1	0	0.5	0.1
HYDROPTILIDAE	0	8	4.0	0.6
CERACLEA	3	0	1.5	0.2
CERACLEA ANCYLUS	2	0	1.0	0.2
CERACLEA MACULATA	16	1	8.5	1.3
CERACLEA NEPHA	14	5	9.5	1.5
OECETIS	0	5	2.5	0.4
OECETIS CINERACENS	1	1	1.0	0.2
OECETIS INCONSPICUA	3	1	2.0	0.3
OPTIOSERVUS	0	1	0.5	0.1
STENELMIS	1	10	5.5	0.9
STENELMIS (ADULTS)	1	0	0.5	0.1
SIMULIIDAE	1	1	1.0	0.2
EMPIDIDAE	3	13	8.0	1.3
CHIRONOMIDAE (PUPAE)	33	7	20.0	3.2
CONCHAPELOPIA GRP	2	4	3.0	0.5
TANYPODINAE SP#1	0	9	4.5	0.7
CHIRONOMUS	1	0	0.5	0.1
CRYPTOCHIRONOMUS FULVUS	0	1	0.5	0.1
DICROTENDIPES MODESTUS	0	1	0.5	0.1
GLYPTOTENDIPES	35	8	21.5	3.4
PARACHIRONOMUS MONOCHROMUS	0	1	0.5	0.1
PARACHIRONOMUS PECTINATELLAE	13	13	13.0	2.1
POLYPEDILUM	11	18	14.5	2.3
RHEOTANYTARSUS	35	39	37.0	5.9
TANYTARSUS	0	1	0.5	0.1
DIAMESA SP# 4	0	1	0.5	0.1
CRICOTOPUS	14	21	17.5	2.8
CRICOTOPUS BICINCTUS	0	2	1.0	0.2
EUKIEFFERIELLA SP#1	1	1	1.0	0.2
NANOCLADIUS	124	162	143.0	22.7
SPHAERIUM	1	2	1.5	0.2
TOTAL ORGANISMS	460	801	631	
ORGANISMS/M2	2822	4914	3868	

Table C-8. Number and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 26 October 1977.

REPLICATE	1	2		
AREA SAMPLED (M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	11	14	12.5	1.3
PROSTOMA RUBRUM	9	18	13.5	1.4
NEMATODA	11	36	23.5	2.4
NAIDIDAE	24	16	20.0	2.1
TUBIFICIDAE	15	23	19.0	2.0
TAENIOPTERYX	0	5	2.5	0.3
POTAMANTHUS	14	12	13.0	1.4
EPHEMERELLA	1	1	1.0	0.1
ISONYCHIA	2	3	2.5	0.3
HEPTAGENIIDAE	22	4	13.0	1.4
STENONEMA	13	16	14.5	1.5
STENONEMA FUSCUM	0	1	0.5	0.1
STENONEMA ITHACA	4	2	3.0	0.3
STENONEMA PULCHELLUM	11	8	9.5	1.0
SIALIS	1	0	0.5	0.1
POLYCENTROPUS	0	1	0.5	0.1
CHEUMATOPSYCHE	326	421	373.5	38.8
HYDROPSYCHE BIFIDA GRP	9	21	15.0	1.6
HYDROPSYCHE PHALERATA	76	76	76.0	7.9
NACRONEMA CAROLINA	1	0	0.5	0.1
HYDROPTILIDAE	0	4	2.0	0.2
OECETIS	4	36	20.0	2.1
OECETIS CINERACENS	0	8	4.0	0.4
ELMIDAE (ADULTS)	0	2	1.0	0.1
DUBIRAPHIA	0	1	0.5	0.1
OPTIOSERVUS	0	1	0.5	0.1
STENELMIS	7	6	6.5	0.7
SIMULIIDAE	1	0	0.5	0.1
EMPIDIDAE	39	47	43.0	4.5
CHIRONOMIDAE (PUPAE)	0	2	1.0	0.1
CONCHAPELOPIA GRP	70	111	90.5	9.4
CRYPTOCHIRONOMUS BLARINA	4	1	2.5	0.3
CRYPTOCHIRONOMUS FULVUS	0	1	0.5	0.1
DICROTENDIPES MODESTUS	1	5	3.0	0.3
GLYPTOTENDIPES	3	4	3.5	0.4
MICROTENDIPES	2	0	1.0	0.1
PARACHIRONOMUS CARINATUS	0	4	2.0	0.2
POLYPEDILUM	58	29	43.5	4.5
RHEOTANYTARSUS	59	141	100.0	10.4
TANYTARSUS	0	4	2.0	0.2
CRICOTOPUS	0	1	0.5	0.1
EUKIEFFERIELLA SP#1	6	2	4.0	0.4
SPHAERIUM	30	1	15.5	1.6
TOTAL ORGANISMS	834	1089	962	
ORGANISMS/M2	5117	6681	5899	

Table C-9. Number and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 12 April 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
NEMATODA	43	4	23.5	13.6
NAIDIDAE	21	0	10.5	6.1
TUBIFICIDAE	40	1	20.5	11.8
EPHEMERA	1	0	0.5	0.3
POTAMANTHUS	7	0	3.5	2.0
EPHEMERELLA	5	2	3.5	2.0
ISONYCHIA	2	4	3.0	1.7
HEPTAGENIIDAE	8	1	4.5	2.6
STENONEMA	1	2	1.5	0.9
STENONEMA INTERPUNCTATUM	0	2	1.0	0.6
CHEUMATOPSYCHE	109	8	58.5	33.8
HYDROPSYCHE BIFIDA GRP	3	0	1.5	0.9
HYDROPSYCHE PHALERATA	13	1	7.0	4.0
OECETIS	0	1	0.5	0.3
OECETIS CINERACENS	9	3	6.0	3.5
STENELMIS	5	0	2.5	1.4
SIMULIIDAE	1	0	0.5	0.3
EMPIDIDAE	9	3	6.0	3.5
CERATOPOGONIDAE	1	0	0.5	0.3
CONCHAPELOPIA GRP	8	0	4.0	2.3
MICROPSECTRA	1	0	0.5	0.3
RHEOTANYTARSUS	8	1	4.5	2.6
CRICOTOPUS	2	1	1.5	0.9
EUKIEFFERIELLA COERULESCENS GRP SP#1	0	3	1.5	0.9
EUKIEFFERIELLA SP#1	2	0	1.0	0.6
NANOCLADIUS	3	2	2.5	1.4
SPHAERIUM	5	0	2.5	1.4
TOTAL ORGANISMS	307	39	173	
ORGANISMS/M2	1883	239	1061	

Table C-10. Number and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 8 June 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
PROSTOMA RUBRUM	8	26	17.0	1.1
NEMATODA	1	8	4.5	0.3
NAIDIDAE	556	578	567.0	36.5
TUBIFICIDAE	58	54	56.0	3.6
NEOPERLA	2	2	2.0	0.1
EPHORON	4	2	3.0	0.2
POTAMANTHUS	11	5	8.0	0.5
CAENIS	110	59	84.5	5.4
EPHEMERELLA	1	0	0.5	0.0
PSEUDOCLOEON	1	0	0.5	0.0
ISONYCHIA	81	8	44.5	2.9
HEPTAGENIIDAE	124	112	118.0	7.6
HEPTAGENIA	5	15	10.0	0.6
STENONEMA	1	0	0.5	0.0
STENONEMA INTERPUNCTATUM	1	0	0.5	0.0
STENONEMA NEPOTELLUM	0	1	0.5	0.0
SIALIS	2	33	17.5	1.1
TRICHOPTERA (PUPAE)	2	0	1.0	0.1
CHEUMATOPSYCHE	137	79	108.0	7.0
HYDROPSYCHE BIFIDA GRP	1	0	0.5	0.0
HYDROPSYCHE PHALERATA	1	0	0.5	0.0
CERACLEA NEPHA	1	1	1.0	0.1
OECETIS	2	0	1.0	0.1
OECETIS CINERACENS	1	6	3.5	0.2
DUBIRAPHIA	0	1	0.5	0.0
OPTIOSERVUS	0	1	0.5	0.0
STENELMIS	6	8	7.0	0.5
SIMULIIDAE	1	4	2.5	0.2
EMPIDIDAE	2	3	2.5	0.2
EMPIDIDAE (PUPAE)	3	0	1.5	0.1
CERATOPOGONIDAE	0	4	2.0	0.1
CHIRONOMIDAE (PUPAE)	30	26	28.0	1.8
ABLABESMYIA MALLOCHI	13	9	11.0	0.7
CONCHAPELOPIA GRP	21	10	15.5	1.0
TANYPODINAE SP#1	13	13	13.0	0.8
CRYPTOCHIRONOMUS FULVUS	10	1	5.5	0.4
DEMICRYPTOCHIRONOMUS	0	1	0.5	0.0
GLYPTOTENDIPES	0	5	2.5	0.2
MICROTENDIPES	2	6	4.0	0.3
PARACHIRONOMUS MONOCHROMUS	4	0	2.0	0.1
PARACHIRONOMUS PECTINATELLAE	3	0	1.5	0.1
POLYPEDILUM	24	23	23.5	1.5
RHEOTANYTARSUS	41	22	31.5	2.0
TANYTARSUS	5	2	3.5	0.2
ZAVRELIA	3	11	7.0	0.5
DIAMESA SP#4	2	0	1.0	0.1
CRICOTOPUS	40	41	40.5	2.6
CRICOTOPUS BICINCTUS	0	4	2.0	0.1
EUKIEFFERIELLA SP#1	1	0	0.5	0.0
NANOCLADIUS	305	272	288.5	18.6
SPHAERIUM	2	5	3.5	0.2
TOTAL ORGANISMS	1642	1461	1552	
ORGANISMS/M2	10074	8963	9518	

Table C-11. Number and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 26 October 1977.

REPLICATE	1	2		
AREA SAMPLED(M2)	0.163	0.163		
TAXA	NO.	NO.	MEAN	% TOTAL
TURBELLARIA	9	35	22.0	2.8
PROSTOMA RUBRUM	1	30	15.5	2.0
NEMATODA	4	20	12.0	1.6
URNATELLA GRACILIS	1	1	1.0	0.1
NAIDIDAE	3	21	12.0	1.6
TUBIFICIDAE	63	174	118.5	15.3
NEOPHASGANOPHORA	1	0	0.5	0.1
POTAMANTHUS	8	23	15.5	2.0
CAENIS	0	4	2.0	0.3
ISONYCHIA	2	10	6.0	0.8
HEPTAGENIIDAE	4	50	27.0	3.5
STENONEMA	6	20	13.0	1.7
STENONEMA FUSCUM	0	1	0.5	0.1
STENONEMA INTERPUNCTATUM	0	2	1.0	0.1
STENONEMA ITHACA	2	5	3.5	0.5
STENONEMA PULCHELLUM	18	28	23.0	3.0
COENAGRIONIDAE	0	1	0.5	0.1
SIALIS	1	8	4.5	0.6
NEURECLIPSIS	0	2	1.0	0.1
CHEUMATOPSYCHE	97	377	237.0	30.6
HYDROPSYCHE BIFIDA GRP	1	3	2.0	0.3
HYDROPSYCHE PHALERATA	2	23	12.5	1.6
NECTOPSYCHE	0	4	2.0	0.3
OECETIS	0	19	9.5	1.2
OECETIS CINERACENS	0	6	3.0	0.4
ELMIDAE (ADULTS)	0	4	2.0	0.3
DUBIRAPHIA	1	1	1.0	0.1
STENELMIS	0	6	3.0	0.4
EMPIDIDAE	17	59	38.0	4.9
CHIRONOMIDAE (PUPAE)	0	1	0.5	0.1
CONCHAPELOPIA GRP	17	96	56.5	7.3
CHIRONOMUS DECORUS	0	1	0.5	0.1
CRYPTOCHIRONOMUS BLARINA	0	1	0.5	0.1
DICROTENDIPES NODESTUS	1	8	4.5	0.6
GLYPTOTENDIPES	3	72	37.5	4.8
POLYPEDILUM	22	20	21.0	2.7
RHEOTANYTARSUS	6	90	48.0	6.2
CRICOTOPUS	1	1	1.0	0.1
EUKIEFFERIELLA SP#1	0	1	0.5	0.1
NANOCLADIUS	0	4	2.0	0.3
UNIDENTIFIED TERRESTRIAL(ADULTS)	0	1	0.5	0.1
PISIDIUM	1	2	1.5	0.2
SPHAERIUM	6	14	10.0	1.3
TOTAL ORGANISMS	298	1249	774	
ORGANISMS/M2	1828	7663	4745	

Table C-12. Mean density and percent total of major macroinvertebrate groups collected at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1977.

SITE	TAXA	APRIL NO./M2	APRIL % TOT.	JUNE NO./M2	JUNE % TOT.	OCTOBER NO./M2	OCTOBER % TOT.	% TOTAL/YEAR
SSES I								
	OLIGOCHAETA	6	6.1	2454	30.1	132	15.1	28.4
	EPHEMEROPTERA	18	18.2	2322	28.5	80	9.1	26.6
	TRICHOPTERA	40	39.4	1853	22.8	166	18.9	22.6
	COLEOPTERA	12	12.1	187	2.3	34	3.9	2.6
	DIPTERA	21	21.2	1224	15.0	393	44.9	18.0
	MISCELLANEOUS	3	3.0	101	1.2	71	8.1	1.9
SSES II								
	OLIGOCHAETA	107	8.8	893	23.1	239	4.1	11.3
	EPHEMEROPTERA	71	5.8	267	6.9	350	5.9	6.3
	TRICHOPTERA	752	61.9	764	19.7	3015	51.1	41.3
	COLEOPTERA	37	3.0	40	1.0	52	0.9	1.2
	DIPTERA	175	14.4	1767	45.7	1825	30.9	34.3
	MISCELLANEOUS	74	6.1	138	3.6	417	7.1	5.7
BELL BEND I								
	OLIGOCHAETA	190	17.9	3822	40.2	801	16.9	31.4
	EPHEMEROPTERA	107	10.1	1659	17.4	561	11.8	15.2
	TRICHOPTERA	451	42.5	709	7.4	1638	34.5	18.3
	COLEOPTERA	15	1.4	49	0.5	37	0.8	0.7
	DIPTERA	138	13.0	3006	31.6	1291	27.2	28.9
	MISCELLANEOUS	160	15.0	273	2.9	417	8.8	5.5

Table C-13. Mean density (No. org/m^2) of naidid worms and three chironomids at SSES I, SSES II, and Bell Bend I on the Susquehanna River, 1975-77.

Taxa	Year	1975			1976			1977		
	Month	Mar	Jun	Oct[a]	Apr	Jun	Oct	Apr	Jun	Oct
Naididae		--[b]	--	--	4473	1436	2742	30	2232	76
Rheotanytarsus		646	716	29	369	1140	3431	11	284	309
Cricotopus		121	32	1	1317	0	224	5	137	3
Nanocladius		22	41	17	164	16	1011	10	982	4

[a]October 1975 samples were collected about 2½ weeks after Hurricane Eloise.

[b]Oligochaetes were not identified to family in 1975.

Table C-14. Macroinvertebrates collected in the study area of the Susquehanna River, 1971-77 (an asterisk denotes 1977 additions).

- Porifera
  - Spongillidae
    - *Spongilla lacustris*
- Coelenterata
  - Hydroida
    - *Hydra* sp.
  - Trachylina
    - *Craspedacusta sowerbii*
- Platyhelminthes
  - Turbellaria
    - *Dugesia tigrina*
- Nemertea
  - Tetrastemmatidae
    - *Prostoma rubrum**
- Nematoda
- Bryozoa
  - Lophopodidae
    - *Lophopodella carteri*
    - *Pectinatella magnifica*
  - Plumatellidae
    - *Hyalinella punctata**
    - *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*
    - Tubificidae
      - *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*
- Arthropoda (cont.)
  - 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*
      - Caenidae
        - *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.

Table C-14 (cont.)

- Insecta (cont.)
  - Siphlonuridae
    - Isonychia bicolor*
    - Siphlonurus quebecensis
  - Heptageniidae
    - Epeorus sp.
    - Heptagenia lucidipennis
    - Rhithrogena sp.
    - Stenonema carolina
    - S. fuscum
    - S. interpunctatum
    - S. ithaca
    - S. nepotellum*
    - S. pulchellum*
    - S. rubrum*
    - S. terminatum*
- Odonata
  - Gomphidae
    - Dromogomphus spinosus
  - Aeschnidae
    - Boyeria vinosa
  - Libellulidae
    - Didymops transversa
    - Macromia illinoiensis
    - 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
    - Protoptila sp.
  - Philopotamidae
    - Chimarra obscura
  - Psychomyiidae
    - Neureclipsis sp.
    - Polycentropus sp.
    - Psychomyia flavida
  - Hydropsychidae
    - Cheumatopsyche campyla
    - C. speciosa
    - Hydropsyche betteni
    - H. bifida grp.
    - H. cheilonis
    - H. morosa
    - H. phalerata
  - Hydropsychidae (cont.)
    - Macronema carolina
    - M. zabrata
    - Potamyia sp.
  - Hydroptilidae
    - Agraylea sp.
  - Limnephilidae
    - Limnephilus sp.
    - Pycnopsyche guttifer
  - Leptoceridae
    - Ceraclea ancylus*
    - C. maculata
    - C. nepha*
    - C. tarsipunctata
    - Nectopsyche sp.
    - Oecetis cineracens
    - O. inconspicua*
    - Triaenoides injusta
  - Lepidostomatidae
    - Lepidostoma sp.
- Lepidoptera
  - Pyralidae
    - Nymphula sp.
    - Paragyractis sp.
- Coleoptera
  - Haliplidae
    - Peltodytes sp.
  - Dytiscidae
  - 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
    - Simulium vittatum
  - Stratiomyiidae
  - Rhagionidae
    - Atherix variegata
  - Tabanidae
  - Empididae
    - Hemerodromia sp.
    - Roederiodes sp.
  - Chironomidae
    - Tanypodinae
      - Ablabesmyia aurlensis
      - A. mallochi

Table C-14 (cont.)

- Tanypodinae (cont.)
  - Ablabesmyia peleensis
  - A. rhamphe
  - Conchapelopia grp.
  - Macropelopia sp.*
  - Procladius sp.
- Chironominae
  - Chironomus decorus
  - C. stigmaterus
  - Cladotanytarsus sp.
  - Cryptochironomus blarina*
  - C. fulvus
  - Cryptotendipes sp.
  - Demicryptochironomus sp.*
  - Dicrotendipes modestus
  - Endochironomus grp.
  - Glyptotendipes lobiferous
  - Micropsectra sp.
  - Microtendipes sp.
  - Parachironomus carinatus
  - P. monochromus
  - P. pectinatellae
  - Pedionomus beckae*
  - Polypedilum convictum
  - P. fallax*
  - P. halterale
  - P. illinoense*
  - Rheotanytarsus (nr. exiguus)
  - Stenochironomus sp.
  - Tanytarsus sp.
  - Tribelos fusicornis
  - T. jucundus*
  - Zavrelia sp.
- Diamesinae
  - Diamesa sp. #1
  - Diamesa sp. #2*
  - Diamesa sp. #3*
  - Diamesa sp. #4*
  - Pseudodiamesa sp.
- Orthocladiinae
  - Brillia sp.*
  - Cardiocladius obscurus
  - Corynoneura taris
  - Cricotopus bicinctus
  - Cricotopus spp.
  - Diplocladius sp.*
  - Eukiefferiella coerulescens grp. sp. #1
  - E. coerulescens grp. sp. #2
  - Eukiefferiella sp.
  - Heterotrissocladius (nr. marcidus)
  - Nanocladius (nr. rectinervis)*
  - Orthocladius sp.
  - Parametriocnemus sp.*
  - Rheocricotopus sp. #1
  - Rheocricotopus sp. #2*
  - Smittia grp.*
  - Synorthocladius sp.
  - Thienemanniella sp.
- Ceratopogonidae
  - Bezzia sp.

- Mollusca
  - Gastropoda
    - Physidae
      - Physa gyrina
    - Lymnaeidae
      - Lymnaea 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 C-15. Percent similarity among macroinvertebrate populations collected at SSES I, SSES II, and Bell Bend I in April, June, and October on the Susquehanna River, 1977.

			APRIL	JUNE	OCTOBER
SSES I	VS.	SSES II	49.5	58.4	54.4
SSES I	VS.	BELL BEND I	48.7	61.1	61.6
SSES II	VS.	BELL BEND I	70.1	67.8	71.2

Table C-16. Coefficient of community among macroinvertebrate populations collected at SSES I, SSES II, and Bell Bend I in April, June, and October on the Susquehanna River, 1977.

			APRIL	JUNE	OCTOBER
SSES I	VS.	SSES II	32.3	60.3	48.9
SSES I	VS.	BELL BEND I	32.3	69.1	43.5
SSES II	VS.	BELL BEND I	54.3	60.0	59.6

Table C-17. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at SSES I on the Susquehanna River, 13 April 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	1	5.3	<0.1	--	<0.1	--
OLIGOCHAETA	4	21.1	<0.1	--	<0.1	--
EPHEMERELLIDAE	1	5.3	<0.1	--	<0.1	--
SIPHLONURIDAE	2	10.5	5.9	37.6	1.2	27.9
HYDROPSYCHIDAE	4	21.1	7.2	45.9	2.0	46.5
EMPIDIDAE	3	15.8	1.7	10.8	0.6	14.0
CHIRONOMIDAE	4	21.1	0.9	5.7	0.5	11.6
TOTAL	19		15.7		4.3	
TOTAL/M2	117		96.3		26.4	
BIOMASS(KG/HA)			1.0		0.3	

Table C-18. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at SSES I on the Susquehanna River, 6 June 1977.

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	3	0.3	<0.1	--	<0.1	--
OLIGOCHAETA	530	46.1	29.6	9.6	6.8	10.4
PERLIDAE	8	0.7	2.6	0.8	0.6	0.9
POLYMITARCIDAE	6	0.5	2.9	0.9	1.3	2.0
POTAMANTHIDAE	3	0.3	41.4	13.4	12.0	18.4
EPHEMERELLIDAE	17	1.5	9.5	3.1	2.4	3.7
BAETIDAE	3	0.3	2.0	0.6	0.4	0.6
SIPHLONURIDAE	125	10.9	56.5	18.3	9.0	13.8
HEPTAGENIIDAE	201	17.5	78.6	25.5	12.6	19.4
SIALIDAE	2	0.2	<0.1	--	<0.1	--
HYDROPSYCHIDAE	88	7.7	26.5	8.6	4.7	7.2
LEPTOCERIDAE	5	0.4	15.5	5.0	4.8	7.4
HYDROPHILIDAE	5	0.4	<0.1	--	<0.1	--
ELMIDAE	9	0.8	5.1	1.7	2.4	3.7
ELMIDAE (ADULTS)	2	0.2	3.1	1.0	1.5	2.3
SIMULIIDAE	8	0.7	9.1	3.0	1.8	2.8
EMPIDIDAE	1	0.1	<0.1	--	<0.1	--
EMPIDIDAE (PUPAE)	2	0.2	0.9	0.3	0.2	0.3
CHIRONOMIDAE	123	10.7	22.5	7.3	4.0	6.1
CHIRONOMIDAE (PUPAE)	8	0.7	2.3	0.7	0.6	0.9
TOTAL	1150		308.1		65.1	
TOTAL/M2	7055		1890.2		399.4	
BIOMASS(KG/HA)			18.9		4.0	

Table C-19. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at SSES I on the Susquehanna River, 26 October 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMERTEA	1	0.4	<0.1	--	<0.1	--
NEMATODA	1	0.4	<0.1	--	<0.1	--
OLIGOCHAETA	163	63.2	111.1	58.2	24.0	59.7
HYDRACARINA	1	0.4	<0.1	--	<0.1	--
TAENIOPTERYGIDAE	1	0.4	<0.1	--	<0.1	--
POTAMANTHIDAE	1	0.4	<0.1	--	<0.1	--
SIPHLONURIDAE	1	0.4	<0.1	--	<0.1	--
HEPTAGENIIDAE	6	2.3	7.8	4.1	1.8	4.5
HYDROPSYCHIDAE	39	15.1	57.7	30.2	10.7	26.6
ELMIDAE	8	3.1	4.4	2.3	1.9	4.7
EMPIDIDAE	13	5.0	4.7	2.5	0.9	2.2
CHIRONOMIDAE	22	8.5	5.2	2.7	0.9	2.2
SPHAERIIDAE	1	0.4	<0.1	--	<0.1	--
TOTAL	258		190.9		40.2	
TOTAL/M2	1583		1171.2		246.6	
BIOMASS(KG/HA)			11.7		2.5	

Table C-20. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at SSES II on the Susquehanna River, 13 April 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	14	4.1	<0.1	--	<0.1	--
OLIGOCHAETA	7	2.1	<0.1	--	<0.1	--
HYDRACARINA	5	1.5	<0.1	--	<0.1	--
EPHEMERIDAE	1	0.3	<0.1	--	<0.1	--
POTAMANTHIDAE	5	1.5	6.7	0.9	2.3	1.3
EPHEMERELLIDAE	5	1.5	0.9	0.1	0.4	0.2
SIPHLONURIDAE	3	0.9	24.6	3.2	6.3	3.6
HEPTAGENIIDAE	7	2.1	10.7	1.4	2.4	1.4
HYDROPSYCHIDAE	222	65.3	710.5	91.1	157.2	89.3
LEPTOCERIDAE	7	2.1	2.9	0.4	0.8	0.5
ELMIDAE	11	3.2	8.1	1.0	3.5	2.0
ELMIDAE (ADULTS)	1	0.3	1.2	0.2	0.6	0.3
EMPIDIDAE	24	7.1	9.0	1.2	2.4	1.4
CHIRONOMIDAE	23	6.8	5.4	0.7	0.2	0.1
CHIRONOMIDAE (PUPAE)	3	0.9	<0.1	--	<0.1	--
SPHAERIIDAE	2	0.6	<0.1	--	<0.1	--
TOTAL	340		780.0		176.1	
TOTAL/M2	2086		4785.3		1080.4	
BIOMASS(KG/HA)			47.9		10.8	

Table C-21. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at SSES II on the Susquehanna River, 7 June 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	5	0.6	<0.1	--	<0.1	--
OLIGOCHAETA	333	42.5	85.8	11.4	17.4	9.9
PERLIDAE	4	0.5	31.5	4.2	5.4	3.1
POLYMITARCIDAE	5	0.6	6.5	0.9	1.6	0.9
POTAMANTHIDAE	16	2.0	186.8	24.9	52.9	30.0
EPHEMERELLIDAE	15	1.9	3.0	0.4	0.3	0.2
BAETIDAE	2	0.3	<0.1	--	<0.1	--
SIPHLONURIDAE	24	3.1	20.2	2.7	2.8	1.6
HEPTAGENIIDAE	28	3.6	13.6	1.8	1.8	1.0
COENAGRIONIDAE	1	0.1	40.8	5.4	9.0	5.1
SIALIDAE	5	0.6	<0.1	--	<0.1	--
TRICHOPTERA (PUPAE)	15	1.9	84.4	11.2	14.9	8.5
HYDROPSYCHIDAE	59	7.5	94.3	12.6	25.5	14.5
LEPTOCERIDAE	31	4.0	44.2	5.9	8.9	5.1
HYDROPHILIDAE	3	0.4	<0.1	--	<0.1	--
ELMIDAE	17	2.2	16.4	2.2	6.2	3.5
ELMIDAE (ADULTS)	4	0.5	9.1	1.2	4.9	2.8
EMPIDIDAE	13	1.7	9.2	1.2	2.1	1.2
EMPIDIDAE (PUPAE)	2	0.3	<0.1	--	<0.1	--
CHIRONOMIDAE	176	22.5	41.4	5.5	7.2	4.1
CHIRONOMIDAE (PUPAE)	21	2.7	6.7	0.9	0.8	0.5
SPHAERIIDAE	4	0.5	56.9	7.6	14.4	8.2
TOTAL	783		750.8		176.1	
TOTAL/M2	4804		4606.1		1080.4	
BIOMASS(KG/HA)			46.1		10.8	

Table C-22. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at SSES II on the Susquehanna River, 26 October 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
NEMATODA	8	1.9	<0.1	--	<0.1	--
OLIGOCHAETA	19	4.6	<0.1	--	<0.1	--
PERLIDAE	2	0.5	22.7	3.5	5.5	4.3
POTAMANTHIDAE	6	1.4	8.5	1.3	1.8	1.4
SIPHLONURIDAE	2	0.5	7.4	1.1	1.1	0.9
HEPTAGENIIDAE	26	6.3	23.6	3.6	4.3	3.4
SIALIDAE	1	0.2	34.4	5.3	7.5	5.9
HYDROPSYCHIDAE	251	60.6	505.0	77.1	93.8	74.0
LEPTOCERIDAE	9	2.2	<0.1	--	<0.1	--
PSEPHENIDAE	2	0.5	8.7	1.3	2.0	1.6
ELMIDAE	5	1.2	<0.1	--	<0.1	--
ELMIDAE (ADULTS)	4	1.0	7.5	1.1	3.8	3.0
EMPIDIDAE	6	1.4	4.9	0.7	1.2	0.9
CHIRONOMIDAE	73	17.6	32.0	4.9	5.7	4.5
TOTAL	414		654.7		126.7	
TOTAL/M2	2540		4016.6		777.3	
BIOMASS(KG/HA)			40.2		7.8	

Table C-23. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at Bell Bend I on the Susquehanna River, 12 April 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
TURBELLARIA	1	0.3	<0.1	--	<0.1	--
NEMATODA	14	3.7	<0.1	--	<0.1	--
OLIGOCHAETA	21	5.5	1.6	0.2	0.6	0.4
AMPHIPODA	1	0.3	<0.1	--	<0.1	--
HYDRACARINA	5	1.3	<0.1	--	<0.1	--
PERLIDAE	1	0.3	39.9	5.4	10.7	6.4
POTAMANTHIDAE	8	2.1	6.7	0.9	1.8	1.1
EPHEMERELLIDAE	5	1.3	0.3	0.0	0.3	0.2
SIPHLONURIDAE	3	0.8	19.4	2.6	4.0	2.4
HEPTAGENIIDAE	15	3.9	10.8	1.5	2.0	1.2
PHILOPOTAMIDAE	1	0.3	<0.1	--	<0.1	--
PSYCHOMYIIDAE	1	0.3	<0.1	--	<0.1	--
HYDROPSYCHIDAE	234	61.1	631.3	85.7	142.2	84.5
LEPTOCERIDAE	9	2.3	2.9	0.4	0.7	0.4
ELMIDAE	2	0.5	<0.1	--	<0.1	--
ELMIDAE (ADULTS)	1	0.3	1.6	0.2	0.6	0.4
EMPIDIDAE	23	6.0	6.3	0.9	1.7	1.0
CHIRONOMIDAE	34	8.9	13.1	1.8	2.8	1.7
SPHAERIIDAE	4	1.0	2.5	0.3	0.8	0.5
TOTAL	383		736.4		168.2	
TOTAL/M2	2350		4517.8		1031.9	
BIOMASS(KG/HA)			45.2		10.3	

Table C-24. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at Bell Bend I on the Susquehanna River, 8 June 1977.

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	2	0.2	<0.1	--	<0.1	--
OLIGOCHAETA	198	22.0	161.3	33.9	32.1	30.2
NAIDIDAE	1	0.1	<0.1	--	<0.1	--
PERLIDAE	1	0.1	0.7	0.1	0.5	0.5
POLYMITARCIDAE	3	0.3	2.6	0.5	1.4	1.3
POTAMANTHIDAE	8	0.9	34.7	7.3	10.4	9.8
EPHEMERELLIDAE	15	1.7	4.5	0.9	1.3	1.2
SIPHLONURIDAE	3	0.3	1.5	0.3	0.8	0.8
HEPTAGENIIDAE	57	6.3	67.9	14.3	14.0	13.2
SIALIDAE	10	1.1	7.7	1.6	1.6	1.5
TRICHOPTERA (PUPAE)	5	0.6	30.0	6.3	5.8	5.5
HYDROPSYCHIDAE	48	5.3	46.0	9.7	13.5	12.7
LEPTOCERIDAE	10	1.1	13.4	2.8	3.0	2.8
HYDROPHILIDAE	1	0.1	<0.1	--	<0.1	--
ELMIDAE	13	1.4	7.7	1.6	3.6	3.4
ELMIDAE (ADULTS)	1	0.1	1.8	0.4	0.9	0.8
EMPIDIDAE	1	0.1	<0.1	--	<0.1	--
CHIRONOMIDAE	454	50.3	72.7	15.3	12.4	11.7
CHIRONOMIDAE (PUPAE)	67	7.4	11.8	2.5	1.5	1.4
SPHAERIIDAE	3	0.3	11.4	2.4	3.4	3.2
TOTAL	902		475.7		106.2	
TOTAL/M2	5534		2918.4		651.5	
BIOMASS(KG/HA)			29.2		6.5	

Table C-25. Biomass of macroinvertebrates (damp and dry weights and percent total) collected with a dome sampler at Bell Bend I on the Susquehanna River, 26 October 1977.

TAXA	NUMBER OF ORGANISMS	% TOTAL (NUMBERS)	DAMP WT (MG)	% TOTAL (DAMP WT)	DRY WT (MG)	% TOTAL (DRY WT)
TURBELLARIA	5	4.3	<0.1	--	<0.1	--
NEMERTEA	3	2.6	<0.1	--	<0.1	--
NEMATODA	1	0.9	<0.1	--	<0.1	--
OLIGOCHAETA	13	11.3	5.7	3.0	1.6	3.9
POTAMANTHIDAE	4	3.5	2.2	1.2	0.9	2.2
SIPHLONURIDAE	4	3.5	41.5	22.1	8.7	21.2
HEPTAGENIIDAE	11	9.6	19.1	10.2	4.0	9.8
SIALIDAE	1	0.9	20.8	11.1	4.8	11.7
HYDROPSYCHIDAE	42	36.5	76.9	41.0	14.6	35.6
LEPTOCERIDAE	2	1.7	<0.1	--	<0.1	--
HYDROPHILIDAE	1	0.9	4.1	2.2	1.3	3.2
ELMIDAE	3	2.6	2.9	1.5	1.7	4.1
EMPIDIDAE	7	6.1	3.2	1.7	1.1	2.7
CHIRONOMIDAE	13	11.3	11.0	5.9	2.3	5.6
CHIRONOMIDAE (PUPAE)	1	0.9	<0.1	--	<0.1	--
SPHAERIIDAE	4	3.5	<0.1	--	<0.1	--
TOTAL	115		187.4		41.0	
TOTAL/M2	706		1149.7		251.5	
BIOMASS(KG/HA)			11.5		2.5	

Table C-26. Number per sample and percent total of chironomids collected in basket samples at SSES-D on the Susquehanna River, 11-12 April 1972.

REPLICATE GEAR	1 SPHERES	2 SPHERES	3 SPHERES		
TAXA	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE	4	0	0	1.3	5.0
ABLABESMYIA RHAMPHE	0	1	0	0.3	1.3
CONCHAPELOPIA GRP	6	6	0	4.0	15.0
PROCLADIUS	21	1	1	7.7	28.8
CHIRONOMUS	0	2	0	0.7	2.5
CHIRONOMUS DECORUS	14	0	0	4.7	17.5
ENDOCHIRONOMUS GRP	4	0	0	1.3	5.0
POLYPEDILUM	2	0	0	0.7	2.5
RHEOTANYTARSUS	2	0	2	1.3	5.0
ORTHOCLADIINAE	0	0	1	0.3	1.3
CRICOTOPUS	6	1	0	2.3	8.8
EUKIEFFERIELLA SP#1	4	0	0	1.3	5.0
NANOCLADIUS	1	1	0	0.7	2.5
TOTAL ORGANISMS	64	12	4	26.7	
ORGANISMS/M2	315	59	20	131.4	
TOTAL TAXA	9	6	3	6.0	

Table C-27. Number per sample and percent total of chironomids collected in basket samples at SSES-E on the Susquehanna River, 12 April 1972.

REPLICATE GEAR	1 SPHERES	2 SPHERES	3 SPHERES		
TAXA	NO.	NO.	NO.	MEAN	% TOTAL
CONCHAPELOPIA GRP	4	0	3	2.3	17.9
PROCLADIUS	0	0	1	0.3	2.6
CHIRONOMUS	0	3	2	1.7	12.8
DICROTENDIPES MODESTUS	0	0	1	0.3	2.6
ENDOCHIRONOMUS GRP	0	1	0	0.3	2.6
POLYPEDILUM	1	2	0	1.0	7.7
RHEOTANYTARSUS	1	0	0	0.3	2.6
CRICOTOPUS	1	1	2	1.3	10.3
EUKIEFFERIELLA SP#1	9	0	0	3.0	23.1
NANOCLADIUS	1	0	2	1.0	7.7
RHEOCRICOTOPUS	4	0	0	1.3	10.3
TOTAL ORGANISMS	21	7	11	13.0	
ORGANISMS/M2	103	34	54	64.0	
TOTAL TAXA	7	4	6	5.7	

Table C-28. Number per sample and percent total of chironomids collected in basket samples at SSES-C on the Susquehanna River, 22, 26, 29 May 1972.

REPLICATE	1	2	3	4	5	6	7	8	9		
GEAR	-	-	-	-	-	-	-	-	-		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE	0	4	1	0	0	0	0	0	0	0.6	0.6
CHIRONOMIDAE (PUPAE)	3	8	2	4	2	13	0	0	5	4.1	4.7
ABLABESMYIA MALLOCHI	0	0	0	0	0	0	0	0	1	0.1	0.1
CONCHAPELOPIA GRP	64	67	40	87	1	20	7	6	37	36.6	41.9
TANYPODINAE SP#1	0	0	0	0	0	0	0	0	1	0.1	0.1
DICROTENDIPES	0	0	0	1	0	0	0	0	0	0.1	0.1
DICROTENDIPES MODESTUS	0	1	0	0	0	0	0	0	0	0.1	0.1
ENDOCHIRONOMUS GRP	0	7	0	0	0	0	0	0	2	1.0	1.1
GLYPTOTENDIPES	3	0	0	0	0	1	0	0	0	0.4	0.5
POLYPEDILUM	11	14	13	15	13	17	10	4	49	16.2	18.6
RHEOTANYTARSUS	28	9	10	20	1	14	12	4	10	12.0	13.8
TANYTARSUS	1	16	9	15	0	6	3	1	5	6.2	7.1
TRIBELOS FUSICORNIS	0	0	0	0	0	0	1	0	0	0.1	0.1
ORTHOCLADIINAE	0	0	1	0	0	0	0	0	0	0.1	0.1
CRICOTOPUS	0	1	0	0	1	0	0	0	0	0.2	0.3
CRICOTOPUS BICINCTUS	0	0	4	4	1	21	11	0	20	6.8	7.8
EUKIEFFERIELLA CGERULESCENS GRP SP#1	0	1	0	0	0	1	0	0	0	0.2	0.3
EUKIEFFERIELLA SP#1	2	0	1	6	1	0	0	1	1	1.3	1.5
NANOCLADIUS	1	1	0	0	0	0	1	0	1	0.4	0.5
ORTHOCLADIUS	0	0	0	0	0	0	0	0	1	0.1	0.1
PARAMETRIOCNEMUS	0	0	0	0	0	0	0	0	1	0.1	0.1
RHEOCRICOTOPUS	0	0	0	0	0	0	1	0	1	0.2	0.3
TOTAL ORGANISMS	113	129	81	152	20	93	46	16	135	87.2	
ORGANISMS/M2	557	635	399	749	99	458	227	79	665	429.7	
TOTAL TAXA	7	9	7	7	6	7	8	5	13	7.7	

Table C-29. Number per sample and percent total of chironomids collected in basket samples at Falls on the Susquehanna River, 26 July 1972.

REPLICATE	1	2	3	4	5	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE	2	0	0	0	0	0	0	0	0.3	0.1
CHIRONOMIDAE (PUPAE)	18	0	32	0	0	7	0	0	7.1	1.7
CONCHAPELOPIA GRP	182	23	225	121	200	94	110	36	123.9	29.0
TANYPODINAE SP#1	0	0	0	8	0	0	0	0	1.0	0.2
POLYPEDILUM	91	10	96	137	40	7	25	41	55.9	13.1
RHEOTANYTARSUS	288	441	193	243	80	29	331	168	221.6	51.9
STENOCHIRONOMUS	2	0	0	0	0	0	0	0	0.3	0.1
CORYNONEURA TARIS	0	0	0	0	0	0	12	0	1.5	0.4
CRICOTOPUS BICINCTUS	0	0	0	0	0	0	0	5	0.6	0.1
EUKIEFFERIELLA SP#1	18	3	0	30	0	4	12	10	9.6	2.3
NANOCLADIUS	2	3	32	8	0	0	0	0	5.6	1.3
TOTAL ORGANISMS	603	480	578	547	320	141	490	260	427.4	
ORGANISMS/M2	2970	2365	2847	2695	1576	695	2414	1281	2105.3	
TOTAL TAXA	6	5	4	6	3	4	5	5	4.8	

Table C-30. Number per sample and percent total of chironomids collected in basket samples at Wilkes-Barre (2) on the Susquehanna River, 24 July 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE	0	0	0	1	0	0	0.2	0.3
CHIRONOMIDAE (PUPAE)	0	1	0	14	0	0	2.5	3.9
CONCHAPELOPIA GRP	28	50	19	92	18	0	34.5	53.8
ENDOCHIRONOMUS GRP	0	0	0	2	0	0	0.3	0.5
MICROPSECTRA	1	0	0	1	0	0	0.3	0.5
POLYPEDILUM	7	12	0	14	0	0	5.5	8.6
RHEOTANYTARSUS	6	6	0	19	3	0	5.7	8.8
CRICOTOPUS	1	4	0	0	3	0	1.3	2.1
CRICOTOPUS BICINCTUS	1	12	9	26	1	0	8.2	12.7
EUKIEFFERIELLA SP#1	0	2	0	0	0	0	0.3	0.5
NANOCLADIUS	1	2	19	9	1	0	5.3	8.3
TOTAL ORGANISMS	45	89	47	178	26	0	64.2	
ORGANISMS/M2	222	438	232	877	128	0	316.1	
TOTAL TAXA	7	7	3	7	5	0	4.8	

Table C-31. Number per sample and percent total of chironomids collected in basket samples at Nanticoke on the Susquehanna River, 21 July 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	0	4	0	0	0	0	0.7	2.5
ABLABESMYIA	0	1	0	0	0	0	0.2	0.6
ABLABESMYIA MALLOCHI	0	1	0	0	0	0	0.2	0.6
CONCHAPELOPIA GRP	3	22	5	0	6	0	6.0	22.6
DEMICRYPTOCHIRONOMUS	0	1	0	0	0	0	0.2	0.6
ENDOCHIRONOMUS GRP	31	20	5	0	16	6	13.0	49.1
POLYPEDILUM	0	17	0	1	0	2	3.3	12.6
RHEOTANYTARSUS	0	6	0	4	3	0	2.2	8.2
TRIBELOS JUCUNDUS	0	1	0	0	0	0	0.2	0.6
EUKIEFFERIELLA SP#1	0	1	0	0	0	0	0.2	0.6
NANOCLADIUS	0	3	0	0	0	0	0.5	1.9
TOTAL ORGANISMS	34	77	10	5	25	8	26.5	
ORGANISMS/M2	167	379	49	25	123	39	130.5	
TOTAL TAXA	2	10	2	2	3	2	3.5	

Table C-32. Number per sample and percent total of chironomids collected in basket samples at SSES-A on the Susquehanna River, 16-17 July 1972.

REPLICATE	1	2	3	4	5	6	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE	2	0	0	0	0	0	0	0	0	0.2	0.3
CHIRONOMIDAE (PUPAE)	2	0	0	0	0	3	0	0	9	1.6	2.2
CONCHAPELOPIA GRP	5	0	0	0	0	5	5	3	6	2.7	3.8
TANYPODINAE SP#1	0	0	0	0	0	0	5	0	0	0.6	0.8
ENDOCHIRONOMUS GRP	0	0	7	0	3	0	0	1	3	1.6	2.2
POLYPEDILUM	23	4	0	20	0	15	11	5	11	9.9	13.9
RHEOTANYTARSUS	12	0	0	21	6	9	0	1	0	5.4	7.7
CRICOTOPUS	29	24	0	0	12	5	11	19	3	11.4	16.1
CRICOTOPUS BICINCTUS	0	0	0	20	32	11	31	0	6	11.1	15.6
EUKIEFFERIELLA COERULESCENS GRP SP#1	0	0	0	0	17	1	16	0	0	3.8	5.3
EUKIEFFERIELLA SP#1	21	20	0	20	9	9	31	6	0	12.9	18.2
NANOCLADIUS	8	0	13	0	0	8	26	1	26	9.1	12.8
ORTHOCLADIUS	0	0	0	0	0	1	0	0	0	0.1	0.2
RHEOCRICOTOPUS	0	0	0	0	0	3	0	0	0	0.3	0.5
THIENEMANNIELLA	0	0	0	0	0	0	0	0	3	0.3	0.5
TOTAL ORGANISMS	102	48	20	81	79	70	136	36	67	71.0	
ORGANISMS/M2	502	236	99	399	389	345	670	177	330	349.8	
TOTAL TAXA	6	3	2	4	6	10	8	7	7	5.9	

Table C-33. Number per sample and percent total of chironomids collected in basket samples at Nescopeck on the Susquehanna River, 28 July 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	0	0	17	5	0	0	3.7	8.2
CONCHAPELOPIA GRP	19	29	25	29	48	18	28.0	62.7
PARACHIRONOMUS CARINATUS	0	0	0	0	0	2	0.3	0.7
POLYPEDILUM	0	0	0	0	15	0	2.5	5.6
RHEOTANYTARSUS	0	0	8	10	15	0	5.5	12.3
CRICOTOPUS BICINCTUS	0	0	0	8	15	2	4.2	9.3
NANOCLADIUS	0	0	0	3	0	0	0.5	1.1
TOTAL ORGANISMS	19	29	50	55	93	22	44.7	
ORGANISMS/M2	94	143	246	271	458	108	220.0	
TOTAL TAXA	1	1	2	4	4	3	2.5	

Table C-34. Number per sample and percent total of chironomids collected in basket samples at Falls on the Susquehanna River, 5 September 1972.

REPLICATE / GEAR	1 SPHERES	2 SPHERES	3 SPHERES	1 STONES	2 STONES	3 STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	56	99	40	43	0	31	44.8	3.2
ABLABESMYIA	0	0	0	3	0	0	0.5	0.0
ABLABESMYIA MALLOCHI	10	6	7	11	0	31	10.8	0.8
CONCHAPELOPIA GRP	95	284	159	191	96	178	167.2	11.9
TANYPODINAE SP#1	10	6	7	8	7	0	6.3	0.5
CRYPTOCHIRONOMUS	0	0	6	0	0	0	1.0	0.1
DICROTENDIPES	1	0	0	6	0	0	1.2	0.1
ENDOCHIRONOMUS GRP	0	6	0	0	0	0	1.0	0.1
PARACHIRONOMUS CARINATUS	17	56	73	85	8	12	41.8	3.0
POLYPEDILUM	73	192	119	60	74	111	104.8	7.5
RHEOTANYTARSUS	1056	1347	860	457	621	1228	928.2	66.0
TANYTARSINI SP#1	1	0	0	0	0	0	0.2	0.0
TANYTARSUS	0	0	6	2	0	0	1.3	0.1
ZAVRELIA	0	0	6	0	0	0	1.0	0.1
ORTHOCLADIINAE	0	0	6	0	0	6	2.0	0.1
CRICOTOPUS	0	0	20	0	0	12	5.3	0.4
CRICOTOPUS BICINCTUS	4	6	0	0	0	0	1.7	0.1
NANOCLADIUS	53	198	106	114	0	49	86.7	6.2
TOTAL ORGANISMS	1376	2200	1415	980	806	1658	1405.8	
ORGANISMS/M2	6778	10837	6970	4828	3970	8167	6925.3	
TOTAL TAXA	10	9	12	10	5	8	9.0	

Table C-35. Number per sample and percent total of chironomids collected in basket samples at Wilkes-Barre (2) on the Susquehanna River, 7 September 1972.

REPLICATE / GEAR	1 SPHERES	2 SPHERES	3 SPHERES	1 STONES	2 STONES	3 STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	63	96	31	89	71	139	81.5	5.4
ABLABESMYIA	2	0	0	0	0	0	0.3	0.0
ABLABESMYIA MALLOCHI	17	31	0	8	7	21	14.0	0.9
CONCHAPELOPIA GRP	192	297	153	175	249	445	251.8	16.8
PROCLADIUS	2	4	3	0	0	0	1.5	0.1
TANYPODINAE SP#1	2	1	0	2	0	0	0.8	0.1
CHIRONOMUS	4	0	0	0	0	0	0.7	0.0
CHIRONOMUS DECORUS	0	1	0	0	0	0	0.2	0.0
CRYPTOCHIRONOMUS FULVUS	0	0	4	0	0	0	0.7	0.0
ENDOCHIRONOMUS GRP	0	0	4	0	8	0	2.0	0.1
MICROPSECTRA	0	0	0	0	3	0	0.5	0.0
PEDIOMONAS BECKAE	0	0	0	0	7	0	1.2	0.1
POLYPEDILUM	193	624	309	549	422	662	459.8	30.6
RHEOTANYTARSUS	68	961	76	1193	357	544	533.2	35.5
TANYTARSUS	4	1	0	0	0	5	1.7	0.1
CRICOTOPUS	9	221	0	192	15	0	72.8	4.8
CRICOTOPUS BICINCTUS	11	0	42	0	60	284	66.2	4.4
EUKIEFFERIELLA SP#1	0	0	0	0	0	2	0.3	0.0
NANOCLADIUS	2	34	0	17	15	5	12.2	0.8
SYNORTHOCLADIUS	0	10	0	2	0	0	2.0	0.1
TOTAL ORGANISMS	569	2281	622	2227	1214	2107	1503.3	
ORGANISMS/M2	2803	11236	3064	10970	5980	10379	7405.6	
TOTAL TAXA	12	11	7	8	10	8	9.3	

Table C-36. Number per sample and percent total of chironomids collected in basket samples at Nanticoke on the Susquehanna River, 7 September 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	1	3	2	0	0	1	1.2	2.5
ABLABESMYIA MALLOCHI	0	0	0	1	0	0	0.2	0.4
ABLABESMYIA RHAMPHE	0	0	0	0	1	0	0.2	0.4
CONCHAPELOPIA GRP	0	12	1	1	5	3	3.7	7.7
TANYPODINAE SP#1	0	0	0	3	0	0	0.5	1.1
DICROTENDIPES	0	1	0	0	0	0	0.2	0.4
GLYPTOTENDIPES	0	1	0	0	0	0	0.2	0.4
PARACHIRONOMUS CARINATUS	0	0	3	1	0	1	0.8	1.8
POLYPEDILUM	16	24	10	4	7	19	13.3	28.2
RHEOTANYTARSUS	8	15	4	2	13	5	7.8	16.5
TANYTARSUS	0	0	1	0	0	0	0.2	0.4
CRICOTOPUS	0	1	0	0	0	0	0.2	0.4
CRICOTOPUS BICINCTUS	3	7	3	0	3	2	3.0	6.3
NANOCLADIUS	15	32	15	9	17	8	16.0	33.8
TOTAL ORGANISMS	43	96	39	21	46	39	47.3	
ORGANISMS/M2	212	473	192	103	227	192	233.2	
TOTAL TAXA	4	8	7	7	6	6	6.3	

Table C-37. Number per sample and percent total of chironomids collected in basket samples at SSES-A on the Susquehanna River, 11 September 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	37	37	28	21	18	18	26.5	2.2
ABLABESMYIA MALLOCHI	4	2	2	0	2	3	2.2	0.2
CONCHAPELOPIA GRP	12	7	8	19	8	22	12.7	1.1
TANYPODINAE SP#1	2	0	0	0	1	0	0.5	0.0
DICROTENDIPES MODESTUS	6	0	0	0	7	0	2.2	0.2
MICROPSECTRA	0	0	0	0	5	0	0.8	0.1
PARACHIRONOMUS CARINATUS	18	5	8	0	14	7	8.7	0.7
POLYPEDILUM	1118	753	597	441	452	629	665.0	56.3
RHEOTANYTARSUS	418	265	140	124	224	546	286.2	24.2
TANYTARSUS	8	2	0	3	0	0	2.2	0.2
CRICOTOPUS	124	65	207	61	124	0	96.8	8.2
CRICOTOPUS BICINCTUS	31	0	0	5	0	107	23.8	2.0
EUKIEFFERIELLA SP#1	0	0	0	0	0	2	0.3	0.0
NANOCLADIUS	82	17	53	45	68	50	52.5	4.4
SYNORTHOCLADIUS	0	0	2	0	0	0	0.3	0.0
TOTAL ORGANISMS	1860	1153	1045	719	923	1384	1180.6	
ORGANISMS/M2	9163	5680	5148	3542	4547	6818	5816.1	
TOTAL TAXA	11	8	8	7	10	8	8.7	

Table C-38. Number per sample and percent total of chironomids collected in basket samples at Nescopeck on the Susquehanna River, 11 September 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	145	90	0	95	140	308	129.7	1.3
ABLABESMYIA MALLOCHI	15	90	0	0	7	0	18.7	0.2
CONCHAPELOPIA GRP	29	90	451	143	10	51	129.0	1.2
CRYPTOCHIRONOMUS FULVUS	0	0	113	0	0	0	18.8	0.2
DICROTENDIPES	15	0	0	0	0	0	2.5	0.0
DICROTENDIPES MODESTUS	15	0	338	0	0	0	58.8	0.6
PARACHIRONOMUS PECTINATELLAE	0	0	0	48	0	26	12.3	0.1
POLYPEDILUM	145	358	788	667	262	205	404.2	3.9
RHEOTANYTARSUS	6890	7442	11153	11051	10591	7792	9153.2	88.3
CRICOTOPUS	87	269	113	0	27	128	104.0	1.0
CRICOTOPUS BICINCTUS	102	179	225	190	279	154	188.2	1.8
EUKIEFFERIELLA SP#1	29	0	0	0	10	51	15.0	0.1
NANOCLADIUS	116	90	225	95	160	102	131.3	1.3
TOTAL ORGANISMS	7588	8608	13406	12289	11486	8817	10365.5	
ORGANISMS/M2	37379	42404	66039	60537	56581	43433	51062.4	
TOTAL TAXA	10	7	8	6	8	8	7.8	

Table C-39. Number per sample and percent total of chironomids collected in basket samples at Wilkes-Barre (2) on the Susquehanna River, 9 October 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	5	10	11	23	5	8	10.3	2.9
ABLABESMYIA	0	1	0	0	0	0	0.2	0.0
ABLABESMYIA MALLOCHI	3	6	9	0	2	7	4.5	1.3
ABLABESMYIA RHAMPHE	2	0	0	0	0	0	0.3	0.1
CONCHAPELOPIA GRP	144	109	158	70	113	91	114.2	32.4
PROCLADIUS	2	0	0	0	0	0	0.3	0.1
CHIRONOMINAE	0	0	0	0	0	1	0.2	0.0
CHIRONOMUS	28	1	16	0	0	15	10.0	2.8
CHIRONOMUS DECORUS	0	0	0	0	112	0	18.7	5.3
ENDOCHIRONOMUS GRP	7	0	5	0	0	5	2.8	0.8
POLYPEDILUM	5	0	1	6	0	0	2.0	0.6
RHEOTANYTARSUS	16	29	11	0	0	23	13.2	3.7
ORTHOCLADIINAE	0	0	0	0	0	1	0.2	0.0
CRICOTOPUS	48	10	0	0	17	5	13.3	3.8
CRICOTOPUS BICINCTUS	93	182	232	139	54	214	152.3	43.3
EUKIEFFERIELLA SP#1	3	4	0	0	0	0	1.2	0.3
NANOCLADIUS	5	10	8	6	13	6	8.0	2.3
SYNORTHOCLADIUS	3	0	0	0	0	0	0.5	0.1
TOTAL ORGANISMS	364	362	451	244	316	376	352.2	
ORGANISMS/M2	1793	1783	2222	1202	1557	1852	1734.8	
TOTAL TAXA	13	9	8	4	6	10	8.3	

Table C-40. Number per sample and percent total of chironomids collected in basket samples at Nanticoke on the Susquehanna River, 11 October 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE	0	0	0	12	0	0	2.0	18.5
PROCLADIUS	1	0	6	0	0	0	1.2	10.8
CRICOTOPUS	0	0	0	0	3	0	0.5	4.6
CRICOTOPUS BICINCTUS	0	0	13	0	0	19	5.3	49.2
NANOCLADIUS	1	0	0	0	10	0	1.8	16.9
TOTAL ORGANISMS	2	0	19	12	13	19	10.8	
ORGANISMS/M2	10	0	94	59	64	94	53.4	
TOTAL TAXA	2	0	2	1	2	1	1.2	

Table C-41. Number per sample and percent total of chironomids collected in basket samples at SSES-A on the Susquehanna River, 16 October 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	0	0	0	0	40	0	6.7	4.1
CONCHAPELOPIA GRP	0	0	0	51	0	25	12.7	7.8
ENDOCHIRONOMUS GRP	0	0	0	0	0	8	1.3	0.8
RHEOTANYTARSUS	63	86	0	43	41	59	48.7	30.0
TANYTARSUS	0	0	0	8	0	0	1.3	0.8
CRICOTOPUS	0	0	0	17	0	0	2.8	1.7
CRICOTOPUS BICINCTUS	127	0	283	17	0	9	72.7	44.8
EUKIEFFERIELLA SP#1	0	0	0	0	40	0	6.7	4.1
NANOCLADIUS	0	0	0	17	40	0	9.5	5.9
TOTAL ORGANISMS	190	86	283	153	161	101	162.3	
ORGANISMS/M2	936	424	1394	754	793	498	799.7	
TOTAL TAXA	2	1	1	6	3	4	2.8	

Table C-42. Number per sample and percent total of chironomids collected in basket samples at Nescopeck on the Susquehanna River, 16 October 1972.

REPLICATE	1	2	1	2	3		
GEAR	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CHIRONOMIDAE (PUPAE)	29	0	36	0	9	14.8	0.4
ABLABESMYIA MALLOCHI	0	0	0	0	28	5.6	0.1
CONCHAPELOPIA GRP	59	58	74	0	55	49.2	1.3
DICROTENDIPES MODESTUS	0	58	0	0	0	11.6	0.3
PARACHIRONOMUS CARINATUS	0	0	0	150	0	30.0	0.8
POLYPEDILUM	30	0	0	0	9	7.8	0.2
RHEOTANYTARSUS	5010	810	737	3148	4539	2848.8	75.9
CRICOTOPUS	0	174	0	150	9	66.6	1.8
CRICOTOPUS BICINCTUS	1032	521	74	750	73	490.0	13.1
EUKIEFFERIELLA SP#1	59	0	0	0	0	11.8	0.3
NANOCLADIUS	29	347	74	450	174	214.8	5.7
TOTAL ORGANISMS	6248	1968	995	4648	4896	3751.0	
ORGANISMS/M2	30778	9695	4901	22897	24118	18477.8	
TOTAL TAXA	6	6	4	5	7	5.6	

Table C-43. Number per sample and percent total of chironomids collected in basket samples at Falls on the Susquehanna River, 21 December 1972.

REPLICATE	1	2	1		
GEAR	SPHERES	SPHERES	STONES		
TAXA	NO.	NO.	NO.	MEAN	% TOTAL
CONCHAPELOPIA GRP	61	9	2	24.0	46.5
CHIRONOMUS	3	0	0	1.0	1.9
DICROTENDIPES MODESTUS	6	0	0	2.0	3.9
GLYPTOTENDIPES	1	0	0	0.3	0.6
POLYPEDILUM	3	0	2	1.7	3.2
RHEOTANYTARSUS	7	9	10	8.7	16.8
CRICOTOPUS	0	1	0	0.3	0.6
CRICOTOPUS BICINCTUS	0	1	0	0.3	0.6
EUKIEFFERIELLA SP#1	13	18	6	12.3	23.9
PARAMETRIOCNEMUS	3	0	0	1.0	1.9
TOTAL ORGANISMS	97	38	20	51.7	
ORGANISMS/M2	478	187	99	254.5	
TOTAL TAXA	8	5	4	5.7	

Table C-44. Number per sample and percent total of chironomids collected in basket samples at Nanticoke on the Susquehanna River, 22 December 1972.

REPLICATE	1	2	1	2	3		
GEAR	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CONCHAPELOPIA GRP	40	13	55	105	135	69.6	53.2
CHIRONOMUS	0	0	5	21	14	8.0	6.1
DICROTENDIPES	1	0	5	0	16	4.4	3.4
DICROTENDIPES MODESTUS	2	4	2	5	0	2.6	2.0
GLYPTOTENDIPES	0	0	0	3	0	0.6	0.5
PARACHIRONOMUS MONOCHROMUS	1	0	0	0	0	0.2	0.2
POLYPEDILUM	4	0	0	0	5	1.8	1.4
RHEOTANYTARSUS	36	12	34	17	20	23.8	18.2
TANYTARSUS	1	0	0	2	0	0.6	0.5
TRIBELOS JUCUNDUS	0	0	5	0	5	2.0	1.5
ORTHOCLADIINAE	0	0	4	0	2	1.2	0.9
BRILLIA	0	0	0	0	2	0.4	0.3
CRICOTOPUS	1	0	0	0	0	0.2	0.2
CRICOTOPUS BICINCTUS	0	0	0	0	2	0.4	0.3
DIPLOCLADIUS	1	2	0	0	0	0.6	0.5
EUKIEFFERIELLA SP#1	16	2	19	5	16	11.6	8.9
PARAMETRIOCNEMUS	0	0	5	2	5	2.4	1.8
RHEOCRICOTOPUS	0	0	0	0	2	0.4	0.3
TOTAL ORGANISMS	103	33	134	160	224	130.8	
ORGANISMS/M2	507	163	660	788	1103	644.3	
TOTAL TAXA	10	5	9	8	12	8.8	

Table C-45. Number per sample and percent total of chironomids collected in basket samples at SSES-A on the Susquehanna River, 4-5 December 1972.

REPLICATE	1	2	3	1	2	3		
GEAR	SPHERES	SPHERES	SPHERES	STONES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CONCHAPELOPIA GRP	10	145	31	58	12	67	53.8	46.3
CHIRONOMUS	0	15	0	2	0	0	2.8	2.4
DICROTENDIPES	2	8	0	0	0	12	3.7	3.2
DICROTENDIPES MODESTUS	0	15	12	9	0	0	6.0	5.2
GLYPTOTENDIPES	0	0	0	1	0	2	0.5	0.4
MICROTENDIPES	0	8	0	0	0	0	1.3	1.1
POLYPEDILUM	2	0	1	1	2	3	1.5	1.3
RHEOTANYTARSUS	16	15	18	83	6	15	25.5	22.0
TRIBELOS JUCUNDUS	1	0	1	0	0	0	0.3	0.3
ORTHOCLADIINAE	3	0	0	3	1	2	1.5	1.3
CRICOTOPUS	0	8	2	4	0	3	2.8	2.4
CRICOTOPUS BICINCTUS	0	0	0	1	0	3	0.7	0.6
DIPLOCLADIUS	0	0	1	0	0	0	0.2	0.1
EUKIEFFERIELLA SP#1	8	8	8	16	1	35	12.7	10.9
PARAMETRIOCNEMUS	0	7	1	1	1	5	2.5	2.2
RHEOCRICOTOPUS	2	0	0	0	0	0	0.3	0.3
TOTAL ORGANISMS	44	229	75	179	23	147	116.2	
ORGANISMS/M2	217	1128	369	882	113	724	572.2	
TOTAL TAXA	8	9	9	11	6	10	8.8	

Table C-46. Number per sample and percent total of chironomids collected in basket samples at Nescopeck on the Susquehanna River, 6 December 1972.

REPLICATE	1	2	1	2		
GEAR	SPHERES	SPHERES	STONES	STONES		
TAXA	NO.	NO.	NO.	NO.	MEAN	% TOTAL
CONCHAPELOPIA GRP	0	3	0	0	0.8	8.3
RHEOTANYTARSUS	6	0	10	17	8.3	91.7
TOTAL ORGANISMS	6	3	10	17	9.0	
ORGANISMS/M2	30	15	49	84	44.3	
TOTAL TAXA	1	1	1	1	1.0	

Table C-47. Chironomids collected in basket samples from Falls to Nescopeck on the Susquehanna River, 1972.

STATION	Falls	WB#2 [a]	NANTICOKE	SSES	NESCOPECK
ABLABESMYIA [b]	X	X	X		
ABLABESMYIA MALLOCHI	X	X	X	X	X
ABLABESMYIA RHAMPHE		X	X	X	
CONCHAPELOPIA GRP	X	X	X	X	X
PROCLADIUS		X	X	X	
TANYPODINAE SP#1	X	X	X	X	
CHIRONOMINAE [c]		X		X	
CHIRONOMUS [b]	X	X	X	X	
CHIRONOMUS DECORUS		X		X	
CRYPTOCHIRONOMUS [b]	X				
CRYPTOCHIRONOMUS FULVUS		X			X
DEMICRYPTOCHIRONOMUS			X		
DICROTENDIPES [b]	X		X	X	X
DICROTENDIPES MODESTUS	X		X	X	X
ENDOCHIRONOMUS GRP	X	X	X	X	
GLYPTOTENDIPES	X		X	X	
MICROPSECTRA		X		X	
MICROTENDIPES				X	
PARACHIRONOMUS CARINATUS	X		X	X	X
PARACHIRONOMUS MONOCHROMUS			X		
PARACHIRONOMUS PECTINATELLAE					X
PEDIONOMUS BECKAE		X			
POLYPEDILUM	X	X	X	X	X
RHEOTANYTARSUS	X	X	X	X	X
STENOCHIRONOMUS	X				
TANYTARSINI SP#1	X			X	
TANYTARSUS	X	X	X	X	
TRIBELOS FUSICORNIS				X	
TRIBELOS JUCUNDUS			X	X	
ZAVRELIA	X				
ORTHOCLADIINAE [c]	X	X	X	X	
BRILLIA			X		
CORYNONEURA TARIS	X				
CRICOTOPUS	X	X	X	X	X
CRICOTOPUS BICINCTUS	X	X	X	X	X
DIPLOCLADIUS			X	X	
EUKIEFFERIELLA COERULESCENS GRP SP#1				X	
EUKIEFFERIELLA SP#1	X	X	X	X	X
NANOCLADIUS	X	X	X	X	X
ORTHOCLADIUS				X	
PARAMETRIOCNEMUS	X		X	X	
RHEOCRICOTOPUS			X	X	
SYNORTHOCLADIUS		X		X	
THIENEMANNIELLA				X	

[a] Wilkes-Barre (2).

[b] These genera were not counted as separate taxa if species within them were identified.

[c] Subfamilies were not counted as separate taxa.

Table C-48. Monthly and total mean density (No. org/m^2) and percent total of chironomids collected in basket samples at Falls on the Susquehanna River, 1972.

TAXA	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOT
CHIRONOMIDAE	-	-	-	1.2	-	0.0	-	-	0.0	0.4	0.0
CHIRONOMIDAE (PUPAE)	-	-	-	35.1	-	220.9	-	-	0.0	85.3	2.8
ABLABESMYIA	-	-	-	0.0	-	2.5	-	-	0.0	0.8	0.0
ABLABESMYIA MALLOCHI	-	-	-	0.0	-	53.4	-	-	0.0	17.8	0.6
CONCHAPELOPIA GRP	-	-	-	610.2	-	823.5	-	-	118.2	517.3	16.7
TANYPODINAE SP#1	-	-	-	4.9	-	31.2	-	-	0.0	12.0	0.4
CHIRONOMUS	-	-	-	0.0	-	0.0	-	-	4.9	1.6	0.1
CRYPTOCHIRONOMUS	-	-	-	0.0	-	4.9	-	-	0.0	1.6	0.1
DICROTENDIPES	-	-	-	0.0	-	5.7	-	-	0.0	1.9	0.1
DICROTENDIPES MODESTUS	-	-	-	0.0	-	0.0	-	-	9.9	3.3	0.1
ENDOCHIRONOMUS GRP	-	-	-	0.0	-	4.9	-	-	0.0	1.6	0.1
GLYPTOTENDIPES	-	-	-	0.0	-	0.0	-	-	1.6	0.5	0.0
PARACHIRONOMUS CARINATUS	-	-	-	0.0	-	206.1	-	-	0.0	68.7	2.2
POLYPEDILUM	-	-	-	275.2	-	516.4	-	-	8.2	266.6	8.6
RHEOTANYTARSUS	-	-	-	1091.7	-	4572.2	-	-	42.7	1902.2	61.5
STENOCHIRONOMUS	-	-	-	1.2	-	0.0	-	-	0.0	0.4	0.0
TANYTARSINI SP#1	-	-	-	0.0	-	0.8	-	-	0.0	0.3	0.0
TANYTARSUS	-	-	-	0.0	-	6.6	-	-	0.0	2.2	0.1
ZAVRELIA	-	-	-	0.0	-	4.9	-	-	0.0	1.6	0.1
ORTHOCLADIINAE	-	-	-	0.0	-	9.9	-	-	0.0	3.3	0.1
CORYNONEURA TARIS	-	-	-	7.4	-	0.0	-	-	0.0	2.5	0.1
CRICOTOPUS	-	-	-	0.0	-	26.3	-	-	1.6	9.3	0.3
CRICOTOPUS BICINCIUS	-	-	-	3.1	-	8.2	-	-	1.6	4.3	0.1
EUKIEFFERIELLA SP#1	-	-	-	47.4	-	0.0	-	-	60.8	36.1	1.2
NANOCLADIUS	-	-	-	27.7	-	426.9	-	-	0.0	151.5	4.9
PARAMETRIOCNEMUS	-	-	-	0.0	-	0.0	-	-	4.9	1.6	0.1
TOTAL ORGANISMS	-	-	-	2105.2	-	6925.2	-	-	254.5	3095.0	
TOTAL TAXA	-	-	-	9	-	17	-	-	10	12	

Table C-49. Monthly and total mean density (No. org/m^2) and percent total of chironomids collected in basket samples at Wilkes-Barre (2) on the Susquehanna River, 1972.

TAXA	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOT
CHIRONOMIDAE	-	-	-	0.8	-	0.0	0.0	-	-	0.3	0.0
CHIRONOMIDAE (PUPAE)	-	-	-	12.3	-	401.5	50.9	-	-	154.9	4.9
ABLABESMYIA	-	-	-	0.0	-	1.6	0.8	-	-	0.8	0.0
ABLABESMYIA MALLOCHI	-	-	-	0.0	-	69.0	22.2	-	-	30.4	1.0
ABLABESMYIA RHAMPHE	-	-	-	0.0	-	0.0	1.6	-	-	0.5	0.0
CONCHAPELOPIA GRP	-	-	-	170.0	-	1240.6	562.4	-	-	657.6	20.9
PROCLADIUS	-	-	-	0.0	-	7.4	1.6	-	-	3.0	0.1
TANYPODINAE SP#1	-	-	-	0.0	-	4.1	0.0	-	-	1.4	0.0
CHIRONOMINAE	-	-	-	0.0	-	0.0	0.8	-	-	0.3	0.0
CHIRONOMUS	-	-	-	0.0	-	3.3	49.3	-	-	17.5	0.6
CHIRONOMUS DECORUS	-	-	-	0.0	-	0.8	92.0	-	-	30.9	1.0
CRYPTOCHIRONOMUS FULVUS	-	-	-	0.0	-	3.3	0.0	-	-	1.1	0.0
ENDOCHIRONOMUS GRP	-	-	-	1.6	-	9.9	14.0	-	-	8.5	0.3
MICROPSECTRA	-	-	-	1.6	-	2.5	0.0	-	-	1.4	0.0
PEDIOMONAS BECKAE	-	-	-	0.0	-	5.7	0.0	-	-	1.9	0.1
POLYPEDILUM	-	-	-	27.1	-	2265.2	9.9	-	-	767.4	24.3
RHEOTANYTARSUS	-	-	-	27.9	-	2626.4	64.9	-	-	906.4	28.8
TANYTARSUS	-	-	-	0.0	-	8.2	0.0	-	-	2.7	0.1
ORTHOCLADIINAE	-	-	-	0.0	-	0.0	0.8	-	-	0.3	0.0
CRICOTOPUS	-	-	-	6.6	-	358.8	65.7	-	-	143.7	4.6
CRICOTOPUS BICINCIUS	-	-	-	40.2	-	325.9	750.4	-	-	372.2	11.8
EUKIEFFERIELLA SP#1	-	-	-	1.6	-	1.6	5.7	-	-	3.0	0.1
NANOCLADIUS	-	-	-	26.3	-	59.9	39.4	-	-	41.9	1.3
SYNORTHOCLADIUS	-	-	-	0.0	-	9.9	2.5	-	-	4.1	0.1
TOTAL ORGANISMS	-	-	-	316.1	-	7405.5	1734.8	-	-	3152.1	
TOTAL TAXA	-	-	-	9	-	19	17	-	-	15	

Table C-50. Monthly and total mean density (No. org/m^2) and percent total of chironomids collected in basket samples at Nanticoke on the Susquehanna River, 1972.

TAXA	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOT
CHIRONOMIDAE	-	-	-	0.0	-	0.0	9.9	-	0.0	2.5	0.9
CHIRONOMIDAE (PUPAE)	-	-	-	3.3	-	5.7	0.0	-	0.0	2.3	0.9
ABLABESMYIA	-	-	-	0.8	-	0.0	0.0	-	0.0	0.2	0.1
ABLABESMYIA MALLOCHI	-	-	-	0.8	-	0.8	0.0	-	0.0	0.4	0.2
ABLABESMYIA RHAMPHE	-	-	-	0.0	-	0.8	0.0	-	0.0	0.2	0.1
CONCHAPELOPIA GRP	-	-	-	29.6	-	18.1	0.0	-	342.9	97.6	36.8
PROCLADIUS	-	-	-	0.0	-	0.0	5.7	-	0.0	1.4	0.5
TANYPODINAE SP#1	-	-	-	0.0	-	2.5	0.0	-	0.0	0.6	0.2
CHIRONOMUS	-	-	-	0.0	-	0.0	0.0	-	39.4	9.9	3.7
DEMICRYPTOCHIRONOMUS	-	-	-	0.8	-	0.0	0.0	-	0.0	0.2	0.1
DICROTENDIPES	-	-	-	0.0	-	0.8	0.0	-	21.7	5.6	2.1
DICROTENDIPES NODESTUS	-	-	-	0.0	-	0.0	0.0	-	12.8	3.2	1.2
ENDOCHIRONOMUS GRP	-	-	-	64.0	-	0.0	0.0	-	0.0	16.0	6.0
GLYPTOTENDIPES	-	-	-	0.0	-	0.8	0.0	-	3.0	0.9	0.4
PARACHIRONOMUS CARINATUS	-	-	-	0.0	-	4.1	0.0	-	0.0	1.0	0.4
PARACHIRONOMUS MONOCHROMUS	-	-	-	0.0	-	0.0	0.0	-	1.0	0.2	0.1
POLYPEDILUM	-	-	-	16.4	-	65.7	0.0	-	8.9	22.7	8.6
RHEOTANYTARSUS	-	-	-	10.7	-	38.6	0.0	-	117.2	41.6	15.7
TANYTARSUS	-	-	-	0.0	-	0.8	0.0	-	3.0	0.9	0.4
TRIBELOS JUCUNDUS	-	-	-	0.8	-	0.0	0.0	-	9.9	2.7	1.0
ORTHOCLADIINAE	-	-	-	0.0	-	0.0	0.0	-	5.9	1.5	0.6
BRILLIA	-	-	-	0.0	-	0.0	0.0	-	2.0	0.5	0.2
CRICOTOPUS	-	-	-	0.0	-	0.8	2.5	-	1.0	1.1	0.4
CRICOTOPUS BICINCTUS	-	-	-	0.0	-	14.8	26.3	-	2.0	10.8	4.1
DIPLOCLADIUS	-	-	-	0.0	-	0.0	0.0	-	3.0	0.7	0.3
EUKIEFFERIELLA SP#1	-	-	-	0.8	-	0.0	0.0	-	57.1	14.5	5.5
NANOCLADIUS	-	-	-	2.5	-	78.8	9.0	-	0.0	22.6	8.5
PARAMETRIOCNEMUS	-	-	-	0.0	-	0.0	0.0	-	11.8	3.0	1.1
RHEOCRICOTOPUS	-	-	-	0.0	-	0.0	0.0	-	2.0	0.5	0.2
TOTAL ORGANISMS	-	-	-	130.5	-	233.2	53.4	-	644.3	265.4	
TOTAL TAXA	-	-	-	10	-	13	4	-	18	11	

Table C-51. Monthly and total mean density (No. org/m^2) and percent total of chironomids collected in basket samples at SSES on the Susquehanna River, 1972.

TAXA	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOT
CHIRONOMIDAE	3.3	2.7	-	1.1	-	0.0	0.0	-	0.0	1.2	0.1
CHIRONOMIDAE (PUPAE)	0.0	20.3	-	7.7	-	130.5	32.8	-	0.0	31.9	2.4
ABLABESMYIA MALLOCHI	0.0	0.5	-	0.0	-	10.7	0.0	-	0.0	1.9	0.1
ABLABESMYIA RHAMPHE	0.8	0.0	-	0.0	-	0.0	0.0	-	0.0	0.1	0.0
CONCHAPELOPIA GRP	15.6	180.1	-	13.1	-	62.4	62.4	-	265.2	99.8	7.4
PROCLADIUS	19.7	0.0	-	0.0	-	0.0	0.0	-	0.0	3.3	0.2
TANYPODINAE SP#1	0.0	0.5	-	2.7	-	2.5	0.0	-	0.0	1.0	0.1
CHIRONOMUS	5.7	0.0	-	0.0	-	0.0	0.0	-	14.0	3.3	0.2
CHIRONOMUS DECORUS	11.5	0.0	-	0.0	-	0.0	0.0	-	0.0	1.9	0.1
DICROTENDIPES	0.0	0.5	-	0.0	-	0.0	0.0	-	18.1	3.1	0.2
DICROTENDIPES NODESTUS	0.8	0.5	-	0.0	-	10.7	0.0	-	29.6	6.9	0.5
ENDOCHIRONOMUS GRP	4.1	4.9	-	7.7	-	0.0	6.6	-	0.0	3.9	0.3
GLYPTOTENDIPES	0.0	2.2	-	0.0	-	0.0	0.0	-	2.5	0.8	0.1
MICROPSECTRA	0.0	0.0	-	0.0	-	4.1	0.0	-	0.0	0.7	0.1
MICROTENDIPES	0.0	0.0	-	0.0	-	0.0	0.0	-	6.6	1.1	0.1
PARACHIRONOMUS CARINATUS	0.0	0.0	-	0.0	-	42.7	0.0	-	0.0	7.1	0.5
POLYPEDILUM	4.1	79.9	-	48.7	-	3275.8	0.0	-	7.4	569.3	42.4
RHEOTANYTARSUS	4.1	59.1	-	26.8	-	1409.7	239.7	-	125.6	310.8	23.1
TANYTARSUS	0.0	30.7	-	0.0	-	10.7	6.6	-	0.0	8.0	0.6
TRIBELOS FUSICORNIS	0.0	0.5	-	0.0	-	0.0	0.0	-	0.0	0.1	0.0
TRIBELOS JUCUNDUS	0.0	0.0	-	0.0	-	0.0	0.0	-	1.6	0.3	0.0
ORTHOCLADIINAE	0.8	0.5	-	0.0	-	0.0	0.0	-	7.4	1.5	0.1
CRICOTOPUS	9.0	1.1	-	56.4	-	477.0	14.0	-	14.0	95.2	7.1
CRICOTOPUS BICINCTUS	0.0	33.4	-	54.7	-	117.4	358.0	-	3.3	94.5	7.0
DIPLOCLADIUS	0.0	0.0	-	0.0	-	0.0	0.0	-	0.8	0.1	0.0
EUKIEFFERIELLA COERULESCENS GRP SP#1	0.0	1.1	-	18.6	-	0.0	0.0	-	0.0	3.3	0.2
EUKIEFFERIELLA SP#1	10.7	6.6	-	63.5	-	1.6	32.8	-	62.4	29.6	2.2
NANOCLADIUS	4.1	2.2	-	44.9	-	258.6	46.8	-	0.0	59.4	4.4
ORTHOCLADIUS	0.0	0.5	-	0.5	-	0.0	0.0	-	0.0	0.2	0.0
PARAMETRIOCNEMUS	0.0	0.5	-	0.0	-	0.0	0.0	-	12.3	2.1	0.2
RHEOCRICOTOPUS	3.3	1.1	-	1.6	-	0.0	0.0	-	1.6	1.3	0.1
SYNORTHOCLADIUS	0.0	0.0	-	0.0	-	1.6	0.0	-	0.0	0.3	0.0
THIENEMANNIELLA	0.0	0.0	-	1.6	-	0.0	0.0	-	0.0	0.3	0.0
TOTAL ORGANISMS	97.7	429.7	-	349.7	-	5816.0	799.7	-	572.2	1344.2	
TOTAL TAXA	14	20	-	13	-	14	8	-	16	14	

Table C-52. Monthly and total mean density (No. org/m^2) and percent total of chironomids collected in basket samples at Nescopeck on the Susquehanna River, 1972.

TAXA	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOT
CHIRONOMIDAE (PUPAE)	-	-	-	18.1	-	638.7	72.9	-	0.0	182.4	1.0
ABLABESMYIA MALLOCHI	-	-	-	0.0	-	92.0	27.6	-	0.0	29.9	0.2
CONCHAPELOPIA GRP	-	-	-	137.9	-	635.5	242.4	-	3.7	254.9	1.5
CRYPTOCHIRONOMUS FULVUS	-	-	-	0.0	-	92.8	0.0	-	0.0	23.2	0.1
DICROTENDIPES	-	-	-	0.0	-	12.3	0.0	-	0.0	3.1	0.0
DICROTENDIPES MODESTUS	-	-	-	0.0	-	289.8	57.1	-	0.0	86.7	0.5
PARACHIRONOMUS CARINATUS	-	-	-	1.6	-	0.0	147.8	-	0.0	37.4	0.2
PARACHIRONOMUS PECTINATELLAE	-	-	-	0.0	-	60.8	0.0	-	0.0	15.2	0.1
POLYPEDILUM	-	-	-	12.3	-	1991.0	38.4	-	0.0	510.4	2.9
RHEOTANYTARSUS	-	-	-	27.1	-	45089.1	14033.4	-	40.6	14797.5	84.8
CRICOTOPUS	-	-	-	0.0	-	512.3	328.1	-	0.0	210.1	1.2
CRICOTOPUS BICINCTUS	-	-	-	20.5	-	926.9	2413.8	-	0.0	840.3	4.8
EUKIEFFERIELLA SP#1	-	-	-	0.0	-	73.9	58.1	-	0.0	33.0	0.2
NANOCLADIUS	-	-	-	2.5	-	647.0	1058.1	-	0.0	426.9	2.4
TOTAL ORGANISMS	-	-	-	220.0	-	51061.7	18477.5	-	44.3	17450.9	
TOTAL TAXA	-	-	-	6	-	12	10	-	2	8	

Table C-53. Mean density (No. org/m^2) of some macroinvertebrates collected in basket samples from Falls to Nescopeck on the Susquehanna River, 1972.

Taxa	Station				
	Falls	Wilkes-Barre(2)	Nanticoke	SSES	Nescopeck
Oligochaeta	26	1014	229	185	52
Heptageniidae	618	32	<1	34	18
Hydropsychidae	1844	5	113	125	5581
Chironomidae	3095	3152	263	1344	17451

Table C-54. Monthly and total mean density (No. org/m^2) and percent total of chironomids collected in basket samples from Falls to Nescopeck on the Susquehanna River, 1972.

TAXA	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOT
CHIRONOMIDAE	3.3	2.7	-	0.7	-	0.0	2.6	-	0.0	1.5	0.0
CHIRONOMIDAE (PUPAE)	0.0	20.3	-	15.8	-	279.5	37.7	-	0.0	58.9	1.7
ABLABESMYIA	0.0	0.0	-	0.1	-	0.8	0.2	-	0.0	0.2	0.0
ABLABESMYIA MALLOCHI	0.0	0.5	-	0.1	-	45.2	11.8	-	0.0	9.6	0.3
ABLABESMYIA RHAMPHE	0.8	0.0	-	0.0	-	0.2	0.4	-	0.0	0.2	0.0
CONCHAPELOPIA GRP	15.6	180.1	-	200.7	-	556.0	215.7	-	204.2	228.7	6.7
PROCLADIUS	19.7	0.0	-	0.0	-	1.5	1.9	-	0.0	3.9	0.1
TANYPODINAE SP#1	0.0	0.5	-	1.8	-	8.0	0.0	-	0.0	1.7	0.1
CHIRONOMINAE	0.0	0.0	-	0.0	-	0.0	0.2	-	0.0	0.0	0.0
CHIRONOMUS	5.7	0.0	-	0.0	-	0.7	12.9	-	16.4	5.9	0.2
CHIRONOMUS DECORUS	11.5	0.0	-	0.0	-	0.2	24.0	-	0.0	5.9	0.2
CRYPTOCHIRONOMUS	0.0	0.0	-	0.0	-	1.0	0.0	-	0.0	0.2	0.0
CRYPTOCHIRONOMUS FULVUS	0.0	0.0	-	0.0	-	19.2	0.0	-	0.0	3.2	0.1
DEMICRYPTOCHIRONOMUS	0.0	0.0	-	0.1	-	0.0	0.0	-	0.0	0.0	0.0
DICROTENDIPES	0.0	0.5	-	0.0	-	3.8	0.0	-	12.0	2.7	0.1
DICROTENDIPES NODESTUS	0.8	0.5	-	0.0	-	60.1	12.4	-	15.1	14.8	0.4
ENDOCHIRONOMUS GRP	4.1	4.9	-	13.2	-	3.0	5.4	-	0.0	5.1	0.1
GLYPTOTENDIPES	0.0	2.2	-	0.0	-	0.2	0.0	-	1.9	0.7	0.0
MICROPSECTRA	0.0	0.0	-	0.3	-	1.3	0.0	-	0.0	0.3	0.0
MICROTENDIPES	0.0	0.0	-	0.0	-	0.0	0.0	-	2.2	0.4	0.0
PARACHIRONOMUS CARINATUS	0.0	0.0	-	0.3	-	50.6	32.1	-	0.0	13.8	0.4
PARACHIRONOMUS MONOCHROMUS	0.0	0.0	-	0.0	-	0.0	0.0	-	0.3	0.0	0.0
PARACHIRONOMUS PECTINATELLAE	0.0	0.0	-	0.0	-	12.2	0.0	-	0.0	2.0	0.1
PEDIONOMUS BECKAE	0.0	0.0	-	0.0	-	1.1	0.0	-	0.0	0.2	0.0
POLYPEDILUM	4.1	79.9	-	85.0	-	1622.8	10.9	-	6.3	301.5	8.8
RHEOTANYTARSUS	4.1	59.1	-	267.7	-	10747.1	3130.2	-	90.6	2383.1	69.4
STENOCHIRONOMUS	0.0	0.0	-	0.3	-	0.0	0.0	-	0.0	0.0	0.0
TANYTARSINI SP#1	0.0	0.0	-	0.0	-	0.2	0.0	-	0.0	0.0	0.0
TANYTARSUS	0.0	30.7	-	0.0	-	5.3	1.7	-	0.8	6.4	0.2
TRIBELOS FUSICORNIS	0.0	0.5	-	0.0	-	0.0	0.0	-	0.0	0.1	0.0
TRIBELOS JUCUNDUS	0.0	0.0	-	0.1	-	0.0	0.0	-	3.3	0.6	0.0
ZAVRELIA	0.0	0.0	-	0.0	-	1.0	0.0	-	0.0	0.2	0.0
ORTHOCLADIINAE	0.8	0.5	-	0.0	-	2.0	0.2	-	4.1	1.3	0.0
ERILLIA	0.0	0.0	-	0.0	-	0.0	0.0	-	0.5	0.1	0.0
CORYNONEURA TARIS	0.0	0.0	-	1.7	-	0.0	0.0	-	0.0	0.3	0.0
CRICOTOPUS	9.0	1.1	-	15.6	-	275.0	92.7	-	5.2	66.5	1.9
CRICOTOPUS BICINCTUS	0.0	33.4	-	25.2	-	278.7	820.7	-	1.9	193.3	5.6
DIPLOCLADIUS	0.0	0.0	-	0.0	-	0.0	0.0	-	1.1	0.2	0.0
EUKIEFFERIELLA COERULESCENS GRP SP#1	0.0	1.1	-	4.8	-	0.0	0.0	-	0.0	1.0	0.0
EUKIEFFERIELLA SP#1	10.7	6.6	-	27.6	-	15.4	22.7	-	46.8	21.6	0.6
NANOCLADIUS	4.1	2.2	-	23.2	-	294.2	254.9	-	0.0	96.4	2.8
ORTHOCLADIUS	0.0	0.5	-	0.1	-	0.0	0.0	-	0.0	0.1	0.0
PARAMETRIOCNEMUS	0.0	0.5	-	0.0	-	0.0	0.0	-	8.2	1.5	0.0
RHEOCRICOTOPUS	3.3	1.1	-	0.4	-	0.0	0.0	-	1.1	1.0	0.0
SYNORTHOCLADIUS	0.0	0.0	-	0.0	-	2.3	0.6	-	0.0	0.5	0.0
THIENEMANNIELLA	0.0	0.0	-	0.4	-	0.0	0.0	-	0.0	0.1	0.0
TOTAL ORGANISMS	97.7	429.7	-	685.4	-	14287.6	4691.9	-	422.0	3435.8	
TOTAL TAXA	14	20	-	21	-	29	20	-	19	21	

Table C-55. Correlations of physicochemical parameters and density of macroinvertebrates collected in basket samples from Falls to Nescopeck on the Susquehanna River, July 1972 (* = P<.05; ** = P<.01).

RHEOTANYTARSUS	POLYPEDILUM	CONCHAPELOPIA	NANOCLADIUS	CRICOTOPUS BICINCTUS	OLIGOCHAETA	HEPTAGENIIDAE	HYDROPSYCHIDAE	TOTAL IRON	DISSOLVED IRON	SULFATES	pH	FECAL COLIFORM
.920**												
.753	.487											
-.134	-.092	-.116										
.459	.694	.059	.552									
-.884*	-.638	-.895*	.024	-.164								
.945**	.890*	.597	.098	.554	-.847*							
.796	.500	.863*	-.100	-.033	-.978**	.761						
-.874*	-.791	-.847*	-.126	-.577	.811*	-.783	-.678					
-.739	-.648	-.665	-.544	-.655	.773	-.812*	-.656	.864*				
-.858*	-.836*	-.780	.151	-.529	.689	-.691	-.550	.942**	.656			
.903*	.680	.874*	.034	.245	-.996**	.883*	.960**	-.835*	-.818*	-.705		
-.559	-.423	-.251	.430	.199	.571	-.608	-.653	.113	.119	.111	-.565	

Table C-56. Correlations of physicochemical parameters and density of macroinvertebrates collected in basket samples from Falls to Nescopeck on the Susquehanna River, September 1972 (* = P<.05; ** = P<.01).

RHEOTANYTARSUS	POLYPEDILUM	CONCHAPELOPIA	NANOCLADIUS	CRICOTOPUS BICINCTUS	OLIGOCHAETA	HEPTAGENIIDAE	HYDROPSYCHIDAE	TOTAL IRON	DISSOLVED IRON	SULFATES	pH	FECAL COLIFORM
.738												
.800	.554											
.624	.732	.393										
.709	.324	.279	.142									
-.635	-.443	-.200	-.080	-.947**								
.502	.276	.665	-.287	.465	-.524							
.816*	.218	.630	.262	.811*	-.614	.485						
-.777	-.395	-.717	.003	-.776	.750	-.894*	-.799					
-.132	.291	.202	.445	-.775	.728	-.328	-.514	.497				
-.047	.213	-.456	.636	-.053	.068	-.838*	.175	.583	.211			
.290	-.122	.546	-.520	.365	-.333	.909*	.509	-.789	-.433	-.944**		
-.578	-.196	-.293	.171	-.931**	.927**	-.698	-.726	.869*	.837*	.037	-.631	

Table C-57. Correlations of physicochemical parameters and density of macroinvertebrates collected in basket samples from Falls to Nescopeck on the Susquehanna River, October 1972 (* = P<.05; ** = P<.01).

RHEOTANYTARSUS	POLYPEDILUM	CONCHAPELOPIA	NANOCLADIUS	CRICOTOPUS BICINCTUS	OLIGOCHAETA	HEPTAGENIIDAE	HYDROPSYCHIDAE	TOTAL IRON	DISSOLVED IRON	SULFATES	pH	FECAL COLIFORM
.740												
.753	.720											
.961**	.826	.633										
.936*	.832	.929*	.874*									
-.165	.439	.401	-.129	.170								
.549	.925*	.797	.591	.766	.722							
.865	.685	.363	.950*	.682	-.349	.367						
-.635	-.536	-.971**	-.462	-.833	-.381	-.670	-.175					
-.831	-.634	-.972**	-.684	-.942*	-.179	-.656	-.445	.956*				
.530	-.021	-.108	.530	.201	-.908*	-.371	.708	.172	-.099			
-.144	.361	.491	-.171	.211	.975**	.684	-.428	-.517	-.291	-.915*		
-.847	-.567	-.295	.912*	-.624	.490	-.228	-.987**	.126	.410	-.810	.553	

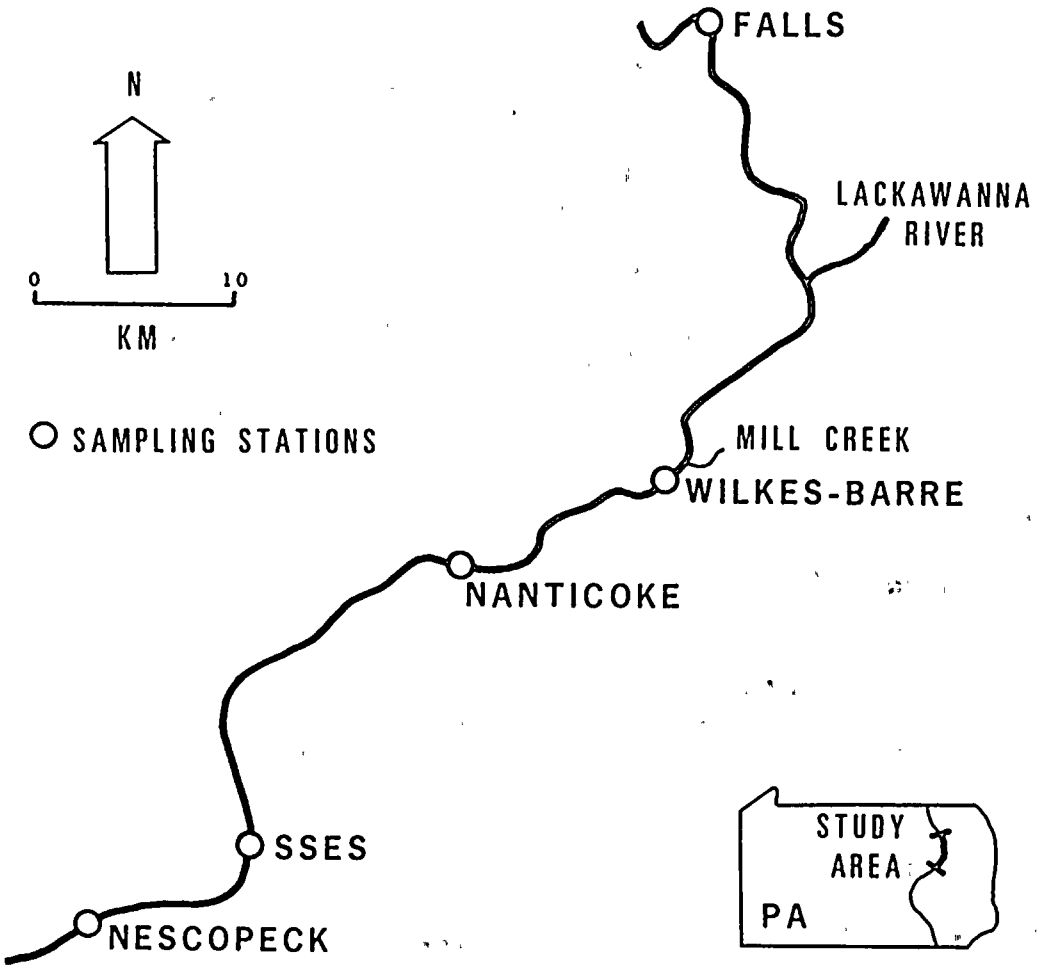

Fig. C-1. Location of benthic macroinvertebrate sampling stations on the Susquehanna River, 1972.

MACROINVERTEBRATE DRIFT

by

Lynn Sabin

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ABSTRACT

Macroinvertebrate drift collected in the Susquehanna River at both Falls and SSES in 1973-74 was composed primarily of chironomids. Naidid worms and hydracarinids were also important components of the fauna at SSES. Mayflies and caddisflies were abundant at Falls. More taxa were collected at SSES (51) than at Falls (36). Macroinvertebrate density near the River bottom was about one-third greater than near the surface, although taxonomic composition was similar. Macroinvertebrate density at SSES was about twice that at Falls. Density was high at both stations in June, July, and August. Maximum density occurred in June and minimum density in March. Macroinvertebrates at Falls were usually most abundant at night, whereas at SSES, periodicity was erratic.

INTRODUCTION

Most benthic macroinvertebrates in streams and rivers enter the water column and drift downstream at some time in their life. The rate at which this occurs is affected by changes in light intensity, current velocity, water temperature, stages of life cycle, and population density (Waters 1969). These and other factors regulate both seasonal and diel fluctuations in macroinvertebrate drift density.

During the past 20 years, many descriptions of macroinvertebrate drift in streams have been published (Waters 1961, 1962; Elliot 1965), but little work has been done in large rivers, such as the Susquehanna. Objectives of this study were to describe seasonal and diel fluctuations of macroinvertebrate drift at two sites on the Susquehanna River.

PROCEDURES

Macroinvertebrate drift in the Susquehanna River was sampled monthly from June 1973 through May 1974 near the Susquehanna SES (SSES) and at a "control" station, 64 km upriver at Falls, Pennsylvania (Fig. C-1). SSES was located near the periphyton station, 240 m upriver from SSES-A (Fig. A-1).

A gasoline-powered, 10-cm (4-inch) trash pump was used to collect samples. The pump was mounted on a pontoon boat anchored in midchannel. The pump intake was positioned 1 m upriver from the boat and could either be lowered or raised, using a small hand winch, to collect bottom or surface samples. Water was pumped through an interchangeable 216-μ mesh net on which an ABS quick-opening bucket (Gale 1975) was attached. Initially, pumping rate was determined by timing the filling of a 1,280-liter trough five times; thereafter, the rate was checked monthly by filling it twice.

Each month, samples were collected at 3-h intervals throughout a 24-h period. In all months except June, four replicates were collected near the River surface (about 50 cm below the surface) and near the bottom (within 10-20 cm of the substrate) during each sampling interval (Table D-1). By releasing dye near the mouth of the intake, a scuba diver was able to observe that benthic organisms were not drawn from the substrate, when the intake was 10 cm or more above it. Sampling began near the mid-point of the following intervals: 2231-0130, 0131-0430, 0431-0730, 0731-1030, 1031-1330, 1331-1630, 1631-1930, and 1931-2230 h.

Both SSES and Falls were sampled in the same 72-h period, usually when River flow was either stationary or decreasing. This negated possible effects of "catastrophic drift," a mechanical response of organisms to the disturbance of the substrate initiated by a rapid increase in current velocity (Waters 1965), and better isolated the behavioral drift.

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

Samples were preserved in 10% buffered formalin. Later, macroscopic organisms were removed from the samples and tabulated. The entire residue (or 1/3 of it, if dense) was examined with a dissecting microscope at 10 X magnification to remove minute specimens. The number of organisms in the residue (adjusted by a factor of 3, if subsampled) was added to the number of macroscopic organisms previously removed. In most instances, invertebrates were identified to the family level with keys of Claassen (1931), Johannsen (1934-37), Ross (1944), Burks (1953), and Pennak (1953).

In 1977, a second series of surface and bottom replicates from SSES was examined (Tables D-2 through D-13) and, to date, two complete series of replicates from Falls and SSES have been examined. Data from both 1976 (Sabin 1977) and 1977 were stored in and processed with a Hewlett-Packard 9830A computer.

RESULTS AND DISCUSSION

Composition of Drift

Composition of macroinvertebrate drift at SSES and Falls reflected differences in water quality at the two stations. Chironomids predominated at SSES (67.2% of the total drift), where acid mine drainage was a major pollutant (Tables D-14, D-15). Other major components of the drift were naidid worms (11.0%) and hydracarinids (8.0%). Mayflies (5.1%) and caddisflies (2.2%) were collected frequently, but not in large numbers. At Falls, where water quality was superior to all other sampling sites in 1973 (Ichthyological Associates 1974), chironomids (40.0%) were not as abundant as at SSES (Tables D-14 through D-17). But mayflies and caddisflies, traditionally considered "clean water" taxa, were more abundant and composed 25.7% and 24.3% of the total, respectively.

Total number of taxa collected at SSES (51) was much greater than at Falls (36). The mean number of taxa was slightly greater near the River bottom than near the surface at both stations. At SSES, the range was from 14 taxa collected in October to 39 in January, and at Falls, from 19 in November to 26 in July (Tables D-14 through D-17).

Density

Mean density of drifting macroinvertebrates at SSES (209 organisms/ 10 m^3 of water) was nearly twice that at Falls (121 org/10 m^3). Mean monthly density at SSES ranged from 39 to 687 org/10 m^3 (Tables D-14, D-15), and at Falls, from 5 to 414 org/10 m^3 (Tables D-16, D-17).

Density of drifting macroinvertebrates near the River bottom was about one-third greater than near the surface at both stations. However, differences within individual taxa were usually not evident, probably because of high variability between samples. Taxonomically, the composition of the drift was similar in surface and bottom samples (Tables D-14 through D-17).

Seasonal Fluctuations

SSES

Macroinvertebrate density fluctuated widely at SSES. Density was high in June, July, and August and then declined through November. It increased in December and January and declined again in February, March, and April. Maximum mean density was observed in June (579 org/10 m^3) and minimum mean density in March (43 org/10 m^3) (Tables D-14, D-15).

Chironomids, naidid worms, mayflies, and nematodes were abundant in spring and summer. Chironomid density was high in June ($\bar{x}$ = 358 org/10 m^3), July ($\bar{x}$ = 308 org/10 m^3), and August ($\bar{x}$ = 386 org/10 m^3). Naidid worms were most abundant in May ($\bar{x}$ = 91 org/10 m^3) and June ($\bar{x}$ = 135 org/10 m^3) (Fig. D-1). Ephemerids, baetids, and heptageniids composed over 90.0% of the mayflies. Baetids were most abundant in May ($\bar{x}$ = 18 org/10 m^3) and June ($\bar{x}$ = 15 org/10 m^3), ephemerids in June ($\bar{x}$ = 18 org/10 m^3), and heptageniids in July ($\bar{x}$ = 18 org/10 m^3). Density of nematodes was high in June ($\bar{x}$ = 15 org/10 m^3).

Hydracarinids, hydropsychids, and empidids were abundant in autumn. Density of hydracarinids was greatest in November ($\bar{x}$ = 54 org/10 m^3); mean monthly density from July through November was 33 org/10 m^3 (Fig. D-1). Hydropsychids were abundant in August ($\bar{x}$ = 11 org/10 m^3), September ($\bar{x}$ = 8 org/10 m^3), and October ($\bar{x}$ = 9 org/10 m^3). Density of empidids was greatest in October ($\bar{x}$ = 14 org/10 m^3).

In winter, densities of chironomids, naidid worms, and nematodes were high. Nematodes were most abundant in January ($\bar{x}$ = 17 org/10 m^3). Density of chironomids and naidid worms decreased in autumn, but rose again in December ($\bar{x}$ = 78 and 27 org/10 m^3, respectively) (Fig. D-1).

Falls

As at SSES, macroinvertebrate density at Falls was high in June, July, and August. It decreased from September through March and then increased in April and May. Maximum mean density occurred in June (350 org/10 m^3) and minimum mean density in March (8 org/10 m^3).

Unlike at SSES, almost all taxa were most abundant in summer at Falls. Chironomids were most abundant in July ($\bar{x}$ = 197 org/10 m^3) and August ($\bar{x}$ = 88 org/10 m^3). Caenids ($\bar{x}$ = 42 org/10 m^3), ephemerids ($\bar{x}$ = 39 org/10 m^3), and heptageniids ($\bar{x}$ = 24 org/10 m^3) were most abundant in June. Density of hydropsychids was greatest in June ($\bar{x}$ = 138 org/10 m^3) and August ($\bar{x}$ = 74 org/10 m^3) (Fig. D-1). Elmid beetles were most abundant in July ($\bar{x}$ = 26 org/10 m^3); simuliids were abundant in June ($\bar{x}$ = 16 org/10 m^3), July ($\bar{x}$ = 14 org/10 m^3), and August ($\bar{x}$ = 12 org/10 m^3) (Tables D-16, D-17).

Drift Rate

Drift rate, the total number of macroinvertebrates in the River passing a given point in one second (org/s), was calculated to compensate for changes in River flow. At SSES, drift rate ranged from 545 to 11,808 org/s and was greatest in January, as was River flow. Drift rate was also high in June and August and was low in October and November. Chironomid rate of drift fluctuated widely. In November, less than 20 chironomids were passing per second, but by January, over 8,000 chironomids/s were drifting (Fig. D-2).

Drift rate at Falls ranged from 109 to 6,576 org/s. It was high in June ($\bar{x}$ = 6,576 org/s), July ($\bar{x}$ = 3,154 org/s), and August ($\bar{x}$ = 2,690 org/s). It was low in November and February, but increased in spring. Seasonal fluctuations in rate of drift of chironomids, mayflies, and hydropsychids were similar to those observed in density (org/10 m^3) (Figs. D-1, D-2).

Diel Periodicity

At SSES, fluctuations in macroinvertebrate density throughout the 24-h sampling periods varied from month to month. Periodicity of chironomids, hydracarinids, mayflies, and caddisflies was erratic. In April and May, for instance, density of chironomids remained relatively stable throughout each sampling period. But in June, they were most abundant during the afternoon ($\bar{x}$ = 555 org/10 m^3) and least so in the morning ($\bar{x}$ = 246 org/10 m^3). By July, density was greatest near dusk ($\bar{x}$ = 560 org/10 m^3) and least in late afternoon ($\bar{x}$ = 202 org/10 m^3) (Fig. D-3).

Periodicity was more stable throughout the year at Falls than at SSES. Mayflies, caddisflies, elmids, and simuliids were most abundant at night. Periodicity of chironomids was also more stable at Falls; during April, May, and June, density ranged from 11 to 80 org/10 m^3. The range in July, though greater than in other months (146 to 290 org/10 m^3), was still much less than at SSES (Fig. D-3).

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Table D-1. Sampling dates, River flow, volume of water filtered, 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 SSES	Falls	Mean River Flow (m^3/s) SSES[a]	Falls[b]	Pumping Rate (liter/min)	Pumping Duration (min/rep)	Vol. Filtered (m^3/rep)	No. of Replicates Surface	Bottom
Jun	13-14	12-13	193.8	188.0	1,150	5.5	6.3	3	3
Jul	26-27	27-28	87.8	105.2	2,250	5.0	11.3	4	4
Aug	21-22	22-23	131.3	105.7	2,250	5.0	11.3	4	4
Sep	21-22	22-23	123.6	93.3	2,250	5.0	11.3	4	4
Oct	12-13	13-14	68.7	60.0	2,250	5.0	11.3	4	4
Nov	16-17	17-18	94.6	100.9	2,250	5.0	11.3	4	4
Dec	20	--	222.3	--	2,250	5.0	11.3	4	4
Jan	26-27	--	964.5	--	2,250	5.0	11.3	4	4
Feb	18-19	19-20	263.0	212.5	2,250	5.0	11.3	4	4
Mar	18-19	19-20	531.9	483.0	2,250	5.0	11.3	4	4
Apr	24-25	25-26	503.0	439.0	2,250	5.0	11.3	4	4
May	28-29	29-30	284.5	218.0	2,250	5.0	11.3	4	4

[a]River flow at the IA Laboratory (see Physicochemical Analyses) was calculated with the formula: *River flow = 215.8 + 322.3 (River level - 149) + 106.4 (River level - 149)^2.*

[b]River flow at Falls was calculated with data provided by the USGS from the Towanda, Old Forge, and Wilkes-Barre gauging stations (Ichthyological Associates 1974).

Table D-2. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	9	37	3	0	3	12	8	16	11.0	4.6
NAIDIDAE	24	105	6	41	46	66	64	57	51.1	21.6
BRANCHIURA	0	3	0	0	0	0	0	0	0.4	0.2
HYDRACARINA	21	6	0	0	0	0	0	12	4.9	2.1
EPHEMERIDAE	6	12	3	20	2	3	8	4	7.3	3.1
CAENIDAE	6	6	0	0	0	3	0	6	2.6	1.1
BAETIDAE	0	11	3	1	4	6	2	7	4.3	1.8
HEPTAGENIIDAE	3	6	0	1	0	1	9	5	3.1	1.3
HYDROPSYCHIDAE	3	0	0	9	0	3	0	0	1.9	0.8
HYDROPTILIDAE	0	3	0	0	0	0	0	0	0.4	0.2
PSYCHODIDAE	0	0	0	3	3	0	0	3	1.1	0.5
SIMULIIDAE	0	1	0	0	0	1	0	2	0.5	0.2
CHIRONOMIDAE	57	285	44	95	70	154	196	252	144.1	60.8
CHIRONOMIDAE (PUPAE)	9	3	0	4	2	1	8	7	4.3	1.8
TOTAL ORGANISMS/SAMPLE	138	478	59	174	130	250	295	371	236.9	
ORGANISMS/10M3	219	759	94	276	206	397	468	589	376.0	

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	12	9	12	10	16	1	9	20	11.1	3.4
NAIDIDAE	146	136	33	48	89	0	76	181	88.6	27.3
HYDRACARINA	0	6	3	3	0	2	0	6	2.5	0.8
COLLEMBOLA	0	1	0	0	0	0	0	0	0.1	0.0
EPHEMERIDAE	4	4	3	33	17	0	5	23	11.1	3.4
CAENIDAE	0	0	3	6	12	1	0	0	2.8	0.8
EPHEMERELLIDAE	0	0	0	0	0	1	0	0	0.1	0.0
BAETIDAE	5	5	19	12	9	7	0	3	7.5	2.3
HEPTAGENIIDAE	3	9	21	14	24	9	6	17	12.9	4.0
PSYCHOMYIIDAE	0	0	0	0	0	4	0	0	0.5	0.2
HYDROPSYCHIDAE	0	3	0	0	0	11	0	0	1.8	0.5
LEPIDOPTERA	0	0	0	0	0	0	0	3	0.4	0.1
DYTISCIDAE	0	0	0	1	0	0	0	0	0.1	0.0
ELMIDAE	0	0	3	1	0	2	0	0	0.8	0.2
ELMIDAE (ADULTS)	0	0	0	0	0	0	0	2	0.3	0.1
TIPULIDAE	0	1	0	0	0	0	0	0	0.1	0.0
SIMULIIDAE	3	1	3	0	6	1	0	4	2.3	0.7
CHIRONOMIDAE	217	217	95	176	199	36	60	371	171.4	52.8
CHIRONOMIDAE (PUPAE)	8	6	15	5	22	1	1	27	10.6	3.3
TOTAL ORGANISMS/SAMPLE	398	398	210	309	394	76	157	657	324.9	
ORGANISMS/10M3	632	632	333	490	625	121	249	1043	515.7	

Table D-3. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	3	1	2	2	1	1	3	8	2.6	1.2
NAIDIDAE	4	2	7	3	2	2	3	5	3.5	1.6
HYDRACARINA	24	9	29	10	18	4	11	58	20.4	9.5
CAENIDAE	0	2	2	0	0	0	1	2	0.9	0.4
EPHEMERELLIDAE	0	0	0	0	0	0	1	0	0.1	0.1
BAETIDAE	0	0	1	0	1	2	1	2	0.9	0.4
HEPTAGENIIDAE	8	4	14	11	5	24	20	28	14.3	6.7
PSYCHOMYIIDAE	0	0	1	2	0	2	1	1	0.9	0.4
HYDROPSYCHIDAE	0	3	0	1	0	0	0	2	0.8	0.4
HYDROPTILIDAE	0	1	2	1	0	0	1	1	0.8	0.4
ELMIDAE	1	0	0	0	0	1	3	0	0.6	0.3
ELMIDAE (ADULTS)	0	0	0	0	0	5	2	0	0.9	0.4
CULICIDAE	0	0	0	0	0	0	2	0	0.3	0.1
SIMULIIDAE	6	5	3	1	6	10	5	12	6.0	2.8
EMPIDIDAE	1	0	2	1	4	0	2	6	2.0	0.9
CHIRONOMIDAE	111	102	123	90	101	116	133	293	133.6	62.6
CHIRONOMIDAE (PUPAE)	4	6	10	4	14	47	36	80	25.1	11.8
TOTAL ORGANISMS/SAMPLE	162	135	196	126	152	214	225	498	213.5	
ORGANISMS/10M3	143	119	173	112	135	189	199	441	188.9	

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	10	8	19	6	7	5	12	5	9.0	2.0
NAIDIDAE	4	8	7	3	3	2	4	4	4.4	1.0
HYDRACARINA	30	33	54	40	80	12	16	30	36.9	8.3
PERLIDAE	0	0	0	0	0	0	2	0	0.3	0.1
CAENIDAE	0	3	1	1	0	1	1	0	0.9	0.2
EPHEMERELLIDAE	0	0	0	0	1	0	1	0	0.3	0.1
BAETIDAE	2	0	1	1	6	0	1	3	1.8	0.4
HEPTAGENIIDAE	19	13	9	17	83	9	35	12	24.6	5.6
PSYCHOMYIIDAE	1	0	1	0	1	0	0	0	0.4	0.1
HYDROPSYCHIDAE	2	4	1	0	2	2	1	0	1.5	0.3
HYDROPTILIDAE	1	2	4	1	0	0	0	0	1.0	0.2
ELMIDAE	0	1	0	0	2	0	3	0	0.8	0.2
ELMIDAE (ADULTS)	0	0	0	0	2	7	6	0	1.9	0.4
CULICIDAE	0	0	0	0	0	0	1	6	0.9	0.2
SIMULIIDAE	2	2	4	2	12	15	11	13	7.6	1.7
EMPIDIDAE	4	1	9	2	5	3	0	2	3.3	0.7
CHIRONOMIDAE	293	260	308	149	455	152	236	144	249.6	56.5
CHIRONOMIDAE (PUPAE)	49	35	31	25	526	28	39	42	96.9	21.9
TOTAL ORGANISMS/SAMPLE	417	370	449	247	1185	236	369	261	441.8	
ORGANISMS/10M3	369	327	397	219	1049	209	327	231	390.9	

Table D-4. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	3	0	1	0	0	0	1	0	0.6	0.2
NAIDIDAE	0	0	0	0	0	0	0	3	0.4	0.1
HYDRACARINA	30	36	21	37	21	12	9	22	23.5	7.8
COLLEMBOLA	0	0	0	0	0	0	3	0	0.4	0.1
CAENIDAE	0	0	0	1	4	0	0	0	0.6	0.2
BAETIDAE	0	0	0	6	0	1	0	0	0.9	0.3
PSYCHOMYIIDAE	11	12	1	6	1	0	0	10	5.1	1.7
HYDROPSYCHIDAE	0	8	2	11	3	5	5	10	5.5	1.8
ELMIDAE (ADULTS)	0	0	0	0	0	1	1	0	0.3	0.1
CULICIDAE	0	0	0	0	0	0	0	6	0.8	0.3
SIMULIIDAE	4	9	5	2	7	2	9	7	5.6	1.9
EMPIDIDAE	4	2	1	9	4	4	1	0	3.1	1.0
EMPIDIDAE (PUPAE)	0	0	0	0	0	0	0	1	0.1	0.0
CERATOPOGONIDAE	0	0	0	0	0	0	1	0	0.1	0.0
CHIRONOMIDAE	122	334	123	195	161	133	229	140	179.6	59.9
CHIRONOMIDAE (PUPAE)	107	70	12	47	67	31	31	220	73.1	24.4
TOTAL ORGANISMS/SAMPLE	281	471	166	314	268	189	290	419	299.8	
ORGANISMS/10M3	249	417	147	278	237	167	257	371	265.3	

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	1	0	0	0	1	0	0	0	0.3	0.0
NAIDIDAE	16	0	3	0	0	0	0	0	2.4	0.3
HYDRACARINA	21	12	126	57	36	18	46	90	50.8	6.4
COLLEMBOLA	0	3	6	0	0	0	1	0	1.3	0.2
CAENIDAE	0	0	0	0	0	0	3	0	0.4	0.0
BAETIDAE	0	0	0	0	0	0	1	3	0.5	0.1
HEPTAGENIIDAE	0	0	0	0	9	0	0	0	1.1	0.1
COENAGRIONIDAE	0	0	0	3	0	3	3	0	1.1	0.1
PSYCHOMYIIDAE	2	8	13	6	3	9	0	0	5.1	0.6
HYDROPSYCHIDAE	15	4	17	6	14	5	5	6	9.0	1.1
HYDROPTILIDAE	0	0	0	0	6	0	0	0	0.8	0.1
LEPTOCERIDAE	0	3	0	0	0	0	0	0	0.4	0.0
ELMIDAE	0	0	0	0	0	0	3	0	0.4	0.0
ELMIDAE (ADULTS)	0	0	0	0	4	1	1	0	0.8	0.1
SIMULIIDAE	10	10	11	4	25	5	6	5	9.5	1.2
SIMULIIDAE (PUPAE)	2	0	0	0	0	0	0	0	0.3	0.0
EMPIDIDAE	48	25	8	2	13	13	7	19	16.9	2.1
EMPIDIDAE (PUPAE)	3	2	0	0	1	2	0	0	1.0	0.1
CHIRONOMIDAE	2092	686	530	505	371	222	182	343	616.4	77.9
CHIRONOMIDAE (PUPAE)	141	71	61	101	74	18	23	92	72.6	9.2
TOTAL ORGANISMS/SAMPLE	2351	824	775	684	557	296	281	558	790.8	
ORGANISMS/10M3	2081	729	686	605	493	262	249	494	699.8	

Table D-5. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	3	9	0	0	0	0	4	1	2.1	1.3
NAIDIDAE	0	0	7	0	0	0	10	3	2.5	1.5
HYDRACARINA	9	24	27	9	12	16	9	12	14.8	8.9
COLLEMBOLA	0	0	0	0	0	3	0	0	0.4	0.2
BAETIDAE	0	0	0	0	0	1	0	0	0.1	0.1
COENAGRIONIDAE	0	0	0	0	3	0	0	3	0.8	0.5
PSYCHOMYIIDAE	0	6	0	3	3	3	1	3	2.4	1.4
HYDROPSYCHIDAE	0	7	10	1	18	9	2	16	7.9	4.7
LEPTOCERIDAE	0	0	0	1	3	0	0	0	0.5	0.3
ELMIDAE	0	0	0	0	0	0	0	1	0.1	0.1
CULICIDAE	0	0	3	0	0	0	0	0	0.4	0.2
SIMULIIDAE	1	4	0	2	1	0	2	0	1.3	0.8
SIMULIIDAE (PUPAE)	0	0	0	0	0	0	1	0	0.1	0.1
EMPIDIDAE	4	3	15	3	1	0	1	0	3.4	2.0
CHIRONOMIDAE	69	126	130	96	164	98	103	82	108.5	65.3
CHIRONOMIDAE (PUPAE)	16	49	17	16	25	18	13	15	21.1	12.7
TOTAL ORGANISMS/SAMPLE	102	228	209	131	230	148	146	136	166.3	
ORGANISMS/10M3	90	202	185	116	204	131	129	120	147.1	

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	0	0	3	3	1	0	0	0.9	0.3
NAIDIDAE	3	0	1	0	0	0	3	1	1.0	0.4
HYDRACARINA	22	21	27	27	30	18	15	14	21.8	8.0
BAETIDAE	0	0	0	0	0	0	1	0	0.1	0.0
COENAGRIONIDAE	0	0	0	0	0	0	3	2	0.6	0.2
PSYCHOMYIIDAE	0	3	3	9	1	0	0	0	2.0	0.7
HYDROPSYCHIDAE	4	5	5	1	8	3	3	2	3.9	1.4
LEPTOCERIDAE	0	0	0	0	0	0	0	1	0.1	0.0
SIMULIIDAE	1	0	1	0	2	0	0	2	0.8	0.3
EMPIDIDAE	1	4	17	6	3	0	0	3	4.1	1.6
CERATOPOGONIDAE	0	0	0	0	0	1	0	0	0.1	0.0
CHIRONOMIDAE	156	148	421	222	292	119	146	108	201.5	74.1
CHIRONOMIDAE (PUPAE)	23	47	64	43	54	20	12	16	34.9	12.8
TOTAL ORGANISMS/SAMPLE	210	228	539	311	393	162	183	149	271.9	
ORGANISMS/10M3	186	202	477	275	348	143	162	132	240.6	

Table D-6. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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
TARDIGRADA	0	2	0	0	0	0	0	0	0.3	0.5
NAIDIDAE	1	0	0	0	0	0	0	0	0.1	0.2
HYDRACARINA	18	12	5	23	38	53	29	30	26.0	51.6
PSYCHOMYIIDAE	0	0	1	0	1	2	1	0	0.6	1.2
HYDROPSYCHIDAE	0	6	1	5	11	19	8	7	7.1	14.1
HYDROPTILIDAE	0	0	0	0	0	0	1	0	0.1	0.2
EMPIDIDAE	2	10	4	1	9	14	9	7	7.0	13.9
CHIRONOMIDAE	7	9	3	2	18	4	11	13	8.4	16.6
CHIRONOMIDAE (PUPAE)	0	0	0	0	2	3	1	0	0.8	1.5
TOTAL ORGANISMS/SAMPLE	28	39	14	31	79	95	60	57	50.4	
ORGANISMS/10M3	25	35	12	27	70	84	53	50	44.6	

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
NAIDIDAE	1	0	0	0	0	0	0	0	0.1	0.1
HYDRACARINA	24	26	23	45	75	53	57	33	42.0	49.9
COENAGRIONIDAE	0	0	0	0	0	0	1	0	0.1	0.1
PSYCHOMYIIDAE	0	0	2	0	2	0	1	1	0.8	0.9
HYDROPSYCHIDAE	3	5	6	13	19	21	15	10	11.5	13.7
HYDROPTILIDAE	1	0	0	0	0	0	2	1	0.5	0.6
SIMULIIDAE	1	0	0	0	0	0	0	0	0.1	0.1
EMPIDIDAE	8	4	15	21	39	13	24	14	17.3	20.5
CHIRONOMIDAE	10	5	5	13	27	9	9	5	10.4	12.3
CHIRONOMIDAE (PUPAE)	1	0	2	2	3	1	1	1	1.4	1.6
TOTAL ORGANISMS/SAMPLE	49	40	53	94	165	97	110	65	84.1	
ORGANISMS/10M3	43	35	47	83	146	86	97	58	74.4	

Table D-7. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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
NAIDIDAE	0	0	0	0	0	0	1	0	0.1	0.2
HYDRACARINA	30	26	121	253	54	15	7	13	64.9	91.5
COLLEMBOLA	0	0	0	1	0	0	0	0	0.1	0.2
PERLIDAE	0	0	0	1	0	0	0	0	0.1	0.2
HEPTAGENIIDAE	0	0	0	0	0	1	0	0	0.1	0.2
HYDROPSYCHIDAE	0	0	2	1	0	0	0	0	0.4	0.5
SIMULIIDAE	0	1	0	0	0	0	0	1	0.3	0.4
EMPIDIDAE	2	0	1	12	7	6	0	2	3.8	5.3
CHIRONOMIDAE	0	1	0	4	2	0	1	1	1.1	1.6
TOTAL ORGANISMS/SAMPLE	32	28	124	272	63	22	9	17	70.9	
ORGANISMS/10M3	28	25	110	241	56	19	8	15	62.7	

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
NEMATODA	0	0	0	1	0	0	0	0	0.1	0.2
HYDRACARINA	51	113	109	134	29	17	25	22	62.5	88.3
COLLEMBOLA	0	0	0	0	0	0	1	0	0.1	0.2
ODONATA	0	0	0	0	1	0	0	0	0.1	0.2
HYDROPSYCHIDAE	1	1	0	1	1	4	1	0	1.1	1.6
HYDROPTILIDAE	1	0	0	0	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	0	1	0	0.1	0.2
SIMULIIDAE	0	0	0	0	0	0	1	0	0.1	0.2
EMPIDIDAE	5	3	1	9	4	4	3	4	4.1	5.8
CHIRONOMIDAE	0	1	0	4	2	5	3	2	2.1	3.0
TOTAL ORGANISMS/SAMPLE	58	118	110	149	37	30	36	28	70.8	
ORGANISMS/10M3	51	104	97	132	33	27	32	25	62.6	

Table D-8. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	1	12	6	9	4	6.4	3.8
TARDIGRADA	0	3	0	0	0	0.6	0.4
NAIDIDAE	2	49	74	3	47	35.0	20.8
HYDRACARINA	8	28	33	3	7	15.8	9.4
COLLEMBOLA	1	0	0	0	5	1.2	0.7
HEPTAGENIIDAE	3	6	3	6	7	5.0	3.0
HYDROPSYCHIDAE	0	3	1	0	4	1.6	1.0
HYDROPTILIDAE	0	6	0	0	0	1.2	0.7
ELMIDAE	0	0	0	3	0	0.6	0.4
TIPULIDAE	0	0	0	0	1	0.2	0.1
PSYCHODIDAE	1	3	0	3	1	1.6	1.0
EMPIDIDAE	1	3	3	0	3	2.0	1.2
CHIRONOMIDAE	28	186	88	54	129	97.0	57.7
TOTAL ORGANISMS/SAMPLE	45	299	208	81	208	168.2	
ORGANISMS/10M3	40	265	184	72	184	124.0	

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	6	0	0	9	4.8	2.8
NAIDIDAE	23	129	4	0	58	42.8	24.8
HYDRACARINA	21	24	12	3	21	16.2	9.4
COLLEMBOLA	3	3	0	9	12	5.4	3.1
BAETIDAE	0	0	0	0	3	0.6	0.3
HEPTAGENIIDAE	12	21	6	12	6	11.4	6.6
PSYCHOMYIIDAE	0	0	0	1	0	0.2	0.1
HYDROPSYCHIDAE	0	1	0	0	4	1.0	0.6
HYDROPTILIDAE	6	0	0	3	0	1.8	1.0
PSYCHODIDAE	0	3	0	0	12	3.0	1.7
CHAOBORIDAE	0	0	0	1	0	0.2	0.1
EMPIDIDAE	0	6	0	0	9	3.0	1.7
CERATOPOGONIDAE	0	0	0	0	4	0.8	0.5
CHIRONOMIDAE	80	95	31	45	154	81.0	47.0
SPHAERIIDAE	0	1	0	0	0	0.2	0.1
TOTAL ORGANISMS/SAMPLE	154	289	53	74	292	172.4	
ORGANISMS/10M3	136	256	47	65	258	127.1	

Table D-9. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	28	36	22	20	29	45	16	36	29.0	21.6
TARDIGRADA	0	0	0	0	0	1	0	0	0.1	0.1
NAIDIDAE	2	4	5	1	7	14	5	5	5.4	4.0
TUBIFICIDAE	0	0	0	3	0	5	0	3	1.4	1.0
HYDRACARINA	0	3	1	4	2	5	2	1	2.3	1.7
COLLEMBOLA	0	3	4	0	3	1	5	1	2.1	1.6
CAPNIIDAE	1	0	0	0	0	0	0	0	0.1	0.1
CAENIDAE	0	0	0	0	0	0	1	1	0.3	0.2
EPHEMERELLIDAE	0	0	0	0	0	1	1	0	0.3	0.2
BAETIDAE	1	0	2	0	0	0	0	1	0.5	0.4
HEPTAGENIIDAE	3	6	5	2	3	5	5	2	3.9	2.9
PSYCHOMYIIDAE	1	0	0	0	0	0	1	2	0.5	0.4
HYDROPSYCHIDAE	2	4	2	4	0	0	3	0	1.9	1.4
HYDROPTILIDAE	3	3	0	2	0	2	0	1	1.4	1.0
COLEOPTERA	0	0	0	1	0	0	0	0	0.1	0.1
ELMIDAE	0	2	0	1	0	0	1	1	0.6	0.5
TIPULIDAE	0	0	0	0	0	0	1	1	0.3	0.2
PSYCHODIDAE	0	0	1	0	0	1	0	0	0.3	0.2
CHAOBORIDAE	0	0	0	0	0	0	1	0	0.1	0.1
SIMULIIDAE	0	0	0	1	0	1	0	0	0.3	0.2
TABANIDAE	0	0	0	1	0	0	0	0	0.1	0.1
EMPIDIDAE	1	0	5	1	0	3	1	0	1.4	1.0
CERATOPOGONIDAE	0	0	2	0	1	0	1	0	0.5	0.4
CHIRONOMIDAE	46	118	59	57	75	143	55	99	81.5	60.8
TOTAL ORGANISMS/SAMPLE	88	179	108	98	120	227	99	154	134.1	
ORGANISMS/10M3	78	158	96	87	106	201	88	136	118.7	

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	18	46	36	78	23	40	42	45	41.0	22.3
NAIDIDAE	0	4	1	6	6	3	7	8	4.4	2.4
TUBIFICIDAE	0	0	7	0	0	6	6	0	2.4	1.3
HYDRACARINA	0	0	3	6	0	15	3	0	3.4	1.8
COLLEMBOLA	0	3	6	12	0	3	3	0	3.4	1.8
CAPNIIDAE	0	0	0	0	1	0	0	0	0.1	0.1
PERLIDAE	0	0	0	1	0	0	0	0	0.1	0.1
EPHEMERELLIDAE	0	0	3	0	0	0	0	0	0.4	0.2
BAETIDAE	4	0	1	0	0	1	0	6	1.5	0.8
HEPTAGENIIDAE	3	3	7	3	0	7	4	9	4.5	2.4
COENAGRIONIDAE	0	0	0	0	1	0	0	0	0.1	0.1
NOTONECTIDAE	0	0	1	0	0	0	0	0	0.1	0.1
PSYCHOMYIIDAE	1	0	0	0	0	0	0	0	0.1	0.1
HYDROPSYCHIDAE	3	11	6	6	3	3	0	4	4.5	2.4
HYDROPTILIDAE	0	0	3	3	0	3	0	0	1.1	0.6
ELMIDAE	3	0	1	1	0	0	0	0	0.6	0.3
ELMIDAE (ADULTS)	0	0	0	0	0	3	0	0	0.4	0.2
PSYCHODIDAE	3	1	0	6	0	0	0	0	1.3	0.7
EMPIDIDAE	0	1	7	0	0	0	0	0	1.0	0.5
CERATOPOGONIDAE	0	0	0	0	0	3	0	0	0.4	0.2
CHIRONOMIDAE	105	91	116	157	62	91	112	172	113.3	61.5
SPHAERIIDAE	1	0	0	0	0	0	0	0	0.1	0.1
TOTAL ORGANISMS/SAMPLE	141	160	198	279	96	178	177	244	164.1	
ORGANISMS/10M3	125	142	175	247	85	158	157	216	162.9	

Table D-10. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	0	6	0	3	0	4	6	12	3.9	5.9
NAIDIDAE	0	1	0	3	4	6	6	0	2.5	3.8
HYDRACARINA	0	6	0	0	0	3	6	0	1.9	2.8
COLLEMBOLA	3	3	0	6	0	0	9	7	3.5	5.3
CAPNIIDAE	1	0	0	1	0	0	0	0	0.3	0.4
EPHEMERELLIDAE	3	0	0	0	0	3	1	0	0.9	1.3
BAETIDAE	0	0	0	0	0	0	6	0	0.8	1.1
HEPTAGENIIDAE	4	2	3	0	3	0	1	1	1.8	2.7
HYDROPSYCHIDAE	3	3	0	3	0	0	1	0	1.3	1.9
ELMIDAE	0	0	0	0	1	0	0	0	0.1	0.2
PSYCHODIDAE	0	0	0	0	0	0	0	3	0.4	0.6
EMPIDIDAE	0	0	3	3	3	3	3	4	2.4	3.6
CHIRONOMIDAE	45	56	47	49	40	27	65	43	46.5	70.5
TOTAL ORGANISMS/SAMPLE	59	77	53	68	51	46	104	70	66.0	
ORGANISMS/10M3	52	68	47	60	45	41	92	62	58.4	

DATE	18 FEB	18 FEB	18 FEB	18 FEB	18 FEB	18 FEB	18 FEB	18 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	9	7	6	15	15	12	39	21	15.5	11.8
TARDIGRADA	3	0	0	0	0	0	0	0	0.4	0.3
NAIDIDAE	10	1	2	0	4	0	6	7	3.8	2.8
TUBIFICIDAE	0	0	0	0	0	0	3	0	0.4	0.3
ISOPODA	1	0	0	0	0	0	0	0	0.1	0.1
HYDRACARINA	6	12	0	3	0	0	3	6	3.8	2.8
COLLEMBOLA	3	3	0	0	3	0	0	6	1.9	1.4
CAPNIIDAE	0	3	0	3	1	3	0	2	1.5	1.1
EPHEMERELLIDAE	3	1	0	0	0	0	0	0	0.5	0.4
BAETIDAE	0	0	0	1	1	0	0	1	0.4	0.3
HEPTAGENIIDAE	4	8	3	19	10	8	4	7	7.9	6.0
HYDROPSYCHIDAE	10	5	1	3	1	0	1	1	2.8	2.1
HYDROPTILIDAE	3	0	0	0	0	0	3	0	0.8	0.6
ELMIDAE	0	0	0	1	0	0	0	0	0.1	0.1
TIPULIDAE	0	0	0	0	1	0	0	0	0.1	0.1
PSYCHODIDAE	0	0	0	0	0	3	0	0	0.4	0.3
EMPIDIDAE	1	3	0	1	0	6	0	1	1.5	1.1
CHIRONOMIDAE	123	142	54	67	49	67	131	89	90.3	68.4
TOTAL ORGANISMS/SAMPLE	176	185	66	113	85	99	190	141	131.9	
ORGANISMS/10M3	156	164	58	100	75	88	168	125	116.7	

Table D-11. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	3	0	8	0	1	0	6	3	2.6	4.4
NAIDIDAE	5	6	11	3	6	5	2	2	5.0	8.3
TUBIFICIDAE	1	0	0	4	3	0	4	0	1.5	2.5
HYDRACARINA	0	0	0	3	0	0	0	0	0.4	0.6
COLLEMBOLA	4	3	0	0	0	0	3	0	1.3	2.1
EPHEMERELLIDAE	0	0	0	0	0	0	0	3	0.4	0.6
BAETIDAE	0	0	0	0	0	0	0	1	0.1	0.2
HEPTAGENIIDAE	0	3	0	1	3	6	1	3	2.1	3.5
HYDROPSYCHIDAE	1	0	1	0	1	0	0	0	0.4	0.6
PSYCHODIDAE	0	1	0	3	0	0	0	0	0.5	0.8
LIMNIDAE	3	0	0	0	0	0	0	0	0.4	0.6
CHIRONOMIDAE	34	40	85	52	31	56	29	36	45.4	75.6
TOTAL ORGANISMS/SAMPLE	51	53	105	66	45	67	45	48	60.0	
ORGANISMS/10M3	45	47	93	58	40	59	40	42	53.1	

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	3	9	15	9	6	18	7.5	11.1
NAIDIDAE	0	0	0	8	6	6	3	5	3.5	5.2
TUBIFICIDAE	3	1	4	0	0	0	0	0	1.0	1.5
HYDRACARINA	0	0	3	0	6	0	0	3	1.5	2.2
COLLEMBOLA	9	9	3	0	9	3	0	9	5.3	7.8
NEMOURIDAE	0	0	0	0	1	0	0	0	0.1	0.2
EPHEMERELLIDAE	0	0	3	1	0	0	1	0	0.6	0.9
BAETIDAE	0	0	0	0	0	1	0	0	0.1	0.2
HEPTAGENIIDAE	0	0	3	3	0	0	6	1	1.6	2.4
HYDROPSYCHIDAE	1	1	3	4	2	1	0	0	1.5	2.2
HYDROPTILIDAE	3	0	3	3	0	0	0	0	1.1	1.7
LEPIDOPTERA	0	0	0	0	1	0	0	0	0.1	0.2
LIMNIDAE	0	0	0	0	0	0	3	0	0.4	0.6
TIPULIDAE (PUPAE)	0	0	0	0	0	0	1	0	0.1	0.2
PSYCHODIDAE	0	0	0	0	0	0	3	1	0.5	0.7
LIMNIDAE	0	0	3	0	3	0	0	3	1.1	1.7
CHIRONOMIDAE	52	11	62	64	46	23	15	59	41.5	61.4
TOTAL ORGANISMS/SAMPLE	68	22	90	92	89	43	38	99	67.6	
ORGANISMS/10M3	60	19	80	81	79	38	34	88	59.8	

Table D-12. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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	15	12	15	1	33	21	6	6	13.6	9.8
NAIDIDAE	7	0	1	5	25	1	16	7	7.8	5.6
TUBIFICIDAE	2	3	0	0	3	0	0	1	1.1	0.8
HYDRACARINA	12	3	18	21	6	6	0	6	9.0	6.5
COLLEMBOLA	6	3	0	0	3	3	0	3	2.3	1.6
PERLIDAE	0	0	0	0	0	6	0	3	1.1	0.8
EPHEMERELLIDAE	0	0	0	0	0	0	0	1	0.1	0.1
BAETIDAE	0	0	0	0	0	0	1	0	0.1	0.1
HEPTAGENIIDAE	1	0	0	0	0	3	8	9	2.6	1.9
PSYCHOMYIIDAE	0	0	0	0	0	1	0	0	0.1	0.1
HYDROPSYCHIDAE	1	1	2	0	0	0	0	1	0.6	0.4
HYDROPTILIDAE	3	3	3	0	9	9	3	3	4.1	3.0
ELMIDAE	1	0	0	0	3	3	0	0	0.9	0.6
EMPIDIDAE	0	4	11	3	1	3	3	8	4.1	3.0
CHIRONOMIDAE	117	104	88	84	110	75	70	71	89.9	64.5
CHIRONOMIDAE (PUPAE)	3	6	0	2	3	0	1	0	1.9	1.3
TOTAL ORGANISMS/SAMPLE	168	139	138	116	196	131	108	119	139.4	
ORGANISMS/10M3	149	123	122	103	173	116	96	105	123.3	

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	14	15	18	10	8	12	9	9	11.9	6.7
NAIDIDAE	6	26	9	17	13	18	24	3	14.5	8.2
TUBIFICIDAE	0	0	0	2	0	3	0	3	1.0	0.6
HYDRACARINA	21	18	30	12	6	0	6	0	11.6	6.5
COLLEMBOLA	0	3	3	0	0	0	0	0	0.8	0.4
EPHEMERIDAE	0	0	3	0	0	0	0	0	0.4	0.2
EPHEMERELLIDAE	3	0	0	0	0	6	1	0	1.3	0.7
BAETIDAE	0	0	0	0	0	0	1	1	0.3	0.1
HEPTAGENIIDAE	6	4	0	6	0	17	2	7	5.3	3.0
PSYCHOMYIIDAE	0	0	0	0	0	0	1	1	0.3	0.1
HYDROPSYCHIDAE	1	2	3	4	0	5	1	0	2.0	1.1
HYDROPTILIDAE	3	3	0	3	0	9	6	0	3.0	1.7
ELMIDAE	0	3	1	0	0	0	0	0	0.5	0.3
PSYCHODIDAE	0	0	0	0	0	0	1	0	0.1	0.1
EMPIDIDAE	1	14	4	10	4	12	6	3	6.8	3.8
CHIRONOMIDAE	84	160	225	83	113	107	77	90	117.4	66.1
CHIRONOMIDAE (PUPAE)	0	0	0	1	4	0	1	0	0.8	0.4
TOTAL ORGANISMS/SAMPLE	139	248	296	148	148	189	136	117	177.6	
ORGANISMS/10M3	123	219	262	131	131	167	120	104	157.2	

Table D-13. Number, mean, and percent total of drifting macroinvertebrates in samples collected near the River surface and bottom 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
NEMATODA	4	11	6	6	3	3	6	3	5.3	1.8
NAIDIDAE	121	133	114	75	80	119	120	82	105.5	36.9
HYDRACARINA	1	5	4	0	12	0	0	0	2.8	1.0
COLLEMBOLA	1	2	0	0	0	0	0	0	0.4	0.1
PERLIDAE	1	0	0	0	0	0	0	0	0.1	0.0
EPHEMERIDAE	0	0	0	0	0	0	6	3	1.1	0.4
CAENIDAE	1	0	0	0	0	0	0	0	0.1	0.0
BAETIDAE	34	23	36	14	5	18	21	36	23.4	8.2
HEPTAGENIIDAE	30	14	19	0	11	24	16	15	16.1	5.6
HYDROPTILIDAE	0	1	3	0	0	0	0	0	0.5	0.2
ELMIDAE	1	0	0	0	0	0	0	0	0.1	0.0
ELMIDAE (ADULTS)	0	3	0	0	0	0	0	2	0.6	0.2
TIPULIDAE	0	1	3	0	0	0	0	0	0.5	0.2
CULICIDAE	0	1	0	0	0	0	0	0	0.1	0.0
SIMULIIDAE	4	1	0	0	0	3	1	5	1.8	0.6
EMPIDIDAE	0	0	3	4	0	0	1	0	1.0	0.3
CHIRONOMIDAE	124	144	159	87	89	148	125	117	124.1	43.4
CHIRONOMIDAE (PUPAE)	4	1	3	0	7	2	1	1	2.4	0.8
TOTAL ORGANISMS/SAMPLE	326	340	350	186	207	317	297	264	285.9	
ORGANISMS/10M3	288	301	310	165	183	281	263	234	253.0	

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	4	3	9	0	6	0	12	0	4.3	1.3
NAIDIDAE	120	167	186	195	143	58	129	84	135.3	42.3
HYDRACARINA	12	9	6	0	3	0	0	3	4.1	1.3
COLLEMBOLA	3	3	0	0	0	0	0	0	0.8	0.2
PERLIDAE	0	0	0	0	0	0	0	1	0.1	0.0
EPHEMERIDAE	3	0	0	0	0	0	0	0	0.4	0.1
BAETIDAE	26	21	22	8	5	23	24	18	18.4	5.8
HEPTAGENIIDAE	25	28	3	6	9	16	30	5	15.3	4.8
HYDROPTILIDAE	0	3	0	0	0	0	0	0	0.4	0.1
ELMIDAE (ADULTS)	1	0	0	0	0	0	5	0	0.8	0.2
PSYCHODIDAE	0	0	0	3	3	0	0	0	0.8	0.2
SIMULIIDAE	1	1	3	1	0	2	0	1	1.1	0.4
EMPIDIDAE	0	0	6	3	0	0	1	0	1.3	0.4
CERATOPOGONIDAE	0	0	0	3	0	0	0	0	0.4	0.1
CHIRONOMIDAE	129	120	177	112	141	112	100	138	128.6	40.3
CHIRONOMIDAE (PUPAE)	10	12	8	3	3	5	10	10	7.6	2.4
TOTAL ORGANISMS/SAMPLE	334	367	420	334	313	216	311	260	319.4	
ORGANISMS/10M3	296	325	372	296	277	191	275	230	282.6	

Table D-14. Mean number of drifting macroinvertebrates/10 m^3 and percent total in samples collected near the River surface 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	13.9	2.5	0.5	1.3	0.0	0.1	4.2	14.2	2.2	1.7	6.5	2.3	4.1	2.5
TARDIGRADA	0.0	0.0	0.0	0.0	0.1	0.4	0.8	0.1	0.0	0.0	0.0	0.0	0.1	0.1
NAIDIDAE	104.6	3.3	0.3	1.3	0.3	0.1	23.8	3.6	2.0	2.9	4.6	76.2	18.6	11.4
TUBIFICIDAE	0.1	0.0	0.0	0.0	0.0	0.0	1.2	0.6	0.0	1.5	0.7	0.0	0.3	0.2
BRANCHIURA	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	0.0
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	5.7	22.6	24.5	9.7	18.8	49.3	13.1	1.3	1.2	0.5	6.5	1.4	12.9	7.9
COLLEMBOLA	0.7	0.0	0.7	0.2	0.0	0.1	2.7	1.8	1.9	0.6	1.2	0.2	0.8	0.5
PLECOPTERA	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.0	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
CAPNIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
PERLIDAE	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.5	0.1	0.1	0.0
EPHEMEROPTERA	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.7	0.5	0.0	0.0	0.0	0.2	0.1
EPHEMERIDAE	12.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.5	1.1	0.7
CAENIDAE	5.1	1.4	0.7	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.6	0.4
EPHEMERELLIDAE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.2	0.1	0.0	0.1	0.0
BAETIDAE	10.5	0.9	0.4	0.1	0.0	0.0	0.4	0.3	0.3	0.1	0.2	16.9	2.5	1.5
HEPTAGENIIDAE	8.0	12.0	0.2	0.2	0.1	0.1	3.4	2.7	1.5	1.2	1.6	11.7	3.6	2.2
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	0.1	0.0	0.5	0.4	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	0.3	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	0.4	2.3	1.1	0.3	0.0	0.0	0.4	0.0	0.1	0.2	0.0	0.4	0.2
HYDROPSYCHIDAE	2.7	2.2	11.0	7.9	6.0	0.4	2.7	2.0	0.9	0.3	0.3	0.3	3.1	1.9
HYDROPTILIDAE	0.3	0.3	0.0	0.0	0.1	0.0	0.5	0.6	0.2	0.0	2.2	0.2	0.4	0.2
LEPTOCERIDAE	0.0	0.2	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
COLEOPTERA	0.1	0.0	0.1	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
HYDROPHILIDAE	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	0.0
ELMIDAE	0.3	0.3	0.0	0.1	0.0	0.1	0.9	0.6	0.1	0.0	0.9	0.1	0.3	0.2
ELMIDAE (ADULTS)	0.6	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	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	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0
TIPULIDAE (PUPAE)	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSYCHODIDAE	1.2	0.0	0.0	0.0	0.0	0.0	1.2	0.1	0.3	0.3	0.0	0.2	0.3	0.2
CULICIDAE	0.1	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
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	2.6	7.8	5.9	1.2	0.1	0.2	0.3	0.1	0.0	0.0	0.0	1.2	1.6	1.0
SIMULIIDAE (PUPAE)	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
TABANIDAE	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	0.1	2.4	2.7	3.5	6.2	3.4	3.1	1.1	1.3	0.3	2.4	0.7	2.3	1.4
EMPIDIDAE (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
CERATOPOGONIDAE	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
CHIRONOMIDAE	281.5	216.4	203.6	101.8	7.7	1.5	80.4	64.2	44.2	29.4	62.8	91.5	98.8	60.4
CHIRONOMIDAE (PUPAE)	20.2	28.6	56.4	20.1	0.6	0.0	0.0	0.0	0.0	0.0	0.9	2.8	10.8	6.6
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	471.2	302.8	310.7	149.3	40.4	55.9	141.1	95.3	57.2	39.3	91.7	207.2	163.5	

Table D-15. Mean number of drifting macroinvertebrates/10 m^3 and percent total in samples collected near the River bottom 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
TRICLADIDA	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	16.2	9.2	0.4	0.4	0.0	0.1	3.4	19.5	7.2	3.4	5.3	2.2	5.6	2.2
TARDIGRADA	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0
NAIDIDAE	165.3	3.7	1.2	2.2	1.2	0.0	30.7	4.5	2.7	2.3	9.0	105.1	27.3	10.7
TUBIFICIDAE	0.2	0.0	0.0	0.0	0.0	0.0	0.2	1.2	0.2	0.8	0.9	0.4	0.3	0.1
HIRUDINEA	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	0.0
ISOPODA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	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	35.2	44.2	21.2	48.5	58.9	14.6	2.5	2.0	1.0	10.1	3.7	20.5	8.0
COLLEMBOLA	0.8	0.0	0.9	0.0	0.0	0.2	4.8	2.2	2.0	3.2	0.3	0.8	1.3	0.5
PLECOPTERA	0.0	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
NEMOURIDAE	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	0.0
CAPNIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.0	0.0	0.0	0.1	0.0
PERLIDAE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.1	0.1	0.0
EPHEMEROPTERA	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.5	0.9	0.2	0.1	0.0	0.3	0.1
EPHEMERIDAE	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.2	2.0	0.8
CAENIDAE	6.2	3.3	0.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.2	0.9	0.4
EPHEMERELLIDAE	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.7	0.0	0.1	0.1
BAETIDAE	20.0	2.6	0.2	0.2	0.0	0.0	0.4	0.8	0.6	0.1	0.3	19.4	3.7	1.5
HEPTAGENIIDAE	23.5	23.6	0.6	0.1	0.0	0.0	7.2	3.8	4.2	1.4	3.1	12.1	6.6	2.6
ODONATA	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COENAGRIONIDAE	0.1	0.0	0.8	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
NOTONECTIDAE	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
CORIXIDAE	0.3	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
TRICHOPTERA(PUPAE)	0.0	0.0	0.0	0.2	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	0.4	0.2	2.3	0.9	0.3	0.0	0.1	0.1	0.1	0.0	0.2	0.0	0.4	0.1
HYDROPSYCHIDAE	3.4	3.7	10.9	7.6	12.7	0.9	1.9	4.0	2.2	1.2	2.3	0.2	4.3	1.7
HYDROPTILIDAE	0.0	0.4	0.3	0.0	0.2	0.1	0.8	1.1	0.3	0.5	1.8	0.2	0.5	0.2
LEPTOCERIDAE	0.1	0.0	0.2	0.7	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.1	0.0
LEPIDOPTERA	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
COLEOPTERA	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	0.0
DYTISCIDAE	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	0.0
PSEPHENIDAE	0.0	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
ELMIDAE	1.5	0.9	0.8	0.1	0.0	0.2	0.0	0.7	0.1	0.2	0.8	0.3	0.4	0.2
ELMIDAE(ADULTS)	1.1	1.8	0.8	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.2	1.2	0.4	0.2
DIPTERA(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
TIPULIDAE	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.1	0.0
TIPULIDAE(PUPAE)	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	0.0
PSYCHODIDAE	0.8	0.0	0.0	0.0	0.0	0.0	2.1	1.1	0.2	0.6	0.2	0.3	0.4	0.2
CULICIDAE	0.4	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0
CHAOBORIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
SIMULIIDAE	5.1	8.9	8.4	1.1	0.1	0.1	0.3	0.0	0.0	0.0	0.0	1.9	2.1	0.8
SIMULIIDAE(PUPAE)	0.0	0.0	0.1	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	0.4	3.4	12.1	6.8	22.5	5.1	2.9	0.9	1.2	0.7	4.2	0.9	5.1	2.0
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	0.1	0.0	0.0	0.1	0.0	0.0	0.6	0.7	0.0	0.0	0.0	0.2	0.1	0.1
CHIRONOMIDAE	392.5	300.3	452.5	211.3	30.5	2.0	75.4	103.3	66.1	29.9	86.3	110.7	155.1	60.9
CHIRONOMIDAE(PUPAE)	21.0	70.7	59.7	34.0	1.9	0.3	0.0	0.2	0.1	0.0	1.0	5.6	16.2	6.4
PHYSIDAE	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPHAERIIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL ORGANISMS	687.4	468.9	599.0	287.3	118.4	68.0	146.9	149.6	92.1	45.8	127.3	265.8	254.7	

Table D-16. Mean number of drifting macroinvertebrates/10 m^3 and percent total in samples collected near the River surface 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	0.9
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	0.0	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	1.1	1.1
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	3.6
CAENIDAE	29.7	14.2	4.8	3.2	0.1	0.0	-	-	0.1	0.0	0.1	1.2	5.3	5.3
EPHEMERELLIDAE	3.1	0.2	0.1	0.0	0.1	0.2	-	-	0.1	0.1	1.0	0.4	0.5	0.5
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	6.9	6.9
HEPTAGENIIDAE	20.3	7.2	16.9	16.3	12.0	1.8	-	-	1.6	0.5	1.9	3.8	8.2	8.2
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	0.7	0.7
HYDROPSYCHIDAE	120.4	12.7	73.3	20.1	13.5	1.7	-	-	0.1	0.3	1.5	2.5	24.6	24.6
HYDROPTILIDAE	0.8	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	1.9
ELMIDAE(ADULTS)	1.4	1.2	1.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.1	0.4	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	3.6	3.6
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	0.2	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	12.8	19.6	34.6	34.6
CHIRONOMIDAE(PUPAE)	5.2	19.5	14.9	4.5	1.1	0.1	-	-	0.0	0.2	5.4	4.6	5.5	5.5
TOTAL ORGANISMS	285.5	243.1	223.1	100.0	51.6	10.7	-	-	6.1	5.2	26.7	48.9	100.1	

Table D-17. Mean number of drifting macroinvertebrates/10 m^3 and percent total in samples collected near the River bottom 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	1.7	1.2
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	5.2	3.7
CAENIDAE	54.0	21.9	7.9	6.7	0.3	0.0	-	-	0.0	0.1	0.0	0.8	9.2	6.5
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	10.5	7.4
HEPTAGENIIDAE	27.2	12.8	21.7	28.2	13.2	1.4	-	-	2.4	1.0	3.1	2.9	11.4	8.0
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	1.4	1.0
HYDROPSYCHIDAE	154.6	23.8	75.6	27.2	17.8	1.2	-	-	0.4	0.4	2.0	1.8	30.5	21.5
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	0.1	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	4.6	3.3
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	5.2	3.7
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	49.0	34.6
CHIRONOMIDAE(PUPAE)	5.7	28.3	12.7	5.8	3.0	0.1	-	-	0.0	0.3	6.9	11.4	7.4	5.2
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	141.6	

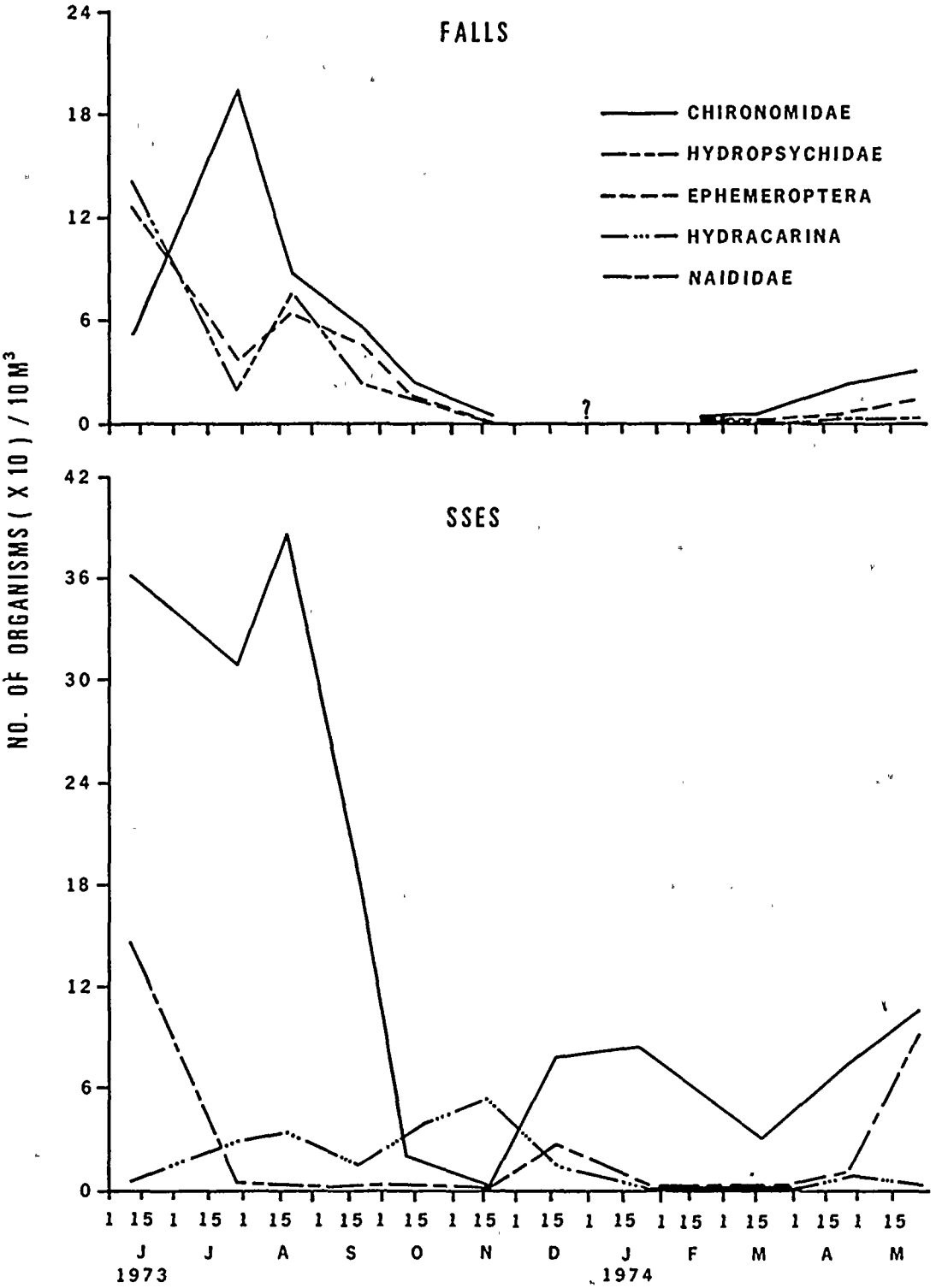

Fig. D-1. Mean number of drifting macroinvertebrates/10 m^3 collected monthly during diel pumping at Falls and SSES on the Susquehanna River, June 1973 through May 1974.

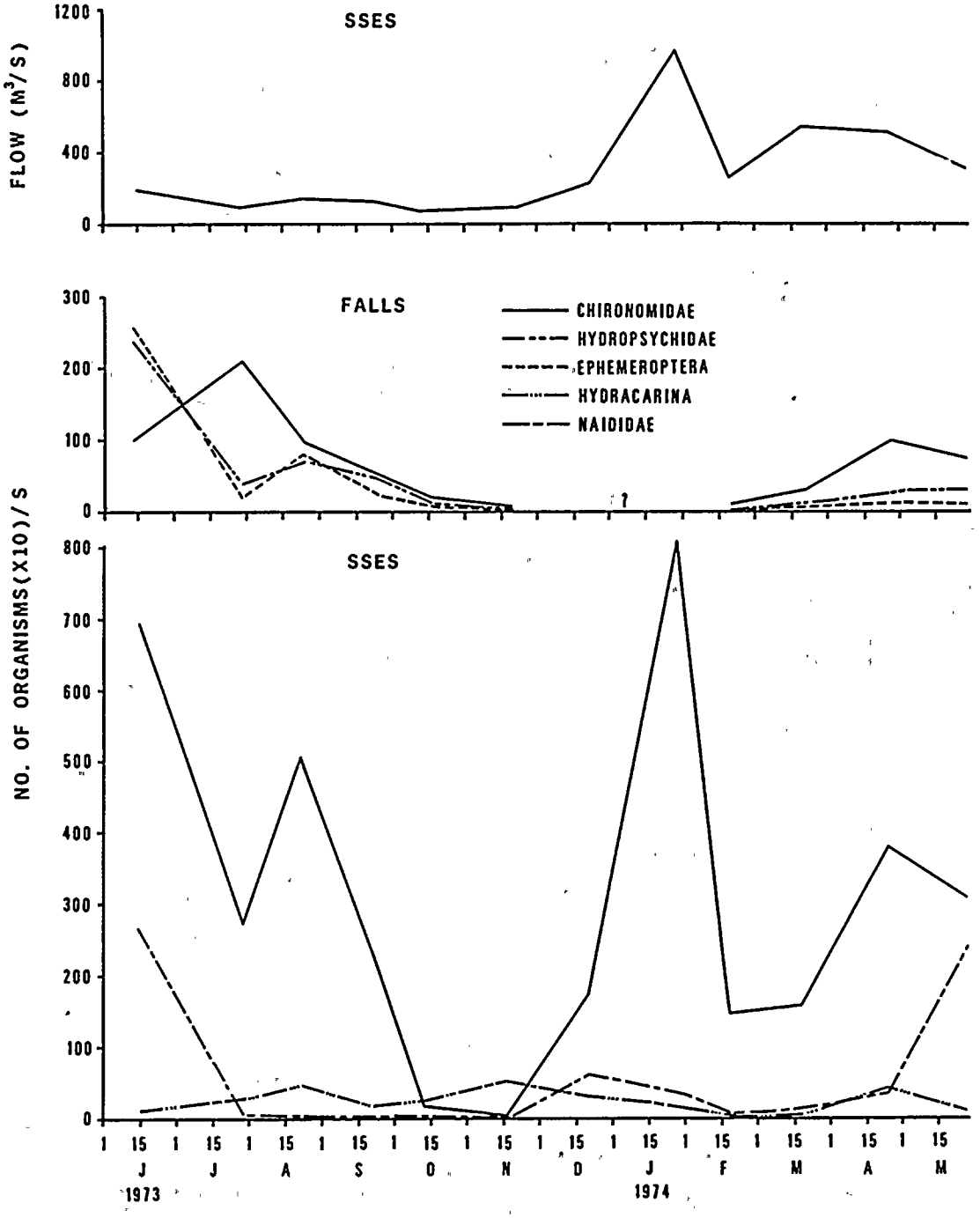

Fig. D-2. River flow and mean number of drifting macroinvertebrates/s collected monthly during diel pumping at Falls and SSES on the Susquehanna River, June 1973 through May 1974.

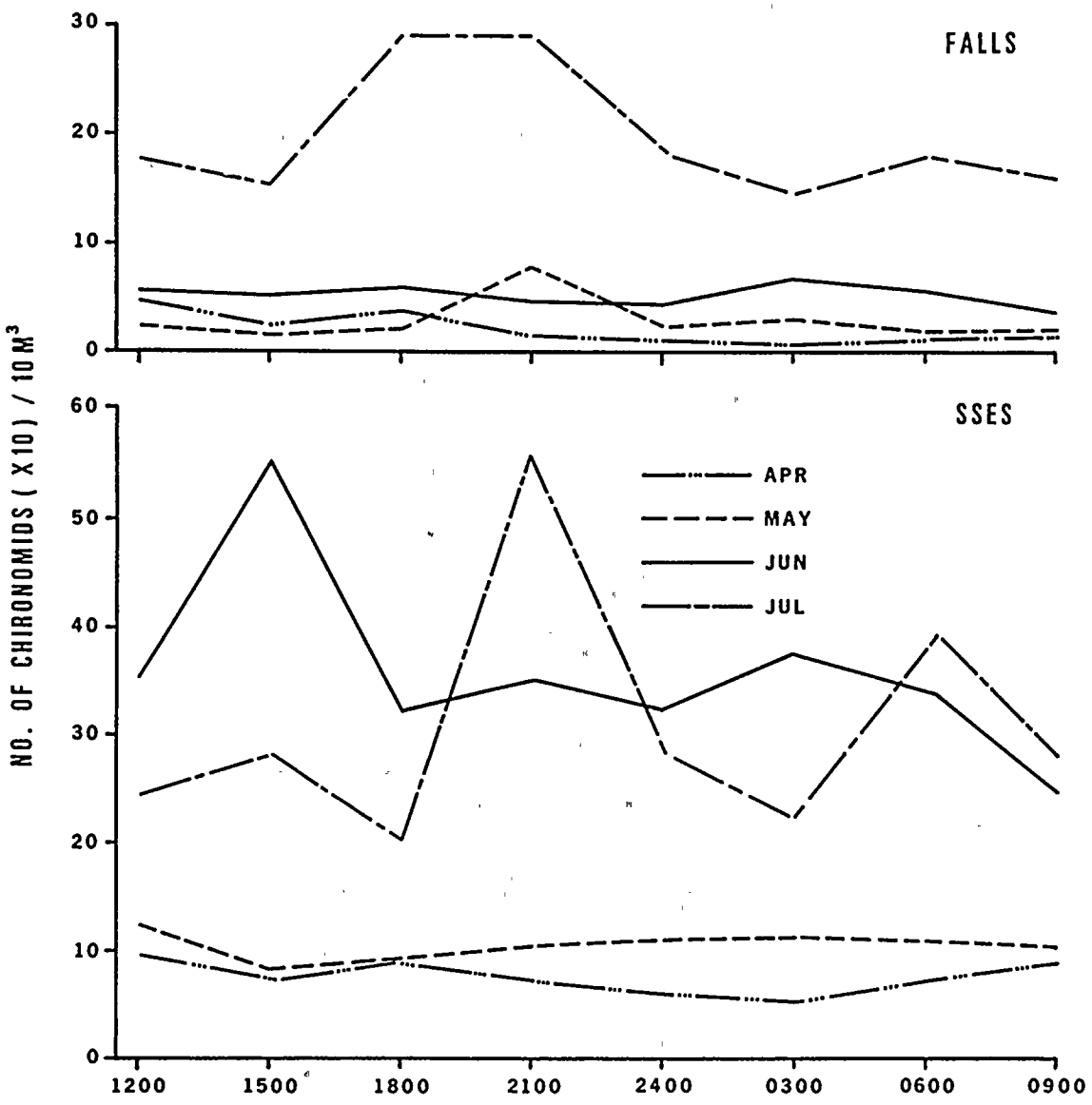

Fig. D-3. Mean number of chironomids/10 m^3 collected at 3-h intervals during diel pumping at Falls and SSES on the Susquehanna River, June and July 1973, and April and May 1974.

DEVELOPMENT OF LARVAL FISHES

by

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

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ABSTRACT

Eggs of northern pike, muskellunge, longnose dace, creek chub, fallfish, and white sucker were hatched and the larvae reared in the Laboratory. A reference series of each species was preserved and the larval development of each described. Included in the descriptions were various morphometrics, meristics, and illustrations of each developmental stage.

INTRODUCTION

Identification of fish larvae to species is a difficult problem because many have not been adequately described or illustrated. The purpose of this study was to describe the larval development of six species found near the Susquehanna SES. These included: northern pike, muskellunge, longnose dace, creek chub, fallfish, and white sucker.

PROCEDURES

Five of the six fishes were artificially spawned by stripping eggs from one or more females of each species into a plastic pan. Eggs were fertilized by mixing them with milt taken from males of the same species. The eggs were rinsed and allowed to water harden for about 24 hours. Fallfish eggs were taken from a nest.

The eggs were hatched and larvae reared in a miniature aquarium system (Gale 1977) using recirculated pool water. Free-swimming larvae were fed brine shrimp and a powdered dry food (Tetramin E) to supplement

natural foods which entered aquaria with the pool water. As larvae grew, they were given a more granular food (Tetramin L). Northern pike and muskellunge were also fed small sucker and minnow larvae daily. A reference series of each species was preserved in 10% buffered formalin.

Definitions of prolarvae, postlarvae, late postlarvae, and juvenile stages were taken from Hubbs (1943) and May and Gasaway (1967) with minor modifications. Prolarvae were those bearing yolk. Postlarvae were those which had absorbed all yolk material but did not have visible fin rays in all fins. Late postlarvae were those which had visible fin rays in all fins but had not formed scales. Juveniles were those resembling the adult.

Total length (TL), standard length, postanal length, head length, eye diameter, and body depth of larvae were measured to the nearest 0.1 mm using an ocular micrometer. All definitions were those of Snyder et al. (1977) except postanal length which was taken from Hogue and Buchanan (1977). All lengths reported in the text are total lengths except when stated otherwise. Myomere counts were made on pro-, post-, and late postlarvae using polarizing filters (Berry and Richards 1973). 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 fish, ranging from newly hatched through early juveniles, were traced from images projected onto drawing paper with a Bausch and Lomb Tri-Simplex Micro-Projector (Buynak and Mohr 1978). Details were added to the illustrations by examining the fish with a dissecting microscope.

RESULTS

Northern Pike

Prolarvae

Northern pike eggs hatched 10 days after fertilization at a mean temperature of 10.9 C. Newly hatched larvae ranged from 7.9 to 8.5 mm ($\bar{x}$ = 8.3 mm); standard length ranged from 7.8 to 8.4 mm ($\bar{x}$ = 8.2 mm). Their heads were decurved over a large spherical yolk sac. These larvae had pectoral fin buds, straight urostyles, and incomplete mouths (Fig. E-1A). Pigmentation in these larvae consisted of a lateral band of brown pigment beginning near the head and extending into the caudal fin fold. This band was faded in most of our specimens. The dorsal fin fold, which originated about 35% of TL behind the snout, was continuous with the caudal and ventral fin folds. Preanal length was greater than postanal length (Table E-1).

Eyes were pigmented around the outer margins and melanophores were present on all body surfaces, including the yolk sac by 9.3 mm (Fig. E-1B). By 12.0 mm, the mouth opened, swim bladder began to inflate, and the eyes were completely pigmented (Fig. E-1C).

Postlarvae

The postlarval stage began by 13.2 mm (Table E-1). In 13.4 mm larvae (Fig. E-1D), caudal fin rays were visible and the snout began to elongate. By 15.9 mm (Fig. E-1E), pectoral fin rays were visible, pelvic fin buds were present, and the location of the dorsal and anal fins became evident.

Dorsal and anal fin rays were visible in 18.2 mm larvae (Fig. E-1F), and the urostyle, which was previously straight, began to flex slightly upward. Pigmentation was found on all body surfaces. Preorbital bars and two concentrations of melanophores on the occipital region were present. In addition, melanophores extended from each concentration along the dorsal body surface to the caudal fin fold. From the head to the dorsal fin area there was a narrow melanophore-free area. The lateral band of brown pigment observed in prolarvae was still present. Melanophores on the lateral and ventral areas of the gut increased in number.

Late Postlarvae

The late postlarval stage began by 19.1 mm (Table E-1). In 22.8 mm (Fig. E-1G) and 26.6 mm larvae (Fig. E-1H) pigmentation increased. The narrow, melanophore-free area on the dorsal body surface observed in younger larvae was covered with numerous small melanophores. By 38.6 mm (Fig. E-1I), lateral concentrations of melanophores formed several bands which extended from the dorsal surface to the gut. The snout was elongated and relatively broad. Fin ray development in all fins was nearly completed.

Juvenile

The bodies of juveniles were long and slender (Fig. E-1J). The greatest body depth occurred near the head and was about 13% of TL (Table E-1). In these fish, the head was long and broad; head length was about 33% of TL. The eyes were large and situated high, near the center of the head.

Body pigmentation consisted of irregularly-shaped concentrations of melanophores and melanophore-free areas on the lateral surfaces.

Muskellunge

Prolarvae

Muskellunge eggs hatched eight days after fertilization at a mean temperature of 16.9 C. Newly hatched larvae ranged from 7.9 to 9.2 mm ($\bar{x}$ = 8.7 mm); standard length was only slightly smaller (<0.05 mm). Their heads were decurved over a large ovoid yolk sac (Fig. E-2A). These larvae had pectoral fin buds, straight urostyles, and incomplete mouths. A band of brown pigment extending from the head to the caudal fin fold was present laterally. The dorsal fin fold, which originated about 30% of TL behind the snout, was continuous with the caudal and ventral fin folds. Preanal length was greater than postanal length (Table E-2).

Eyes were pigmented in 10.6 mm larvae (Fig. E-2B) and no melanophores were present on the dorsal or ventral body surfaces. By 11.4 mm (Fig. E-2C), the mouth opened. Melanophores were present on the head, pectoral fin rays were visible, the swim bladder began to inflate, and the snout began to elongate in 14.0 mm larvae (Fig. E-2D). Also, the lower jaw extended slightly beyond the upper jaw.

Postlarvae

The postlarval stage began by 14.4 mm (Fig. E-2E). In larvae 17.4 mm (Fig. E-2F), dorsal, anal, and caudal fin rays were visible and pigmentation

was found on all body surfaces. On the occipital region, a narrow melanophore-free area separated two concentrations of melanophores. This unpigmented area continued from the head to the dorsal fin area. Small melanophores were scattered on both sides of the melanophore-free area. The lateral band of brown pigment found in the younger larvae was still present. Very few melanophores were present on the ventral portions of the gut. Pelvic fin buds were present and the urostyle was flexed upward in 24.9 mm larvae (Fig. E-2G).

Late Postlarvae

The late postlarval stage began by 21.8 mm (Table E-2). In 25.7 mm larvae (Fig. E-2H), the lower jaw extended beyond the upper jaw. The snout was broad and very long. Pigmentation had increased on all surfaces, especially the ventral portion of the gut. Laterally, concentrations of melanophores formed several bands that extended from the dorsal body surface to the gut. By 37.5 mm (Fig. E-2I), development of fin elements was nearly completed and the lower jaw extended well beyond the upper jaw.

Juvenile

The bodies of juveniles were long and slender (Table E-2; Fig. E-2J). Greatest body depth (9% of TL) occurred between the paired fins. The head was long (30% of TL) and the eyes were large and situated high, near the center of the head. Body pigmentation consisted of a band of melanophores on the upper lateral portion of the body extending from the

head to the caudal fin. This band was separated from a second lower band by a relatively melanophore-free area along the entire body of the fish.

Longnose Dace

Prolarvae

Longnose dace eggs hatched six days after fertilization at a mean temperature of 18.3 C. Newly hatched larvae ranged from 5.8 to 6.0 mm ($\bar{x}$ = 5.9 mm); standard length ranged from 5.6 to 5.8 mm ($\bar{x}$ = 5.7 mm). Their heads were slightly decurved over a bulbous yolk sac. They were unpigmented, had pectoral fin buds, straight urostyles, and incomplete mouths (Fig. E-3A). Preanal length was greater than postanal length (Table E-3).

Eyes of larvae 7.7 mm (Fig. E-3B) were pigmented and melanophores were present on the dorsal surface of the head and body. No pigmentation occurred on the ventral portion of the body. The dorsal fin fold, which originated about 45% of TL behind the snout, was continuous with the caudal and ventral fin folds. The mouth opened and the swim bladder began to inflate in 8.7 mm larvae (Fig. E-3C).

Postlarvae

The postlarval stage began by 9.4 mm (Table E-3). In 9.5 mm larvae (Fig. E-3D), caudal fin rays were visible and the urostyle began to flex upward. By 11.6 mm (Fig. E-3E), pelvic fin buds were present and dorsal, anal, and

pectoral fin rays were visible. The origin of the pelvic fin began slightly ahead of the dorsal fin. The snout elongated in these larvae and the mouth was slightly inferior and nonprotractile. Dorsal pigmentation consisted of melanophores in the occipital region and two rows extending from the head to the dorsal fin. Between these rows a subsurface row was also observed. Pigmentation along the entire lateral line area was evident, melanophores there ended in a caudal spot which extended into the caudal fin. A row of melanophores started near the pectoral fins and extended dorsally along the gut, over the anal fin, to the caudal fin. This pigmentation could also be seen ventrally. By 14.0 mm (Fig. E-3F), fin ray development, except in the pelvic fins, was more advanced than in 11.6 mm larvae and pigmentation continued to increase.

Late Postlarvae

The late postlarval stage began by 14.0 mm (Table E-3). In 15.8 mm larvae (Fig. E-3G), the snout was long and overhung the mouth. Dorsal, ventral, and lateral pigmentation patterns in 17.8 mm larvae (Fig. E-3H) were similar to those described for younger larvae, except that melanophores were more numerous on all surfaces. By 20.6 mm (Fig. E-3I), fin ray development in all fins was nearly completed.

Juvenile

In juveniles the head was large, about 20% of TL (Table E-3; Fig. E-3J). The snout was long and extended well beyond the mouth. In

these fish, a hump occurred at the nape where body depth was greatest, about 16% of TL. A lateral band of melanophores was present from the head to the caudal fin where it ended in a caudal spot. The spot extended into the caudal fin.

Creek Chub

Prolarvae

Creek chub eggs hatched six days after fertilization at a mean temperature of 18.3 C. Newly hatched larvae ranged from 6.0 to 6.2 mm ($\bar{x}$ = 6.1 mm); standard length ranged from 5.8 to 6.0 mm ($\bar{x}$ = 5.9 mm). Their heads were slightly decurved over a relatively large bulbous yolk sac (Fig. E-4A). These unpigmented larvae had pectoral fin buds, straight urostyles, and incomplete mouths. The dorsal fin fold, which originated about 45% of TL behind the snout, was continuous with the caudal and ventral fin folds. Preanal length was greater than postanal length (Table E-4).

The mouths of larvae 8.2 mm (Fig. E-4B) opened and their eyes and bodies were pigmented. Dorsal pigmentation consisted of melanophores on the occipital region and a few on the snout. Two surface rows of melanophores extended from the head to the origin of the dorsal fin fold; between these two rows, a subsurface row was also present. Behind the dorsal fin fold, the surface rows fused and continued to the caudal fin fold. Laterally, a few melanophores were present in the anterior part of the lateral line area. Ventrally, two rows of melanophores were present

on the margins of the yolk sac (Fig. E-4B). By 8.3 mm (Fig. E-4C), the swim bladder had begun to inflate, caudal fin rays were visible, and the urostyle began to flex upward.

Postlarvae

The postlarval stage began by 9.2 mm (Table E-4). The location of the dorsal and anal fins was evident and pectoral fin rays were visible in 9.8 mm larvae (Fig. E-4D). Dorsal and anal fin rays were visible in larvae 11.8 mm (Fig. E-4E). In 14.0 mm larvae (Fig. E-4F), the pelvic fin buds appeared; they originated in front of the dorsal fin origin. These larvae were more densely pigmented than prolarvae, especially on the lateral body surfaces; pigmentation patterns, however, remained similar. A faint caudal spot was evident at 14.0 mm; it did not extend into the caudal fin. Dorsal pigmentation patterns were similar to those described above.

Late Postlarvae

The late postlarval stage began by 14.2 mm (Table E-4). Small melanophores were present on all fins, and a defined caudal spot was apparent by 15.2 mm (Fig. E-4G). Dorsal and lateral pigmentation was dense (Fig. E-4H). The distinct rows of dorsal melanophores seen in earlier stages were no longer noticeable in larvae of this size. Ventral patterns were similar to those of postlarvae. By 18.6 mm (Fig. E-4I), fin ray development was nearly completed. A distinct lateral band originated behind the eye and ended on the caudal peduncle.

Juvenile

Juveniles had large heads (23% of TL) and relatively small eyes (Table E-4; Fig. E-4J). Pelvic fins originated slightly in front of the dorsal fin. Greatest body depth, 20% of TL, occurred in front of the dorsal fin. These fish had a wide lateral band that terminated in a large black caudal spot on the caudal peduncle. This spot did not extend into the caudal fin. Premaxillaries were protractile.

Fallfish

Prolarvae

Fallfish eggs were collected from a nest and thus the exact time of fertilization was not known. The eggs hatched within 24 hours after collection. Newly hatched larvae ranged from 6.8 to 7.5 mm ($\bar{x}$ = 7.1 mm); standard length ranged from 6.6 to 7.3 mm ($\bar{x}$ = 6.9 mm). At hatching, the heads were decurved over a relatively large bulbous yolk sac. By 7.4 mm (Fig. E-5A), larvae had pectoral fin buds, straight urostyles, and incomplete mouths. The dorsal fin fold, which originated about 42% of TL behind the snout, was continuous with the caudal and ventral fin folds. Preanal length was greater than postanal length (Table E-5).

By 9.3 mm, the eyes and dorsal body surface of larvae were pigmented (Fig. E-5B). Pigmentation consisted of melanophores on the occipital region and a few extended about half way to the caudal fin fold. All other portions of the body lacked pigmentation. By 10.5 mm (Fig. E-5C), the mouth opened, the swim bladder began to inflate, the urostyle flexed

upward, and the location of the dorsal fin was evident. Dorsal pigmentation in these larvae increased, and lateral and ventral pigment was found for the first time. A line of lateral melanophores extended from the pectoral fin, over the dorsal surface of the yolk, to the anus.

Postlarvae

The postlarval stage began by 9.7 mm (Table E-5). In 12.2 mm larvae (Fig. E-5D), fin rays were visible in the pectoral, dorsal, caudal, and anal fins. In 13.4 mm larvae (Fig. E-5E), all body surfaces were becoming more densely pigmented. Dorsal pigmentation consisted of two rows of melanophores which extended from the occipital region to the dorsal fin. Between these two rows, a subsurface row was present. From the dorsal fin, the three rows fused and continued to the caudal fin. Lateral pigmentation consisted of a row of melanophores along the lateral line area and a second row (also seen ventrally) which extended from the pectoral fin, dorsally along the gut, over the anal fin, to the caudal fin. A few melanophores were present on the ventral surface of the head and gut. Pelvic fin buds and a lateral band of dark pigment were present in 15.6 mm larvae (Fig. E-5F). The pelvic fins originated directly under the origin of the dorsal fin. A caudal spot occurred in these larvae, but it did not extend into the caudal fin.

Late Postlarvae

The late postlarval stage began by 14.8 mm (Table E-5). Dorsal and lateral pigmentation had become more dense and the caudal spot was very

distinct in 16.8 mm (Fig. E-5G) and 18.4 mm larvae (Fig. E-5H). The rows of dorsal melanophores described in earlier stages were no longer noticeable in these larvae. Ventral patterns of melanophores were more dense, but basically unchanged from the postlarval stage. By 20.1 mm (Fig. E-5I), fin ray development was nearly completed. The dark lateral band widened and ended in a caudal spot that did not extend into the caudal fin.

Juvenile

Juveniles had large (21% of TL) blunt heads, large scales, and a wide lateral band that terminated in a black caudal spot on the caudal peduncle (Table E-5; Fig. E-5J). The mouth was slightly subterminal and overhung by the snout. Premaxillaries were protractile. Pelvic fins originated directly under the dorsal fin origin. Maximum body depth (18% of TL) occurred in front of the dorsal fin.

White Sucker

Prolarvae

White sucker eggs hatched eight days after fertilization at a mean temperature of 14.3 C. Newly hatched larvae ranged from 8.7 to 9.2 mm ($\bar{x}$ = 8.9 mm); standard length ranged from 8.5 to 9.1 mm ($\bar{x}$ = 8.7 mm). Their heads were decurved over a bulbous yolk sac. These larvae were unpigmented, had pectoral fin buds, straight urostyles, and incomplete mouths (Fig. E-6A). The dorsal fin fold, which originated about 30% of TL behind the snout, was continuous with the caudal and ventral fin folds.

Preanal length was greater than postanal length (Table E-6).

The eyes of larvae 11.4 mm (Fig. E-6B) were pigmented, but the body remained unpigmented. Melanophores began forming on the dorsal surface of the head by 11.9 mm (Fig. E-6C). By 13.9 mm (Fig. E-6D), the mouth had opened and concentrations of melanophores occurred on the dorsal and ventral surfaces of the body. The swim bladder had begun to inflate and the caudal fin rays were visible in 14.4 mm larvae (Fig. E-6E). In larger prolarvae (Figs. E-6D, E-6E), pigmentation along the lateral line area above the pectoral fins branched back and down toward the gut. This pigment pattern was found to be characteristic of these larvae.

Postlarvae

The postlarval stage began by 14.4 mm (Table E-6). The location of the dorsal fin became evident, the urostyle began to flex upward, and pigmentation on the body increased in 14.7 mm larvae (Fig. E-6F). Lateral pigment patterns remained the same as that found in the larger prolarvae. By 15.5 mm (Fig. E-6G), the urostyle was flexed upward and a substantial number of caudal fin rays was present. Pectoral fin rays first occurred by 16.8 mm (Fig. E-6H). The location of the anal fin was evident, pelvic fin buds appeared, and the dorsal fin rays became visible in larvae 17.9 mm (Fig. E-6I).

Late Postlarvae

The late postlarval stage began by 17.9 mm (Table E-6). Lateral pigment patterns observed in younger larvae were not seen in 20.4 mm

larvae (Fig. E-6J). Body pigmentation became more diffused in 23.8 mm larvae (Fig. E-6K).

Juvenile

Heads of juveniles were large (23% of TL) and scaleless (Table E-6; Fig. E-6L). Maximum body depth occurred near the origin of the dorsal fin and was 17% of TL. Melanophores were scattered over the entire body and on all fins. Each scale margin was outlined with pigment. Several spots or blotches of dark pigment were present on the dorsal and lateral surfaces.

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Table E-1. Morphometrics and meristics of artificially propagated northern pike (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Standard	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
20	$\bar{x}$	10.4	10.2	3.1	1.8	0.8	2.5	prolarvae	M	42	21	63
	R	8.0-13.2	7.9-12.9	1.9-4.3	1.3-3.3	0.6-1.0	2.0-2.9		R	41-46	20-24	61-68
20	$\bar{x}$	16.0	15.7	5.1	4.3	1.3	2.3	postlarvae	M	43	20	63
	R	13.2-18.9	12.9-18.5	4.2-6.2	3.2-5.7	1.0-1.5	1.9-3.0		R	42-45	19-22	62-66
20	$\bar{x}$	27.7	25.4	8.7	8.4	2.1	4.2	late	M	40	18	60
	R	19.1-44.6	18.7-40.0	5.7-14.6	5.5-13.6	1.5-2.8	2.7-6.6	postlarvae	R	40-44	17-19	57-63
1		65.0	57.0	22.4	21.6	3.8	8.4	juvenile		--	--	--

Table E-2. Morphometrics and meristics of artificially propagated muskellunge (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Standard	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
20	$\bar{x}$	11.9	11.8	3.5	2.2	0.8	2.3	prolarvae	M	47	19	69
	R	7.9-15.6	7.9-15.4	2.1-4.7	1.2-3.4	0.6-0.9	1.7-3.3		R	44-48	18-24	64-70
20	$\bar{x}$	17.0	16.8	4.8	4.4	1.0	2.1	postlarvae	M	47	21	67
	R	15.1-20.8	14.9-20.5	4.2-5.6	3.7-5.6	0.9-1.1	1.9-2.5		R	45-48	19-21	64-68
20	$\bar{x}$	36.6	33.8	10.7	11.3	1.8	4.1	late	M	45	19	64
	R	21.8-56.5	21.5-50.5	5.7-18.8	6.1-17.9	1.2-2.8	2.3-6.2	postlarvae	R	44-47	17-20	61-66
1		75.0	65.0	25.6	22.8	3.6	7.0	juvenile		--	--	--

Table E-3. Morphometrics and meristics of artificially propagated longnose dace (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Standard	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
20	$\bar{x}$	7.8	7.4	2.8	1.3	0.6	1.5	prolarvae	M	26	14	39
	R	6.0-9.5	5.8-8.9	1.8-3.6	1.0-1.7	0.5-0.7	1.2-2.2		R	25-27	13-15	39-41
20	$\bar{x}$	11.6	10.4	4.5	2.3	0.9	1.9	postlarvae	M	26	13	39
	R	9.4-14.2	8.9-12.1	3.6-5.9	1.7-3.0	0.7-1.0	1.3-2.4		R	25-26	12-14	38-40
20	$\bar{x}$	17.6	14.6	7.9	3.7	1.1	3.1	late	M	24	13	37
	R	14.0-21.2	11.8-17.4	5.9-10.0	3.0-4.4	1.0-1.2	2.4-3.9	postlarvae	R	24-26	12-14	37-39
1		31.8	25.6	14.2	6.4	1.4	5.2	juvenile		--	--	--

Table E-4. Morphometrics and meristics of artificially propagated creek chub (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Standard	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
20	$\bar{x}$	7.7	7.3	2.7	1.3	0.6	1.3	prolarvae	M	28	14	42
	R	6.0-8.9	5.8-8.3	1.8-3.3	0.9-1.8	0.4-0.7	1.1-1.9		R	27-30	11-15	41-43
20	$\bar{x}$	12.3	10.8	4.6	2.6	0.9	2.1	postlarvae	M	28	12	41
	R	9.2-15.4	8.5-13.2	3.3-6.2	1.7-3.5	0.7-1.2	1.3-2.7		R	28-29	11-14	40-42
20	$\bar{x}$	18.0	15.1	8.0	4.1	1.3	3.4	late	M	27	13	40
	R	14.2-20.2	11.8-17.0	5.8-9.4	3.3-4.5	1.1-1.5	2.7-4.2	postlarvae	R	26-29	12-14	40-41
1		27.8	23.8	11.8	6.4	1.8	5.6	juvenile		--	--	--

Table E-5. Morphometrics and meristics of fallfish reared from a natural spawn (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Standard	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
20	$\bar{x}$	9.0	8.6	2.8	1.5	0.7	1.8	prolarvae	M	30	13	43
	R	6.8-10.6	6.6-10.0	1.7-3.6	0.9-2.1	0.5-0.9	1.5-1.9		R	30-32	11-15	41-45
20	$\bar{x}$	12.7	11.3	4.6	2.7	1.0	2.0	postlarvae	M	30	12	42
	R	9.7-15.6	9.2-13.2	3.4-5.7	1.9-3.5	0.8-1.2	1.3-2.6		R	29-31	10-14	41-44
20	$\bar{x}$	18.5	15.4	7.6	4.2	1.4	3.2	late	M	29	12	41
	R	14.8-22.4	12.6-18.0	5.4-9.6	3.3-4.9	1.2-1.6	2.4-4.0	postlarvae	R	29-31	11-12	40-42
1		26.2	21.2	11.0	5.6	1.8	4.6	juvenile		--	--	--

Table E-6. Morphometrics and meristics of artificially propagated white sucker (R = range, $\bar{x}$ = mean, and M = mode).

Number of Fish		Length (mm) Total	Standard	Postanal	Head	Eye Diameter (mm)	Greatest Body Depth (mm)	Life Stage		Myomere Number Preanal	Postanal	Total
23	$\bar{x}$	12.6	12.2	2.9	1.6	0.8	1.6	prolarvae	M	37	9	46
	R	8.7-14.8	8.5-14.2	1.6-3.8	0.9-2.2	0.6-1.0	1.4-1.8		R	36-38	8-10	43-47
20	$\bar{x}$	16.1	14.9	4.3	2.8	1.1	2.0	postlarvae	M	37	9	46
	R	14.4-18.4	13.8-16.2	3.7-5.4	2.0-3.8	0.9-1.2	1.5-2.7		R	37-38	7-9	45-47
20	$\bar{x}$	21.8	18.5	7.1	4.8	1.4	3.5	late	M	36	9	45
	R	17.9-28.5	15.6-23.3	5.1-10.3	3.8-6.5	1.2-1.7	3.0-4.8	postlarvae	R	35-39	7-10	44-46
1		30.0	24.6	11.2	6.8	1.8	5.2	juvenile		--	--	--

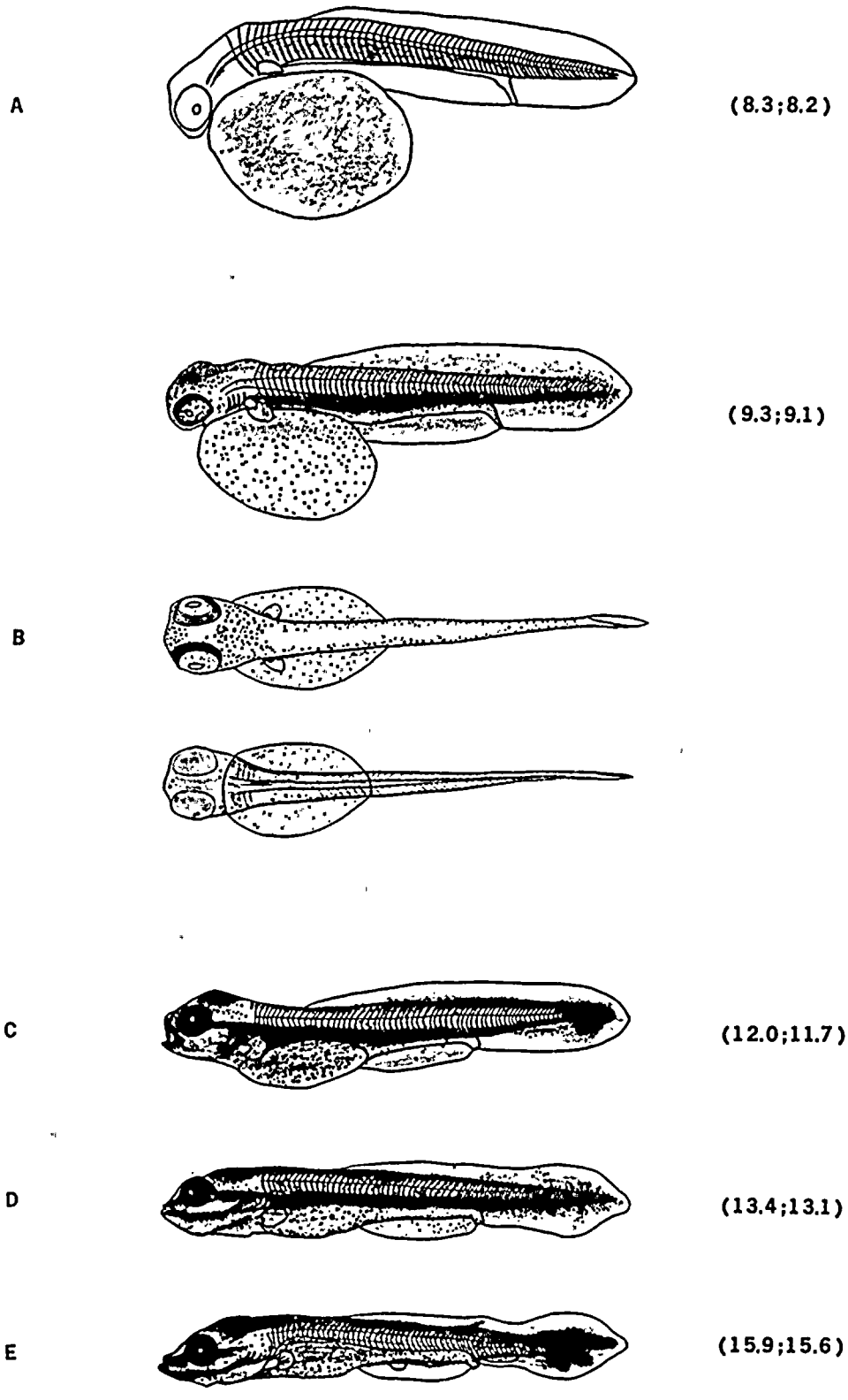


Fig. E-1. Development of northern pike. A-C. prolarvae. D-F. postlarvae. G-I. late postlarvae. J. juvenile. B, F, and H show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; standard).

(18.2;17.8)

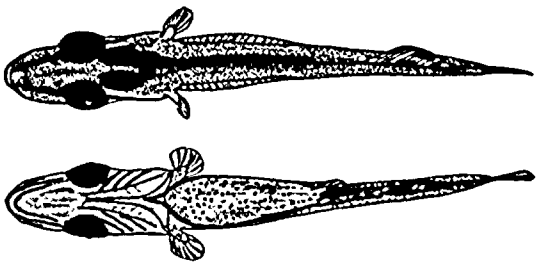
F

G

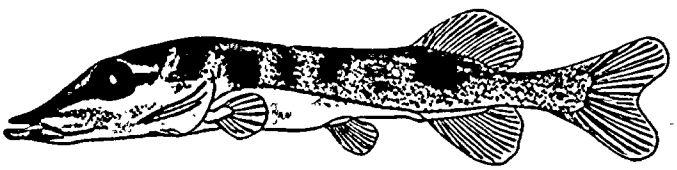
(22.8;22.0)

(26.6;24.4)

H



I



(38.6;36.4)

J

(65.0;57.0)

Fig. E-1. (cont.)

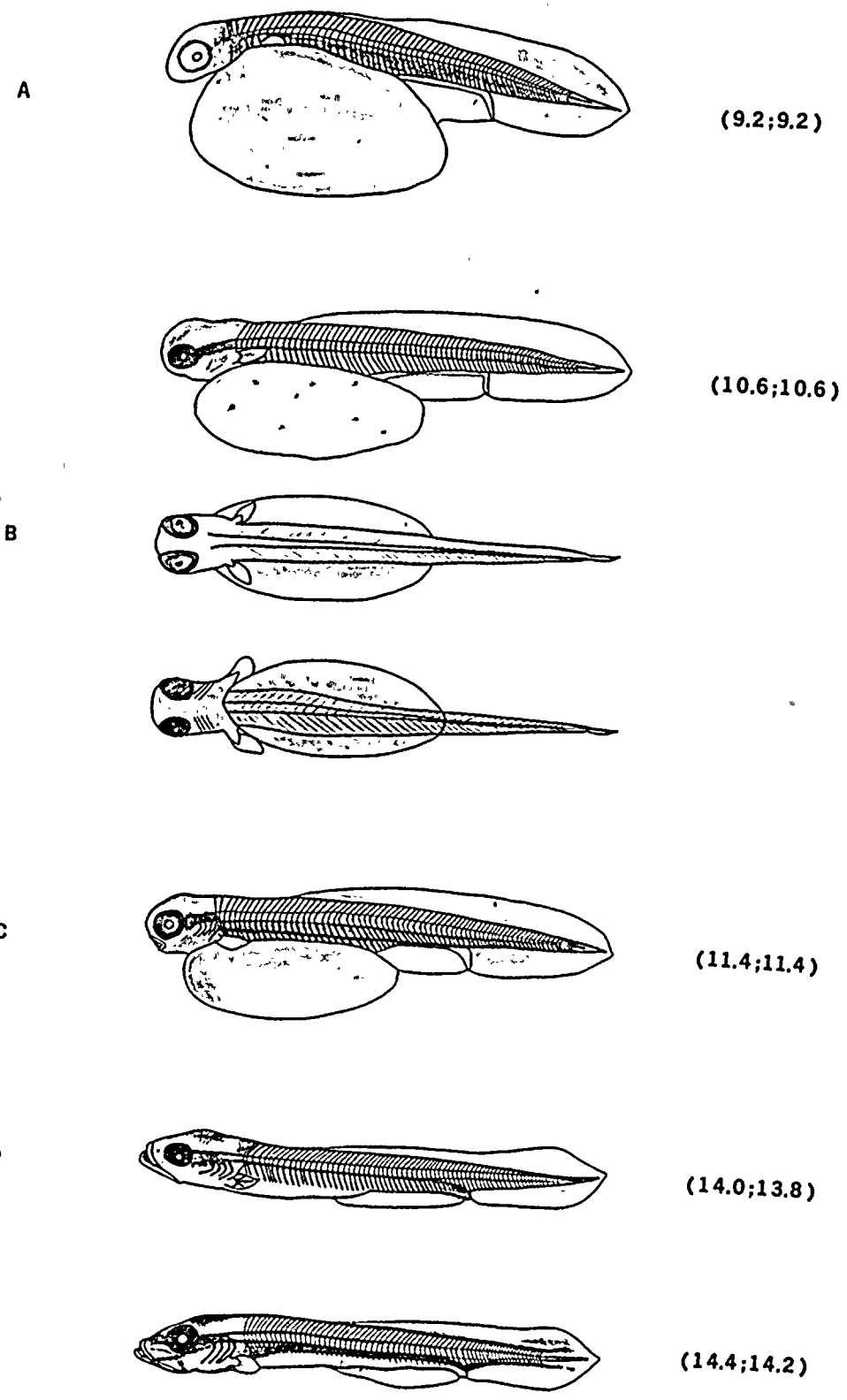
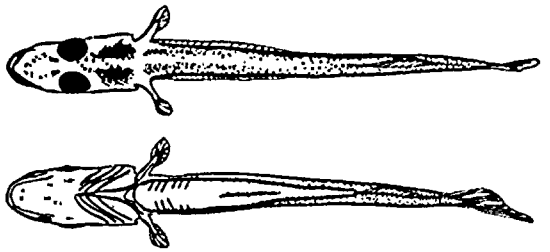


Fig. E-2. Development of muskellunge. A-D. prolarvae. E-G. postlarvae. H-I. late postlarvae. J. juvenile. B, F, and H show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; standard).

(17.4;17.1)

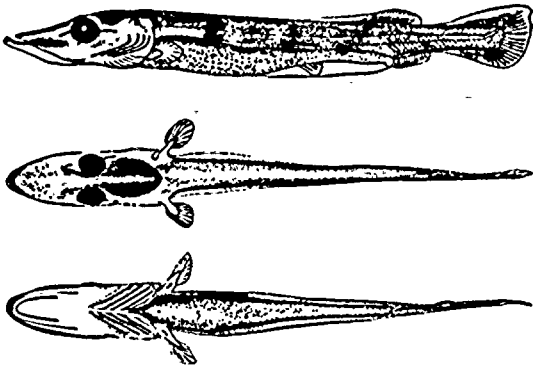
F



G

(24.9;23.7)

H



I

(37.5;34.9)

J

(75.0;65.0)

Fig. E-2 (cont.)

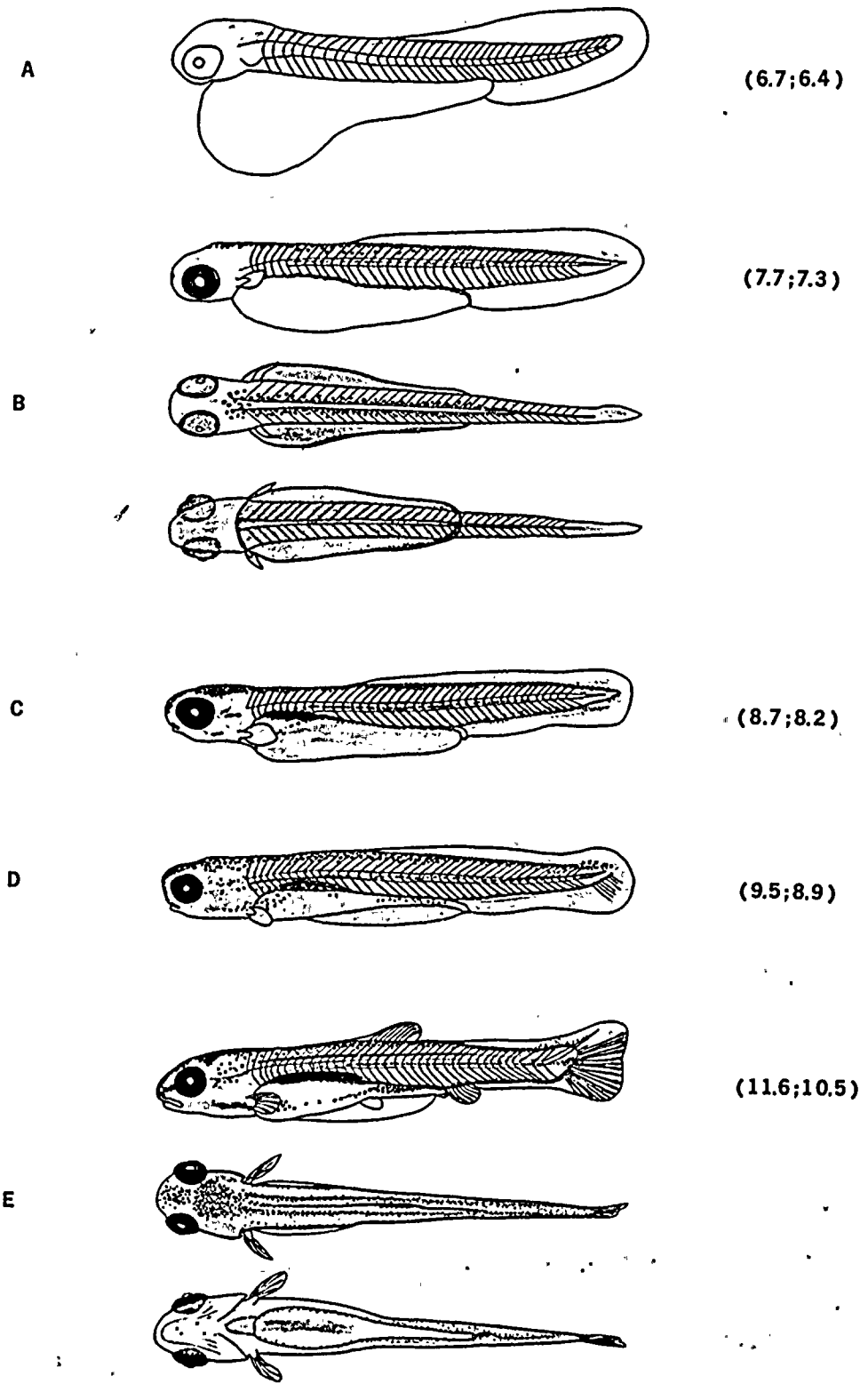
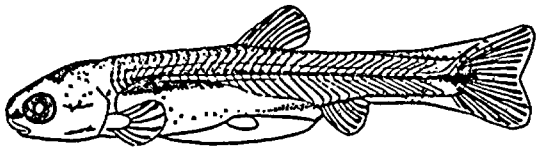


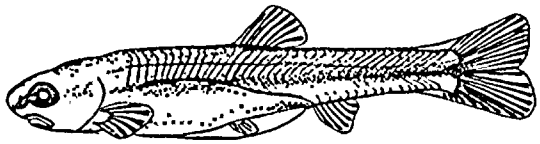
Fig. E-3. Development of longnose dace. A-C. prolarvae. D-F. postlarvae. G-I. late postlarvae. J. juvenile. B, E, and H show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; standard).

F

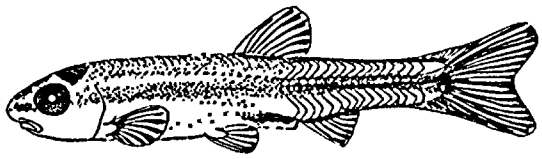


(14.0;12.1)

G

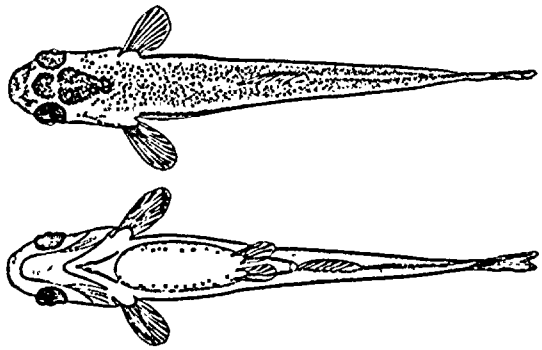


(15.8;13.4)

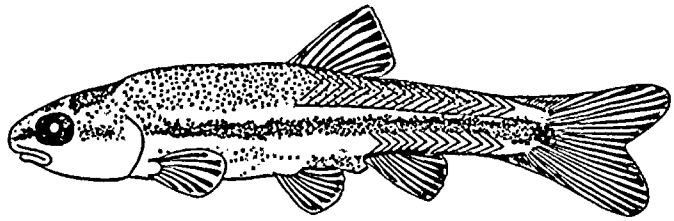


(17.8;14.8)

H

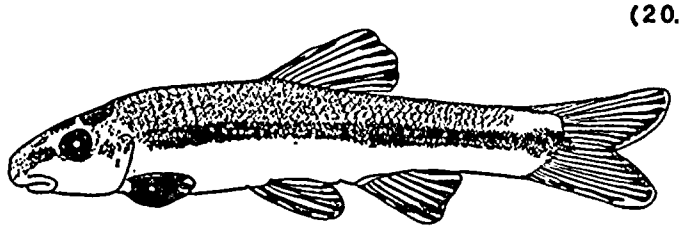


I



(20.6;11.8)

J



(31.8;25.6)

Fig. E-3 (cont.)

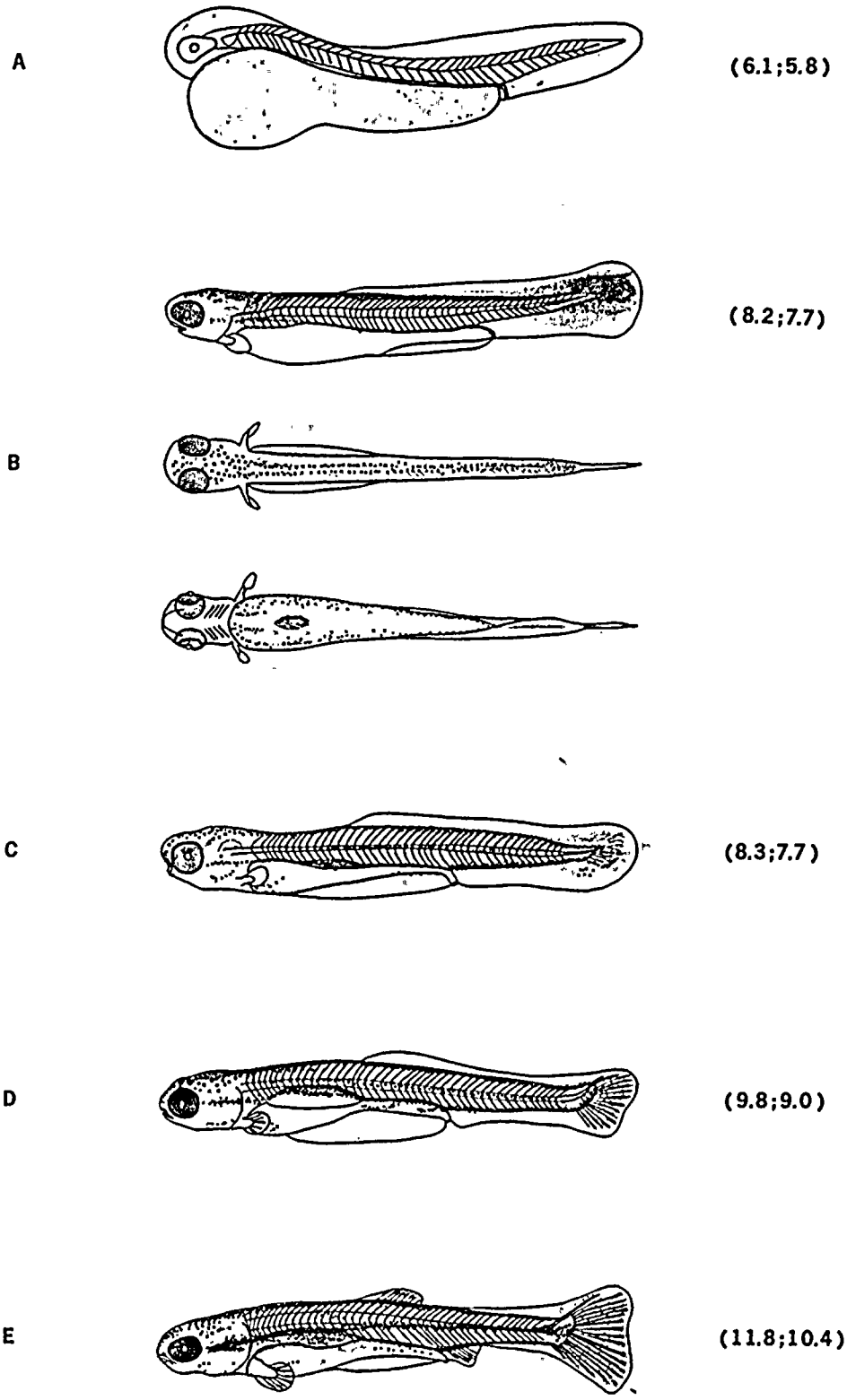
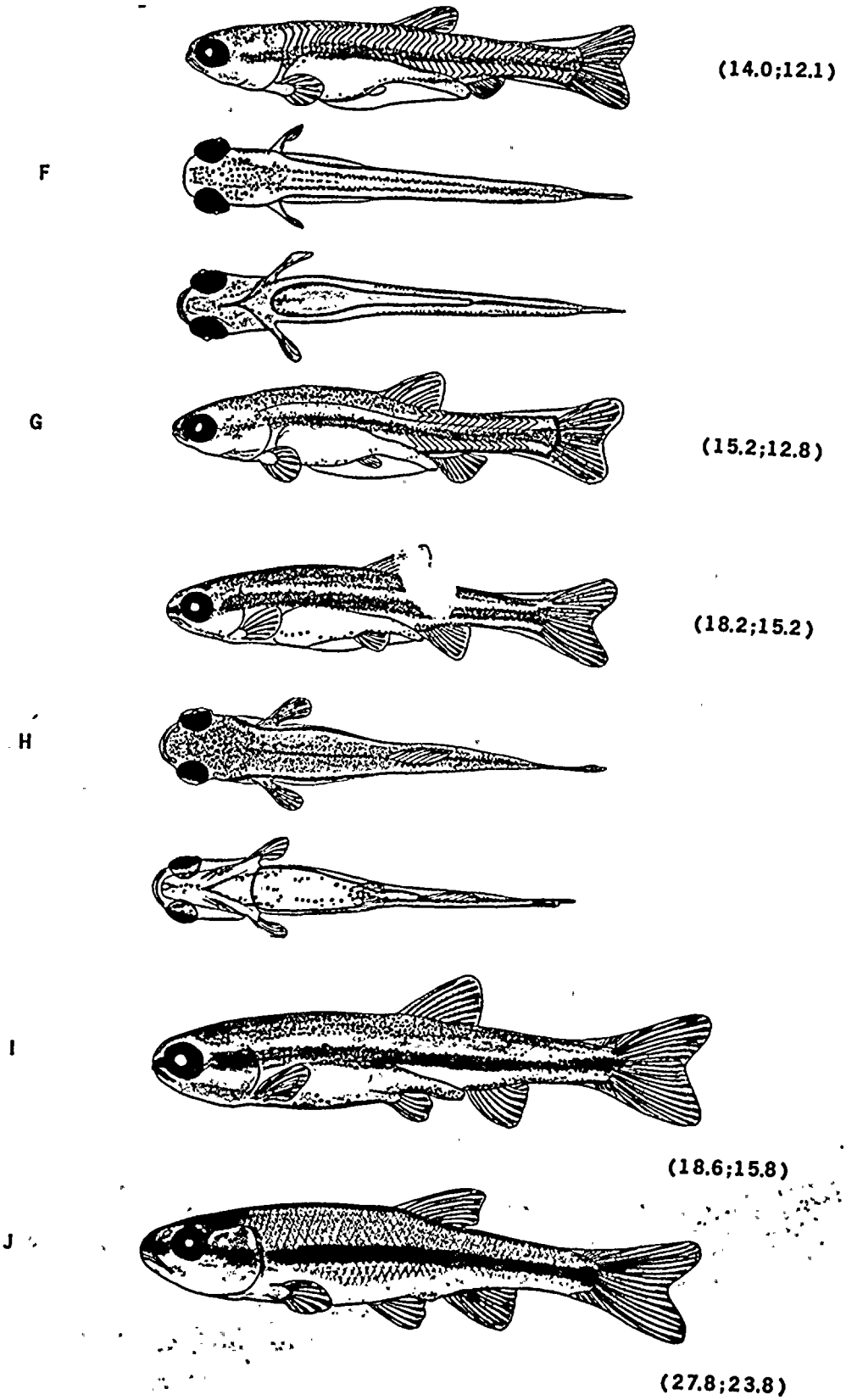


Fig. E-4. Development of creek chub. A-C. prolarvae. D-F. postlarvae. G-I. late postlarvae. J. juvenile. B, F, and H show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; standard).



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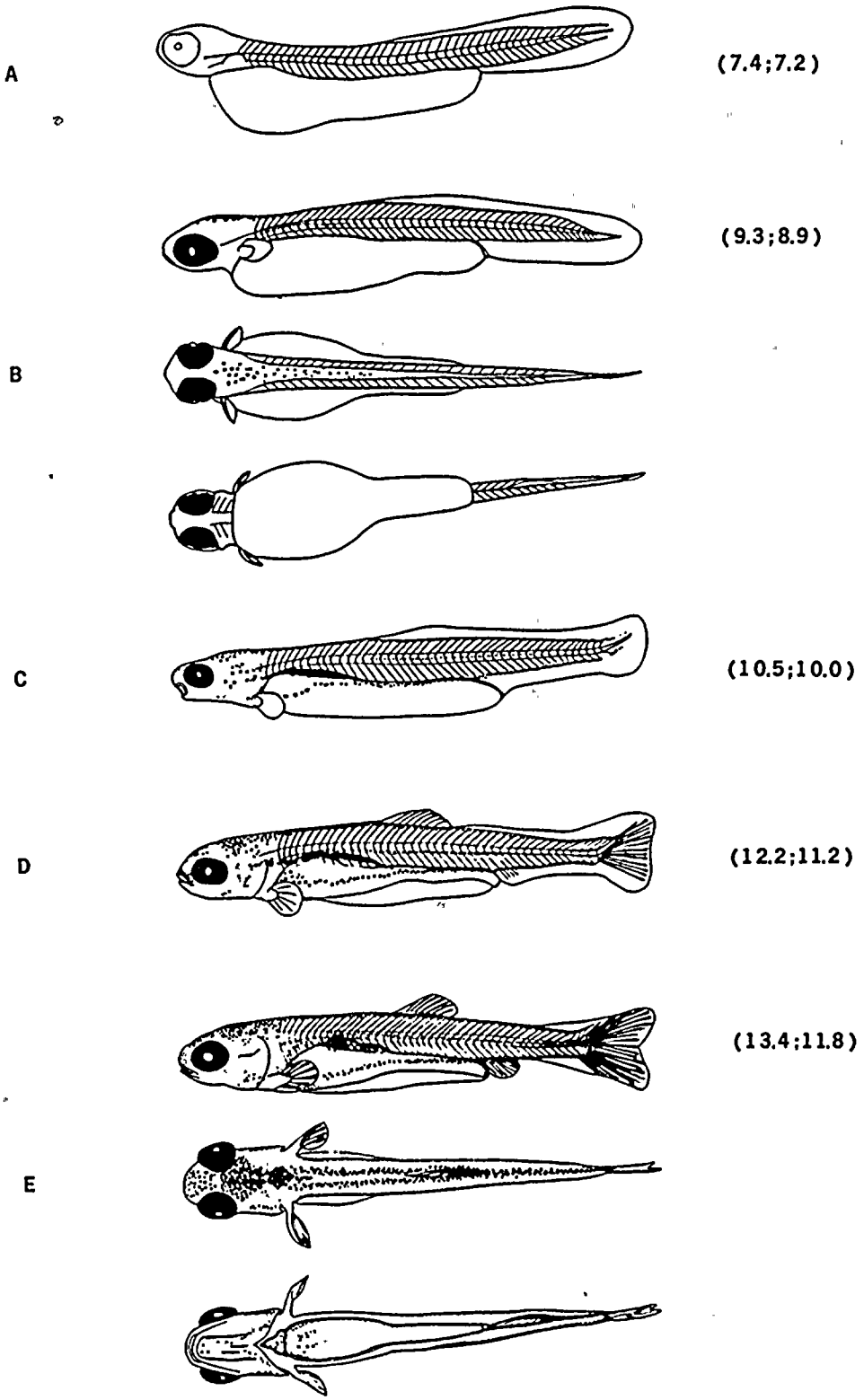
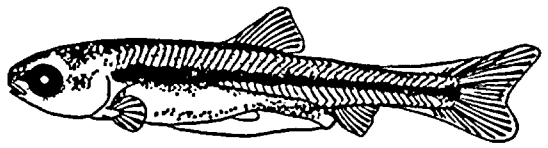
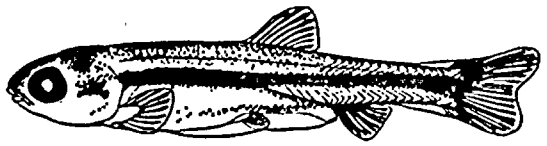


Fig. E-5. Development of fallfish. A-C. prolarvae. D-F. postlarvae. G-I. late postlarvae. J. juvenile. B, E, and G show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; standard).

F

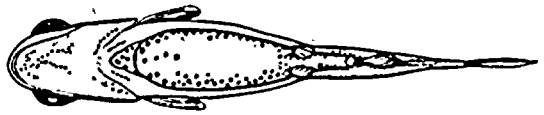


(15.6;13.2)

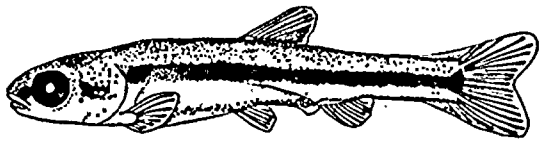


(16.8;14.3)

G

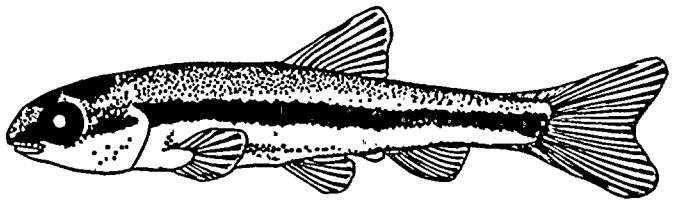


H



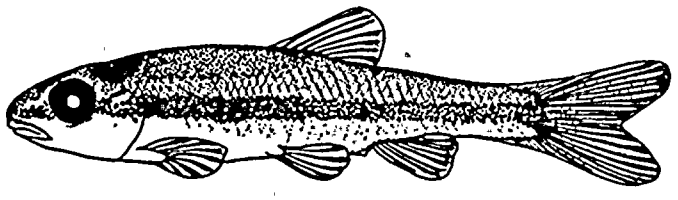
(18.4;15.6)

I



(20.1;16.8)

J



(26.2;21.2)

Fig. E-5 (cont.)

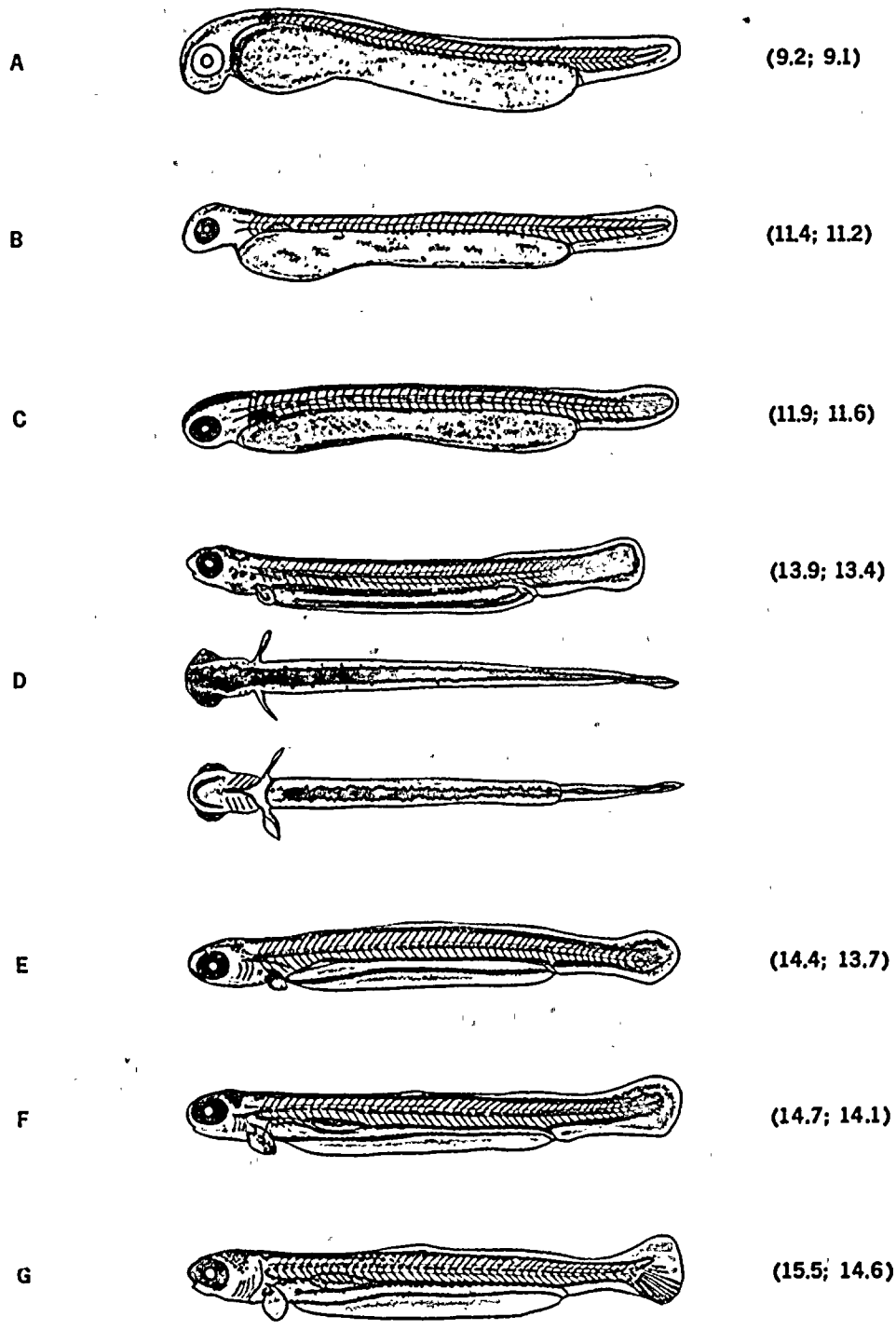


Fig. E-6. Development of white sucker. A-E. prolarvae. F-I. postlarvae. J-K. late postlarvae. L. juvenile. D, H, and J show lateral, dorsal, and ventral views. Numbers in parenthesis are lengths (total; standard).

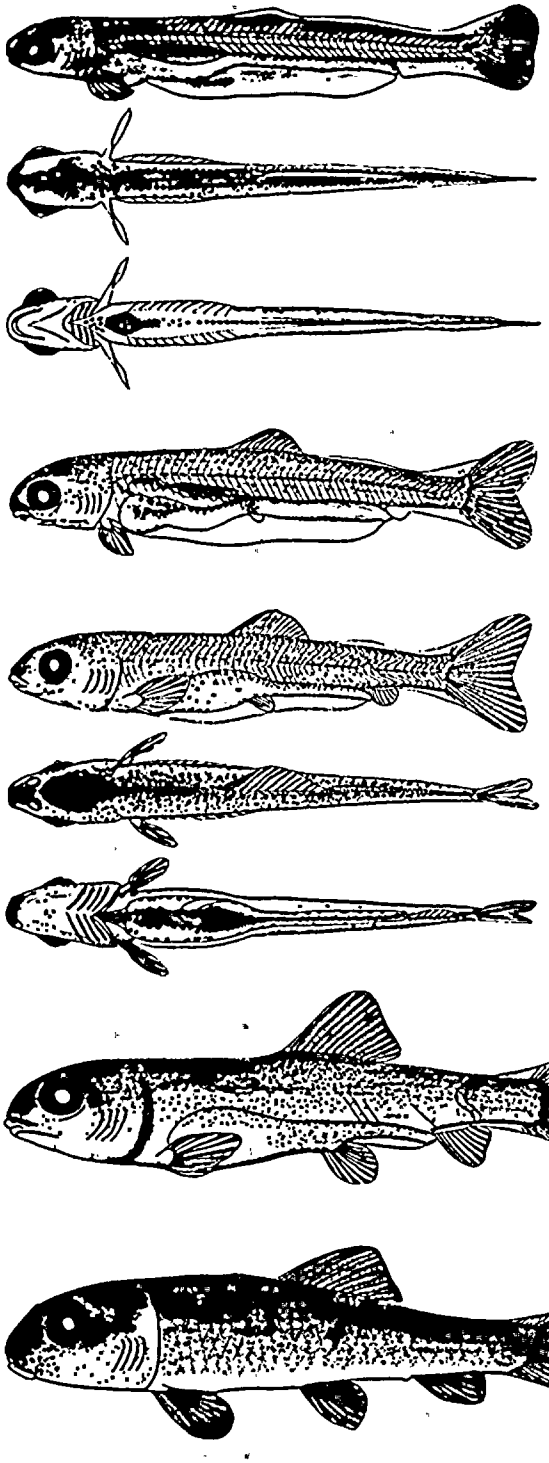


Fig. E-6 (cont.)

LARVAL FISHES

by

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

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ABSTRACT

In 1977, a total of 1,219 larvae of at least 15 fishes was collected at SSES-A from 5 May through 17 August to study the seasonal fluctuation of drifting larvae near the Susquehanna SES intake structure. Quillback composed about 57% of the total catch. Significantly more larvae ($P<0.001$) were taken near the surface of the River than near the bottom and more ($P<0.001$) were taken at night than during the day.

A total of 5,085 larvae of at least 9 fishes was captured in diel studies at SSES-A and SSES on 10-11 and 17-18 June 1976, respectively. These studies were conducted to determine the vertical distribution of drifting larvae near the Station's intake structure. Overall, the number of larvae drifting downriver at the different depths varied with time. In most instances, fewer larvae drifted during the day (0600-1800 h) than at night (2100-0300 h). During the day, most were found at 1 m or below. Between 1800 and 2100 h, larvae began to move toward the surface and at night, more larvae were found at 1 m or above. Number of larvae remained greater near the surface and at 1 m than at the other depths from 2100 through 0300 h.

INTRODUCTION

The relative abundance and density of drifting larval fish near the Susquehanna SES intake structure has been monitored since 1974 (Gale and Mohr 1976a, 1976b; Buynak and Mohr 1976, 1977). This monitoring was conducted to evaluate entrainment losses which will occur because River water will be used as a coolant in the Station.

Analyses of data collected in the 1977 monitoring program and in two diel studies conducted in 1976 are presented in this report. The monitoring program was designed to study the seasonal fluctuation in density of drifting larvae. Diel studies were conducted to determine vertical distribution of larvae drifting downriver past the Susquehanna SES.

PROCEDURES

In the monitoring and diel studies, larval fish were sampled by pumping River water through a 216-μ mesh net with a high-capacity, gasoline-powered trash pump. The pump was mounted on a pontoon boat (Gale and Mohr 1978). The pump intake was positioned upriver directly in front of the anchored pontoon boat and could be lowered to the River bottom and raised with a hand winch. Pumping rate was approximately 2,500 liters/min. The volume of water sampled was determined by multiplying pumping duration (3 or 5 min) by pumping rate. Pumping rate was determined with a hand-held tachometer (Stewart-Warner, Model 757-W). About 2,900 revolutions/min resulted in pumping 11.3 m^3 of water/5 min (6.8 m^3/3 min). Tachometer readings remained constant throughout the sampling season. Pumping rate was checked in 1977 by filling a 1,280-liter trough to assure that impellar wear had not reduced pump efficiency. The rate was identical to that measured in 1976.

In the 1977 monitoring program, samples were taken on 5, 11, 19, and 26 May; 2, 8, 15, 23, and 30 June; 7 and 21 July; and 4 and 17 August at

SSES-A (Fig. A-1). On each date, three replicate surface and bottom samples (5 min each) were taken at 0900 and 2100 h.

The diel studies were conducted on 10-11 and 17-18 June 1976 at SSES-A and SSES, respectively. The SSES sampling station was located 240 m upriver from SSES-A near the periphyton station. At both stations, three replicate samples (3 min each) were taken near the surface and at each 1-m interval until the bottom was reached. Sampling began at 0600 h and continued at 3-h intervals through 0600 h the next day.

Each sample was preserved in the field with 10% formalin containing rose bengal stain, and transported to the Laboratory where larvae were sorted. After sorting, identifications and life stages (prolarva or postlarva) of all larvae were determined using a dissecting microscope (10-70 X). Prolarvae were defined as fish with yolk and postlarvae were those without yolk until scalation began (Hubbs 1943). Identifications were made by comparing larvae to a reference series of laboratory-reared specimens 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). In a few instances, positive identifications to species could not be made, either because of damaged specimens or a lack of adequate keys. These fish were identified as minnow spp., sucker spp., crappie spp., or perch spp.. Severely damaged fish which could not be identified were tabulated as fish (fragments). Names and order of listing(Table F-1) conform to Bailey et al. (1970). All specimens were stored in 10% buffered formalin.

Data collected in the monitoring program and diel studies were analyzed using a three-way and a two-way analysis of variance (Hewlett-Packard 1974), respectively. Prior to analysis, data underwent a log (X + 1) transformation. Upon completion of the analysis of variance, Bartlett's test for homogeneity of variances was applied. Nonsignificant results in Bartlett's test indicated that variances were suitably homogeneous for significance testing. The 5% probability level was used to determine significance in each test.

RESULTS AND DISCUSSION

Seasonal Fluctuation

A total of 1,219 larvae of at least 15 fishes was collected from 5 May through 17 August at SSES-A in 1977 (Tables F-2 through F-19). Fishes in three of the five families collected composed about 98% of the total catch (Table F-19). Suckers were most abundant (62.3%), followed by minnows and carp (25.4%), and perches (10.1%). Sucker larvae were taken earliest and white sucker were collected first. Three species of sucker were captured from 5 May through 30 June. Minnows and carp were found over the longest time period; larvae were captured from 19 May through 17 August. Perches were captured from 11 May through 30 June and most of these were tessellated darter. Sunfishes were taken from 26 May through 21 July. Crappie were the first sunfishes collected. Fishes in the catfish family were the last to begin spawning. Catfishes were found over the shortest time period and were collected between 23 June and 21 July.

The total catch at SSES-A in 1977 was similar to that in 1975-76 (Buynak and Mohr 1976, 1977). In all three years, maximum densities occurred between 20 May and 20 June (Fig. F-1). In 1977, larval fish densities increased from 0.1 fish/10 m^3 on 5 May to a maximum of over 33.0 fish/10 m^3 on 26 May (Table F-19), when carp, minnow spp., and quillback were abundant. Mean densities then decreased to 1.0 fish/10 m^3 or less from 7 July through 17 August.

Of the 15 species captured in 1977, larval quillback were the most abundant, as they were from 1974 through 1976 (Gale and Mohr 1976a, 1976b; Buynak and Mohr 1976, 1977), and composed 56.7% of the total catch (Table F-19). Minnow spp. were next in abundance (13.1%), followed by carp (11.2%) and tessellated darter (9.4%). Maximum densities of quillback and tessellated darter occurred on 19 May when 26.5 and 1.8 fish/10 m^3 were taken, respectively (Table F-19). Maximum densities of carp and minnow spp. occurred on 26 May when 7.0 and 4.8 fish/10 m^3 were collected, respectively.

Significantly more larvae ($P<0.001$) were taken near the surface of the River than near the bottom (Table F-20). Mean larval fish density was over 3-fold greater near the surface (10.8 fish/10 m^3) as compared to the bottom (3.1 fish/10 m^3). Significantly more carp ($P<0.001$), quillback ($P<0.001$), and shorthead redhorse ($P<0.001$) were captured near the surface.

No significant surface-bottom differences were found for minnow spp. and tessellated darter. However, significant differences ($P<0.001$) were found for the statistical interaction of surface-bottom and sampling dates

(Table F-20). This revealed that there were differences in the number of these fishes collected at the surface and bottom on certain dates. This probably occurred as a result of differences in drifting behavior of pro- and postlarvae. For example, 60% of the prolarval minnow spp. were captured near the bottom, whereas 75% of the postlarvae were found near the surface. For tessellated darter, 71% of the prolarvae were captured near the surface, whereas 95% of the postlarvae were captured near the bottom.

Significantly more larvae ($P<0.001$) were taken at night than during the day (Table F-20). The mean density at night (11.7 fish/10 m^3) was over 5-fold greater than during the day (2.2 fish/10 m^3). Significantly more ($P<0.001$) minnow spp., quillback, shorthead redhorse, and tessellated darter were captured at night (Table F-20).

No significant day-night differences occurred in the number of drifting carp larvae. Significant interaction differences ($P<0.001$), however, were found between day-night and sampling dates (Table F-20). This revealed that day-night differences existed on certain sampling dates. For example, differences did occur on 26 May (Table F-5) when 63% of the carp were captured at night, and on 2 June (Table F-6) when 76% were taken during the day.

Vertical Distribution

A total of 5,085 larvae of at least 9 fishes (Tables F-21 through F-24) was captured in the vertical-distribution studies at SSES-A and

SSES in 1976. Overall, the number of larvae drifting at the different depths varied with time (Tables F-25, F-26; Figs. F-2, F-3).

In most instances at SSES-A, fewer fish drifted during the day (0600-1800 h) than at night (2100-0300 h). During the day, either very few larvae (tessellated darter and shorthead redhorse) drifted at all depths, or if larvae (carp and quillback) continued to drift, more were captured at 1 m or below. Larvae of all species captured moved toward the surface between 1800 and 2100 h. Peak number of drifting larvae occurred between 2100 and 0300 h when more larvae were captured near the surface and at 1 m than in deeper water. In most instances, during this period the number of drifting larvae decreased with depth. The number of larvae remained greater near the surface and at 1 m than at the other depths until 0600 h of the next day when more fish were usually found below 1 m. Trends were similar at the shallower SSES.

The vertical distribution of drifting carp larvae differed on 10-11 and 17-18 June. On 10-11 June, the behavior observed was similar to that described above for other larvae. However, on 17-18 June, the number of larvae at all depths decreased throughout the day and a peak in number, which usually occurred between 2400 and 0300 h, was not observed. It probably did not occur because carp were past their peak hatching period by 17-18 June.

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Table F-1. Larval fishes collected on the Susquehanna River, 1977.

Cyprinidae - Minnows and Carp
- *Cyprinus carpio* - carp
- *Notropis amoenus* - comely shiner
- *N. hudsonius* - spottail shiner
- *N. spilopterus* - spotfin shiner
- Unidentified Cyprinidae - minnow spp.

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

Ictaluridae - Freshwater Catfishes
- *Ictalurus catus* - white catfish
- *I. punctatus* - channel catfish
- *Noturus insignis* - margined madtom

Centrarchidae - Sunfishes
- *Ambloplites rupestris* - rock bass
- *Lepomis macrochirus* - bluegill
- *Pomoxis* spp. - crappie spp.

Percidae - Perches
- *Etheostoma olmstedi* - tessellated darter
- Unidentified Percidae - perch spp.

Table F-2. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 5 May 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
WHITE SUCKER PROLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	0	0	0	0.0	0	0	0	0.0

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
WHITE SUCKER PROLARVA	1	0	0	0.3	0	0	0	0.0
TOTAL	1	0	0	0.3	0	0	0	0.0

Table F-3. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 11 May 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
QUILLBACK PROLARVA	0	0	0	0.0	0	0	0	0.0
WHITE SUCKER PROLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER PROLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	0	0	0	0.0	0	0	0	0.0

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
QUILLBACK PROLARVA	2	0	0	0.7	0	0	0	0.0
WHITE SUCKER PROLARVA	1	0	1	0.7	0	0	0	0.0
TESSELLATED DARTER PROLARVA	0	2	3	1.7	0	2	1	1.0
TOTAL	3	2	4	3.0	0	2	1	1.0

Table F-4. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 19 May 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
MINNOW SPP. PROLARVA	0	0	0	0.0	0	0	1	0.3
QUILLBACK PROLARVA	4	8	9	7.0	3	3	3	3.0
WHITE SUCKER PROLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER PROLARVA	0	0	0	0.0	1	0	1	0.7
FISH (FRAGMENTS)	0	0	0	0.0	0	1	0	0.3
TOTAL	4	8	9	7.0	4	4	5	4.3

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
MINNOW SPP. PROLARVA	1	1	2	1.3	1	1	1	1.0
QUILLBACK PROLARVA	93	110	118	107.0	5	1	2	2.7
WHITE SUCKER PROLARVA	0	1	0	0.3	0	0	0	0.0
TESSELLATED DARTER PROLARVA	2	8	8	6.0	0	2	2	1.3
FISH (FRAGMENTS)	1	0	0	0.3	0	0	0	0.0
TOTAL	97	120	128	115.0	6	4	5	5.0

Table F-5. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 26 May 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
CARP								
PROLARVA	11	5	6	7.3	4	5	2	3.7
POSTLARVA	1	0	0	0.3	0	1	0	0.3
MINNOW SPP.								
PROLARVA	1	0	0	0.3	3	3	6	4.0
POSTLARVA	1	0	0	0.3	0	1	0	0.3
QUILLBACK								
PROLARVA	1	1	0	0.7	4	3	2	3.0
POSTLARVA	0	0	0	0.0	0	0	1	0.3
SHORTHEAD REDHORSE								
PROLARVA	0	0	0	0.0	3	0	0	1.0
POSTLARVA	0	0	0	0.0	0	0	0	0.0
CRAPPIE SPP.								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
TESSELLATED DARTER								
PROLARVA	0	0	0	0.0	0	0	0	0.0
PERCH SPP.								
PROLARVA	0	0	0	0.0	0	1	0	0.3
FISH (FRAGMENTS)	0	0	0	0.0	3	0	0	1.0
TOTAL	15	6	6	9.0	18	14	11	14.3

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
CARP								
PROLARVA	17	15	23	18.3	2	3	0	1.7
POSTLARVA	0	0	0	0.0	0	0	0	0.0
MINNOW SPP.								
PROLARVA	3	4	4	3.7	10	17	10	12.3
POSTLARVA	1	1	0	0.7	0	0	0	0.0
QUILLBACK								
PROLARVA	39	43	64	48.7	0	1	3	1.3
POSTLARVA	11	23	33	22.3	1	0	1	0.7
SHORTHEAD REDHORSE								
PROLARVA	4	4	5	4.3	0	0	0	0.0
POSTLARVA	1	7	4	4.0	0	1	0	0.3
CRAPPIE SPP.								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER								
PROLARVA	4	4	7	5.0	3	4	1	2.7
PERCH SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
FISH (FRAGMENTS)	0	1	0	0.3	0	0	1	0.3
TOTAL	80	102	140	107.3	16	26	16	19.3

Table F-6. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 2 June 1977.

SPECIES	DAY SURFACE			MEAN	DAY BOTTOM			MEAN
CARP								
PROLARVA	4	3	9	5.3	7	2	4	4.3
POSTLARVA	0	0	0	0.0	0	0	0	0.0
MINNOW SPP.								
PROLARVA	0	0	1	0.3	1	0	0	0.3
POSTLARVA	0	0	0	0.0	0	1	0	0.3
QUILLBACK								
PROLARVA	2	1	0	1.0	2	5	2	3.0
POSTLARVA	0	0	0	0.0	0	0	0	0.0
SHORTHEAD REDHORSE								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
SUCKER SPP.								
POSTLARVA	0	1	0	0.3	0	0	0	0.0
CRAPPIE SPP.								
PROLARVA	0	0	0	0.0	0	1	0	0.3
TESSELLATED DARTER								
PROLARVA	0	0	0	0.0	0	0	0	0.0
PERCH SPP.								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
FISH (FRAGMENTS)	0	0	0	0.0	0	0	0	0.0
TOTAL	6	5	10	7.0	11	9	6	8.7

SPECIES	NIGHT SURFACE			MEAN	NIGHT BOTTOM			MEAN
CARP								
PROLARVA	2	2	3	2.3	0	1	0	0.3
POSTLARVA	1	0	0	0.3	0	0	0	0.0
MINNOW SPP.								
PROLARVA	2	0	3	1.7	2	8	6	5.3
POSTLARVA	0	1	0	0.3	0	0	0	0.0
QUILLBACK								
PROLARVA	8	14	26	16.0	2	2	4	2.7
POSTLARVA	1	0	1	0.7	0	4	1	1.7
SHORTHEAD REDHORSE								
POSTLARVA	4	5	2	3.7	0	0	1	0.3
SUCKER SPP.								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
CRAPPIE SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER								
PROLARVA	0	1	4	1.7	1	1	1	1.0
PERCH SPP.								
POSTLARVA	0	0	0	0.0	0	0	2	0.7
FISH (FRAGMENTS)	0	1	0	0.3	0	0	0	0.0
TOTAL	18	24	39	27.0	5	16	15	12.0

Table F-7. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 8 June 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
CARP								
PROLARVA	0	0	0	0.0	0	0	0	0.0
MINNOW SPP.								
PROLARVA	1	1	1	1.0	2	1	3	2.0
POSTLARVA	0	1	0	0.3	0	0	0	0.0
QUILLBACK								
PROLARVA	0	0	0	0.0	1	0	1	0.7
POSTLARVA	0	0	0	0.0	0	0	1	0.3
SHORTHEAD REDHORSE								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
CRAPPIE SPP.								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
TESSELLATED DARTER								
PROLARVA	0	0	0	0.0	0	0	0	0.0
POSTLARVA	0	0	0	0.0	0	0	0	0.0
PERCH SPP.								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	1	2	1	1.3	5	1	5	3.7

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
CARP								
PROLARVA	0	0	0	0.0	0	2	0	0.7
MINNOW SPP.								
PROLARVA	0	2	6	2.7	4	1	2	2.3
POSTLARVA	1	0	0	0.3	0	0	0	0.0
QUILLBACK								
PROLARVA	0	4	1	1.7	0	0	0	0.0
POSTLARVA	0	0	2	0.7	0	0	0	0.0
SHORTHEAD REDHORSE								
POSTLARVA	7	5	4	5.3	3	0	0	1.0
CRAPPIE SPP.								
POSTLARVA	0	1	0	0.3	0	1	0	0.3
TESSELLATED DARTER								
PROLARVA	1	4	5	3.3	0	0	0	0.0
POSTLARVA	1	0	0	0.3	2	3	0	1.7
PERCH SPP.								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
TOTAL	10	16	18	14.7	10	7	2	6.3

Table F-8. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 15 June 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
MINNOW SPP.								
PROLARVA	0	1	0	0.3	1	1	2	1.3
POSTLARVA	0	0	0	0.0	0	0	1	0.3
QUILLBACK								
PROLARVA	1	1	3	1.7	0	0	0	0.0
POSTLARVA	0	0	0	0.0	1	0	0	0.3
TESSELLATED DARTER								
PROLARVA	0	0	0	0.0	1	0	0	0.3
POSTLARVA	0	0	0	0.0	0	0	0	0.0
PERCH SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
POSTLARVA	0	0	0	0.0	0	0	1	0.3
TOTAL	1	2	3	2.0	3	1	4	2.7

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
MINNOW SPP.								
PROLARVA	2	0	3	1.7	1	0	0	0.3
POSTLARVA	0	0	0	0.0	0	0	0	0.0
QUILLBACK								
PROLARVA	1	1	4	2.0	0	0	0	0.0
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER								
PROLARVA	2	4	4	3.3	1	1	1	1.0
POSTLARVA	0	0	0	0.0	0	1	0	0.3
PERCH SPP.								
PROLARVA	0	0	0	0.0	1	0	0	0.3
POSTLARVA	0	0	0	0.0	0	1	0	0.3
TOTAL	5	5	11	7.0	3	3	1	2.3

Table F-9. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 23 June 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
SPOTFIN SHINER								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
MINNOW SPP.								
PROLARVA	0	0	0	0.0	1	0	0	0.3
POSTLARVA	1	0	0	0.3	0	0	0	0.0
QUILLBACK								
PROLARVA	0	0	0	0.0	0	0	0	0.0
SHORTHEAD REDHORSE								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
CHANNEL CATFISH								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
MARGINED MADTOM								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
CRAPPIE SPP.								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER								
PROLARVA	0	0	0	0.0	0	1	0	0.3
POSTLARVA	0	0	0	0.0	0	1	0	0.3
TOTAL	1	0	0	0.3	2	2	0	1.3

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
SPOTFIN SHINER								
POSTLARVA	0	1	1	0.7	0	0	0	0.0
MINNOW SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
POSTLARVA	0	0	0	0.0	0	0	0	0.0
QUILLBACK								
PROLARVA	0	2	0	0.7	0	1	0	0.3
SHORTHEAD REDHORSE								
POSTLARVA	0	0	0	0.0	0	1	1	0.7
CHANNEL CATFISH								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
MARGINED MADTOM								
POSTLARVA	0	0	0	0.0	0	0	1	0.3
CRAPPIE SPP.								
POSTLARVA	0	1	0	0.3	0	0	0	0.0
TESSELLATED DARTER								
PROLARVA	0	1	2	1.0	1	0	1	0.7
POSTLARVA	0	0	0	0.0	2	2	0	1.3
TOTAL	0	5	3	2.7	4	4	3	3.7

Table F-10. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 30 June 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
COMELY SHINER								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
SPOTTAIL SHINER								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
SPOTFIN SHINER								
POSTLARVA	1	0	0	0.3	0	0	0	0.0
MINNOW SPP.								
PROLARVA	0	0	0	0.0	0	0	1	0.3
POSTLARVA	0	0	0	0.0	0	0	0	0.0
SHORTHEAD REDHORSE								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
WHITE CATFISH								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
ROCK BASS								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TESSELLATED DARTER								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	1	0	0	0.3	0	0	1	0.3

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
COMELY SHINER								
POSTLARVA	1	0	0	0.3	0	0	0	0.0
SPOTTAIL SHINER								
POSTLARVA	0	0	0	0.0	0	0	1	0.3
SPOTFIN SHINER								
POSTLARVA	0	1	0	0.3	0	0	0	0.0
MINNOW SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
POSTLARVA	1	0	0	0.3	0	0	0	0.0
SHORTHEAD REDHORSE								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
WHITE CATFISH								
POSTLARVA	0	0	0	0.0	0	1	0	0.3
ROCK BASS								
POSTLARVA	0	0	0	0.0	0	0	1	0.3
TESSELLATED DARTER								
POSTLARVA	0	0	0	0.0	3	4	3	3.3
TOTAL	2	1	0	1.0	4	5	5	4.7

Table F-11. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 7 July 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
SPOTFIN SHINER								
POSTLARVA	0	0	0	0.0	1	0	0	0.3
MINNOW SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
CHANNEL CATFISH								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
CRAPPIE SPP.								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	0	0	0	0.0	1	0	0	0.3

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
SPOTFIN SHINER								
POSTLARVA	0	1	0	0.3	0	0	0	0.0
MINNOW SPP.								
PROLARVA	1	1	0	0.7	0	0	0	0.0
CHANNEL CATFISH								
POSTLARVA	0	0	0	0.0	0	1	1	0.7
CRAPPIE SPP.								
POSTLARVA	1	0	0	0.3	0	0	0	0.0
TOTAL	2	2	0	1.3	0	1	1	0.7

Table F-12. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 21 July 1977.

	DAY SURFACE				DAY BOTTOM			
SPECIES				MEAN				MEAN
SPOTFIN SHINER								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
MINNOW SPP.								
PROLARVA	0	0	0	0.0	0	0	0	0.0
POSTLARVA	0	0	0	0.0	0	0	0	0.0
CHANNEL CATFISH								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
BLUEGILL								
POSTLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	0	0	0	0.0	0	0	0	0.0

	NIGHT SURFACE				NIGHT BOTTOM			
SPECIES				MEAN				MEAN
SPOTFIN SHINER								
POSTLARVA	0	1	1	0.7	0	0	0	0.0
MINNOW SPP.								
PROLARVA	0	4	5	3.0	0	0	0	0.0
POSTLARVA	0	1	0	0.3	0	0	0	0.0
CHANNEL CATFISH								
POSTLARVA	0	0	0	0.0	0	1	0	0.3
BLUEGILL								
POSTLARVA	0	1	0	0.3	0	0	0	0.0
TOTAL	0	7	6	4.3	0	1	0	0.3

Table F-13. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 4 August 1977.

SPECIES	DAY SURFACE			MEAN	DAY BOTTOM			MEAN
SPOTFIN SHINER POSTLARVA	0	0	0	0.0	0	0	0	0.0
MINNOW SPP. PROLARVA	0	0	0	0.0	0	0	0	0.0
FISH (FRAGMENTS)	0	0	0	0.0	0	0	0	0.0
TOTAL	0	0	0	0.0	0	0	0	0.0

SPECIES	NIGHT SURFACE			MEAN	NIGHT BOTTOM			MEAN
SPOTFIN SHINER POSTLARVA	0	1	0	0.3	0	0	0	0.0
MINNOW SPP. PROLARVA	4	2	3	3.0	0	0	0	0.0
FISH (FRAGMENTS)	0	0	2	0.7	0	0	0	0.0
TOTAL	4	3	5	4.0	0	0	0	0.0

Table F-14. Number of larval fishes captured in three replicate samples at SSES-A on the Susquehanna River, 17 August 1977.

SPECIES	DAY SURFACE			MEAN	DAY BOTTOM			MEAN
SPOTFIN SHINER POSTLARVA	0	1	0	0.3	0	0	0	0.0
MINNOW SPP. PROLARVA	0	1	0	0.3	0	0	0	0.0
TOTAL	0	2	0	0.7	0	0	0	0.0

SPECIES	NIGHT SURFACE			MEAN	NIGHT BOTTOM			MEAN
SPOTFIN SHINER POSTLARVA	0	0	0	0.0	0	0	0	0.0
MINNOW SPP. PROLARVA	0	0	0	0.0	0	0	0	0.0
TOTAL	0	0	0	0.0	0	0	0	0.0

Table F-15. Mean density of larval fishes/10 m^3 captured near the surface during the day at SSES-A on the Susquehanna River, 1977.

SPECIES	5 MAY	11 MAY	19 MAY	26 MAY	2 JUN	8 JUN	15 JUN	23 JUN	30 JUN	7 JUL	21 JUL	4 AUG	17 AUG	MEAN	% TOT
CARP															
PROLARVA	0.0	0.0	0.0	6.5	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	45.8
POSTLARVA	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	1.2
SPOTFIN SHINER															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	2.4
MINNOW SPP.															
PROLARVA	0.0	0.0	0.0	0.3	0.3	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.2	8.4
POSTLARVA	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1	3.6
QUILLBACK															
PROLARVA	0.0	0.0	6.2	0.6	0.9	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.7	37.3
SUCKER SPP.															
POSTLARVA	0.0	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	1.2
TOTAL	0.0	0.0	6.2	8.0	6.2	1.2	1.8	0.3	0.3	0.0	0.0	0.0	0.6	1.9	

Table F-16. Mean density of larval fishes/10 m^3 captured near the bottom during the day at SSES-A on the Susquehanna River, 1977.

SPECIES	5 MAY	11 MAY	19 MAY	26 MAY	2 JUN	8 JUN	15 JUN	23 JUN	30 JUN	7 JUL	21 JUL	4 AUG	17 AUG	MEAN	% TOT
CARP															
PROLARVA	0.0	0.0	0.0	3.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	22.4
POSTLARVA	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	0.9
SHOTFIN SHINER															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	1.9
MINNOW SPP.															
PROLARVA	0.0	0.0	0.3	3.5	0.3	1.8	1.2	0.3	0.3	0.0	0.0	0.0	0.0	0.6	24.3
POSTLARVA	0.0	0.0	0.0	0.3	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.8
QUILLBACK															
PROLARVA	0.0	0.0	2.7	2.7	2.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	27.1
POSTLARVA	0.0	0.0	0.0	0.3	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.8
SHORTHEAD REDHORSE															
PROLARVA	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.8
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
CRAPPIE SPP.															
PROLARVA	0.0	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	0.9
POSTLARVA	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
TESSELLATED DARTER															
PROLARVA	0.0	0.0	0.6	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.1	3.7
POSTLARVA	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	0.9
PERCH SPP.															
PROLARVA	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	0.9
POSTLARVA	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
FISH (FRAGMENTS)	0.0	0.0	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.7
TOTAL	0.0	0.0	3.8	12.7	7.7	3.2	2.4	1.2	0.3	0.3	0.0	0.0	0.0	2.4	

Table F-17. Mean density of larval fishes/10 m^3 captured near the surface at night at SSES-A on the Susquehanna River, 1977.

SPECIES	5 MAY	11 MAY	19 MAY	26 MAY	2 JUN	8 JUN	15 JUN	23 JUN	30 JUN	7 JUL	21 JUL	4 AUG	17 AUG	MEAN	% TOT
CARP															
PROLARVA	0.0	0.0	0.0	16.2	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	7.2
POSTLARVA	0.0	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	0.1
COMELY SHINER															
POSTLARVA	0.0	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	0.1
SPOTFIN SHINER															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.3	0.6	0.3	0.0	0.2	0.8
MINNOW SPP.															
PROLARVA	0.0	0.0	1.2	3.2	1.5	2.4	1.5	0.0	0.0	0.6	2.7	2.7	0.0	1.2	6.1
POSTLARVA	0.0	0.0	0.0	0.6	0.3	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.1	0.7
QUILLBACK															
PROLARVA	0.0	0.6	94.7	43.1	14.2	1.5	1.8	0.6	0.0	0.0	0.0	0.0	0.0	12.0	61.4
POSTLARVA	0.0	0.0	0.0	19.8	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	8.2
WHITE SUCKER															
PROLARVA	0.3	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
SHORTHEAD REDHORSE															
PROLARVA	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5
POSTLARVA	0.0	0.0	0.0	3.5	3.2	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	4.5
BLUEGILL															
POSTLARVA	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	0.0	0.1
CRAPPIE SPP.															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.1	0.3
TESSELLATED DARTER															
PROLARVA	0.0	1.5	5.3	4.4	1.5	2.9	2.9	0.9	0.0	0.0	0.0	0.0	0.0	1.5	7.6
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FISH (FRAGMENTS)	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.1	0.6
TOTAL	0.3	2.7	101.8	95.0	23.9	13.0	6.2	2.4	0.9	1.2	3.8	3.5	0.0	19.6	

Table F-18. Mean density of larval fishes/10 m^3 captured near the bottom at night at SSES-A on the Susquehanna River, 1977.

SPECIES	5 MAY	11 MAY	19 MAY	26 MAY	2 JUN	8 JUN	15 JUN	23 JUN	30 JUN	7 JUL	21 JUL	4 AUG	17 AUG	MEAN	% TOT
CARP															
PROLARVA	0.0	0.0	0.0	1.5	0.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	6.0
SPOTTAIL SHINER															
POSTLARVA	0.0	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	0.6
MINNOW SPP.															
PROLARVA	0.0	0.0	0.9	10.9	4.1	2.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.4	37.3
QUILLBACK															
PROLARVA	0.0	0.0	2.4	1.2	2.4	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	12.7
POSTLARVA	0.0	0.0	0.0	0.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	4.2
SHORTHEAD REDHORSE															
POSTLARVA	0.0	0.0	0.0	0.3	0.3	0.9	0.0	0.6	0.3	0.0	0.0	0.0	0.0	0.2	4.8
WHITE CATFISH															
POSTLARVA	0.0	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	0.6
CHANNEL CATFISH															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.6	0.3	0.0	0.0	0.1	2.4
MARGINED MADTOM															
POSTLARVA	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	0.6
ROCK BASS															
POSTLARVA	0.0	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	0.6
CRAPPIE SPP.															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
TESSELLATED DARTER															
PROLARVA	0.0	0.9	1.2	2.4	0.9	0.0	0.9	0.6	0.0	0.0	0.0	0.0	0.0	0.5	13.9
POSTLARVA	0.0	0.0	0.0	0.0	0.0	1.5	0.3	1.2	2.9	0.0	0.0	0.0	0.0	0.5	12.0
PERCH SPP.															
PROLARVA	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	0.0	0.6
POSTLARVA	0.0	0.0	0.0	0.0	0.6	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.4
FISH (FRAGMENTS)	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	0.6
TOTAL	0.0	0.9	4.4	17.1	10.6	5.6	2.1	3.2	4.1	0.6	0.3	0.0	0.0	3.8	

Table F-19. Mean density of larval fishes/10 m^3 captured at SSES-A on the Susquehanna River, 1977.

SPECIES	5 MAY	11 MAY	19 MAY	26 MAY	2 JUN	8 JUN	15 JUN	23 JUN	30 JUN	7 JUL	21 JUL	4 AUG	17 AUG	MEAN	% TOT
CARP															
PROLARVA	0.0	0.0	0.0	6.9	2.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	11.0
POSTLARVA	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	0.0	0.2
COMELY SHINER															
POSTLARVA	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	0.1
SPOTTAIL SHINER															
POSTLARVA	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	0.1
SPOTFIN SHINER															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.9
MINNOW SPP.															
PROLARVA	0.0	0.0	0.6	4.5	1.5	1.8	0.8	0.1	0.1	0.1	0.7	0.7	0.1	0.8	12.1
POSTLARVA	0.0	0.0	0.0	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1	1.0
QUILLBACK															
PROLARVA	0.0	0.1	26.5	11.9	5.0	0.5	0.8	0.2	0.0	0.0	0.0	0.0	0.0	3.5	50.1
POSTLARVA	0.0	0.0	0.0	5.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	6.6
WHITE SUCKER															
PROLARVA	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
SHORTHEAD REDHORSE															
PROLARVA	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.3
POSTLARVA	0.0	0.0	0.0	1.0	0.9	1.5	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.3	3.9
SUCKER SPP.															
POSTLARVA	0.0	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	0.1
WHITE CATFISH															
POSTLARVA	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	0.1
CHANNEL CATFISH															
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.3
MARGINED MADTOM															
POSTLARVA	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	0.1
ROCK BASS															
POSTLARVA	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	0.1
BLUEGILL															
POSTLARVA	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	0.1
CRAPPIE SPP.															
PROLARVA	0.0	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	0.1
POSTLARVA	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.5
TESSELLATED DARTER															
PROLARVA	0.0	0.6	1.8	1.7	0.6	0.7	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.5	7.6
POSTLARVA	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.4	0.7	0.0	0.0	0.0	0.0	0.1	1.8
PERCH SPP.															
PROLARVA	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
POSTLARVA	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
FISH (FRAGMENTS)	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.8
TOTAL	0.1	0.9	29.1	33.2	12.1	5.8	3.1	1.8	1.4	0.5	1.0	0.9	0.1	6.9	

Table F-20. Results (F values) of six analysis of variance tests comparing catch/unit effort among replicates, sampling dates (1), day and night (2), and surface and bottom (3) at SSES-A on the Susquehanna River, 1977 (N.S. = not significant, *** = <0.001, * = <0.05).

	Main Effects				Interaction Effects				Bartlett's Test
Degrees of Freedom	Replicates (2, 102)	1 (12, 102)	2 (1, 102)	3 (1, 102)	1X2 (12, 102)	1X3 (12, 102)	2X3 (1, 102)	1X2X3 (12, 102)	
Species									
Combined	0.52	80.69***	139.03***	23.56***	3.91***	5.91***	43.57***	4.85***	N.S.
Carp	0.95	106.07***	1.36	14.06***	3.42***	10.99***	4.18*	4.01***	N.S.
Minnow spp.	0.68	20.83***	28.84***	0.02	4.30***	4.22***	13.95***	1.71	N.S.
Quillback	0.55	89.03***	57.58***	57.18***	11.83***	13.07***	83.64***	15.72***	N.S.
Shorthead redhorse	1.14	17.99***	52.13***	12.93***	11.09***	6.28***	26.51***	11.80***	N.S.
Tessellated darter	3.34*	12.90***	156.15***	0.04	9.93***	3.09***	3.81	4.20***	N.S.

Table F-21. Number of larval fishes captured in three replicate samples during diel, vertical-distribution studies at SSES-A on the Susquehanna River, 10-11 June 1976.

Species	Time / Depth	0600 Sur	0600 1 m	0600 2 m	0600 3 m	0600 Bot	0900 Sur	0900 1 m	0900 2 m	0900 3 m	0900 Bot	1200[a] Sur	1200[a] 1 m	1200[a] 2 m	1200[a] 3 m	1200[a] Bot	1500 Sur	1500 1 m	1500 2 m	1500 3 m	1500 Bot	1800 Sur	1800 1 m	1800 2 m	1800 3 m	1800 Bot
Carp																										
	prolarva	41	74	72	65	65	41	46	42	41	32	13	21	29	29	19	41	56	57	38	36	29	39	47	64	34
	postlarva	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
Minnow spp.																										
	prolarva	6	10	31	26	45	11	10	12	20	19	2	8	9	18	14	4	10	5	14	14	3	5	13	16	16
	postlarva	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quillback																										
	prolarva	1	2	16	16	14	5	3	5	10	7	0	0	7	7	4	0	1	6	6	2	2	1	6	6	2
	postlarva	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
Shorthead redhorse																										
	prolarva	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
	postlarva	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
Crappie spp.																										
	prolarva	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
	postlarva	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
Tessellated darter																										
	prolarva	0	0	0	1	6	0	0	1	3	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0	2
	postlarva	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
Yellow perch																										
	prolarva	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
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Fish (fragments)		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
Total		50	87	119	109	130	57	59	60	74	58	15	29	45	55	37	45	68	70	58	54	35	46	67	86	54

Species	Time / Depth	2100 Sur	2100 1 m	2100 2 m	2100 3 m	2100 Bot	2400 Sur	2400 1 m	2400 2 m	2400 3 m	2400 Bot	0300 Sur	0300 1 m	0300 2 m	0300 3 m	0300 Bot	0600 Sur	0600 1 m	0600 2 m	0600 3 m	0600 Bot	Total	% Total
Carp																							
	prolarva	80	108	78	50	8	173	185	127	57	30	212	174	108	46	18	76	110	150	146	77	3084	70.8
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Minnow spp.																							
	prolarva	15	8	15	16	17	32	25	26	28	10	24	24	31	27	7	9	13	42	33	33	776	17.8
	postlarva	0	0	0	0	0	1	0	1	0	0	3	0	1	0	0	0	0	4	3	2	17	0.4
Quillback																							
	prolarva	7	10	8	2	3	29	17	9	2	1	17	11	10	2	1	0	0	11	6	5	280	6.4
	postlarva	0	0	1	0	0	1	3	0	1	0	4	1	1	1	0	0	0	0	1	0	14	0.3
Shorthead redhorse																							
	prolarva	0	2	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	6	0.1
	postlarva	3	3	1	1	0	3	2	5	2	0	4	2	0	1	0	0	0	0	0	1	29	0.7
Crappie spp.																							
	prolarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	<0.1
Tessellated darter																							
	prolarva	38	36	6	8	4	9	4	1	2	1	4	1	1	0	1	1	0	0	1	4	141	3.2
	postlarva	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	<0.1
Yellow perch																							
	prolarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	<0.1
Fish (fragments)		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	<0.1
Total		143	167	109	78	33	248	237	169	92	42	269	214	152	78	27	86	123	208	190	122	4354	

[a]Due to pump failure only one replicate was taken near the surface, at 1 m, and at 2 m and two replicates at 3 m and near the bottom.

Table F-22. Mean density of larval fishes/10 m^3 captured in three replicate samples during diel, vertical-distribution studies at SSES-A on the Susquehanna River, 10-11 June 1976.

Species	Time / Depth	0600 Sur	0600 1 m	0600 2 m	0600 3 m	0600 Bot	0900 Sur	0900 1 m	0900 2 m	0900 3 m	0900 Bot	1200[a] Sur	1200[a] 1 m	1200[a] 2 m	1200[a] 3 m	1200[a] Bot	1500 Sur	1500 1 m	1500 2 m	1500 3 m	1500 Bot	1800 Sur	1800 1 m	1800 2 m	1800 3 m	1800 Bot
Carp																										
	prolarva	20.1	36.3	35.3	31.9	31.9	20.1	22.5	20.6	20.1	15.7	19.1	30.9	42.6	21.3	14.0	20.1	27.5	27.9	18.6	17.6	14.2	19.1	23.0	31.4	16.7
	postlarva	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
Minnow spp.																										
	prolarva	2.9	4.9	15.2	12.7	22.1	5.4	4.9	5.9	9.8	9.3	2.9	11.8	13.2	13.2	10.3	2.0	4.9	2.5	6.9	6.9	1.5	2.5	6.4	7.8	7.8
	postlarva	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quillback																										
	prolarva	0.5	1.0	7.8	7.8	6.9	2.5	1.5	2.5	4.9	3.4	0	0	10.3	5.1	2.9	0	0.5	2.9	2.9	1.0	1.0	0.5	2.9	2.9	1.0
	postlarva	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
Shorthead redhorse																										
	prolarva	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0
Crappie spp.																										
	prolarva	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
	postlarva	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tessellated darter																										
	prolarva	0	0	0	0.5	2.9	0	0	0.5	1.5	0	0	0	0	0.7	0	0	0.5	0.5	0	0.5	0	0.5	0.5	0	1.0
	postlarva	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
Yellow perch																										
	prolarva	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
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0
Fish (fragments)		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
Total		24.5	42.6	58.3	53.4	63.7	27.9	28.9	29.4	36.3	28.4	22.1	42.6	66.2	40.4	27.2	22.1	33.3	34.3	28.4	26.5	17.2	22.5	32.8	42.2	26.5

Species	Time / Depth	2100 Sur	2100 1 m	2100 2 m	2100 3 m	2100 Bot	2400 Sur	2400 1 m	2400 2 m	2400 3 m	2400 Bot	0300 Sur	0300 1 m	0300 2 m	0300 3 m	0300 Bot	0600 Sur	0600 1 m	0600 2 m	0600 3 m	0600 Bot
Carp																					
	prolarva	39.2	52.9	38.2	24.5	3.9	84.8	90.7	62.3	27.9	14.7	103.9	85.3	52.9	22.5	8.8	37.3	53.9	73.5	71.6	37.7
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minnow spp.																					
	prolarva	7.4	3.9	7.4	7.8	8.3	15.7	12.3	12.7	13.7	4.9	11.8	11.8	15.2	13.2	3.4	4.4	6.4	20.6	16.2	16.2
	postlarva	0	0	0	0	0	0.5	0	0.5	0	0	1.5	0	0.5	0	0	0	0	2.0	1.5	1.0
Quillback																					
	prolarva	3.4	4.9	3.9	1.0	1.5	14.2	8.3	4.4	1.0	0.5	8.3	5.4	4.9	1.0	0.5	0	0	5.4	2.9	2.5
	postlarva	0	0	0.5	0	0	0.5	1.5	0	0.5	0	2.0	0.5	0.5	0.5	0	0	0	0	0.5	0
Shorthead redhorse																					
	prolarva	0	1.0	0	0	0	0	0.5	0	0	0	0.5	0.5	0	0	0	0	0	0	0	0
	postlarva	1.5	1.5	0.5	0.5	0	1.5	1.0	2.5	1.0	0	2.0	1.0	0	0.5	0	0	0	0	0	0.5
Crappie spp.																					
	prolarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0
Tessellated darter																					
	prolarva	18.6	17.6	2.9	3.9	2.0	4.4	2.0	0.5	1.0	0.5	2.0	0.5	0.5	0	0.5	0.5	0	0	0.5	2.0
	postlarva	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow perch																					
	prolarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	postlarva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish (fragments)		0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0
Total		70.1	81.9	53.4	38.2	16.2	121.6	116.2	82.8	45.1	20.6	131.9	104.9	74.5	38.2	13.2	42.2	60.3	102.0	93.1	59.8

[a]Due to pump failure only one replicate was taken near the surface, at 1 m and at 2 m and two replicates at 3 m and near the bottom.

Table F-23. Number of larval fishes captured in three replicate samples during diel, vertical-distribution studies at SSES on the Susquehanna River, 17-18 June 1976.

Species	Time	0600			0900			1200			1500			1800		
	Depth	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot
Carp																
prolarva		12	9	9	17	15	9	10	8	5	12	9	4	7	6	1
postlarva		0	0	1	1	1	0	0	1	0	0	1	0	0	0	0
Minnow spp.																
prolarva		16	14	10	5	5	3	7	13	11	9	7	12	8	9	9
postlarva		0	1	1	0	0	0	0	0	0	1	0	1	1	1	1
Quillback																
prolarva		2	4	11	0	0	5	1	2	0	1	3	6	1	4	11
postlarva		0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
White sucker																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shorthead redhorse																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crappie spp.																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tessellated darter																
prolarva		0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perch spp.																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish (fragments)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		31	28	33	24	21	18	19	24	16	23	20	24	17	20	22

Species	Time	2100			2400			0300			0600			Total	% Total
	Depth	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot		
Carp															
prolarva		1	6	1	8	2	3	4	0	1	1	0	1	161	22.0
postlarva		0	0	0	0	0	0	1	0	0	1	0	0	7	1.0
Minnow spp.															
prolarva		28	21	8	19	5	3	23	4	4	9	15	22	299	40.9
postlarva		0	1	0	2	0	0	2	2	0	0	0	1	15	2.1
Quillback															
prolarva		41	17	0	19	7	0	22	0	0	1	5	3	166	22.7
postlarva		0	0	0	2	4	1	3	0	0	0	0	2	14	1.9
White sucker															
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
postlarva		0	0	1	0	0	0	0	0	0	0	0	0	1	0.1
Shorthead redhorse															
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
postlarva		1	0	0	2	1	0	2	0	0	0	0	0	6	0.8
Crappie spp.															
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
Tessellated darter															
prolarva		22	24	2	2	1	0	2	1	0	0	0	0	56	7.7
postlarva		0	0	0	1	1	0	0	0	0	0	1	0	3	0.4
Perch spp.															
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	1	0.1
Fish (fragments)		0	0	0	0	0	1	0	0	0	0	0	0	1	0.1
Total		93	69	12	55	21	8	59	7	5	12	21	29	731	

Table F-24. Mean density of larval fishes/10 m^3 captured in three replicate samples during diel, vertical-distribution studies at SSES on the Susquehanna River, 17-18 June 1976.

Species	Time	0600			0900			1200			1500			1800		
	Depth	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot
Carp																
prolarva		5.9	4.4	4.4	8.3	7.4	4.4	4.9	3.9	2.5	5.9	4.4	2.0	3.4	2.9	0.5
postlarva		0	0	0.5	0.5	0.5	0	0	0.5	0	0	0.5	0	0	0	0
Minnow spp.																
prolarva		7.8	6.9	4.9	2.5	2.5	1.5	3.4	6.4	5.4	4.4	3.4	5.9	3.9	4.4	4.4
postlarva		0	0.5	0.5	0	0	0	0	0	0	0.5	0	0.5	0.5	0.5	0.5
Quillback																
prolarva		1.0	2.0	5.4	0	0	2.5	0.5	1.0	0	0.5	1.5	2.9	0.5	2.0	5.4
postlarva		0	0	0.5	0	0	0.5	0	0	0	0	0	0	0	0	0
White sucker																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shorthead redhorse																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crappie spp.																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0
Tessellated darter																
prolarva		0	0	0	0.5	0	0	0	0	0	0	0	0.5	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perch spp.																
prolarva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish (fragments)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		15.2	13.7	16.2	11.8	10.3	8.8	9.3	11.8	7.8	11.3	9.8	11.8	8.3	9.8	10.8

Species	Time	2100			2400			0300			0600		
	Depth	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot	Sur	1 m	Bot
Carp													
prolarva		0.5	2.9	0.5	3.9	1.0	1.5	2.0	0	0.5	0.5	0	0.5
postlarva		0	0	0	0	0	0	0.5	0	0	0.5	0	0
Minnow spp.													
prolarva		13.7	10.3	3.9	9.3	2.5	1.5	11.3	2.0	2.0	4.4	7.4	10.8
postlarva		0	0.5	0	1.0	0	0	1.0	1.0	0	0	0	0.5
Quillback													
prolarva		20.1	8.3	0	9.3	3.4	0	10.8	0	0	0.5	2.5	1.5
postlarva		0	0	0	1.0	2.0	0.5	1.5	0	0	0	0	1.0
White sucker													
prolarva		0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0.5	0	0	0	0	0	0	0	0	0
Shorthead redhorse													
prolarva		0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0.5	0	0	1.0	0.5	0	1.0	0	0	0	0	0
Crappie spp.													
prolarva		0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0
Tessellated darter													
prolarva		10.8	11.8	1.0	1.0	0.5	0	1.0	0.5	0	0	0	0
postlarva		0	0	0	0.5	0.5	0	0	0	0	0	0.5	0
Perch spp.													
prolarva		0	0	0	0	0	0	0	0	0	0	0	0
postlarva		0	0	0	0	0	0	0	0	0	0	0	0
Fish (fragments)		0	0	0	0	0	0.5	0	0	0	0	0	0
Total		45.6	33.8	5.9	27.0	10.3	3.9	28.9	3.4	2.5	5.9	10.3	14.2

Table F-25. Results (F values) of six analysis of variance tests comparing catch/unit effort among replicates, time periods (1), and depths (2) at SSES-A on the Susquehanna River, 10-11 June 1976 (N.S. = not significant, *** = <0.001, ** = <0.01).

	Main Effects			Interaction Effect	Bartlett's
Degrees of Freedom	Replicates (2, 78)	1 (7, 78)	2 (4, 78)	1X2 (28, 78)	Test
Species					
Combined	1.05	30.33***	23.83***	10.75***	N.S.
Carp	0.58	27.11***	42.31***	8.37***	N.S.
Minnow spp.	0.81	11.02***	9.58***	3.81***	N.S.
Quillback	0.69	4.55***	4.54**	4.62***	N.S.
Shorthead redhorse	1.22	8.44***	3.59**	1.62	N.S.
Tessellated darter	0.79	39.60***	4.13**	5.58***	**

Table F-26. Results (F values) of six analysis of variance tests comparing catch/unit effort among replicates, time periods (1), and depths (2) at SSES on the Susquehanna River, 17-18 June 1976 (N.S. = not significant, *** = <0.001, ** = <0.01, * = <0.05).

	Main Effects			Interaction Effect	Bartlett's
Degrees of Freedom	Replicates (2, 52)	1 (8, 52)	2 (2, 52)	1X2 (16, 52)	Test
Species					
Combined	0.69	4.60***	12.31***	5.61***	N.S.
Carp	0.72	8.55***	7.10**	1.26	N.S.
Minnow spp.	0.56	3.56**	2.49	2.28*	N.S.
Quillback	0.17	4.19***	1.81	5.64***	N.S.
Shorthead redhorse	1.22	1.86	3.19*	0.94	N.S.
Tessellated darter	0.22	22.67***	6.94**	3.32***	N.S.

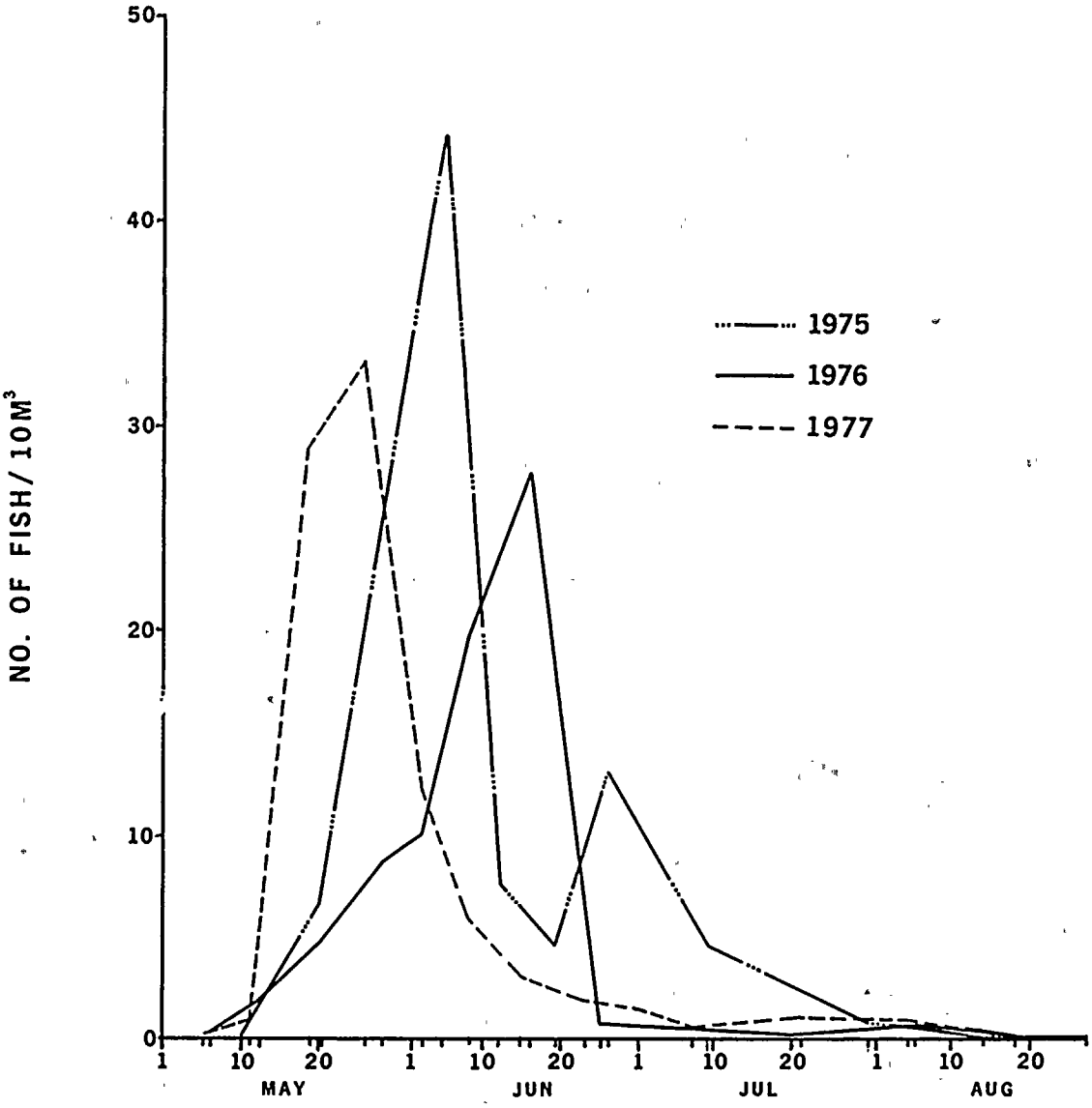

Fig. F-1. Mean density of larvae captured during each sampling period on the Susquehanna River, 1975-77.

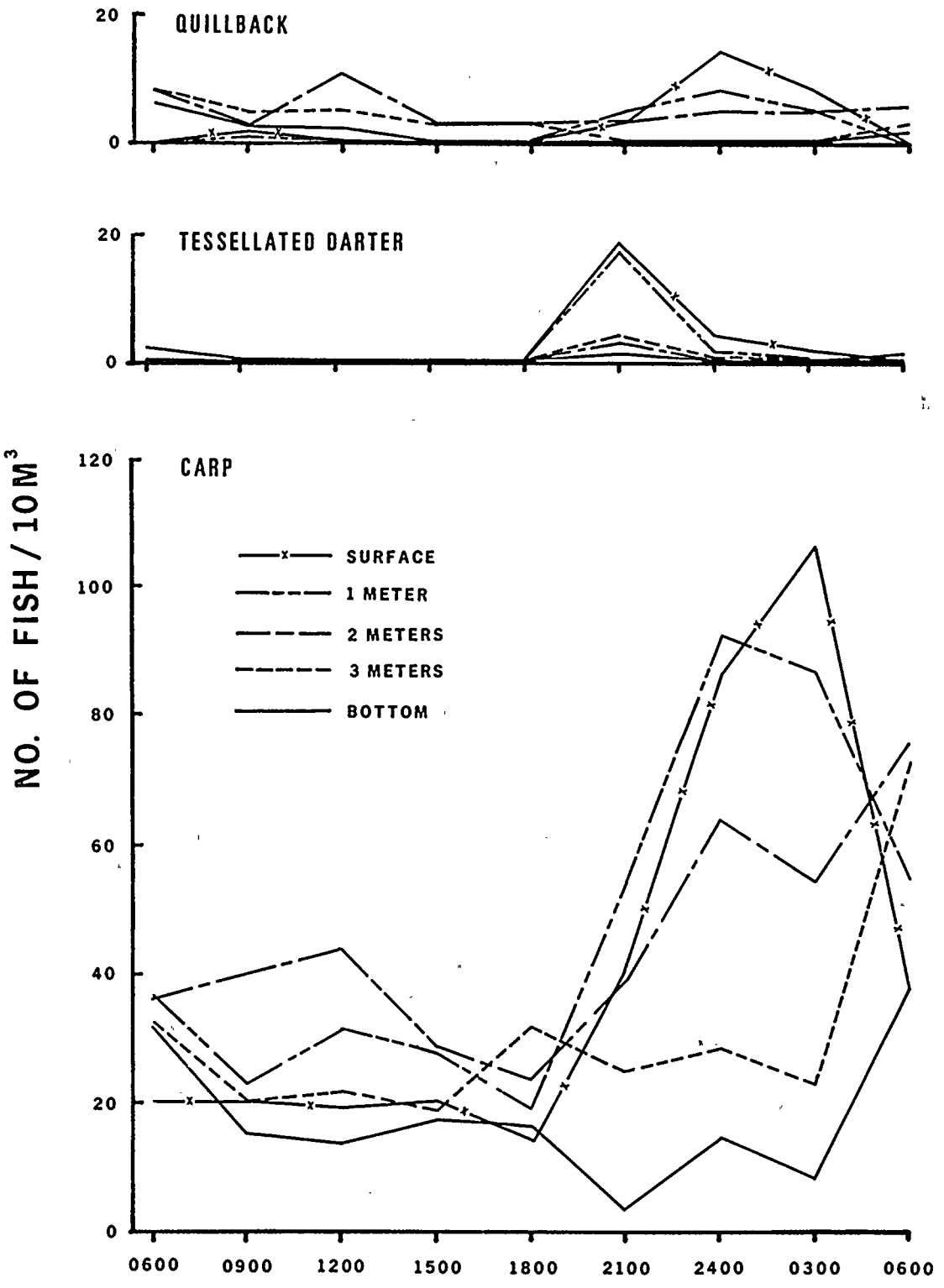

Fig. F-2. Mean density of larval fishes captured during diel, vertical-distribution studies at SSES-A on the Susquehanna River, 10-11 June 1976.

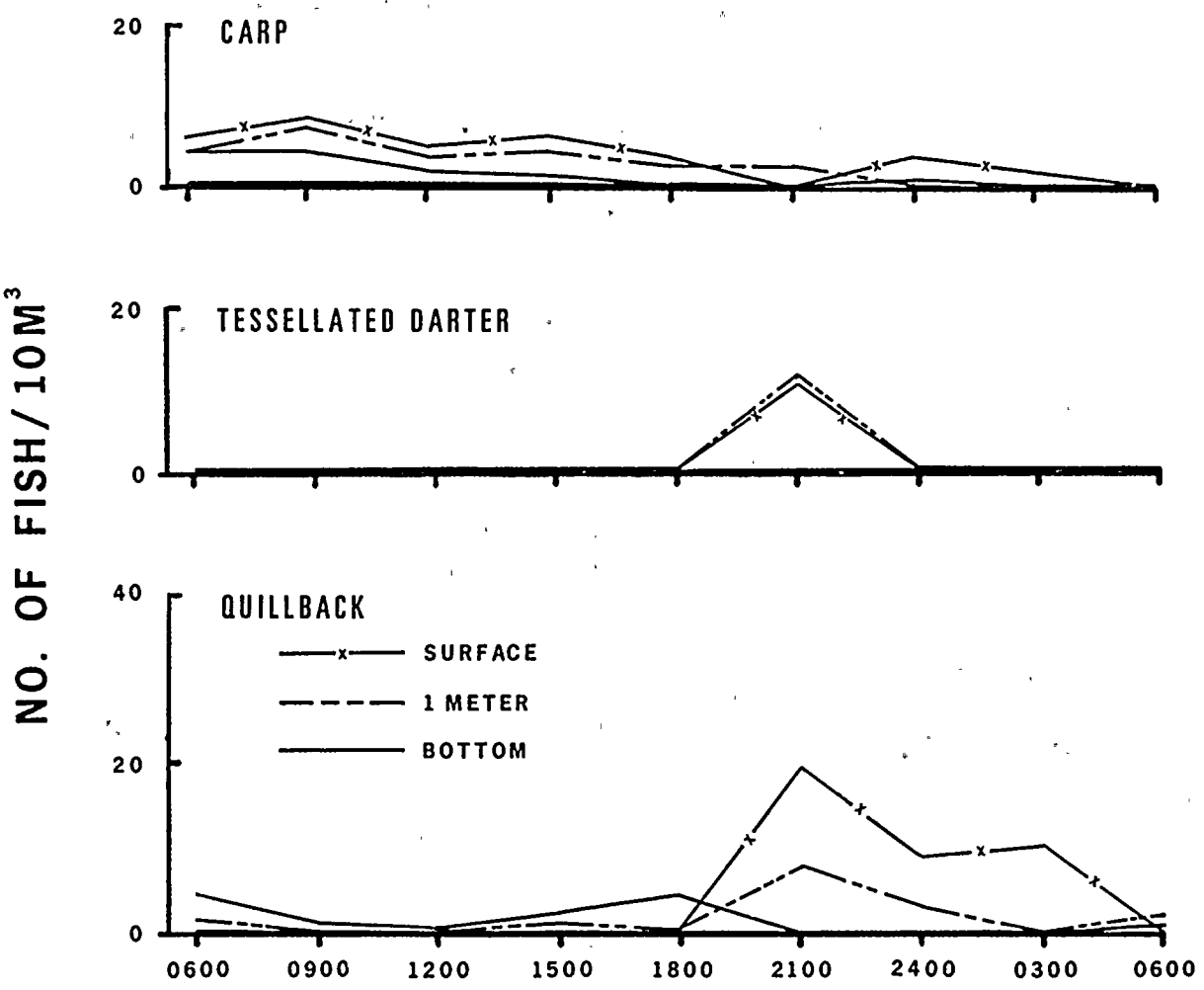

Fig. F-3. Mean density of larval fishes captured during diel, vertical-distribution studies at SSES on the Susquehanna River, 17-18 June 1976.

ELECTROFISHING OF FISHES

by

Gerard L. Buynak, Andrew J. Gurzynski, and Harold W. Mohr, Jr.

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ABSTRACT

At SSES and Bell Bend, a combined total of 1,368 specimens of at least 24 fishes was observed. Quillback, white sucker, northern hog sucker, shorthead redhorse, smallmouth bass, and walleye composed 70% of the total catch. White sucker was the most abundant specimen observed at both stations. Significantly more specimens were observed/unit effort in the east shore runs at both SSES ($P<0.01$, $n = 16$) and Bell Bend ($P<0.05$, $n = 16$) than in the west shore runs. More specimens/unit effort ($P<0.001$, $n = 31$) were observed at night than during the day at both stations. No significant differences were found between Bell Bend and SSES when data from sampling runs were combined.

INTRODUCTION

Electrofishing was conducted in 1977 to determine species composition and relative abundance of large fish near the Susquehanna SES. Included here are data gathered at the SSES and Bell Bend sampling stations in 64 electrofishing collections. These baseline data will be used to assess environmental impact during operation of the Susquehanna SES.

PROCEDURES

The AC-DC electrofisher has been used to sample fish since 1972. The major components are a 4-KW Onan generator, a variable voltage pulsator (Power Control Corporation, Pittsburgh, Pennsylvania), and a 20-ft flat-bottomed boat. Designs and operational guidelines of electrofishing boats are given in Novotny and Priegel (1974).

Electrofishing was conducted monthly from March through November (excluding September) at SSES and Bell Bend (2 runs at each station) using DC current. The two runs at SSES, one near each shore, were upriver from the Susquehanna SES intake structure and those at Bell Bend, also near each shore, were downriver from the discharge diffuser (Table G-1; Fig. G-1).

Runs were electrofished once during the day and once at night. Each 1,000-m run was considered one unit of effort. Day sampling was usually conducted between 0900 and 1130 h; night sampling began one hour after sunset. On a run, the electrofishing boat was driven slowly downriver, parallel to the current and from 1 to 15 m from shore. All species of stunned fish larger than about 10 cm were identified and counted by two observers on the bow of the boat. Fish that surfaced in the water behind the observers were enumerated by the boat operator. These data were recorded on a cassette tape recorder (Craig No. 8108) by one of the observers on the bow. Fish which could not be positively identified in the water were captured for closer examination, and those that escaped were recorded as unidentified. Names and order of listing (Table G-2) conform to Bailey et al. (1970).

During each electrofishing run, a separate crew collected physico-chemical data. At the downriver end of the run, a 1-liter surface grab sample and a 300-ml surface dissolved oxygen sample were collected. In addition, air and surface water temperatures were measured. The samples were transported to the Laboratory where analyses were performed for

dissolved oxygen, pH, turbidity, and specific conductance according to methods in Table A-1.

Fisheries data were analyzed using a "nonparametric sign test" (Siegel 1956) to determine if there were significant differences in the number of specimens captured. The 5% probability level was used to determine significance in each test.

RESULTS AND DISCUSSION

At SSES, a total of 665 specimens of at least 21 fishes was observed (Tables G-3 through G-10). Six fishes (white sucker, shorthead redhorse, northern hog sucker, quillback, walleye, and smallmouth bass) composed 73.0% of the total catch at SSES (Table G-11). As was found in 1976 (Buynak and Gurzynski 1977), white sucker was the most abundant fish observed in 1977 and composed 27.1% of the total catch. It was followed in abundance by shorthead redhorse (13.4%), northern hog sucker (10.2%), quillback (10.1%), walleye (6.2%), and smallmouth bass (6.0%).

The number of fishes observed at SSES was low in March (8) and April (8), increased in May (12), remained high throughout the summer, and peaked in August (13). The number then declined sharply to 7 in October and 8 in November (Table G-11). White sucker and walleye were the only species observed in all months sampled. Northern hog sucker and shorthead redhorse were observed in 7 of 8 months sampled.

The catch/unit effort at SSES was low in March; it increased in April and May, and then decreased in June. In July and August, it increased again, whereas in October and November it decreased. Most specimens were observed in May, and fewest in October (Table G-11).

A significantly higher ($P<0.01$, $n = 16$) catch/unit effort was observed at the SSES east shore run as compared to the west shore run (Tables G-3 through G-10). Totals of 390 specimens of at least 21 fishes and 275 specimens of at least 12 fishes were observed at the east and west runs, respectively. Quillback, white sucker, northern hog sucker, and shorthead redhorse were the most abundant specimens observed at both runs. Brown trout, northern pike, muskellunge, chain pickerel, brown bullhead, pumpkinseed, largemouth bass, black crappie, and yellow perch were observed only at the SSES east run; all other species observed at the east run were also seen at the west run.

At Bell Bend, a total of 703 specimens of at least 19 fishes was observed (Tables G-3 through G-10). White sucker was the most abundant fish observed and composed 26.7% of the total catch (Table G-12). It was followed in abundance by quillback and smallmouth bass (both 11.8%), shorthead redhorse (9.5%), and rock bass (4.8%).

The number of fishes observed at Bell Bend was low in March (9) and April (8), increased markedly in May (15), and remained high (11-15) through August. The number then decreased sharply to 9 in October and 4 in November (Table G-12). The largest number of fishes was observed in May and July. White sucker was observed in all months sampled.

Quillback, northern hog sucker, and walleye were observed in 7 of 8 months sampled.

The catch/unit effort at Bell Bend was low in March, increased in April and May, then decreased in June. It peaked in July and then decreased and remained low in August, October, and November (Table G-12).

In 1977, as in 1975 and 1976 (Buynak and Gurzynski 1976b, 1977), significantly more ($P<0.05$, $n = 16$) specimens were observed at the Bell Bend east shore run as compared to the west shore run. Totals of 423 specimens of at least 17 fishes and 280 specimens of at least 17 fishes were observed at the east and west runs, respectively (Tables G-3 through G-10). Yellow bullhead and pumpkinseed were observed only at the Bell Bend east run; brown trout and white crappie were only observed at the west run.

At SSES and Bell Bend, a combined total of 1,368 specimens of at least 24 fishes was observed (Tables G-3 through G-10). Of the 24 fishes, six (quillback, white sucker, northern hog sucker, shorthead redhorse, smallmouth bass, and walleye) composed 70% of the total catch. Similar results were obtained in 1976 (Buynak and Gurzynski 1977) when the same six species composed 77% of the catch. Northern pike, river chub, largemouth bass, black crappie, and yellow perch were observed only at SSES, whereas yellow bullhead, redbreast sunfish, and white crappie were observed only at Bell Bend. No significant differences in catch/unit effort were found at SSES east and Bell Bend east runs or at SSES west and Bell Bend west runs. White sucker was the most abundant fish observed in the east and west runs at both stations.

Significantly more ($P<0.001$, $n = 31$) fish/unit effort were observed at night than during the day at both SSES and Bell Bend. Totals of 536 specimens of at least 21 fishes and 832 specimens of at least 21 fishes were observed during the day and night, respectively (Tables G-3 through G-10). At both stations, percent composition of the total catch of northern hog sucker, smallmouth bass, and walleye tended to increase from 1974 through 1977 (Buynak and Gurzynski 1976a, 1976b, 1977). This trend might be due to the improved water quality near the Susquehanna SES site in 1973-76 (Jacobsen and Soya 1977).

No significant difference was found between Bell Bend and SSES when data from sampling runs were combined at each station; a difference, however, did exist between sides of the River. Significantly more specimens were observed at the SSES east ($P<0.01$, $n = 16$) and Bell Bend east ($P<0.05$, $n = 16$) shore runs that at the west shore runs at both stations. It is believed that these differences are related to the creek mouths which enter the River on the east shore, even though no major differences were found in water quality parameters in 1977 (Tables G-13 through G-20). In 1975 and 1976 (Buynak and Gurzynski 1976b, 1977), fish seemed to congregate near these areas.

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Table G-1. Descriptions of electrofishing runs on the Susquehanna River, 1977.

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

Table G-2. Fishes collected or observed at SSES and Bell Bend on the Susquehanna River, 1977.

Salmonidae - Trouts
- *Salmo trutta* - brown trout

Esocidae - Pikes
- *Esox lucius* - northern pike
- *E. masquinongy* - muskellunge
- *E. niger* - chain pickerel
- *Esox* spp. - pike spp.

Cyprinidae - Minnows and Carp
- *Cyprinus carpio* - carp
- *Nocomis micropogon* - river chub
- *Notropis amoenus* - comely shiner
- *N. hudsonius* - spottail shiner
- *N. procne* - swallowtail shiner
- *N. spilopterus* - spotfin shiner
- *Notropis* spp. - shiner spp.
- *Pimephales notatus* - bluntnose minnow
- *Rhinichthys cataractae* - longnose 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 natalis* - yellow bullhead
- *I. nebulosus* - brown bullhead
- *I. punctatus* - channel catfish

Centrarchidae - Sunfishes
- *Ambloplites rupestris* - rock bass
- *Lepomis auritus* - redbreast 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

Table G-3. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 29 March 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	0919-0937	2008-2030	0955-1010	2050-2060	
SPECIES					MEAN
BROWN TROUT	0	0	0	0	0.0
NORTHERN PIKE	1	0	0	0	0.3
MUSKELLUNGE	0	1	0	0	0.3
CARP	2	0	1	0	0.8
FALLFISH	0	0	0	0	0.0
QUILLBACK	1	2	0	0	0.8
WHITE SUCKER	11	2	2	0	3.8
NORTHERN HOG SUCKER	0	1	0	0	0.3
SHORTHEAD REDHORSE	1	2	0	0	0.8
WALLEYE	0	1	0	0	0.3
FISH (UNIDENTIFIED)	0	2	1	0	0.8
TOTAL	16	11	4	0	7.8

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	1037-1050	1945-1960	1011-1024	1925-1938	
SPECIES					MEAN
BROWN TROUT	0	0	0	1	0.3
NORTHERN PIKE	0	0	0	0	0.0
MUSKELLUNGE	1	0	0	0	0.3
CARP	0	0	2	0	0.5
FALLFISH	0	0	0	1	0.3
QUILLBACK	0	0	1	1	0.5
WHITE SUCKER	3	13	12	28	14.0
NORTHERN HOG SUCKER	0	0	1	0	0.3
SHORTHEAD REDHORSE	0	1	0	1	0.5
WALLEYE	0	1	0	0	0.3
FISH (UNIDENTIFIED)	0	0	0	1	0.3
TOTAL	4	15	16	33	17.0

Table G-4. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 28 April 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	1021-1035	2250-2303	1001-1012	2235-2245	
SPECIES					MEAN
BROWN TROUT	0	1	0	0	0.3
MUSKELLUNGE	0	0	0	0	0.0
CARP	1	0	0	0	0.3
FALLFISH	3	0	0	0	0.8
QUILLBACK	0	6	1	3	2.5
WHITE SUCKER	3	9	2	3	4.3
NORTHERN HOG SUCKER	0	1	0	0	0.3
SHORTHEAD REDHORSE	1	10	1	6	4.5
WALLEYE	0	0	0	1	0.3
FISH (UNIDENTIFIED)	4	2	1	1	2.0
TOTAL	12	29	5	14	15.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	1037-1051	2106-2126	0927-0940	2129-2143	
SPECIES					MEAN
BROWN TROUT	0	0	0	1	0.3
MUSKELLUNGE	1	0	0	1	0.5
CARP	3	0	2	2	1.8
FALLFISH	1	0	0	1	0.5
QUILLBACK	11	2	5	2	5.0
WHITE SUCKER	1	3	3	7	3.5
NORTHERN HOG SUCKER	0	1	0	0	0.3
SHORTHEAD REDHORSE	5	4	8	5	5.5
WALLEYE	0	0	0	0	0.0
FISH (UNIDENTIFIED)	2	1	2	3	2.0
TOTAL	24	11	20	22	19.3

Table G-5. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 26-27 May 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	0933-0956	2340-2360	1009-1025	0010-0030	
SPECIES					MEAN
CARP	0	2	2	0	1.0
RIVER CHUB	0	0	1	0	0.3
FALLFISH	1	0	4	0	1.3
QUILLBACK	2	2	1	6	2.8
WHITE SUCKER	7	8	15	9	9.8
NORTHERN HOG SUCKER	2	5	12	0	4.8
SHORTHEAD REDHORSE	2	4	11	5	5.5
YELLOW BULLHEAD	0	0	0	0	0.0
BROWN BULLHEAD	1	1	0	0	0.5
CHANNEL CATFISH	0	0	0	0	0.0
ROCK BASS	1	7	0	3	2.8
REDBREAST SUNFISH	0	0	0	0	0.0
PUMPKINSEED	0	0	0	0	0.0
BLUEGILL	1	0	1	1	0.8
SMALLMOUTH BASS	0	1	1	1	0.8
SUNFISH SPP.	0	1	0	1	0.5
WALLEYE	0	3	1	2	1.5
FISH (UNIDENTIFIED)	4	17	6	11	9.5
TOTAL	21	51	55	39	41.5

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	1058-1124	2221-2245	1031-1050	2306-2325	
SPECIES					MEAN
CARP	0	1	2	2	1.3
RIVER CHUB	0	0	0	0	0.0
FALLFISH	5	5	4	0	3.5
QUILLBACK	1	1	2	1	1.3
WHITE SUCKER	11	7	13	3	8.5
NORTHERN HOG SUCKER	1	0	1	0	0.5
SHORTHEAD REDHORSE	0	0	3	0	0.8
YELLOW BULLHEAD	0	1	0	0	0.3
BROWN BULLHEAD	0	0	0	1	0.3
CHANNEL CATFISH	0	0	0	1	0.3
ROCK BASS	0	2	0	1	0.8
REDBREAST SUNFISH	0	1	0	0	0.3
PUMPKINSEED	2	1	0	0	0.8
BLUEGILL	0	3	1	0	1.0
SMALLMOUTH BASS	3	23	2	3	7.8
SUNFISH SPP.	0	4	1	0	1.3
WALLEYE	1	1	2	3	1.8
FISH (UNIDENTIFIED)	5	9	5	7	6.5
TOTAL	29	59	36	22	36.5

Table G-6. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 22 June 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	1100-1120	2153-2212	1032-1052	2222-2236	
SPECIES					MEAN
CARP	1	1	0	1	0.8
FALLFISH	0	0	0	0	0.0
QUILLBACK	2	3	1	2	2.0
WHITE SUCKER	2	7	3	6	4.5
NORTHERN HOG SUCKER	3	11	0	3	4.3
SHORTHEAD REDHORSE	4	12	0	4	5.0
BROWN BULLHEAD	0	0	0	0	0.0
CHANNEL CATFISH	0	0	0	1	0.3
ROCK BASS	0	0	0	0	0.0
PUMPKINSEED	0	0	0	0	0.0
BLUEGILL	0	1	0	0	0.3
SMALLMOUTH BASS	0	2	0	0	0.5
LARGEMOUTH BASS	0	1	0	0	0.3
SUNFISH SPP.	0	0	0	0	0.0
WALLEYE	0	1	0	0	0.3
FISH (UNIDENTIFIED)	0	6	0	3	2.3
TOTAL	12	45	4	20	20.3

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	0957-1017	2240-2255	0930-0950	2304-2320	
SPECIES					MEAN
CARP	0	0	0	0	0.0
FALLFISH	0	0	0	1	0.3
QUILLBACK	0	4	0	6	2.5
WHITE SUCKER	5	9	3	3	5.0
NORTHERN HOG SUCKER	1	2	1	0	1.0
SHORTHEAD REDHORSE	2	5	2	1	2.5
BROWN BULLHEAD	0	0	0	1	0.3
CHANNEL CATFISH	0	0	0	0	0.0
ROCK BASS	0	1	0	2	0.8
PUMPKINSEED	1	0	0	0	0.3
BLUEGILL	0	1	0	1	0.5
SMALLMOUTH BASS	1	4	1	0	1.5
LARGEMOUTH BASS	0	0	0	0	0.0
SUNFISH SPP.	0	3	0	1	1.0
WALLEYE	0	1	0	2	0.8
FISH (UNIDENTIFIED)	0	7	0	4	2.8
TOTAL	10	37	7	22	19.0

Table G-7. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 13 July 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	0910-0928	2304-2325	0935-0953	2334-2350	
SPECIES					MEAN
CHAIN PICKEREL	0	0	0	0	0.0
CARP	0	0	0	0	0.0
FALLFISH	0	0	3	2	1.3
QUILLBACK	4	10	0	7	5.3
WHITE SUCKER	2	0	17	5	6.0
NORTHERN HOG SUCKER	8	3	13	0	6.0
SHORTHEAD REDHORSE	2	2	10	0	3.5
BROWN BULLHEAD	0	0	0	0	0.0
CHANNEL CATFISH	0	0	0	1	0.3
ROCK BASS	0	5	0	1	1.5
REDBREAST SUNFISH	0	0	0	0	0.0
PUMPKINSEED	0	0	0	0	0.0
BLUEGILL	0	0	0	0	0.0
SMALLMOUTH BASS	3	4	1	0	2.0
SUNFISH SPP.	0	1	0	1	0.5
WALLEYE	0	3	0	1	1.0
FISH (UNIDENTIFIED)	2	5	6	1	3.5
TOTAL	21	33	50	19	30.8

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	1020-1046	2225-2252	0957-1015	2200-2220	
SPECIES					MEAN
CHAIN PICKEREL	0	2	0	1	0.8
CARP	1	0	1	0	0.5
FALLFISH	1	0	0	0	0.3
QUILLBACK	2	20	6	8	9.0
WHITE SUCKER	5	8	0	1	3.5
NORTHERN HOG SUCKER	8	2	1	0	2.8
SHORTHEAD REDHORSE	8	5	5	0	4.5
BROWN BULLHEAD	0	1	0	1	0.5
CHANNEL CATFISH	0	1	0	0	0.3
ROCK BASS	1	11	0	5	4.3
REDBREAST SUNFISH	1	0	0	0	0.3
PUMPKINSEED	1	1	0	0	0.5
BLUEGILL	1	3	0	0	1.0
SMALLMOUTH BASS	5	8	3	2	4.5
SUNFISH SPP.	0	4	0	1	1.3
WALLEYE	0	2	1	1	1.0
FISH (UNIDENTIFIED)	9	1	1	2	3.3
TOTAL	43	69	18	22	38.0

Table G-8. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 18 August 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	0849-0910	2220-2244	0919-0936	2251-2309	
SPECIES					MEAN
CHAIN PICKEREL	0	0	0	0	0.0
PIKE SPP.	0	0	0	0	0.0
CARP	0	2	0	0	0.5
RIVER CHUB	0	1	0	0	0.3
FALLFISH	1	0	0	0	0.3
QUILLBACK	1	5	2	6	3.5
WHITE SUCKER	5	11	7	10	8.3
NORTHERN HOG SUCKER	4	0	1	0	1.3
SHORTHEAD REDHORSE	3	1	6	1	2.8
CHANNEL CATFISH	0	2	0	1	0.8
ROCK BASS	0	0	0	1	0.3
REDBREAST SUNFISH	0	0	0	0	0.0
PUMPKINSEED	1	0	0	0	0.3
BLUEGILL	0	1	0	0	0.3
SMALLMOUTH BASS	2	11	5	9	6.8
SUNFISH SPP.	0	3	0	0	0.8
WALLEYE	1	10	0	7	4.5
FISH (UNIDENTIFIED)	3	7	2	6	4.5
TOTAL	21	54	23	41	34.8

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	1010-1031	2145-2211	0942-0960	2121-2140	
SPECIES					MEAN
CHAIN PICKEREL	1	0	0	0	0.3
PIKE SPP.	1	1	0	0	0.5
CARP	0	0	0	0	0.0
RIVER CHUB	0	0	0	0	0.0
FALLFISH	0	0	0	0	0.0
QUILLBACK	0	6	0	3	2.3
WHITE SUCKER	5	3	0	9	4.3
NORTHERN HOG SUCKER	3	0	1	1	1.3
SHORTHEAD REDHORSE	5	1	4	2	3.0
CHANNEL CATFISH	0	1	0	0	0.3
ROCK BASS	0	7	0	4	2.8
REDBREAST SUNFISH	1	0	1	0	0.5
PUMPKINSEED	0	0	0	0	0.0
BLUEGILL	0	1	1	0	0.5
SMALLMOUTH BASS	9	6	3	2	5.0
SUNFISH SPP.	1	3	0	0	1.0
WALLEYE	0	5	0	2	1.8
FISH (UNIDENTIFIED)	2	9	2	3	4.0
TOTAL	28	43	12	26	27.3

Table G-9. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 24 October 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	1052-1110	1940-2000	1036-1046	2012-2024	
SPECIES					MEAN
NORTHERN PIKE	0	1	0	0	0.3
MUSKELLUNGE	1	0	0	0	0.3
CARP	0	0	0	0	0.0
QUILLBACK	0	0	0	0	0.0
WHITE SUCKER	1	8	0	0	2.3
NORTHERN HOG SUCKER	0	1	0	0	0.3
BROWN BULLHEAD	1	0	0	0	0.3
CHANNEL CATFISH	0	0	0	0	0.0
SMALLMOUTH BASS	0	0	0	0	0.0
WHITE CRAPPIE	0	0	0	0	0.0
BLACK CRAPPIE	2	0	0	0	0.5
WALLEYE	1	1	0	0	0.5
FISH (UNIDENTIFIED)	1	2	0	0	0.8
TOTAL	7	13	0	0	5.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	1010-1021	2015-2036	0949-1001	2055-2110	
SPECIES					MEAN
NORTHERN PIKE	0	0	0	0	0.0
MUSKELLUNGE	0	2	0	1	0.8
CARP	0	1	0	1	0.5
QUILLBACK	0	0	0	1	0.3
WHITE SUCKER	0	6	0	4	2.5
NORTHERN HOG SUCKER	0	1	0	0	0.3
BROWN BULLHEAD	0	0	0	0	0.0
CHANNEL CATFISH	0	1	0	0	0.3
SMALLMOUTH BASS	0	5	2	1	2.0
WHITE CRAPPIE	0	0	1	0	0.3
BLACK CRAPPIE	0	0	0	0	0.0
WALLEYE	0	0	1	0	0.3
FISH (UNIDENTIFIED)	0	5	1	1	1.8
TOTAL	0	21	5	9	8.8

Table G-10. Number of fish observed in day and night electrofishing runs at SSES and Bell Bend on the Susquehanna River, 16 November 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	0919-0940	1921-1947	0900-0913	1910-1921	
SPECIES					MEAN
MUSKELLUNGE	0	0	0	0	0.0
CHAIN PICKEREL	1	0	0	0	0.3
WHITE SUCKER	10	14	0	1	6.3
SHORTHEAD REDHORSE	0	1	0	0	0.3
REDBREAST SUNFISH	0	0	0	0	0.0
PUMPKINSEED	0	1	0	0	0.3
LARGEMOUTH BASS	1	1	0	0	0.5
BLACK CRAPPIE	1	0	0	0	0.3
CRAPPIE SPP.	2	0	0	0	0.5
YELLOW PERCH	1	0	0	0	0.3
WALLEYE	0	8	0	0	2.0
FISH (UNIDENTIFIED)	2	1	0	0	0.8
TOTAL	18	26	0	1	11.3

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	0944-1002	1830-1855	1005-1022	1803-1825	
SPECIES					MEAN
MUSKELLUNGE	3	1	1	1	1.5
CHAIN PICKEREL	0	0	0	0	0.0
WHITE SUCKER	8	9	2	4	5.8
SHORTHEAD REDHORSE	0	0	0	0	0.0
REDBREAST SUNFISH	0	1	0	0	0.3
PUMPKINSEED	0	0	0	0	0.0
LARGEMOUTH BASS	0	0	0	0	0.0
BLACK CRAPPIE	0	0	0	0	0.0
CRAPPIE SPP.	0	0	0	0	0.0
YELLOW PERCH	0	0	0	0	0.0
WALLEYE	0	5	0	2	1.8
FISH (UNIDENTIFIED)	1	2	0	0	0.8
TOTAL	12	18	3	7	10.0

Table G-11. Mean catch/1,000-m electrofishing run and species composition (% total) of fish observed at SSES on the Susquehanna River, 1977.

SPECIES	MAR	APR	MAY	JUN	JUL	AUG	OCT	NOV	MEAN	% TOT
BROWN TROUT	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
NORTHERN PIKE	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.3
MUSKELLUNGE	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.3
CHAIN PICKEREL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2
CARP	0.8	0.3	1.0	0.8	0.0	0.5	0.0	0.0	0.4	2.0
RIVER CHUB	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.1	0.3
FALLFISH	0.0	0.8	1.3	0.0	1.3	0.3	0.0	0.0	0.4	2.1
QUILLBACK	0.8	2.5	2.8	2.0	5.3	3.5	0.0	0.0	2.1	10.1
WHITE SUCKER	3.8	4.3	9.8	4.5	6.0	8.3	2.3	6.3	5.6	27.1
NORTHERN HOG SUCKER	0.3	0.3	4.8	4.3	6.0	1.3	0.3	0.0	2.1	10.2
SHORTHEAD REDHORSE	0.8	4.5	5.5	5.0	3.5	2.8	0.0	0.3	2.8	13.4
BROWN BULLHEAD	0.0	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.1	0.5
CHANNEL CATFISH	0.0	0.0	0.0	0.3	0.3	0.8	0.0	0.0	0.2	0.8
ROCK BASS	0.0	0.0	2.8	0.0	1.5	0.3	0.0	0.0	0.6	2.7
PUMPKINSEED	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.1	0.3
BLUEGILL	0.0	0.0	0.8	0.3	0.0	0.3	0.0	0.0	0.2	0.8
SMALLMOUTH BASS	0.0	0.0	0.8	0.5	2.0	6.8	0.0	0.0	1.3	6.0
LARGEMOUTH BASS	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.5	0.1	0.5
SUNFISH SPP.	0.0	0.0	0.5	0.0	0.5	0.8	0.0	0.0	0.2	1.1
BLACK CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.1	0.5
CRAPPIE SPP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.3
YELLOW PERCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2
WALLEYE	0.3	0.3	1.5	0.3	1.0	4.5	0.5	2.0	1.3	6.2
FISH (UNIDENTIFIED)	0.8	2.0	9.5	2.3	3.5	4.5	0.8	0.8	3.0	14.4
TOTAL	7.8	15.0	41.5	20.3	30.8	34.8	5.0	11.3	20.8	

Table G-12. Mean catch/1,000-m electrofishing run and species composition (% total) of fish observed at Bell Bend on the Susquehanna River, 1977.

SPECIES	MAR	APR	MAY	JUN	JUL	AUG	OCT	NOV	MEAN	% TOT
BROWN TROUT	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
MUSKELLUNGE	0.3	0.5	0.0	0.0	0.0	0.0	0.8	1.5	0.4	1.7
CHAIN PICKEREL	0.0	0.0	0.0	0.0	0.8	0.3	0.0	0.0	0.1	0.6
PIKE SPP.	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.1	0.3
CARP	0.5	1.8	1.3	0.0	0.5	0.0	0.5	0.0	0.6	2.6
FALLFISH	0.3	0.5	3.5	0.3	0.3	0.0	0.0	0.0	0.6	2.7
QUILLBACK	0.5	5.0	1.3	2.5	9.0	2.3	0.3	0.0	2.6	11.8
WHITE SUCKER	14.0	3.5	8.5	5.0	3.5	4.3	2.5	5.8	5.9	26.7
NORTHERN HOG SUCKER	0.3	0.3	0.5	1.0	2.8	1.3	0.3	0.0	0.8	3.6
SHORTHEAD REDHORSE	0.5	5.5	0.8	2.5	4.5	3.0	0.0	0.0	2.1	9.5
YELLOW BULLHEAD	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1
BROWN BULLHEAD	0.0	0.0	0.3	0.3	0.5	0.0	0.0	0.0	0.1	0.6
CHANNEL CATFISH	0.0	0.0	0.3	0.0	0.3	0.3	0.3	0.0	0.1	0.6
ROCK BASS	0.0	0.0	0.8	0.8	4.3	2.8	0.0	0.0	1.1	4.8
REDBREAST SUNFISH	0.0	0.0	0.3	0.0	0.3	0.5	0.0	0.3	0.2	0.7
PUMPKINSEED	0.0	0.0	0.8	0.3	0.5	0.0	0.0	0.0	0.2	0.9
BLUEGILL	0.0	0.0	1.0	0.5	1.0	0.5	0.0	0.0	0.4	1.7
SMALLMOUTH BASS	0.0	0.0	7.8	1.5	4.5	5.0	2.0	0.0	2.6	11.8
SUNFISH SPP.	0.0	0.0	1.3	1.0	1.3	1.0	0.0	0.0	0.6	2.6
WHITE CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
WALLEYE	0.3	0.0	1.8	0.8	1.0	1.8	0.3	1.8	0.9	4.3
FISH (UNIDENTIFIED)	0.3	2.0	6.5	2.8	3.3	4.0	1.8	0.8	2.7	12.1
TOTAL	17.0	19.3	36.5	19.0	38.0	27.3	8.8	10.0	22.0	

Table G-13. Physicochemical data collected in conjunction with day electrofishing runs at SSES east on the Susquehanna River, 1977.

DATE TIME	29 MAR 0919	28 APR 1021	26 MAY 0933	22 JUN 1100	13 JUL 0910	18 AUG 0849	24 OCT 1110	16 NOV 0940
TEMPERATURE(C)								
AIR	11.0	14.0	21.0	24.0	23.0	19.0	8.0	7.0
WATER	5.5	11.0	23.0	23.5	25.0	22.0	8.0	6.5
TURBIDITY(NTU)	12	19	10	11	13	15	11	9.7
OXYGEN								
DISSOLVED(MG/L)	12.20	11.50	10.10	10.30	8.70	7.40	10.80	11.40
PH	7.2	7.2	7.6	7.6	7.5	7.6	7.4	7.7
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	188	120	299	391	330	315	140	147

Table G-14. Physicochemical data collected in conjunction with day electrofishing runs at SSES west on the Susquehanna River, 1977.

DATE TIME	29 MAR 0955	28 APR 1001	26 MAY 1009	22 JUN 1032	13 JUL 0935	18 AUG 0919	24 OCT 1046	16 NOV 0913
TEMPERATURE(C)								
AIR	11.0	13.5	24.0	22.0	24.0	20.0	8.0	7.0
WATER	5.0	11.0	24.0	23.0	25.0	23.0	9.0	6.5
TURBIDITY(NTU)	14	22	9.3	11	11	15	12	11
OXYGEN								
DISSOLVED(MG/L)	12.10	11.60	9.20	8.70	7.80	7.60	10.80	11.80
PH	7.4	7.4	7.8	7.5	7.4	7.7	7.4	7.4
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	170	117	301	388	339	325	135	159

Table G-15. Physicochemical data collected in conjunction with night electrofishing runs at SSES east on the Susquehanna River, 1977.

DATE TIME	29 MAR 2008	28 APR 2250	26 MAY 2340	22 JUN 2153	13 JUL 2304	18 AUG 2220	24 OCT 2000	16 NOV 1946
TEMPERATURE(C)								
AIR	13.0	8.0	17.0	18.0	20.0	16.0	9.0	12.0
WATER	6.0	11.0	23.0	23.0	25.0	22.0	8.5	7.0
TURBIDITY(NTU)	19	15	11	12	—	11	8.3	5.8
OXYGEN								
DISSOLVED(MG/L)	13.40	11.70	11.60	10.00	--	11.60	10.80	10.50
PH	7.3	7.3	8.1	7.6	7.4	7.8	7.4	7.6
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	162	128	300	388	311	317	140	142

Table G-16. Physicochemical data collected in conjunction with night electrofishing runs at SSES west on the Susquehanna River, 1977.

DATE TIME	29 MAR 2050	28 APR 2235	27 MAY 0010	22 JUN 2222	13 JUL 2334	18 AUG 2251	24 OCT 2024	16 NOV 1921
TEMPERATURE(C)								
AIR	14.0	8.0	17.0	18.0	20.0	16.0	9.0	12.0
WATER	6.5	11.0	24.0	23.0	25.0	22.0	8.5	7.0
TURBIDITY(NTU)	19	18	13	12	19	14	9.2	6.4
OXYGEN								
DISSOLVED(MG/L)	13.60	11.60	10.80	9.20	7.20	10.20	10.80	11.80
PH	7.4	7.4	8.0	7.5	7.3	7.4	7.5	7.6
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	159	123	307	391	309	330	145	150

Table G-17. Physicochemical data collected in conjunction with day electrofishing runs at Bell Bend east on the Susquehanna River, 1977.

DATE TIME	29 MAR 1037	28 APR 1037	26 MAY 1058	22 JUN 0957	13 JUL 1020	18 AUG 1010	24 OCT 1021	16 NOV 1002
TEMPERATURE(C)								
AIR	11.0	12.0	23.5	18.0	23.5	19.0	5.0	8.5
WATER	5.0	11.0	23.5	22.0	25.0	22.0	9.0	6.5
TURBIDITY(NTU)	14	24	9.6	11	9.7	10	11	8.7
OXYGEN								
DISSOLVED(MG/L)	12.60	11.60	9.60	8.60	8.90	7.50	10.80	11.60
PH	7.4	7.3	7.7	7.4	7.6	7.7	7.4	7.7
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	185	121	301	388	333	327	150	155

Table G-18. Physicochemical data collected in conjunction with day electrofishing runs at Bell Bend west on the Susquehanna River, 1977.

DATE TIME	29 MAR 1011	28 APR 0927	26 MAY 1031	22 JUN 0930	13 JUL 0957	18 AUG 0942	24 OCT 1001	16 NOV 1025
TEMPERATURE(C)								
AIR	11.0	11.0	23.5	17.0	23.5	20.0	5.0	9.0
WATER	5.0	11.0	24.0	22.5	25.0	23.0	9.0	6.0
TURBIDITY(NTU)	13	25	8.4	13	10	18	12	9.2
OXYGEN								
DISSOLVED(MG/L)	12.80	11.60	10.20	8.70	8.00	8.50	10.80	11.70
PH	7.4	7.3	7.9	7.5	7.5	7.8	7.4	7.7
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	172	117	303	390	340	332	135	160

Table G-19. Physicochemical data collected in conjunction with night electrofishing runs at Bell Bend east on the Susquehanna River, 1977.

DATE TIME	29 MAR 1945	28 APR 2106	26 MAY 2221	22 JUN 2240	13 JUL 2225	18 AUG 2145	24 OCT 2036	16 NOV 1855
TEMPERATURE(C)								
AIR	14.0	8.0	19.0	15.5	21.0	17.0	7.0	13.0
WATER	6.0	11.0	24.0	23.0	25.0	22.0	8.5	7.0
TURBIDITY(NTU)	18	19	8.3	11	13	11	9.7	6.9
OXYGEN								
DISSOLVED(MG/L)	13.50	11.60	11.40	10.10	8.70	12.40	10.80	11.60
PH	7.3	7.2	8.4	7.6	7.5	7.9	7.4	7.7
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	170	121	295	391	319	326	150	155

Table G-20. Physicochemical data collected in conjunction with night electrofishing runs at Bell Bend west on the Susquehanna River, 1977.

DATE TIME	29 MAR 1925	28 APR 2129	26 MAY 2306	22 JUN 2304	13 JUL 2200	18 AUG 2121	24 OCT 2110	16 NOV 1825
TEMPERATURE(C)								
AIR	15.0	8.0	19.0	15.0	21.0	17.0	7.5	14.0
WATER	6.0	11.0	24.0	23.0	25.0	22.0	8.5	7.0
TURBIDITY(NTU)	18	18	8.7	---	17	15	9.3	7.0
OXYGEN								
DISSOLVED(MG/L)	13.30	11.60	12.70	9.50	7.80	10.70	10.80	11.60
PH	7.4	7.3	8.2	7.5	7.3	7.7	7.5	7.7
SPECIFIC CONDUCTANCE								
AT 25 C(µMHOS/CM)	160	123	302	---	321	328	150	150

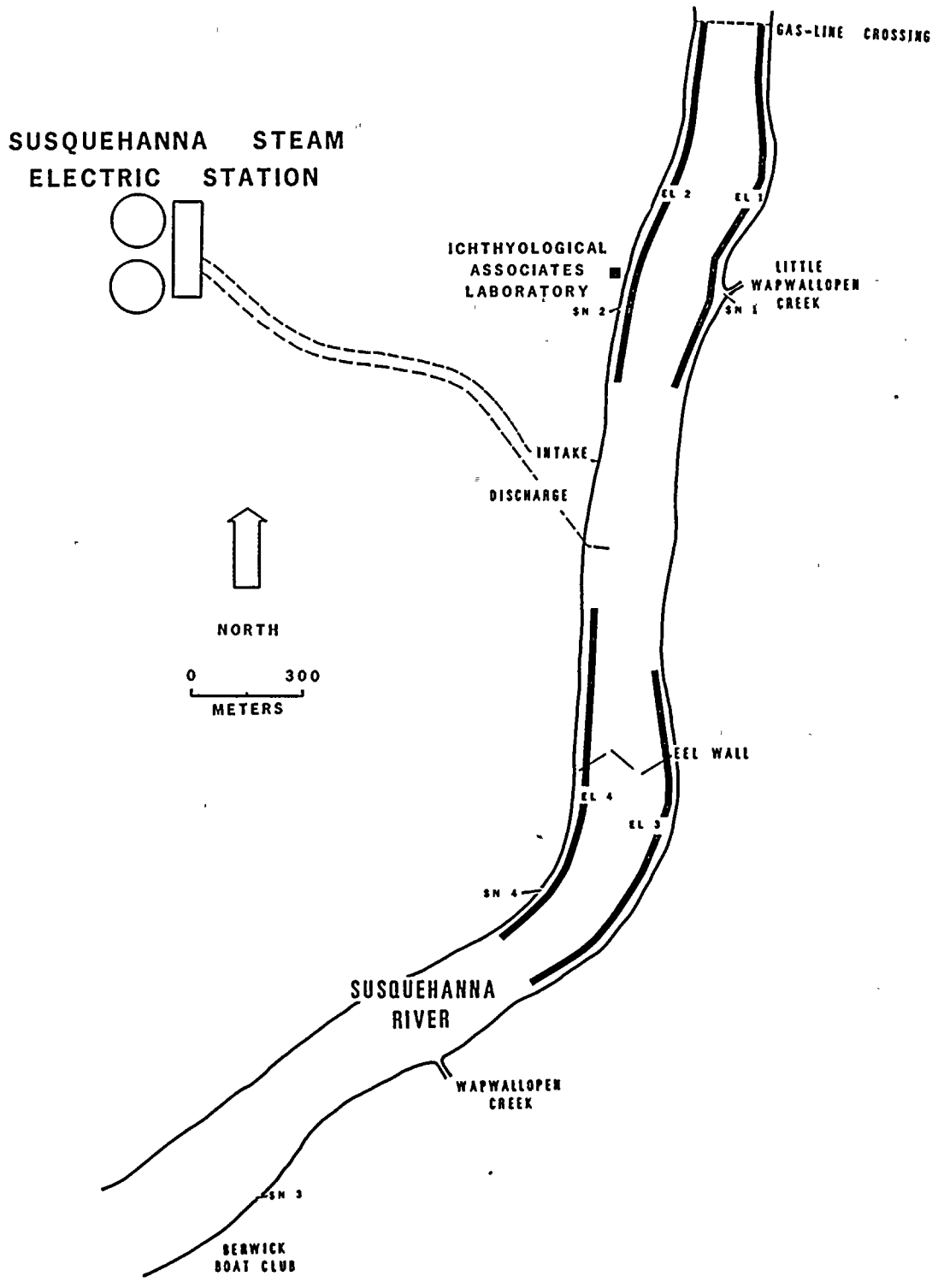

Fig. G-1. Sampling stations for electrofishing (EL) and seining (SN) on the Susquehanna River near the Susquehanna SES, 1977.

SEINING OF FISHES

by

Gerard L. Buynak, Andrew J. Gurzynski, and Harold W. Mohr, Jr.

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ABSTRACT

At SSES and Bell Bend, a combined total of 2,916 specimens of at least 19 fishes was captured by seine. Shorthead redhorse was the most abundant specimen taken at SSES; at Bell Bend, white sucker was the most abundant. At both stations, most fishes were captured in August and most specimens were taken in June. As was found in 1976, no significant differences in the catch/unit effort were found within and between sampling sites at SSES and Bell Bend in 1977.

INTRODUCTION

The seining program in 1977 was conducted to determine species composition and relative abundance of fish near the Susquehanna SES. Included are data gathered at the SSES and Bell Bend sampling stations in 48 collections. These baseline data will be used to assess environmental impact during operation of the Susquehanna SES.

PROCEDURES

A 7.6-m bag seine with 0.64-cm mesh, was used monthly from April through October (excluding September) at SSES and Bell Bend (two sites each). Both sites at SSES, one on each shore, were upriver from the Susquehanna SES intake structure and the two sites at Bell Bend, also on each shore, were downriver from the discharge diffuser (Table H-1; Fig. G-1). Sites were selected in areas free of underwater obstructions that might decrease sampling efficiency. Seining began about one hour

after sunset. At each site, seining consisted of two onshore hauls, one immediately after the other. Each haul was considered one unit of effort. During an onshore haul, one of the seine brails was held on the River bank while the other was taken into the River to a distance of about 6 m or to a depth of 1.3 m. The brail on the River bank was held stationary while the other one was pulled slowly upriver and then to shore. Specimens were preserved in 10% formalin in the field after each haul.

In the Laboratory, all specimens were identified and stored in vials containing 40% isopropyl alcohol. Identifications were made using keys by Pflieger (1968), Eddy (1969), and Scott and Crossman (1973). Names and order of listing (Table G-2) conform to Bailey et al. (1970).

At each sampling site, a separate crew collected physicochemical data. A 1-liter surface grab sample and a 300-ml surface dissolved oxygen sample were collected. In addition, air and surface water temperatures were measured. The samples were transported to the Laboratory where analyses were performed for dissolved oxygen, pH, turbidity, and specific conductance according to methods in Table A-1.

All catch data were analyzed using a "nonparametric sign test" (Siegel 1956) to determine if there were significant differences in the number of specimens captured. The 5% probability level was used to determine significance in each test.

RESULTS AND DISCUSSION

At SSES, a total of 678 specimens of at least 15 fishes was captured by seine (Tables H-2 through H-7). Five fishes (shorthead redhorse, spottail shiner, spotfin shiner, bluntnose minnow, and tessellated darter) composed 87.8% of the total catch (Table H-8). In 1975 and 1976, spotfin shiner was the most abundant specimen taken (Buynak and Gurzynski 1976, 1977); in 1977, however, shorthead redhorse was the most abundant (39.5%). All of the shorthead redhorse were small, young-of-the-year fish captured in June. Spottail shiner was the second most abundant (17.7%), followed by spotfin shiner (13.7%), bluntnose minnow (11.1%), and tessellated darter (5.8%).

At SSES, the total number of fishes captured in each month was highest in August (13) and lowest in May (3) (Table H-8). Spottail shiner was the only fish taken in each month sampled. Spotfin shiner was captured in 5 of 6 months sampled. The mean catch/unit effort was greatest in June (86.0 fish/haul) and least in May (7.0 fish/haul).

Totals of 74 specimens of at least 11 fishes and 604 specimens of at least 15 fishes were captured at the SSES east and west shore sites, respectively (Tables H-2 through H-7). These results were similar to those observed in 1976. Swallowtail shiner, rock bass, smallmouth bass, and white crappie were captured only at the west site; all species captured at the east site were also taken at the west site. No significant difference was found between the number of fish at the east and west sites even though 8-fold more fish were captured at the west site. While sampling at the east site, large numbers of small

fish were observed in the relatively clear water, but few were captured. The low turbidity measured at this site (Tables H-9 through H-12), especially during low water levels, was caused by the dilution of turbid River water with clear water from Little Wapwallopen Creek which enters about 15 m upriver. The smaller catches at the east site probably occurred because the fish could see the seine and therefore avoid it more easily than at the west site.

At Bell Bend, a total of 2,238 specimens of at least 19 fishes was captured (Tables H-2 through H-7). Four fishes (white sucker, spotfin shiner, spottail shiner, and shorthead redhorse) composed 89.5% of the total catch (Table H-13). White sucker was the most abundant specimen captured and composed 39.3% of the total catch. Spotfin shiner (23.8%) was the second most abundant followed by spottail shiner (20.6%) and shorthead redhorse (5.8%).

At Bell Bend, the greatest number of fishes was taken in August (17) and the smallest number in May (3) (Table H-13). No single species was collected in all months sampled. Spottail shiner, spotfin shiner, and tessellated darter were captured in 5 of 6 months sampled. The mean catch/unit effort was greatest in June (332.8 fish/haul) and least in July (3.5 fish/haul).

No significant difference was found in the number of specimens captured/unit effort at the east and west shore sites at Bell Bend. Totals of 742 specimens of at least 15 fishes and 1,496 specimens of at least 17 fishes were captured at the east and west sites, respectively

(Tables H-2 through H-7). Carp, longnose dace, northern hog sucker, and yellow bullhead were captured only at the west site, whereas white crappie and black crappie were only taken at the east site.

As was found in 1976, no significant difference occurred in the number of specimens captured/unit effort at SSES and Bell Bend. Carp, quillback, northern hog sucker, and yellow bullhead were taken only at Bell Bend; no additional fishes were captured only at SSES. Over 50% of the total number of specimens captured at both stations were taken in June, when high River levels flooded terrestrial vegetation along the shore at all sites. Large numbers of fish moved into vegetation, and were more vulnerable to seining than they were at other times.

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Table H-1. Descriptions of seining stations on the Susquehanna River, 1977.

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

[a]Classification modified from Cummins (1962).

Table H-2. Number of fish captured/haul with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 18 April 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	2030	2035	2045	2050	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	1	0	1	0	0.5
SPOTTAIL SHINER	0	0	2	0	0.5
SPOTFIN SHINER	0	1	24	5	7.5
SHINER SPP.	2	0	0	0	0.5
BLUNTNOSE MINNOW	0	0	1	0	0.3
FALLFISH	3	0	0	0	0.8
ROCK BASS	0	0	0	0	0.0
TESSELLATED DARTER	0	0	0	0	0.0
TOTAL	6	1	28	5	10.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	2010	2015	1955	2000	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	2	0	1	1	1.0
SPOTTAIL SHINER	6	0	5	0	2.8
SPOTFIN SHINER	179	21	41	5	61.5
SHINER SPP.	0	0	0	0	0.3
BLUNTNOSE MINNOW	0	0	1	0	0.0
FALLFISH	6	0	0	0	1.5
ROCK BASS	0	0	0	1	0.3
TESSELLATED DARTER	0	0	4	0	1.0
TOTAL	193	21	52	7	68.3

Table H-3. Number of fish captured/haul with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 17 May 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	2055	2100	2108	2112	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	0	0	0	0	0.0
SPOTTAIL SHINER	3	2	0	0	1.3
SPOTFIN SHINER	15	2	2	3	5.5
FALLFISH	0	1	0	0	0.3
TOTAL	18	5	2	3	7.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	2134	2139	2121	2126	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	0	2	0	0	0.5
SPOTTAIL SHINER	0	0	0	0	0.0
SPOTFIN SHINER	5	22	14	2	10.8
FALLFISH	0	1	1	0	0.5
TOTAL	5	25	15	2	11.8

Table H-4. Number of fish captured/haul with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 16 June 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	2130	2133	2140	2149	
HAUL	1	2	1	2	
SPECIES					MEAN
SPOTTAIL SHINER	0	2	18	9	7.3
SPOTFIN SHINER	0	0	11	3	3.5
BLUNTNOSE MINNOW	0	0	0	0	0.0
LONGNOSE DACE	0	0	1	1	0.5
FALLFISH	0	0	0	1	0.3
QUILLBACK	0	0	0	0	0.0
WHITE SUCKER	0	0	8	3	2.8
SHORTHEAD REDHORSE	0	3	255	10	67.0
SMALLMOUTH BASS	0	0	0	1	0.3
TESSELLATED DARTER	0	0	9	9	4.5
TOTAL	0	5	302	37	86.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	2230	2243	2202	2210	
HAUL	1	2	1	2	
SPECIES					MEAN
SPOTTAIL SHINER	130	55	88	15	72.0
SPOTFIN SHINER	2	0	18	4	6.0
BLUNTNOSE MINNOW	0	0	1	0	0.3
LONGNOSE DACE	0	0	0	1	0.3
FALLFISH	0	0	8	1	2.3
QUILLBACK	3	3	5	4	3.8
WHITE SUCKER	4	2	666	181	213.3
SHORTHEAD REDHORSE	63	17	38	1	29.8
SMALLMOUTH BASS	0	0	0	0	0.0
TESSELLATED DARTER	2	1	11	7	5.3
TOTAL	204	78	835	214	332.8

Table H-5. Number of fish captured/haul with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 21 July 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	2200	2204	2145	2151	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	1	0	2	1	1.0
SPOTTAIL SHINER	0	0	12	8	5.0
BLUNTNOSE MINNOW	0	0	6	6	3.0
FALLFISH	2	2	0	0	1.0
WHITE SUCKER	0	2	0	0	0.5
ROCK BASS	0	0	0	0	0.0
BLUEGILL	0	0	0	0	0.0
SMALLMOUTH BASS	0	0	0	1	0.3
TESSELLATED DARTER	0	1	0	0	0.3
TOTAL	3	5	20	16	11.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	2120	2123	2131	2135	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	0	0	0	0	0.0
SPOTTAIL SHINER	1	0	0	0	0.3
BLUNTNOSE MINNOW	0	0	1	0	0.3
FALLFISH	0	0	1	2	0.8
WHITE SUCKER	0	0	5	1	1.5
ROCK BASS	0	0	1	0	0.3
BLUEGILL	1	0	0	0	0.3
SMALLMOUTH BASS	0	0	0	0	0.0
TESSELLATED DARTER	0	0	0	1	0.3
TOTAL	2	0	8	4	3.5

Table H-6. Number of fish captured/haul with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 17 August 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	2105	2108	2115	2120	
HAUL	1	2	1	2	
SPECIES					MEAN
CARP	0	0	0	0	0.0
COMELY SHINER	2	0	1	0	0.8
SPOTTAIL SHINER	0	0	50	7	14.3
SWALLOWTAIL SHINER	0	0	10	0	2.5
SPOTFIN SHINER	0	0	9	3	3.0
BLUNTNOSE MINNOW	0	0	41	7	12.0
LONGNOSE DACE	1	0	0	0	0.3
QUILLBACK	0	0	0	0	0.0
WHITE SUCKER	0	0	9	1	2.5
NORTHERN HOG SUCKER	0	0	0	0	0.0
SHORTHEAD REDHORSE	0	0	0	0	0.0
YELLOW BULLHEAD	0	0	0	0	0.0
ROCK BASS	0	0	1	1	0.5
BLUEGILL	0	0	5	0	1.3
SMALLMOUTH BASS	0	0	3	0	0.8
SUNFISH SPP.	0	0	0	0	0.0
WHITE CRAPPIE	0	0	1	1	0.5
BLACK CRAPPIE	0	0	2	0	0.5
TESSELLATED DARTER	0	0	13	6	4.8
TOTAL	3	0	145	26	43.5

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	2153	2159	2135	2142	
HAUL	1	2	1	2	
SPECIES					MEAN
CARP	0	0	1	0	0.3
COMELY SHINER	0	0	38	2	10.0
SPOTTAIL SHINER	9	1	109	0	29.8
SWALLOWTAIL SHINER	1	0	6	0	1.8
SPOTFIN SHINER	1	0	135	3	34.8
BLUNTNOSE MINNOW	5	0	14	0	4.8
LONGNOSE DACE	0	0	0	0	0.0
QUILLBACK	0	0	1	0	0.3
WHITE SUCKER	1	0	17	2	5.0
NORTHERN HOG SUCKER	0	0	1	0	0.3
SHORTHEAD REDHORSE	0	0	10	0	2.5
YELLOW BULLHEAD	0	0	0	1	0.3
ROCK BASS	1	0	3	1	1.3
BLUEGILL	2	0	1	0	0.8
SMALLMOUTH BASS	3	0	6	1	2.5
SUNFISH SPP.	0	0	1	0	0.3
WHITE CRAPPIE	5	0	0	0	1.3
BLACK CRAPPIE	10	0	0	0	2.5
TESSELLATED DARTER	0	0	5	0	1.3
TOTAL	38	1	348	10	99.3

Table H-7. Number of fish captured/haul with a 7.6-m bag seine at SSES and Bell Bend on the Susquehanna River, 31 October 1977.

STATION	SSES				
SHORE	EAST	EAST	WEST	WEST	
TIME	2140	2145	2153	2158	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	2	0	2	0	1.0
SPOTTAIL SHINER	5	2	0	0	1.8
SWALLOWTAIL SHINER	0	0	0	0	0.0
SPOTFIN SHINER	6	1	5	3	3.8
BLUNTNOSE MINNOW	5	1	2	6	3.5
WHITE SUCKER	0	0	0	1	0.3
BLUEGILL	2	2	0	0	1.0
SMALLMOUTH BASS	0	0	1	0	0.3
BLACK CRAPPIE	1	0	0	0	0.3
TESSELLATED DARTER	0	1	0	0	0.3
TOTAL	21	7	10	10	12.0

STATION	BELL BEND				
SHORE	EAST	EAST	WEST	WEST	
TIME	2217	2224	2207	2210	
HAUL	1	2	1	2	
SPECIES					MEAN
COMELY SHINER	14	1	0	0	3.8
SPOTTAIL SHINER	32	11	0	0	10.8
SWALLOWTAIL SHINER	1	1	0	0	0.5
SPOTFIN SHINER	70	10	0	0	20.0
BLUNTNOSE MINNOW	15	12	0	0	6.8
WHITE SUCKER	1	0	0	0	0.3
BLUEGILL	0	0	0	0	0.0
SMALLMOUTH BASS	0	1	0	1	0.5
BLACK CRAPPIE	0	0	0	0	0.0
TESSELLATED DARTER	1	5	0	0	1.5
TOTAL	134	41	0	1	44.0

Table H-8. Mean catch/haul and species composition (% total) of fish captured with a 7.6-m bag seine at SSES on the Susquehanna River, 1977.

SPECIES	APR	MAY	JUN	JUL	AUG	OCT	MEAN	% TOT
COMELY SHINER	0.5	0.0	0.0	1.0	0.8	1.0	0.5	1.9
SPOTTAIL SHINER	0.5	1.3	7.3	5.0	14.3	1.8	5.0	17.7
SWALLOWTAIL SHINER	0.0	0.0	0.0	0.0	2.5	0.0	0.4	1.5
SPOTFIN SHINER	7.5	5.5	3.5	0.0	3.0	3.8	3.9	13.7
SHINER SPP.	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.3
BLUNTNOSE MINNOW	0.3	0.0	0.0	3.0	12.0	3.5	3.1	11.1
LONGNOSE DACE	0.0	0.0	0.5	0.0	0.3	0.0	0.1	0.4
FALLFISH	0.8	0.3	0.3	1.0	0.0	0.0	0.4	1.3
WHITE SUCKER	0.0	0.0	2.8	0.5	2.5	0.3	1.0	3.5
SHORTHEAD REDHORSE	0.0	0.0	67.0	0.0	0.0	0.0	11.2	39.5
ROCK BASS	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.3
BLUEGILL	0.0	0.0	0.0	0.0	1.3	1.0	0.4	1.3
SMALLMOUTH BASS	0.0	0.0	0.3	0.3	0.8	0.3	0.3	0.9
WHITE CRAPPIE	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.3
BLACK CRAPPIE	0.0	0.0	0.0	0.0	0.5	0.3	0.1	0.4
TESSELLATED DARTER	0.0	0.0	4.5	0.3	4.8	0.3	1.6	5.8
TOTAL	10.0	7.0	86.0	11.0	43.5	12.0	28.2	

Table H-9. Physicochemical data collected in conjunction with seining collections at SSES east on the Susquehanna River, 1977.

DATE	18 APR	17 MAY	16 JUN	21 JUL	17 AUG	31 OCT
TIME	2030	2055	2130	2200	2105	2140
TEMPERATURE(C)						
AIR	16.0	19.0	20.5	23.0	18.0	8.0
WATER	12.0	18.0	23.0	29.0	22.5	10.5
TURBIDITY(NTU)	1.7	7.3	13	9.7	21	4.6
OXYGEN						
DISSOLVED(MG/L)	11.40	11.80	15.40	10.40	8.10	10.80
PH	6.8	7.7	8.9	7.8	7.4	7.3
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	65	202	340	385	167	123

Table H-10. Physicochemical data collected in conjunction with seining collections at SSES west on the Susquehanna River, 1977.

DATE	18 APR	17 MAY	16 JUN	21 JUL	17 AUG	31 OCT
TIME	2050	2108	2140	2145	2115	2153
TEMPERATURE(C)						
AIR	16.0	19.0	19.0	23.0	17.0	8.0
WATER	14.0	18.0	23.0	29.0	24.0	10.5
TURBIDITY(NTU)	12	7.8	16	10	14	12
OXYGEN						
DISSOLVED(MG/L)	13.10	12.20	13.50	8.90	8.40	10.40
PH	7.4	7.9	8.4	7.6	7.7	7.5
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	--	218	375	389	335	230

Table H-11. Physicochemical data collected in conjunction with seining collections at Bell Bend east on the Susquehanna River, 1977.

DATE	18 APR	17 MAY	16 JUN	21 JUL	17 AUG	31 OCT
TIME	2010	2134	2230	2120	2153	2217
TEMPERATURE(C)						
AIR	17.0	19.0	20.0	23.0	17.5	7.0
WATER	13.0	18.0	22.0	29.0	22.5	9.0
TURBIDITY(NTU)	5.5	6.8	--	7.7	25	2.6
OXYGEN						
DISSOLVED(MG/L)	12.60	12.20	13.50	10.20	8.40	11.40
PH	7.4	8.0	8.5	7.8	7.8	7.5
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	123	172	370	360	247	98

Table H-12. Physicochemical data collected in conjunction with seining collections at Bell Bend west on the Susquehanna River, 1977.

DATE	18 APR	17 MAY	16 JUN	21 JUL	17 AUG	31 OCT
TIME	1955	2121	2202	2131	2135	2207
TEMPERATURE(C)						
AIR	17.0	19.0	19.0	23.0	17.0	7.5
WATER	14.0	18.0	23.0	29.0	24.0	11.0
TURBIDITY(NTU)	9.8	8.8	13	8.9	17	9.1
OXYGEN						
DISSOLVED(MG/L)	13.50	12.10	13.60	9.40	8.60	10.20
PH	7.5	8.0	8.5	7.6	7.7	7.5
SPECIFIC CONDUCTANCE						
AT 25 C(µMHOS/CM)	250	217	370	390	337	231

Table H-13. Mean catch/haul and species composition (% total) of fish captured with a 7.6-m bag seine at Bell Bend on the Susquehanna River, 1977.

SPECIES	APR	MAY	JUN	JUL	AUG	OCT	MEAN	% TOT
CARP	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
COMELY SHINER	1.0	0.5	0.0	0.0	10.0	3.8	2.5	2.7
SPOTTAIL SHINER	2.8	0.0	72.0	0.3	29.8	10.8	19.3	20.6
SWALLOWTAIL SHINER	0.0	0.0	0.0	0.0	1.8	0.5	0.4	0.4
SPOTFIN SHINER	61.5	10.8	6.0	0.0	34.8	20.0	22.2	23.8
SHINER SPP.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUNTNOSE MINNOW	0.0	0.0	0.3	0.3	4.8	6.8	2.0	2.1
LONGNOSE DACE	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
FALLFISH	1.5	0.5	2.3	0.8	0.0	0.0	0.8	0.9
QUILLBACK	0.0	0.0	3.8	0.0	0.3	0.0	0.7	0.7
WHITE SUCKER	0.0	0.0	213.3	1.5	5.0	0.3	36.7	39.3
NORTHERN HOG SUCKER	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
SHORTHEAD REDHORSE	0.0	0.0	29.8	0.0	2.5	0.0	5.4	5.8
YELLOW BULLHEAD	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
ROCK BASS	0.3	0.0	0.0	0.3	1.3	0.0	0.3	0.3
BLUEGILL	0.0	0.0	0.0	0.3	0.8	0.0	0.2	0.2
SMALLMOUTH BASS	0.0	0.0	0.0	0.0	2.5	0.5	0.5	0.5
SUNFISH SPP.	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
WHITE CRAPPIE	0.0	0.0	0.0	0.0	1.3	0.0	0.2	0.2
BLACK CRAPPIE	0.0	0.0	0.0	0.0	2.5	0.0	0.4	0.4
TESSELLATED DARTER	1.0	0.0	5.3	0.3	1.3	1.5	1.5	1.7
TOTAL	68.3	11.8	332.8	3.5	99.3	44.0	93.2	

AGE AND GROWTH OF SMALLMOUTH BASS

by

Gerard L. Buynak and Andrew J. Gurzynski

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ABSTRACT

Growth rates of smallmouth bass collected in the Susquehanna River near the Susquehanna SES (heavily polluted by acid mine drainage) and near Falls, Pennsylvania (slightly polluted) were studied in 1976. Ninety percent of the specimens collected were between 2 and 5 years old; the oldest was 8 years. No significant difference in growth rates was found between males and females. At both stations growth rates were similar and most rapid during the first 2 years, but in 3- and 4-year-old fish, growth near the Susquehanna SES was significantly slower ($P<0.05$) than at Falls. The difference was probably due to a scarcity of food that resulted from mine drainage pollution.

INTRODUCTION

The Susquehanna River near the Susquehanna SES is heavily polluted by acid mine drainage rich in dissolved iron. The effluents reduce pH only slightly but disrupt the ecosystem by greatly increasing turbidity and by coating the substrate with ferric compounds (Gale et al. 1976). Ferric iron seemed to reduce the standing crop of periphyton 10-fold and macroinvertebrates, excluding chironomids, 4-fold near the Susquehanna SES as compared to Falls, Pennsylvania, where the River is slightly polluted (Gale et al. 1976). Iron not only has a detrimental effect on these fish foods, but it can also affect fish directly. Sykora et al. (1972), for example, concluded that "the most important effect of suspended iron on aquatic fauna is of a physical nature, producing high

turbidities which prevent fish from eating (in high concentrations) or exerting some effect on the most susceptible stages of the life cycle -- the eggs and hatching fry -- in low concentrations."

The objectives of this study were to: 1) describe the age and growth of smallmouth bass in the Susquehanna River near the Susquehanna SES and at Falls, about 64 km upriver, and 2) determine if acid mine drainage has an effect on the growth and abundance of this important game species near the power station.

PROCEDURES

In 1976, smallmouth bass were captured near the Susquehanna SES and at Falls, Pennsylvania (Fig. C-1), with a boat-mounted AC-DC electrofisher. Fork length (mm) and weight (g) of each fish were measured. The sex of each fish was determined, when possible, from external characteristics. Scales were removed from the left side, below the lateral line, near the tip of the extended pectoral fin.

Three to six scales from each fish were pressed on cellulose acetate slides with a flat rolling mill (No. 191-1, William Dixon, Inc.). Impressions were read at 24 X with a Bausch and Lomb Tri-Simplex Micro-Projector. Annuli were recognized by the criteria of Lagler (1961). Age was read as the number of annuli along the longitudinal anterior axis through the focus. Anterior scale radius and growth fields between annuli were recorded separately for each fish. Impressions were read twice, and if they differed, a third time. In a few instances, no

agreement was found in the third reading, and results from those fish were discarded leaving a total of 112 fish in the sample from near the Susquehanna SES and 114 from Falls.

Body-scale and length-weight relationships were determined with 95% confidence intervals at each annulus for calculated lengths and weights. Body-scale relationships were derived by fitting a straight line, by the least squares method, to the length of the fish and the projected scale radius (Ricker 1971). The formula was $L_n - C = \frac{S_n}{S}(L-C)$, 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') and S = total scale radius. Length-weight relationships were calculated by fitting a straight line, by the least squares method, to logarithms of the lengths and weights. The resulting formula was $\log W = \log a + b\ (\log l)$, where W = weight of the fish, L = length of the fish, a = intercept on the weight axis, and b = slope of the line.

RESULTS

The body-scale and length-weight relationships found for all smallmouth bass collected from the River were $L = -19.4339 + 0.9779\ S$ and $\log W = -4.7440 + 3.0610 \log L$, respectively. Correlation coefficients of 0.94 for the body-scale relationship and 0.98 for the length-weight relationship indicated that linear regression was adequate to compute growth histories.

Ninety percent of the 226 specimens captured were between 2 and 5 years old; the oldest was 8 years. Growth was greatest during the first

2 years (Table I-1). No significant differences in growth rates were found between males and females (Tables I-2, I-3).

The calculated lengths at each annulus near the Susquehanna SES and Falls were similar for the first 2 years (Tables I-4, I-5). However, the mean calculated length of 3- and 4-year-old fish was significantly greater ($P<0.05$) at Falls. Too few fish older than 4 years were collected to allow meaningful comparisons of growth rates at the two sampling stations.

DISCUSSION

Acid mine drainages which enter upriver from the Susquehanna SES have disrupted the ecosystem. The abundance of organisms in the food chain has been seriously reduced, and as a result, the growth rates and abundance of smallmouth bass near the Susquehanna SES seems to have suffered.

Although growth rates of smallmouth bass were similar at Falls and near the Susquehanna SES in the first 2 years of life, studies of young-of-the-year bass at both stations in 1973 revealed substantial differences in their food habits (Ichthyological Associates 1974). Small fish composed about 40% of the volume of food eaten near the Susquehanna SES; few mayflies and no caddisflies were consumed. At Falls, no fish were consumed and about 40% of the food eaten was mayflies and caddisflies. Mayflies and caddisflies are more numerous at Falls than near the Susquehanna SES (Gale et al. 1976). The near lack of these benthic

macroinvertebrates in the stomach of bass near the Susquehanna SES was probably due to their low abundance. Comsumption of either small macroinvertebrates or fish is probably sufficient for good growth rates in younger smallmouth bass, but as they become older, larger forage organisms are necessary for rapid growth to occur.

Other studies have shown that there were differences in the abundance of large forage organisms at the two sampling stations (Ichthyological Associates 1974, Gale et al. 1976). At Falls, crayfish were much more abundant than near the Susquehanna SES and probably composed a more important part of the fish's diet. Crayfish can compose up to 67% of the food eaten by smallmouth bass (Carlander 1977). Large sucker populations, have also been correlated with good smallmouth bass growth (Sullivan 1956). In 1973 (Ichthyological Associates 1974), suckers were 5-fold more abundant at Falls than near the Susquehanna SES (3,121 vs. 636).

Smallmouth bass not only grew faster at Falls, but were more abundant there. Results of electrofishing runs from January through November 1973 (Ichthyological Associates 1974) revealed that smallmouth bass were 70-fold more abundant at Falls than near the Susquehanna SES. The greater food supply at Falls is probably capable of supporting a larger population of smallmouth bass.

From 1973 (Ichthyological Associates 1974) through 1977 (see Electrofishing of Fishes), the relative abundance of smallmouth bass near the Susquehanna SES has increased from 0.8 to 8.9% of the total

electrofishing catch. In part, this may be due to improvement in the water quality near the Susquehanna SES. After Tropical Storm Agnes in 1972, the pumping of mine water into the River ceased. From 1973 through 1977, significant annual increases occurred in dissolved oxygen concentrations, alkalinity concentrations, and pH, whereas significant annual decreases occurred in total iron concentrations, specific conductance, and turbidity (see Physicochemical Analyses).

In summary, it is believed that growth rates and abundance of smallmouth bass near the Susquehanna SES have been severely affected by pollution from acid mine drainages. This pollution has probably reduced the food supply enough near the Susquehanna SES to cause slower growth and lower abundance of smallmouth bass than at Falls. It is expected that if water quality continues to improve, growth rates and abundance of smallmouth bass near the Susquehanna SES will increase over that observed in 1976.

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Table I-1. Calculated mean fork length (mm) of smallmouth bass collected in the Susquehanna River, 1976 (CI = confidence interval).

AGE	FREQ	MIN	MAX	MEAN	STD DEV	STD ERR	95% CI LOW	95% CI HIGH
1	226	43.74	121.42	76.35	13.56	0.90	74.59	78.12
2	221	82.42	195.99	131.40	19.72	1.33	128.80	134.00
3	155	114.73	247.55	176.47	21.92	1.76	173.02	179.93
4	76	157.17	301.59	224.14	26.20	3.01	218.19	230.09
5	41	204.59	329.30	260.51	24.52	3.83	252.77	268.25
6	17	228.72	337.75	279.08	25.19	6.11	266.13	292.03
7	8	261.18	361.49	317.90	31.71	11.21	291.39	344.41
8	2	344.24	395.11	369.68	35.97	25.43	46.52	692.83

Table I-2. Calculated mean fork length (mm) of male smallmouth bass collected in the Susquehanna River, 1976 (CI = confidence interval).

AGE	FREQ	MIN	MAX	MEAN	STD DEV	STD ERR	95% CI LOW	95% CI HIGH
1	49	51.86	121.42	76.13	14.73	2.10	71.92	80.34
2	49	88.56	189.41	135.55	20.47	2.92	129.71	141.40
3	38	133.35	226.88	178.63	20.10	3.26	172.04	185.22
4	13	166.84	262.46	218.55	27.73	7.69	201.79	235.31
5	4	220.41	280.39	259.63	27.62	13.81	215.69	303.57
6	0	-	-	-	-	-	-	-
7	0	-	-	-	-	-	-	-
8	0	-	-	-	-	-	-	-

Table I-3. Calculated mean fork length (mm) of female smallmouth bass collected in the Susquehanna River, 1976 (CI = confidence interval).

AGE	FREQ	MIN	MAX	MEAN	STD DEV	STD ERR	95% CI LOW	95% CI HIGH
1	34	54.48	103.52	75.43	11.65	2.00	71.39	79.46
2	34	90.60	161.73	130.02	18.30	3.14	123.67	136.36
3	30	114.73	210.51	170.98	15.75	2.88	165.10	176.86
4	11	157.17	238.26	206.68	22.77	6.87	191.38	221.97
5	6	204.59	270.83	245.66	22.60	9.23	221.93	269.38
6	4	228.72	308.24	274.33	33.79	16.89	220.57	328.09
7	4	261.18	354.09	312.62	39.19	19.60	250.27	374.98
8	1	395.11	395.11	395.11	-	-	-	-

Table I-4. Calculated mean fork length (mm) of smallmouth bass collected near the Susquehanna SES on the Susquehanna River, 1976 (CI = confidence interval).

AGE	FREQ	MIN	MAX	MEAN	STD DEV	STD ERR	95% CI LOW	95% CI HIGH
1	112	43.74	110.56	78.16	14.83	1.40	75.39	80.94
2	107	82.42	195.99	129.58	20.94	2.02	125.57	133.59
3	59	114.73	215.42	167.78	16.83	2.19	163.40	172.16
4	15	157.17	243.88	202.22	24.41	6.30	188.71	215.74
5	4	204.59	271.63	244.47	28.95	14.47	198.42	290.52
6	2	228.72	288.15	258.44	42.02	29.71	-119.11	635.98
7	2	261.18	307.81	284.49	32.98	23.32	-11.78	580.77
8	0	-	-	-	-	-	-	-

Table I-5. Calculated mean fork length (mm) of smallmouth bass collected at Falls on the Susquehanna River, 1976 (CI = confidence interval).

AGE	FREQ	MIN	MAX	MEAN	STD DEV	STD ERR	95% CI LOW	95% CI HIGH
1	114	53.23	121.42	74.58	11.97	1.12	72.36	76.80
2	114	93.86	189.41	133.11	18.43	1.73	129.69	136.52
3	96	141.47	247.55	181.82	23.02	2.35	177.17	186.47
4	61	175.80	301.59	229.52	23.87	3.06	223.41	235.64
5	37	219.46	329.30	262.24	23.80	3.91	254.34	270.15
6	15	247.53	337.75	281.83	23.03	5.95	269.08	294.59
7	6	302.31	361.49	329.04	24.38	9.95	303.45	354.63
8	2	344.24	395.11	369.68	35.97	25.43	46.52	692.83

LERNAEA CYPRINACEA ON TWO CATOSTOMIDS

by

William G. Deutsch

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ABSTRACT

The parasitic copepod, Lernaea cyprinacea, occurred on 66% of white sucker and 32% of quillback collected in the Susquehanna River from June through November 1973. Numbers of copepodids were high on both fishes from August through October (in September, 90% of white sucker were infected), but declined sharply with River temperature in November. Infection rates of adult copepods were highest in November (64% of white sucker, 27% of quillback), when parasite reproduction was interrupted. Intensities of copepodids ranged from 1 to 104/host ($\bar{x}$ = 10/host) on white sucker and from 1 to 5/host ($\bar{x}$ = 2/host) on quillback; those of adult copepods varied from 1 to 28/host ($\bar{x}$ = 4/host) on white sucker and from 1 to 2/host ($\bar{x}$ = 1/host) on quillback. The gills of white sucker were infected more frequently than the body surface or any fin; only the gills of quillback were infected.

INTRODUCTION

Lernaea cyprinacea is a nonspecific, ectoparasitic copepod of worldwide distribution (Fryer 1961). Epizootics of it have killed large numbers of North American freshwater fish (Tidd 1934), and it is a serious pest in fish culture (Hoffman 1970). The copepod's complex life cycle is well documented (Bauer 1962, Grabda 1963), and it has been found that both the copepodid and adult female may complete development on the same fish host. Several workers have surveyed fish populations from relatively shallow streams to determine copepod infection rates (Demaree 1967, Amin

et al. 1973, Whitaker and Schlueter 1975), but fish from large rivers have received little attention. Also, most studies have dealt with adult parasites, and information concerning copepodid infections is scarce.

L. cyprinacea is common in the Susquehanna River in northeastern Pennsylvania, and was observed on 20 fishes (Deutsch 1978; Timmy B. Hess, Ichthyological Associates, personal communication) and bullfrog tadpoles, Rana catesbeiana (William F. Gale, Ichthyological Associates, personal communication). The purpose of this study was to observe changes in the incidence (percent of fish infected), intensity (number of parasites/host), and site of infection of L. cyprinacea copepodids and adults on white sucker and quillback from the Susquehanna River. These fishes are very common in the study area and were selected because of their ease of capture. River depth ranged from 1 to 5 m and width varied from 100 to 350 m.

PROCEDURES

From June through November 1973, 98 white sucker (7-47 cm fork length; age class I-VII+) and 69 quillback (29-47 cm; IV-VII+) were examined for L. cyprinacea infections. Fish were collected from two River stations established for various ecological investigations (Ichthyological Associates 1974). One station was in relatively clean water at Falls, Pennsylvania (Wyoming County), and the other was in polluted water (acid mine drainage) near the Susquehanna SES (Luzerne County) (Fig. C-1). Fish were captured both near shore and in deep water with a boat-mounted AC electrofisher, trapnet, or seine.

Most fish were processed immediately, but some were held in a live box for up to 24 hours before they were measured, aged, sexed, and examined for parasites. After gross examination of the fins and body surface, the gills were removed and examined under a dissecting microscope (7-30 X). Copepods were preserved in 10% formalin for reference and species identification. Adult specimens were identified with the key of Harding (1950).

RESULTS AND DISCUSSION

There were large seasonal fluctuations in the percentage of fish infected with L. cyprinacea (Fig. J-1). Infections were found two months earlier, and were more common on white sucker than on quillback. Because the parasite occurred at Falls and near the Susquehanna SES, with no observable difference in infection rates, data from both stations were combined for analysis. Overall, 66% of white sucker and 32% of quillback were infected with the copepod (adults, copepodids, or both). Based upon temperature requirements for L. cyprinacea development (Grabda 1963), there could have been three generations produced in the River in 1973.

Copepodids were most abundant from August through October; in September, 90% of white sucker were infected with them (Table J-1). Overall, copepodids infected 44% of white sucker and from 1 to 104/host were found ($\bar{x}$ = 10/host). Only 20% of quillback were infected, and from 1 to 5 copepodids/host were found ($\bar{x}$ = 2/host). Copepodid abundance on both fishes declined sharply by November, probably due to low River temperature. Grabda (1963) noted that 14 C was the minimum temperature for embryonic development of L. cyprinacea.

Adult copepods infected 41% of white sucker, and intensities ranged from 1 to 28/host ($\bar{x}$ = 4/host). About 4-fold fewer adults were found on infected white sucker in streams of Indiana (Demaree 1967) and Wisconsin (Amin et al. 1973). Only 10% of quillback from the Susquehanna River were parasitized, and from 1 to 2 adults/host were found ($\bar{x}$ = 1/host).

Demaree (1967), Amin et al. (1973), and Whitaker and Schlueter (1975) observed peak incidence of adult copepods in mid to late summer, but in this study, incidence was highest in November (Fig. J-1). Parasite reproduction declined in colder months, however, and copepods, which usually bore egg sacs in summer, infrequently bore them in October and November.

The gills of white sucker were infected with adult copepods more frequently than the body surface or the fins (Table J-2); adult copepods on quillback were found only on the gills. During respiration, bottom-feeding fishes may draw infective cyclopoids into gill chambers from the substrate, and be more susceptible to infection on the gills. Amin et al. (1973) noted that white sucker from Wisconsin were often infected with L. cyprinacea in the "head region."

The gills may also be more infected than other areas because parasites on them cannot be removed by accidental or intentional rubbing, or by symbiotic cleaning behavior of fishes. In the Laboratory, infected bluegill, rock bass, and smallmouth bass were observed twitching infected parts of their body and rubbing parasites against stones (Deutsch 1974). In one instance, a smallmouth bass infected between the pelvic fins was observed

rubbing these fins together, as if attempting to dislodge the parasite. Adult copepods on infected fish disappeared before host tissue became necrotic, perhaps as a result of rubbing, or by cleaning symbiosis between fish. The presence of an adult copepod in the stomach of a bluegill taken in the River also indicated that fish may remove parasites from themselves or other fish. Both Spall (1970) and Kabata (1970) observed "mutual assistance behavior," when one freshwater fish cleaned another of the ectoparasite Argulus sp. (Crustacea: Branchiura).

A chi square test (Schefler 1969) indicated a highly significant ($P<0.01$) seasonal change in the infection site of adult copepods on white sucker (Table J-2). The gills became progressively more infected, and in November, 75% of adult copepods were found on them. Also, the total number of different sites infected decreased from 9 in October to 5 in November. This seasonal change in infection site may have been the reason why previous workers, who did not examine the gills, found heaviest infections in summer.

Copepods infected significantly more ($P<0.05$) female white sucker than males (Deutsch 1974). Female vertebrates are usually less parasitized than males, probably due to the presence of estrogen, but the trend tends to be reversed during the breeding season (Pennycuick 1971). Male and female quillback were about equally parasitized.

The ubiquity of L. cyprinacea may be partly attributed to the durability of its egg. An adult copepod, with egg sacs intact, was found on a nearly digested minnow in the stomach of a smallmouth bass. The eggs were cultured in a dish of aerated River water, and most hatched and developed through several instars. Copepod eggs in fish feces might also be viable.

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Table J-1. Incidence and intensity of Lernaea cyprinacea copepodids (C) and adults (A) on white sucker and quillback, June through November 1973.

	No. Examined		% Infected				Mean No. Parasites/Host			
	White sucker	Quillback	White sucker		Quillback		White sucker		Quillback	
			C	A	C	A	C	A	C	A
Jun	3	5	0	0	0	0	0	0	0	0
Jul	11	9	27	18	0	0	1	1	0	0
Aug	3	6	67	33	0	0	18	8	0	0
Sep	30	20	90	40	30	10	11	4	2	1
Oct	26	18	39	35	44	11	8	7	2	1
Nov	25	11	4	64	0	27	3	2	0	1
Total	98	69	44	41	20	10	10	4	2	1

Table J-2. Seasonal changes in infection site of adult Lernaea cyprinacea on white sucker.

	Jul-Aug	Sep	Oct	Nov	Total
No. adult Lernaea found	10	47	64	36	157
% Infection					
Gills	10	34	30	75	40
Fins					
pectoral	10	9	9	0	7
dorsal	50	23	14	8	18
pelvic	10	4	13	0	7
anal	10	0	3	11	5
caudal	0	15	9	3	9
Body					
head	0	2	6	0	3
dorsal surface	10	0	0	0	1
lateral surface	0	6	9	0	6
ventral surface	0	6	6	3	5

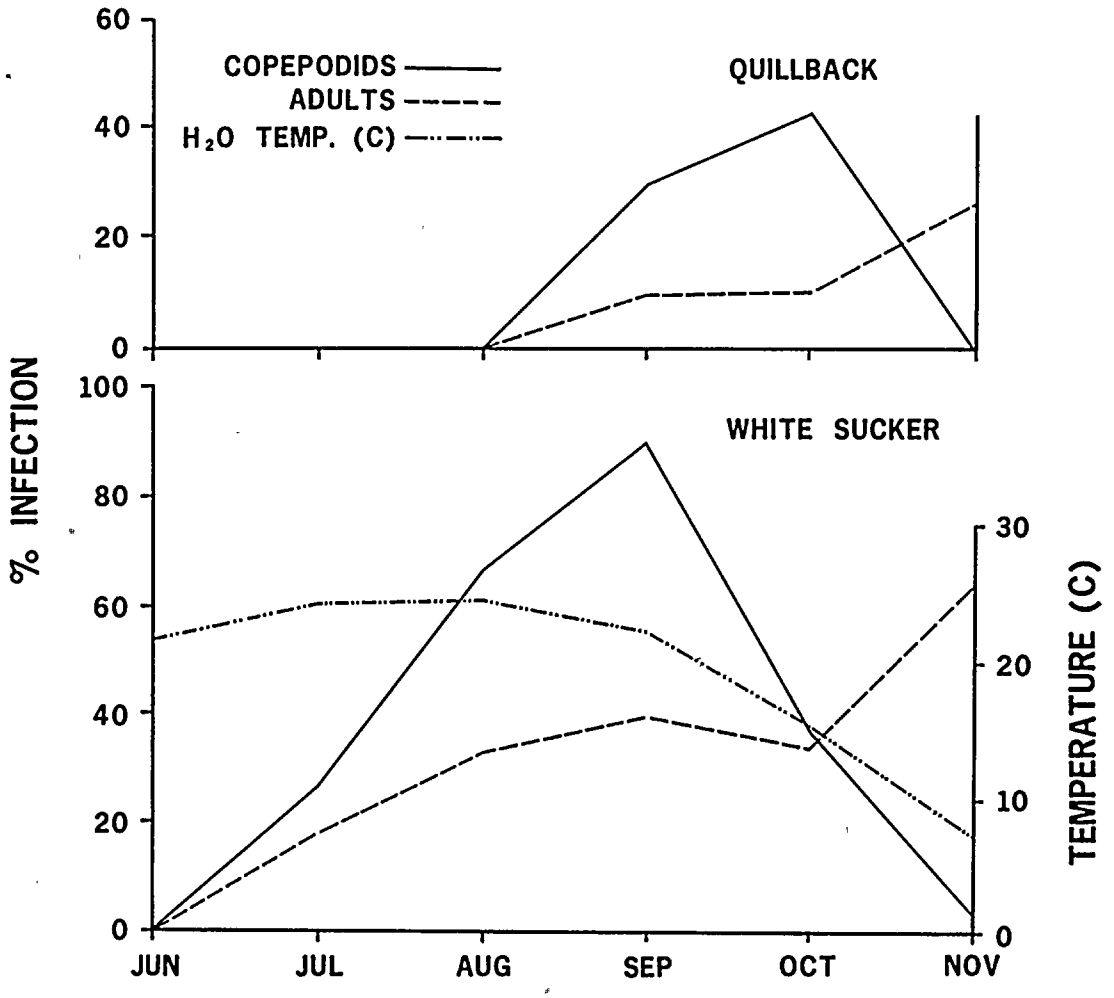

Fig. J-1. Percent infection of Lernaea cyprinacea copepodids and adults on quillback and white sucker, with mean monthly River temperature.

FLORA AND VEGETATION

by

James D. Montgomery

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ABSTRACT

A total of 568 species of vascular plants was observed on the Susquehanna SES site from 1972 through 1974 and 1977. More than half of this total was first observed in the 1977 survey. Five general types of plant communities occur on the site: river flood plain forest, upland forest, abandoned field, agricultural field, and open marsh. The phenology of the plants of the site was reported.

Two upland forest communities were sampled quantitatively using nested quadrats for trees, saplings, seedlings, shrubs, herbs, and ground cover. Various oaks and Virginia pine (Pinus virginiana) were the important trees (measured by relative frequency, relative density, and relative dominance). Sweet birch (Betula lenta) was important in the Council Cup forest but was absent in the Township Road 419 forest. Sapling composition was similar to tree composition of the forests.

INTRODUCTION

Terrestrial ecological studies were conducted on the Susquehanna SES site from 1972 through 1974 (Ichthyological Associates 1973, 1974; Burton 1976). These studies were conducted on the construction site and in the immediate vicinity. Results included lists of plants and animals observed, quantitative vegetation studies, and systematic bird counts. No terrestrial studies were conducted in 1975 or 1976. In January 1977, terrestrial studies were initiated to gather additional baseline information on plants and birds to compare with information to be collected during operation of the Susquehanna SES.

The purpose of the flora and vegetation studies in 1977 was to obtain information on the vascular plants of the Susquehanna SES site, including an inventory, habitat information, phenological data about the plants on the site (flora), and quantitative information about selected plant communities (vegetation). These studies are designed as part of a continuing monitoring program.

PROCEDURES

Flora

Floristic studies were conducted from March through November 1977. Observations were made throughout the Susquehanna SES site, on both sides of the Susquehanna River (Fig. K-1). An effort was made to visit different habitats at least once a month. Identifications were made using Gleason and Cronquist (1963), Fernald (1950), Peterson and McKenny (1968), and Wherry (1961) for ferns, and Hitchcock (1950) for grasses. Nomenclature follows Gleason and Cronquist (1963), except for ferns and fern-allies, for which Wherry (1961) is used. Because of the confusion of some common names of plants, scientific names are used at first reference in the text and in all tables. Species not previously collected from the site were collected and added to the reference herbarium.

Notes on abundance and habitat were made. Phenology data were collected in two ways: random surveys of the Susquehanna SES property, and systematic surveys of several selected routes in different community

types. The routes were selected to be useful for observing possible effects of salt drift from the Susquehanna SES cooling towers during operation. Observations were made approximately once a month. All plants in flower were noted. The routes used in 1977 were (Fig. K-1): along the Susquehanna River from the IA Laboratory north to the southern tip of Gould Island, along the western shore of Gould Island, on T.R. 419 from U.S. 11 to T.R. 438, on the Council Cup Nature Trail and Overlook, on a trail from PA. 239 (quarry trail) to the transmission line along a ridge to the transmission line down the slope of Little Wapwallopen Valley to a trail past an abandoned spring house ending at PA. 239, in the field north of the IA Laboratory, in the field in the transmission corridor south of Susquehanna SES, in the field north of the switching station east of PA. 239, in the cornfield north of the IA Laboratory, in the marsh along U.S. 11 west of the IA Laboratory, and in the marsh south of the Susquehanna SES intake.

Vegetation

Quantitative vegetation studies were conducted in two upland forest areas in 1977: the Council Cup forest (CC), and the forest on the hillside above Township Road 419 (TR419) (Fig. K-1). The CC forest is located east of the Council Cup Overlook, in Conyngham and Hollenback Townships, Luzerne County, approximately 3 km southeast of the Susquehanna SES. The survey area is nearly level to gently east-facing, at elevation of approximately 335 m. The CC forest is a mixed oak-pine forest. The

TR419 forest is located on a steep south-facing hillside above a dirt road (Township Road 419), just north of the Susquehanna SES fence, in Salem Township, Luzerne Co. The plot is 0.2-0.5 km north of the generating station. Elevation ranges from 200 to 250 m. The TR419 forest is also mixed oak-pine, with several other hardwood species.

The areas were surveyed in the spring and marked into permanent transects parallel with the long direction of the plot. Points were located at approximately 50-m intervals on CC and 75-m intervals on TR419. At each point, a 10-m x 10-m quadrat was marked for sampling trees and saplings (Cain and Castro 1959). Trees were defined as 10-cm diameter breast height (dbh) or greater, saplings as 1.0-9.5-cm dbh, and seedlings less than 1.0-cm dbh. All trees and saplings in the 10 x 10-m quadrat were identified, counted, and the dbh measured to the nearest cm with a diameter tape. Two 1 x 1-m quadrats were established in diagonally opposite corners of the 10 x 10-m quadrat for sampling tree seedlings, shrubs, herbs, and ground cover (litter, moss, rock, and bare soil were defined as ground cover). Plants were identified and an estimate was made of the percent cover in the quadrat for each species. Stems were not counted in this investigation because many of the shrubs and herbs are colonial, and stem number was judged not to be useful. Sampling was completed in mid-July to early August on both plots. Only trees and saplings were sampled in 1977 on TR419; all data were collected for CC.

The following were calculated for trees and saplings:

$$\text{Frequency} = \frac{\text{number of quadrats in which a species occurs}}{\text{total number of plots}}$$

$$\text{Relative frequency} = \frac{\text{frequency of a species}}{\text{total frequency of all species}} \times 100$$

$$\text{Density} = \frac{\text{number of stems of a species}}{\text{hectare}}$$

$$\text{Relative density} = \frac{\text{density of a species}}{\text{total density of all species}} \times 100$$

$$\text{Dominance} = \frac{\text{basal area of a species}}{\text{hectare}}, \text{ where basal area} = \pi \left(\frac{\text{dbh}}{2}\right)^2$$

$$\text{Relative dominance} = \frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$$

Importance Value = relative frequency + relative density + relative dominance (maximum value = 300)

The following were calculated from the quadrat data for tree seedlings, shrubs, herbs, and ground cover (calculated separately for each):

Frequency and relative frequency = same as above

$$\text{Dominance} = \frac{\text{total cover value for a species}}{\text{area sampled in } m^2}$$

$$\text{Relative dominance} = \frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$$

Importance value = relative frequency + relative dominance

In early fall, increment borings were made on selected trees in the CC forest (Smith 1966). Increment cores were stored in soda straws. Annual rings were counted in the Laboratory with a dissecting microscope at 10-30 X.

RESULTS AND DISCUSSION

Flora

A total of 568 species of vascular plants was observed on the Susquehanna SES site from 1972 through 1974 and 1977. This total included 112 woody plants (Table K-1), and 456 herbaceous plants (Table K-2). The herbaceous plants included 36 ferns and fern-allies, and 420 flowering plants. The largest families were Asteraceae (66 species), Gramineae (49), Rosaceae (29), Cyperaceae (27), and Leguminosae (23). The largest genera were Carex (19), Aster (12), Polygonum (12), Solidago (10), and Viola (10).

None of the plants observed on the site has been proposed as endangered by the U. S. Department of the Interior (1975, 1976).

Five general types of plant communities are present on the site: river flood plain forest, upland forest, abandoned field, agricultural field, and open marsh. A brief description of each of these plant communities follows; plants found in each community are indicated in Tables K-1 and K-2.

River flood plain forest occurs along the banks of the Susquehanna River and on Gould Island. Where undisturbed, the forest is dominated by large trees of silver maple (Acer saccharinum), river birch (Betula nigra), and red oak (Quercus borealis). Important associates are American elm

(Ulmus americana), bitternut hickory (Carya cordiformis), black maple (Acer nigrum), basswood (Tilia americana), and sycamore (Platanus occidentalis). Spicebush (Lindera benzoin) is the only common shrub, and poison ivy (Rhus radicans) and Virginia creeper (Parthenocissus quinquefolia) are common vines. Herbs are conspicuous in the spring; trout lily (Erythronium americanum), Dutchman's breeches (Dicentra cucullaria), May apple (Podophyllum peltatum), common blue violet (Viola papilionacea), garlic mustard (Alliaria officinalis), and false mermaid (Floerkia proserpinacoides) were the most abundant. Many spring herbs become dormant in the summer and are replaced as dominant herbs by ostrich fern (Matteuccia struthiopteris), dame's rocket (Hesperis matronalis), and Virginia knotweed (Polygonum virginanum).

Upland forests on the Susquehanna SES site are mixtures of pine and hardwoods, especially oaks. Composition depends on slope and exposure, which in turn affect soil moisture. Ridge tops and steep south-facing slopes have forests dominated by Virginia pine (Pinus virginiana), sweet birch (Betula lenta), red oak, and black oak (Quercus velutina). Common associates include red maple (Acer rubrum), white pine (Pinus strobus), pignut hickory (Carya glabra), and black cherry (Prunus serotina). Flowering dogwood (Cornus florida) is a conspicuous understory tree. The shrub layer may be dense and is chiefly ericaceous, with low-bush blueberry (Vaccinium vacillans), deerberry (V. stamineum), and black huckleberry (Gaylussacia baccata) the most common. The most abundant herbs are ground pine (Lycopodium flabelliforme), evergreen wood fern (Dryopteris intermedia), and sedges (Carex swannii and C. pensylvanica).

On the valley floors, Virginia pine and black oak are less common, and white oak (Quercus alba) and tulip-tree (Liriodendron tulipifera) are more abundant. Hemlock (Tsuga canadensis) is dominant in ravines and on north-facing slopes. Dogwood is abundant in the understory except in hemlock stands, and the ericaceous shrub layer is replaced by maple-leaved viburnum (Viburnum acerifolium) and spicebush. The most conspicuous herbs are common blue violet, gill-over-the-ground (Glechoma hederacea), cinquefoil (Potentilla simplex), and avens (Geum canadense).

Abandoned fields in various stages of secondary succession are found on the site. Earlier stages are dominated by perennial herbs, including heath aster (Aster ericoides), goldenrods (Solidago spp.), sheep sorrel (Rumex acetosella), cinquefoil, sedges (Carex spp.), and grasses (Agrostis stolonifera, Andropogon scoparius, Danthonia spicata, and Panicum spp.). Later stages have more shrub species, and may have scattered trees, including gray birch (Betula populifolia), red maple, dogwoods (Cornus spp.), blackberry (Rubus allegheniensis), and dewberry (R. flagellaris).

Agricultural fields include chiefly cornfields and associated "weeds." The latter are mostly annual herbs (Table K-2).

Two marsh areas and two small ponds are also present on the site. Marshes are dominated by wool-grass (Scirpus cyperinus), cat-tail (Typha latifolia), rush (Juncus effusus), rice cutgrass (Leersia oryzoides), arrow-head (Sagittaria latifolia), arrow-leaved tearthumb (Polygonum sagittatum), and various species of Carex. Ponds contain true aquatics,

including Engelmann's quillwort (Isoetes engelmanni), duckweed (Lemna minor) and pondweed (Potamogeton spirillus).

Phenology data are presented in Tables K-1 and K-2. Most forest species flower in the spring or early summer. Field species flower throughout the growing season with many composites (Asteraceae) flowering in the fall. The majority of marsh species flower in late summer and early fall.

The number of vascular plant taxa reported for the site was more than doubled in the 1977 survey. The study area was expanded considerably to include the large area east of the Susquehanna River and the transmission corridor south of the plant site (Fig. K-1). Also, two major families, Gramineae (49 sp.) and Cyperaceae (27 sp.), were not included in the 1972-74 survey. The diversity of habitats on the site accounts for the relatively large number of plant species. Of the 112 woody plant species, 44 (39.3%) occurred in the river flood plain forest, 77 (68.8%) in the upland forest, 27 (24.1%) in the abandoned fields, and 8 (7.1%) in the marshes; of the 456 herbaceous species, 157 (34.4%) occurred in the river flood plain forest, 267 (58.6%) in the upland forest, 143 (31.4%) in the abandoned fields, 25 (5.5%) in agricultural fields, and 99 (21.7%) in open marshes.

Vegetation

The most important (highest importance value) tree in the CC forest was sweet birch (Table K-3). Oaks (chestnut, Quercus prinus, black, red, and white), red maple, white pine, and Virginia pine were important associates. Fourteen tree species were encountered. Total density was

585 trees/ha. The most important saplings were sweet birch and red maple, with red oak, chestnut oak, and black oak important associates (Table K-4); 18 species were encountered as saplings. Red maple was the most important seedling, with chestnut oak, black cherry, red oak, and sweet birch of secondary importance. Thirteen species were encountered as seedlings (Table K-5). The shrub layer was dominated by ericaceous plants, with low-bush blueberry and mountain laurel (Kalmia latifolia) the most important (Table K-6). Ground pine, wild sarsaparilla (Aralia nudicaulis), and hay-scented fern (Dennstaedtia punctilobula) were the most important of the 16 herbaceous species in quadrats (Table K-6). Herbs were unevenly distributed in the forest; some quadrats had nearly complete coverage and several species present, others had almost no herbaceous cover. Frequencies were low for all herbs except ground pine (Table K-6). Litter was the most important ground cover, with low coverage of moss, rock, and bare soil in some quadrats.

In the TR419 forest, black oak was the most important tree, with Virginia pine the next most important (Table K-7). Flowering dogwood, red maple, and white pine were associates; 17 species were encountered. Total density was 576 trees/ha. Dogwood was the most important sapling, with black oak, red maple, and mockernut hickory (Carya tomentosa) as associates (Table K-8). Dogwood is a small tree, which seldom reaches tree canopy size (hawthorne and shadbush are similar species) (Braun 1950). There were 1,183 saplings/ha (Table K-8).

Increment borings were made on 15 trees of 8 species in the CC forest. Ages ranged from 20 to more than 105 years (Table K-9). Oaks were older than other species aged.

Both of the forests sampled were similar in the importance of hardwood, especially oaks, and Virginia pine. The composition is similar to that described for this region of the oak-chestnut forest by Braun (1950). Of the 14 species present in the CC forest, 11 (78.6%) were found in the TR419 forest; of the 17 species present in the TR419 forest, 11 (64.7%) were present in the CC forest. The most important difference between the forests was the absence of sweet birch in the TR419 forest. Virginia pine and dogwood were more important in the TR419 forest. Saplings in both forests were similar in composition to the canopy. Red maple was more important as a sapling (and seedling in CC forest). Pines were less important in the sapling class (and seedlings in the CC forest) indicating a long-term lowered importance of pines in the forest. Shrubs were typical of the ridge-top forest as described by Braun (1950). Insufficient data were obtained for aging comparisons.

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Table K-1. Woody plants observed on the Susquehanna SES site, 1972-74 and 1977. Arranged within phyla alphabetically by family; nomenclature follows Gleason and Cronquist (1963).

Habitat: RF = river flood plain forest
UF = upland forest
AF = abandoned field
OM = open marsh and pond
* = dominant in community indicated
No habitat is listed for species observed 1972-74 for which no habitat was given.

Flowering Date: dates observed flowering are indicated by month (4 = April, 5 = May, etc.); - = not applicable; n.o. = not observed.

Scientific Name	Common Name	Habitat				Flowering Date
		RF	UF	AF	OM	
PINOPHYTA						
CUPRESSACEAE						
Juniperus virginiana	red cedar			X		-
Thuja occidentalis	arbor vitae					-
PINACEAE						
Picea glauca	white spruce					-
Picea rubens	red spruce					-
Pinus rigida	pitch pine		X			-
Pinus strobus	white pine		X			-
Pinus sylvestris	scotch pine		X			-
Pinus virginiana	Virginia pine		X*	X		-
Tsuga canadensis	eastern hemlock	X	X			-
MAGNOLIOPHYTA-DICOTYLEDONEAE						
ACERACEAE						
Acer nigrum	black maple	X				n.o.
Acer pensylvanicum	striped maple		X			n.o.
Acer platanoides	Norway maple		X			n.o.
Acer rubrum	red maple	X	X	X		3-4
Acer saccharinum	silver maple	X*	X			3-4
Acer saccharum	sugar maple		X			n.o.
Acer spicatum	mountain maple					n.o.
ANACARDIACEAE						
Rhus glabra	smooth sumac				X	n.o.
Rhus radicans	poison ivy	X	X			5
Rhus typhina	staghorn sumac		X	X		6
Rhus vernix	poison sumac					n.o.
BERBERIDACEAE						
Berberis thunbergii	Japanese barberry	X				4-5
BETULACEAE						
Alnus rugosa	speckled alder			X	X	3-4
Betula lenta	sweet birch		X*			n.o.
Betula lutea	yellow birch		X			n.o.
Betula nigra	river birch	X*	X	X		4
Betula papyrifera	paper birch		X			n.o.
Betula populifolia	gray birch	X	X	X*		n.o.
Carpinus caroliniana	American hornbeam		X			n.o.
Corylus americana	hazel-nut		X			n.o.
Ostrya virginiana	hop-hornbeam					n.o.
BIGNONIACEAE						
Catalpa bignonioides	catalpa	X	X			6-7
CAPRIFOLIACEAE						
Diervilla lonicera	bush-honeysuckle		X			6
Sambucus canadensis	common elder	X	X		X	6
Viburnum acerifolium	maple-leaf viburnum		X			5
Viburnum dentatum	arrowwood		X		X	6
CELASTRACEAE						
Celastrus scandens	bittersweet			X		n.o.
CORNACEAE						
Cornus alternifolia	alternate-leaf dogwood		X			n.o.
Cornus amomum	silky dogwood	X		X	X	6
Cornus florida	flowering dogwood		X*	X		4-5
Cornus racemosa	gray dogwood			X		n.o.
Cornus rugosa	round-leaf dogwood		X			5
Nyssa sylvatica	black gum		X			n.o.

Table K-1 (cont.)

Scientific Name	Common Name	Habitat				Flowering Date
		RF	UF	AF	OM	
ERICACEAE						
Gaylussacia baccata	black huckleberry		X			5
Kalmia angustifolia	sheep laurel		X	X		n.o.
Kalmia latifolia	mountain laurel		X			5-6
Rhododendron maximum	rhododendron					n.o.
Rhododendron nudiflorum	pinxter-flower		X			5
Vaccinium corymbosum	high-bush blueberry		X	X		5
Vaccinium stamineum	deerberry		X	X		5-6
Vaccinium vacillans	low-bush blueberry		X	X		5
FAGACEAE						
Castanea dentata	American chestnut		X			n.o.
Fagus grandifolia	American beech	X	X			n.o.
Quercus alba	white oak	X	X*			n.o.
Quercus borealis	red oak	X*	X*			5
Quercus palustris	pin oak	X				n.o.
Quercus prinus	chestnut oak		X			4-5
Quercus velutina	black oak		X*			5
HAMAMELIDACEAE						
Hamamelis virginiana	witch hazel		X			n.o.
JUGLANDACEAE						
Carya cordiformis	bitternut hickory	X				6
Carya glabra	pignut hickory		X			n.o.
Carya ovata	shagbark hickory		X			n.o.
Carya tomentosa	mockernut hickory		X			n.o.
Juglans cinerea	butternut	X				n.o.
Juglans nigra	black walnut	X	X			5
LEGUMINOSAE						
Gleditsia triacanthos	honey locust					n.o.
Robinia pseudoacacia	black locust	X				6
LAURACEAE						
Lindera benzoin	spicebush	X	X		X	4
Sassafras albidum	sassafras	X	X			4
MAGNOLIACEAE						
Liriodendron tulipifera	tulip-tree	X	X*			6
MORACEAE						
Morus rubra	red mulberry		X			n.o.
MYRICACEAE						
Myrica asplenifolia	sweet fern		X			4
OLEACEAE						
Forsythia sp.	forsythia		X			4
Fraxinus americana	white ash	X	X	X		4
Fraxinus pennsylvanica	red ash	X				n.o.
Ligustrum vulgare	common privet	X				6
PLATANACEAE						
Platanus occidentalis	sycamore	X				n.o.
RHAMNACEAE						
Ceanothus americanus	New Jersey tea		X			6-7
ROSACEAE						
Amelanchier arborea	shad-bush		X	X		4
Aronia melanocarpa	chokeberry			X		5
Crataegus pruinosa	hawthorne		X			5
Crataegus sp.	hawthorne	X	X	X		5
Physocarpus opulifolius	ninebark	X				6
Prunus avium	sweet cherry		X			4
Prunus pensylvanica	pin cherry	X	X			4
Prunus serotina	black cherry	X	X	X		5
Prunus virginiana	choke cherry	X	X	X		4-5
Pyrus communis	pear		X			4
Pyrus malus	apple	X	X	X		4-5
Pyrus sp.	crabapple		X			5
Rosa multiflora	multiflora rose			X		n.o.
Rosa palustris	swamp rose				X	7
Rosa virginiana	wild rose		X	X		6-7
Rubus allegheniensis	blackberry	X	X	X*		5-6

Table K-1 (cont.)

Scientific Name	Common Name	Habitat				Flowering Date
		RF	UF	AF	OM	
ROSACEAE (cont.)						
Rubus flagellaris	dewberry	X	X	X*		5-6
Rubus occidentalis	black raspberry	X	X			5
Spiraea latifolia	meadow-sweet			X		7-8
Spiraea tomentosa	steeplebush				X	7
RUBUACEAE						
Cephalanthus occidentalis	buttonbush					n.o.
RUTACEAE						
Zanthoxylum americanum	prickly ash					n.o.
SALICACEAE						
Populus grandidentata	big-toothed aspen		X			n.o.
Populus tremuloides	quaking aspen		X			n.o.
Salix nigra	black willow	X				4
SAXIFRAGACEAE						
Hydrangea arborescens	hydrangea	X	X			6
STAPHYLEACEAE						
Staphylea trifolia	bladder-nut	X				4-5
TRILIACEAE						
Tilia americana	basswood	X	X			6
ULMACEAE						
Celtis occidentalis	hackberry	X				n.o.
Ulmus americana	American elm	X	X			n.o.
Ulmus rubra	slippery elm	X				n.o.
VITACEAE						
Parthenocissus quinquefolia	Virginia creeper	X	X			n.o.
Vitis aestivalis	summer grape		X			6
Vitis labrusca	fox-grape	X	X			6
MAGNOLIOPHYTA-MONOCOTYLEDONEAE						
LILIACEAE						
Smilax rotundifolia	greenbrier		X			n.o.

Table K-2. Herbaceous vascular plants observed on the Susquehanna SES site, 1972-74 and 1977. Arranged within phyla, alphabetically by families; nomenclature follows Wherry (1961) for ferns and fern allies and Gleason and Cronquist (1963) for flowering plants.

Habitat: RF = river flood plain forest
UF = upland forest
AF = abandoned field
AG = agricultural field
OM = open marsh and pond
* = dominant in indicated community
No habitat is listed for species observed 1972-74 for which no habitat was given.

Flowering Date: dates observed flowering (shedding spore for ferns) are indicated by month (3 = March, 4 = April, etc.); n.o. = not observed.

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
EQUISETOPHYTA							
EQUISETACEAE							
Equisetum arvense	field horsetail	X		X	X		4
LYCOPODIOPHYTA							
ISOETACEAE							
Isoetes engelmanni	Engelmann's quillwort					X	6-9
LYCOPODIACEAE							
Lycopodium clavatum	staghorn clubmoss		X				n.o.
Lycopodium flabelliforme	ground pine		X*	X			10
Lycopodium inundatum	bog clubmoss					X	n.o.
Lycopodium lucidulum	shining clubmoss		X				n.o.
Lycopodium obscurum	tree clubmoss		X	X			n.o.
Lycopodium tristachyum	ground cedar			X			9
SELAGINELLACEAE							
Selaginella apoda	meadow spike-moss					X	n.o.
POLYPODIOPHYTA							
OPHIOGLOSSACEAE							
Botrychium dissectum	grape fern	X	X	X			9-10
Botrychium lanceolatum	lanceolate grape fern		X				5-6
Botrychium matricariaefolium	daisy-leaf grape fern		X	X			5
Botrychium virginianum	rattlesnake fern		X				n.o.
OSMUNDACEAE							
Osmunda cinnamomea	cinnamon fern		X			X	5
Osmunda claytoniana	interrupted fern	X	X				5
POLYPODIACEAE							
Adiantum pedatum	maidenhair fern		X				n.o.
Asplenium platyneuron	ebony speenwort		X	X			6-7
Athyrium filix-femina	lady fern	X	X				6-7
Athyrium thelypteroides	silvery spleenwort	X	X				6-7
Cystopteris fragilis	fragile fern		X				6
Cystopteris protrusa	lowland fragile fern	X					6-7
Dennstaedtia punctilobula	hay-scented fern		X				7
Dryopteris cristata	crested wood fern		X				n.o.
Dryopteris intermedia	evergreen wood fern		X*				6
Dryopteris marginalis	marginal wood fern		X				6-7
Dryopteris spinulosa	spinulose wood fern		X				6
Dryopteris x boottii	Boott's wood fern		X				n.o.
Dryopteris x triploidea	hybrid wood fern		X				n.o.
Matteuccia struthiopteris	ostrich fern	X*					10-11
Onoclea sensibilis	sensitive fern	X	X	X		X	n.o.
Polypodium virginianum	common polypody		X				7
Polystichum acrostichoides	Christmas fern		X				6
Pteridium aquilinum	bracken		X	X			n.o.
Thelypteris noveboracensis	New York fern		X				7
Thelypteris palustris	marsh fern					X	9-10
Woodsia obtusa	blunt-lobed woodsia		X				6-7
MAGNOLIOPHYTA-DICOTYLEDONEAE							
AIZOACEAE							
Mollugo verticellata	carpet-weed			X			6
APOCYNACEAE							
Apocynum androsaemifolium	dogbane		X				6-8
Apocynum cannabinum	Indian hemp			X			6-7
Vinca minor	periwinkle		X				4-5

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
ARALIACEAE							
Aralia nudicaulis	wild sarsaparilla		X				n.o.
Panax trifolium	dwarf ginseng		X				5
ASCLEPIADACEAE							
Asclepias amplexicaulis	blunt-leaved milkweed			X			6
Asclepias incarnata	swamp milkweed					X	7
Asclepias quadrifolia	four-leaved milkweed		X				5
Asclepias syriaca	common milkweed			X	X		6-7
Asclepias tuberosa	butterfly-weed		X	X			7
ASTERACEAE							
Achillea millefolium	yarrow		X	X			6-10
Ambrosia artemisiifolia	ragweed		X	X			8
Ambrosia trifida	giant ragweed			X			8
Anaphalis margaritacea	pearly everlasting		X				8
Antennaria neglecta	pussytoes		X	X			4
Antennaria plantaginifolia	pussytoes		X				4-5
Anthemis cotula	mayweed			X			6
Arctium minus	burdock	X			X		8
Aster acuminatus	whorled wood aster		X				9
Aster cordifolius	heart-leaved aster	X	X	X		X	9-10
Aster divaricatus	white wood aster	X	X				8-10
Aster dumosus	aster		X				10
Aster ericoides	heath aster		X	X*			9-10
Aster lateriflorus	calico aster	X	X	X			9-10
Aster novae-angliae	New England aster					X	9-10
Aster patens	late purple aster		X				9
Aster paternus	aster		X				7-8
Aster puniceus	purple-stemmed aster			X		X	9-10
Aster simplex	aster	X	X	X*		X	9-10
Aster undulatus	aster		X				10
Bidens cernua	beggar-ticks	X				X	9-10
Bidens frondosa	beggar-ticks					X	9
Bidens tripartita	beggar-ticks	X		X			9
Cacalia suaveolens	Indian-plantain	X					9
Centaurea maculosa	spotted knapweed			X			8
Chrysanthemum leucanthemum	ox-eye diasy		X	X			6-8
Cichorium intybus	chicory		X				7
Cirsium arvense	Canada thistle					X	7
Cirsium vulgare	bull thistle			X	X		8-9
Conyza canadensis	horseweed		X	X			8-9
Erechtites hieracifolia	fireweed	X	X			X	9-10
Erigeron annus	diasy fleabane	X	X	X			6-10
Eupatorium maculatum	spotted Joe-Pye-weed			X		X	7-8
Eupatorium perfoliatum	boneset			X		X	7-9
Eupatorium rugosum	white snakeroot	X	X	X		X	7-10
Galinsoga ciliata	galinsoga		X				8-10
Gnaphalium obtusifolium	cudweed	X	X	X			9-10
Helenium autumnale	sneezeweed	X	X	X		X	8-10
Helianthus divaricatus	woodland sunflower		X				7-8
Helianthus tuberosus	Jerusalem artichoke	X		X			8-9
Heliopsis helianthoides	ox-eye	X					9
Hieracium paniculatum	hawkweed		X				8
Hieracium pratense	hawkweed		X	X	X		5-6
Hieracium venosum	rattlesnake-weed		X				5-6
Krigia virginica	dwarf dandelion		X				5-6
Lactuca canadensis	wild lettuce		X	X			6-10
Matricaria matricarioides	pineapple-weed		X		X		6-7
Prenanthes alba	tall white lettuce		X				8
Rudbeckia hirta	black-eyed susan		X	X	X		6-10
Rudbeckia laciniata	coneflower	X					8-9
Senecio aureus	golden ragwort	X	X				5
Senecio obovatus	roundleaf ragwort		X				4-6
Solidago arguta	sharp-leaved goldenrod		X				7
Solidago bicolor	silverrod		X				8-10
Solidago caesia	blue-stemmed goldenrod		X				9-10
Solidago canadensis	Canada goldenrod	X	X	X			9
Solidago flexicaulis	zigzag goldenrod	X	X				9-10
Solidago gigantea	late goldenrod	X	X			X	8-10
Solidago graminifolia	flat-topped goldenrod		X	X		X	8-10
Solidago juncea	early goldenrod		X	X	X	X	7-9
Solidago nemoralis	little grey goldenrod		X	X			8-10
Solidago rugosa	rough goldenrod	X	X	X*		X	8-10
Taraxacum officinale	dandelion	X	X	X			4-6
Tussilago farfara	coltsfoot		X				3-4
Vernonia noveboracensis	ironweed					X	9
Xanthium strumarium	cocklebur			X	X		n.o.

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
BALSAMINACEAE							
Impatiens biflora	jewelweed	X	X			X	6-10
Impatiens pallida	pale jewelweed	X					8
BERBERIDACEAE							
Caulophyllum thalictroides	blue cohosh	X					5
Podophyllum peltatum	May apple	X*	X				4-5
BORAGINACEAE							
Hackelia virginiana	beggar's lice	X				X	7
Mertensia virginica	Virginia bluebells	X					4-5
Myosotis laxa	forget-me-not					X	7
Myosotis scorpioides	forget-me-not	X				X	5-6
CALLITRICHACEAE							
Callitriche heterophylla	water starwort					X	6
CAMPANULACEAE							
Triodanis perfoliata	Venus' looking-glass		X	X			6-7
CANNABINACEAE							
Cannabis sativa	marijuana	X					n.o.
CAPRIFOLIACEAE							
Lonicera japonica	Japanese honeysuckle	X					n.o.
CARYOPHYLLACEAE							
Cerastium arvense	field chickweed	X	X				5
Cerastium vulgatum	mouse-ear chickweed		X				5
Dianthus armeria	deptford pink		X	X			6-8
Lychnis alba	white campion		X				5-6
Paronychia canadensis	whitlow-wort		X				7
Saponaria officinalis	bouncing bet		X	X			7-10
Silene stellata	starry campion		X				7
Stellaria aquatica	chickweed	X					5-8
Stellaria graminea	common stitchwort						n.o.
Stellaria longifolia	chickweed	X	X			X	5-6
Stellaria media	common chickweed		X	X			5-6
CHENOPODIACEAE							
Chenopodium album	lamb's quarters		X				8
Chenopodium ambrosioides	Mexican tea		X				7-8
CISTACEAE							
Helianthemum canadense	frostweed		X				5
CONVOLVULACEAE							
Convolvulus sepium	hedge bindweed			X			6
Cuscuta gronovii	dodder					X	7-10
CRASSULACEAE							
Sedum telephium	orpine						n.o.
CRUCIFERAE							
Alliaria officinalis	garlic mustard	X*					4-7
Arabidopsis thalliana	mouse-ear cress	X	X	X	X		4-5
Arabis laevigata	rock cress	X					5
Arabis lyrata	rock cress	X	X				4-5
Arabis shortii	rock cress	X					5
Barbarea vulgaris	wintercress	X	X	X	X	X	4-5
Brassica kaber	charlock	X					6
Brassica nigra	black mustard		X				6-7
Capsella bursa-pastoris	shepherds purse			X			5-6
Cardamine bulbosa	bitter cress	X					5
Cardamine pensylvanica	bitter cress		X				4-6
Cardamine pratensis	cuckoo-flower	X					5
Dentaria diphylla	pepperwort		X				5
Dentaria laciniata	cut-leaf toothwort	X					4-5
Erysimum cheiranthoides	wormseed mustard		X				6
Hesperis matronalis	dame's rocket	X*					5-6
Lepidium campestre	field cress		X	X			5
Nasturtium officinale	water-cress					X	6
Rorippa sylvestris	yellow cress	X					5-6
Sisymbrium altissimum	tumble mustard						6
Thlaspi arvense	field pennycress						6

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
CUCURBITACEAE							
Sicyos angulatus	bur-cucumber	X					8-9
ERICACEAE							
Chimaphila maculata	spotted wintergreen		X				7
Epigaea repens	trailing arbutus		X				4
Gaultheria procumbens	wintergreen		X				n.o.
Monotropa uniflora	Indian pipe		X				7
Pyrola elliptica	shinleaf		X				7
EUPHORBIACEAE							
Acalypha virginica	three-seeded mercury		X	X			9-10
Euphorbia preslii	spurge		X				8
GERANIACEAE							
Geranium carolinianum	Carolina cranesbill		X				6
Geranium maculatum	wild geranium		X				5-6
GUTTIFERAE							
Hypericum mutilum	St. John's wort					X	7-8
Hypericum perforatum	common St. John's wort		X	X	X		6-8
Hypericum punctatum	spotted St. John's wort	X	X	X	X	X	6-8
Hypericum pyramidatum	great St. John's wort	X		X			6-7
Triadenum virginicum	marsh St. John's wort					X	7-9
HYDROPHYLLACEAE							
Hydrophyllum virginianum	waterleaf	X					5
LABIATAE							
Cunila origanoides	dittany		X				8
Galeopsis tetrahit	hemp-nettle	X					8
Glecoma hederacea	gill-over-the-ground	X	X*				4-5
Hedeoma pulegioides	American pennyroyal		X				8
Leonurus cardiaca	motherwort	X	X				6-7
Lycopus americanus	water horehound			X		X	7-9
Lycopus virginicus	water horehound					X	6-9
Monarda clinopodia	wild bergamot	X					7
Nepeta cataria	catnip			X			7
Prunella vulgaris	self-heal	X	X	X			7-9
Pycnanthemum incanum	mountain-mint		X				7-8
Pycnanthemum virginianum	mountain-mint		X				7
Satureja vulgaris	wild basil		X	X			6-8
Scutellaria lateriflora	skullcap					X	8
Scutellaria galericulata	skullcap					X	7
Stachys hispida	rough hedge-nettle	X		X		X	6
Teucrium canadense	wood-sage	X	X	X			7-8
Trichostema dichotomum	blue curls			X			9
LEGUMINOSAE							
Amphicarpa bracteata	hog-peanut		X				8
Apios americana	groundnut						n.o.
Baptisia tinctoria	wild indigo		X				6-8
Coronilla varia	crown vetch		X				6-8
Desmodium canescens	tick-trefoil			X			8
Desmodium dillenii	tick-trefoil		X	X	X		7-8
Desmodium glutinosum	tick-trefoil		X				7
Desmodium lineatum	tick-trefoil		X				8
Desmodium nudiflorum	tick-trefoil		X				8
Desmodium paniculatum	tick-trefoil		X				7-8
Lathyrus latifolius	everlasting pea				X		6
Lespedeza virginica	bush clover		X				8
Lotus corniculatus	bird's-foot trefoil		X				7
Medicago lupulina	black medick			X			5-6
Melilotus alba	white sweet clover		X				6-8
Melilotus officinalis	yellow sweet cover			X	X		6
Trifolium agrarium	hop-clover		X	X			6-7
Trifolium hydridum	alsike clover			X			6
Trifolium pratense	red clover		X	X			5-7
Trifolium repens	white clover		X	X			5-7
Vicia cracca	cow vetch				X		n.o.
LIMNANTHACEAE							
Floerkia proserpinacoides	false mermaid	X*					5
LINACEAE							
Linum virginianum	wild flax		X				7

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
LOBELIACEAE							
Lobelia cardinalis	cardinal-flower			X			8
Lobelia inflata	Indian-tobacco	X	X	X			7-8
Lobelia siphilitica	great lobelia			X		X	8-10
MALVACEAE							
Abutilon theophrasti	velvet-leaf				X		8-10
ONAGRACEAE							
Circaea quadrisulcata	enchanter's nightshade	X	X			X	6-8
Epilobium coloratum	willow-herb		X	X		X	8
Gaura biennis	biennial gaura			X			8
Ludwigia alternifolia	seed-box					X	7-9
Oenothera biennis	evening-primrose		X	X		X	7-9
OROBANCHACEAE							
Orobanche uniflora	cancer-root						5
OXALIDACEAE							
Oxalis dillenii	yellow wood sorrel	X	X	X			5-9
Oxalis stricta	yellow wood sorrel	X	X				6-8
Oxalis violacea	violet wood sorrel		X				5
PAPAVERACEAE							
Chelidonium majus	celandine	X	X				5-6
Dicentra cucullaria	Dutchman's breeches	X*					4-5
Sanguinaria canadensis	bloodroot		X				4
PHYTOLACCACEAE							
Phytolacca americana	pokeweed	X	X			X	7-9
PLANTAGINACEAE							
Plantago lanceolata	English plantain		X	X			7
POLEMONIACEAE							
Phlox subulata	moss-pink		X				4-5
POLYGALACEAE							
Polygala paucifolia	fringed polygala		X				5
Polygala verticillata	whorled milkwort			X			7-9
POLYGONACEAE							
Polygonum arifolium	halberd-leaved tearthumb					X	9
Polygonum caespitosum	long-bristled smartweed	X					6
Polygonum cilinode	bindweed	X	X				5-8
Polygonum cuspidatum	Mexican bamboo	X					8-9
Polygonum hydropiperoides	mild water pepper	X	X			X	7-10
Polygonum natans	water smartweed					X	9
Polygonum pensylvanicum	smartweed		X	X		X	7-10
Polygonum persicaria	smartweed	X	X				6-10
Polygonum punctatum	smartweed		X	X			7
Polygonum sagittatum	arrow-leaved tearthumb	X				X*	6-10
Polygonum scandens	false buckwheat	X					9-10
Polygonum virginianum	Virginia knotweed	X*	X			X	7-9
Rumex acetosella	sheep sorrel	X	X	X*			4-7
Rumex crispus	curly dock		X	X			6
Rumex obtusifolius	bitter dock	X	X				6-7
Rumex patientia	patience dock	X					5-6
PORTULACACEAE							
Claytonia virginica	spring beauty	X					4
PRIMULACEAE							
Lysimachia ciliata	fringed loosestrife	X				X	6-7
Lysimachia quadrifolia	whorled loosestrife		X			X	6
Lysimachia terrestris	yellow loosestrife					X	5-7
Lysimachia vulgaris	garden loosestrife			X			7
Trientalis borealis	starflower		X				5
RANUNCULACEAE							
Anemone canadensis	Canada anemone					X	6
Anemone quinquefolia	wood anemone		X				5
Anemone virginiana	thimbleweed		X				7
Anemonella thalictroides	rue anemone		X				4-5
Aquilegia canadensis	columbine		X				4-5
Cimicifuga racemosa	bugbane		X				7-8

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
RANUNCULACEAE (cont.)							
Clematis virginiana	virgin's bower		X				8
Coptis trifolia	goldthread		X				5
Hepatica americana	hepatica		X				3-4
Ranunculus abortivus	kidneyleaf buttercup	X	X				4-5
Ranunculus acris	common buttercup		X	X			5-7
Ranunculus pensylvanicus	buttercup					X	6-7
Ranunculus recurvatus	buttercup		X				5
Ranunculus repens	creeping buttercup	X		X			5-10
Thalictrum polygamum	tall meadow rue	X	X				6-7
ROSACEAE							
Agrimonia grypsosepala	agrimony	X	X				7-8
Fragaria virginiana	wild strawberry	X	X	X			4-5
Geum canadense	avens	X	X*	X			6-7
Geum laciniatum	avens					X	6
Gillenia trifoliata	bowman's root		X				6
Potentilla canadensis	dwarf cinquefoil		X				4-5
Potentilla norvegica	rough cinquefoil	X	X	X			6-8
Potentilla recta	rough-fruited cinquefoil			X	X		6-8
Potentilla simplex	cinquefoil	X	X*	X*			4-6
RUBIACEAE							
Galium aparine	cleavers	X	X			X	5-6
Galium asprellum	bedstraw	X					7
Galium circaezans	bedstraw		X				6-7
Galium palustre	bedstraw			X			6
Galium trifidum	bedstraw					X	6-7
Galium triflorum	bedstraw		X				7-8
Houstonia caerulea	bluets		X	X			4-6
Mitchella repens	partridge-berry		X				n.o.
SANTALACEAE							
Commandra umbellata	bastard toad-flax		X				5
SAXIFRAGACEAE							
Saxifraga virginiensis	early saxifrage	X	X				4-5
Mitella diphylla	miterwort		X				5
SCROPHULARIACEAE							
Aureolaria virginica	downy false foxglove		X				7-8
Chelone glabra	turtle-head	X					9
Gerardia tenuifolia	slender gerardia			X			9
Linaria vulgaris	butter-and-eggs		X	X			7-10
Lindernia dubia	false pimpernel	X					7
Melampyrum lineare	cow-wheat		X				6-8
Mimulus ringens	monkey-flower	X				X	7-9
Pedicularis canadensis	lousewort		X				5
Penstemon hirsutus	hairy beardtongue		X				5-6
Scrophularia lanceolata	figwort	X	X				5-6
Verbascum blattaria	moth-mullein			X	X		6
Verbascum thapsus	common mullein	X	X	X			7-8
Veronica anagallis-aquatica	water speedwell					X	6
Veronica arvensis	speedwell		X	X		X	4-6
Veronica officinalis	common speedwell		X				5-6
Veronica serpyllifolia	speedwell			X			5
SOLANACEAE							
Solanum carolinense	horse-nettle	X	X	X			6-8
Solanum dulcamara	nightshade	X	X				6-8
Solanum nigrum	black nightshade		X				8
UMBELLIFERAE							
Cicuta maculata	water hemlock			X			7
Cryptotaenia canadensis	honewort		X				6
Daucus carota	Queen Anne's lace	X	X	X			7-10
Osmorhiza claytoni	sweet cicely	X	X				5-6
Pastinaca sativa	wild parsnip			X			7
Sanicula marilandica	black snakeroot		X				6
URTICACEAE							
Boehmeria cylindrica	false nettle	X				X	7
Pilea pumila	clearweed	X					8
Urtica dioica	stinging nettle	X				X	6-8

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering
		RF	UF	AF	AG	OM	Date
VERBENACEAE							
Verbena hastata	blue vervain	X	X			X	6-8
Verbena urticifolia	white vervain	X	X	X			7-8
VIOLACEAE							
Viola blanda	sweet white violet	X	X				4-5
Viola conspersa	American dog-violet		X				4-5
Viola cucullata	blue marsh violet		X				5
Viola eriocarpa	smooth yellow violet	X					4
Viola fimbriatula	northern downy violet		X	X			4-5
Viola palmata	wood-violet		X				4-5
Viola papilionacea	common blue violet	X*	X*	X			4-5
Viola pubsecens	downy yellow violet	X	X				4-5
Viola soriora	woolly blue violet	X	X				4-5
Viola striata	pale violet	X					5
MAGNOLIOPHYTA-MONOCOTYLEDONEAE							
ALISMACEAE							
Alisma subcordatum	water-plantain					X	7-9
Sagittaria latifolia	arrow-head					X*	7-8
AMARYLLIDACEAE							
Hypoxis hirsuta	stargrass		X				5
ARACEAE							
Arisaema dracontium	green dragon	X					5
Arisaema triphyllum	jack-in-the-pulpit	X	X				5
Symplocarpus foetidus	skunk cabbage	X				X*	n.o.
COMMELINACEAE							
Commelina communis	day-flower		X				6-10
CYPERACEAE							
Bulbostylis capillaris	sedge			X			7
Carex annectens	sedge			X*			n.o.
Carex bromoides	sedge	X					5
Carex comosa	sedge					X	n.o.
Carex crinita	sedge	X				X*	5
Carex debilis	sedge		X				n.o.
Carex intumescens	sedge	X					5
Carex laevivaginata	sedge					X	n.o.
Carex laxiflora	sedge	X					5
Carex lurida	sedge					X	6
Carex muhlenbergii	sedge		X			X	6
Carex pensylvanica	sedge		X				4
Carex rosea	sedge	X	X	X			5
Carex scoparia	sedge			X		X*	n.o.
Carex stipata	sedge	X				X	5
Carex stricta	sedge					X	6
Carex swannii	sedge		X*	X			5-6
Carex tribuloides	sedge	X					5
Carex vulpinoidea	sedge			X		X	6
Carex sp. (unidentified)	sedge	X					5
Cyperus esculentus	yellow nut-grass				X		n.o.
Cyperus filiculmis	galingale			X			n.o.
Cyperus strigosus	galingale	X				X	n.o.
Eleocharis ovata	spike-rush					X	6
Scirpus atrovirens	bulrush					X	6
Scirpus cyperinus	wool grass					X*	6
Scirpus validus	great bulrush					X	6
DIOSCOREACEAE							
Dioscorea villosa	wild yam		X				6-7
GRAMINEAE							
Agrostis perennans	autumn bent		X				5
Agrostis stolonifera	bentgrass			X*			n.o.
Andropogon scoparius	little bluestem		X	X*			n.o.
Anthoxanthum odoratum	sweet vernal grass		X	X		X	5
Aristida dichotoma	three-awn		X				n.o.
Bromus japonicus	Japanese chess		X				n.o.
Bromus mollis	soft chess	X					n.o.
Bromus tectorum	downy chess	X					n.o.
Cinna arundinacea	stout woodreed			X			n.o.
Dactylis glomerata	orchard grass		X	X			n.o.
Danthonia spicata	poverty oatgrass		X	X*			6

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
GRAMINEAE (cont.)							
Deschampsia flexuosa	hairgrass		X				6
Digitaria ischaemum	crabgrass			X			n.o.
Digitaria sanguinalis	crabgrass		X		X		n.o.
Echinochloa muricata	barnyard grass	X	X	X	X		n.o.
Elymus riparius	wild rye	X					n.o.
Elymus villosus	wild rye	X					6
Elymus virginicus	wild rye		X				n.o.
Eragrostis capillaris	lovegrass		X				n.o.
Eragrostis frankii	lovegrass	X					n.o.
Eragrostis hypnoides	lovegrass	X					n.o.
Eragrostis spectabilis	purple lovegrass			X			7
Festuca obtusa	nodding fescue	X					5
Glyceria canadensis	rattlesnake mannagrass					X	6
Glyceria striata	fowl mannagrass					X	6
Holcus lanatus	velvet grass		X				n.o.
Hystrix patula	bottlebrush		X				n.o.
Leersia oryzoides	rice cutgrass					X*	8
Leersia virginica	white grass		X				8
Lolium perenne	perennial ryegrass	X					5
Muhlenbergia frondosa	wirestem muhly	X					n.o.
Muhlenbergia schreberi	nimblewill		X				n.o.
Muhlenbergia sylvatica	muhly		X				n.o.
Panicum capillare	witchgrass	X		X	X*		n.o.
Panicum commutatum	panic-grass		X				6
Panicum dichotomiflorum	panic-grass	X					n.o.
Panicum lanuginosum	panic-grass		X	X			n.o.
Panicum virgatum	switchgrass		X	X			8
Panicum spp.	panic-grass		X	X			n.o.
Phalaris arundinacea	reed canary grass	X				X	5-6
Phleum pratense	timothy	X	X	X*			6
Poa compressa	Canada bluegrass		X	X			7
Poa palustris	fowl bluegrass			X			n.o.
Poa pratensis	Kentucky bluegrass	X	X	X			5
Setaria faberii	nodding foxtail		X		X		8
Setaria glauca	foxtail grass	X	X				8
Setaria italica	foxtail millet			X			n.o.
Sphenopholis intermedia	wedgegrass		X				6
Triodia flava	purpletop		X	X			8
HYDROCHARITACEAE							
Anacharis canadensis	water-weed					X	6
IRIDACEAE							
Iris versicolor	blue flag	X				X	5-6
Sisyrinchium angustifolium	blue-eyed grass		X	X		X	5-6
JUNCACEAE							
Juncus articulatus	rush					X	6
Juncus effusus	rush	X				X*	6
Juncus tenuis	path rush		X	X			6
Luzula campestris	wood rush		X				4-5
LEMNACEAE							
Lemna minor	duckweed					X	n.o.
LILIACEAE							
Allium canadense	wild garlic	X					6
Allium vineale	field garlic	X		X			7
Asparagus officinalis	asparagus			X			6
Erythronium albidum	white trout-lily	X					4
Erythronium americanum	trout-lily	X*					4-5
Hemerocallus fulva	day-lily		X				6-7
Lilium canadense	Canada lily	X					7
Maianthemum canadense	wild lily-of-the-valley		X				5
Medeola virginiana	Indian cucumber		X				5
Ornithogalum umbellatum	star of Bethlehem		X				4
Polygonatum biflorum	Soloman's seal	X	X				4-5
Polygonatum pubescens	Soloman's seal		X				5
Smilacina racemosa	false Soloman's seal		X				5-6
Trillium erectum	purple trillium	X					4-5
Uvularia perfoliata	perfoliate bellwort		X				4-5
Uvularia sessilifolia	sessile-leaved bellwort	X	X				4-5
Veratrum viride	false hellebore	X					n.o.

Table K-2 (cont.)

Scientific Name	Common Name	Habitat					Flowering Date
		RF	UF	AF	AG	OM	
NAJADACEAE							
Potamogeton spirillus	pondweed					X	6
ORCHIDACEAE							
Cypripedium acaule	pink lady's slipper		X				4-5
Epipactis helleborine	helleborine	X					7
Goodyera pubescens	rattlesnake plantain		X				7
Habenaria lacera	ragged fringed orchid			X			7
Spiranthes cernua	ladies' tresses			X			9-10
SPARGANIACEAE							
Sparganium eurycarpum	bur-reed					X	6
TYPHACEAE							
Typha angustifolia	narrow-leaf cat-tail					X	7
Typha latifolia	cat-tail					X*	6

Table K-3. Vegetation analysis for trees in the Council Cup forest, 1977.

Species	Common Name	Frequency	Relative Frequency	Density (No./ha)	Relative Density	Dominance (ba/ha)	Relative Dominance	Importance Value
Betula lenta	sweet birch	0.70	26.4	225	38.5	52635	32.7	97.6
Quercus prinus	chestnut oak	0.25	9.4	65	11.1	17490	10.9	31.4
Quercus velutina	black oak	0.35	13.2	55	9.4	10440	6.5	29.1
Pinus strobus	white pine	0.25	9.4	50	8.5	16305	10.1	28.0
Quercus borealis	red oak	0.20	7.5	45	7.7	11615	7.2	22.4
Acer rubrum	red maple	0.25	9.4	40	6.8	9400	5.8	22.0
Pinus virginiana	Virginia pine	0.15	5.7	40	6.8	12855	8.0	20.5
Quercus alba	white oak	0.10	3.8	15	2.6	21240	13.2	19.6
Cornus florida	flowering dogwood	0.10	3.8	15	2.6	3030	1.9	8.3
Populus grandidentata	big-tooth aspen	0.10	3.8	15	2.6	2840	1.8	8.2
Pyrus malus	apple	0.05	1.9	5	0.9	1135	0.7	3.5
Carya glabra	pignut hickory	0.05	1.9	5	0.9	1005	0.6	3.4
Sassafras albidum	sassafras	0.05	1.9	5	0.9	475	0.3	3.1
Tsuga canadensis	hemlock	0.05	1.9	5	0.9	395	0.2	3.0
Total		--	100.0	585	100.2	160860	99.9	300.1

Table K-4. Vegetation analysis for saplings in the Council Cup forest, 1977.

Species	Common Name	Frequency	Relative Frequency	Density (No./ha)	Relative Density	Dominance (ba/ha)	Relative Dominance	Importance Value
Betula lenta	sweet birch	0.70	11.7	655	24.2	9515	23.2	59.1
Acer rubrum	red maple	0.85	14.2	665	24.6	7550	18.4	57.2
Quercus borealis	red oak	0.60	10.0	285	10.5	5580	13.6	34.1
Quercus prinus	chestnut oak	0.45	7.5	275	10.2	4755	11.6	29.3
Quercus velutina	black oak	0.50	8.3	180	6.7	4170	10.2	25.2
Betula populifolia	gray birch	0.45	7.5	135	5.0	2985	7.3	19.8
Pinus strobus	white pine	0.55	9.2	120	4.4	1825	4.4	18.0
Carya glabra	pignut hickory	0.40	6.7	75	2.8	1150	2.8	12.3
Quercus alba	white oak	0.30	5.0	100	3.7	645	1.6	10.3
Cornus florida	flowering dogwood	0.20	3.3	50	1.8	450	1.1	6.2
Prunus serotina	black cherry	0.20	3.3	45	1.7	230	0.6	5.6
Sassafras albidum	sassafras	0.20	3.3	30	1.1	455	1.1	5.5
Prunus pensylvanica	pin cherry	0.10	1.7	15	0.6	575	1.4	3.7
Pinus virginiana	Virginia pine	0.10	1.7	15	0.6	505	1.2	3.5
Fraxinus americana	white ash	0.15	2.5	15	0.6	25	0.1	3.2
Amelanchier arborea	shad-bush	0.10	1.7	15	0.6	135	0.3	2.6
Tsuga canadensis	hemlock	0.05	0.8	20	0.7	450	1.1	2.6
Castanea dentata	chestnut	0.10	1.7	10	0.4	80	0.2	2.3
Total		--	100.1	2705	100.2	41080	100.2	300.5

Table K-5. Vegetation analysis for tree seedlings in the Council Cup forest, 1977.

Species	Common Name	Frequency	Relative Frequency	Dominance (cover/m^2)	Relative Dominance	Importance Value
Acer rubrum	red maple	0.52	30.4	1.38	24.4	54.8
Quercus prinus	chestnut oak	0.18	10.1	1.10	19.5	29.6
Prunus serotina	black cherry	0.30	17.4	0.55	9.7	27.1
Quercus borealis	red oak	0.20	11.6	0.85	15.0	26.6
Betula lenta	sweet birch	0.15	8.7	0.75	13.3	22.0
Quercus velutina	black oak	0.08	4.3	0.25	4.4	8.7
Carya glabra	pignut hickory	0.05	2.9	0.20	3.5	6.4
Fraxinus americana	white ash	0.05	2.9	0.20	3.5	6.4
Pinus strobus	white pine	0.05	2.9	0.18	3.2	6.1
Sassafras albidum	sassafras	0.05	2.9	0.10	1.8	4.7
Quercus alba	white oak	0.05	2.9	0.05	0.9	3.8
Betula populifolia	gray birch	0.02	1.4	0.02	0.4	1.8
Populus tremuloides	quaking aspen	0.02	1.4	0.02	0.4	1.8
Total		--	99.8	5.65	100.0	199.8

Table K-6. Vegetation analysis for shrubs, herbs, and ground cover in the Council Cup forest, 1977.

Species	Common Name	Frequency	Relative Frequency	Dominance (cover/m^2)	Relative Dominance	Importance Value
SHRUBS						
Vaccinium vacillans	low-bush blueberry	0.50	50.0	8.15	59.5	109.5
Kalmia latifolia	mountain laurel	0.15	15.0	3.32	24.3	39.3
Rhododendron nudiflorum	pinxter-flower	0.10	10.0	1.32	9.6	19.6
Rhus radicans	poison ivy	0.15	15.0	0.38	2.8	17.8
Rubus allegheniensis	blackberry	0.05	5.0	0.12	0.9	5.9
Viburnum acerifolium	malpe-leaf viburnum	0.02	2.5	0.38	2.8	5.3
Parthenocissus quinquefolia	Virginia creeper	0.02	2.5	0.02	0.1	2.6
HERBS						
Lycopodium flabelliforme	ground pine	0.38	35.7	4.58	48.4	84.1
Aralia nudicaulis	wild sarsaparilla	0.12	11.9	2.80	29.6	41.5
Dennstaedtia punctilobula	hay-scented fern	0.08	7.1	1.28	13.5	20.6
Polygala paucifolia	fringed polygala	0.08	7.1	0.18	1.9	9.0
Maianthemum canadense	wild lily-of-the-valley	0.05	4.8	0.25	2.6	7.4
Chimaphila maculata	spotted wintergreen	0.05	4.8	0.05	0.5	5.3
Lysimachia quadrifolia	whorled loosestrife	0.05	4.8	0.05	0.5	5.3
Pyrola elliptica	shinleaf	0.05	4.8	0.05	0.5	5.3
Deschampsia flexuosa	hairgrass	0.02	2.4	0.08	0.8	3.2
Carex swannii	sedge	0.02	2.4	0.02	0.2	2.6
Galium circaezans	bedstraw	0.02	2.4	0.02	0.2	2.6
Gaultheria procumbens	wintergreen	0.02	2.4	0.02	0.2	2.6
Medeola virginiana	Indian cucumber	0.02	2.4	0.02	0.2	2.6
Mitchella repens	partridge berry	0.02	2.4	0.02	0.2	2.6
Prenanthes alba	tall white lettuce	0.02	2.4	0.02	0.2	2.6
Grass (unidentified)	--	0.02	2.4	0.02	0.2	2.6
GROUND COVER						
Litter	--	1.00	65.6	97.80	98.2	163.8
Moss	--	0.32	21.3	0.55	0.6	21.9
Rock	--	0.12	8.2	0.88	0.9	9.1
Bare Soil	--	0.08	4.9	0.32	0.3	5.2

Table K-7. Vegetation analysis for trees in the Township Road 419 forest, 1977.

Species	Common Name	Frequency	Relative Frequency	Density (No./ha)	Relative Density	Dominance (ba/ha)	Relative Dominance	Importance Value
Quercus velutina	black oak	0.50	16.5	112	19.4	75758	35.7	71.6
Pinus virginiana	Virginia pine	0.38	12.5	125	21.7	50654	23.9	58.1
Cornus florida	flowering dogwood	0.46	15.2	75	13.0	8775	4.1	32.3
Acer rubrum	red maple	0.29	9.6	50	8.7	12338	5.8	24.1
Pinus strobus	white pine	0.21	6.9	46	8.0	12783	6.0	20.9
Quercus prinus	chestnut oak	0.29	9.6	42	7.3	8533	4.0	20.9
Prunus serotina	black cherry	0.17	5.6	33	5.7	10492	4.9	16.2
Carya tomentosa	mockernut hickory	0.21	6.9	29	5.0	5842	2.8	14.7
Quercus alba	white oak	0.08	2.6	8	1.4	8917	4.2	8.2
Pyrus malus	apple	0.08	2.6	12	2.1	2554	1.2	5.9
Fraxinus americana	white ash	0.08	2.6	8	1.4	3788	1.8	5.8
Prunus avium	sweet cherry	0.08	2.6	8	1.4	3775	1.8	5.8
Tsuga canadensis	hemlock	0.04	1.3	8	1.4	3942	1.9	4.6
Betula populifolia	gray birch	0.04	1.3	8	1.4	1196	0.6	3.3
Liriodendron tulipifera	tulip-tree	0.04	1.3	4	0.7	2046	1.0	3.0
Sassafras albidum	sassafras	0.04	1.3	4	0.7	642	0.3	2.3
Carya glabra	pignut hickory	0.04	1.3	4	0.7	329	0.2	2.2
Total		--	99.7	576	100.0	212364	100.2	299.9

Table K-8. Vegetation analysis for saplings in the Township Road 419 forest, 1977.

Species	Common Name	Frequency	Relative Frequency	Density (No./ha)	Relative Density	Dominance (ba/ha)	Relative Dominance	Importance Value
Cornus florida	flowering dogwood	0.79	24.9	567	47.9	14250	55.5	128.3
Quercus velutina	black oak	0.29	9.1	208	17.6	3008	11.7	38.4
Acer rubrum	red maple	0.50	15.8	67	5.7	1167	4.5	26.0
Carya tomentosa	mockernut hickory	0.25	7.9	75	6.3	2150	8.4	22.6
Carya glabra	pignut hickory	0.21	6.6	42	3.6	1108	4.3	14.5
Betula populifolia	gray birch	0.12	3.8	46	3.9	946	3.7	11.4
Prunus serotina	black cherry	0.21	6.6	33	2.8	467	1.8	11.2
Pinus virginiana	Virginia pine	0.12	3.8	29	2.5	1146	4.5	10.8
Crataegus sp.	hawthorne	0.12	3.8	25	2.1	246	1.0	6.9
Quercus prinus	chestnut oak	0.12	3.8	25	2.1	188	0.7	6.6
Quercus alba	white oak	0.08	2.5	21	1.8	404	1.6	5.9
Amelanchier arborea	shad-bush	0.08	2.5	17	1.4	317	1.2	5.1
Fagus grandifolia	American beech	0.08	2.5	8	0.7	42	0.2	3.4
Quercus borealis	red oak	0.08	2.5	8	0.7	58	0.2	3.4
Fraxinus americana	white ash	0.04	1.3	4	0.3	83	0.3	1.9
Pinus strobus	white pine	0.04	1.3	4	0.3	83	0.3	1.9
Sassafras albidum	sassafras	0.04	1.3	4	0.3	4	0.0	1.6
Total		--	100.0	1183	100.0	25667	99.9	299.9

Table K-9. Ages and diameter breast height (dbh) of selected trees in the Council Cup forest, 1977.

Species	Common Name	Age (years)[a]	dbh (cm)
Acer rubrum	red maple	20	14.5
		34+	18.0
Betula lenta	sweet birch	24+	23.0
Liriodendron tulipifera	tulip-tree	59	28.5
Pinus strobus	white pine	95+	45.0
		56	30.5
		47+	30.5
		44+	37.0
Pinus virginiana	Virginia pine	52	19.5
		50+	24.0
Populus grandidentata	big-toothed aspen	17	14.0
Quercus alba	white oak	101+	42.5
		60++	34.0
Quercus prinus	chestnut oak	105+	42.0
		92++	31.5

[a] + indicates center of tree not reached, less than 5 years additional.
++ indicates center of tree not reached or rotten center, more than 5 years additional.

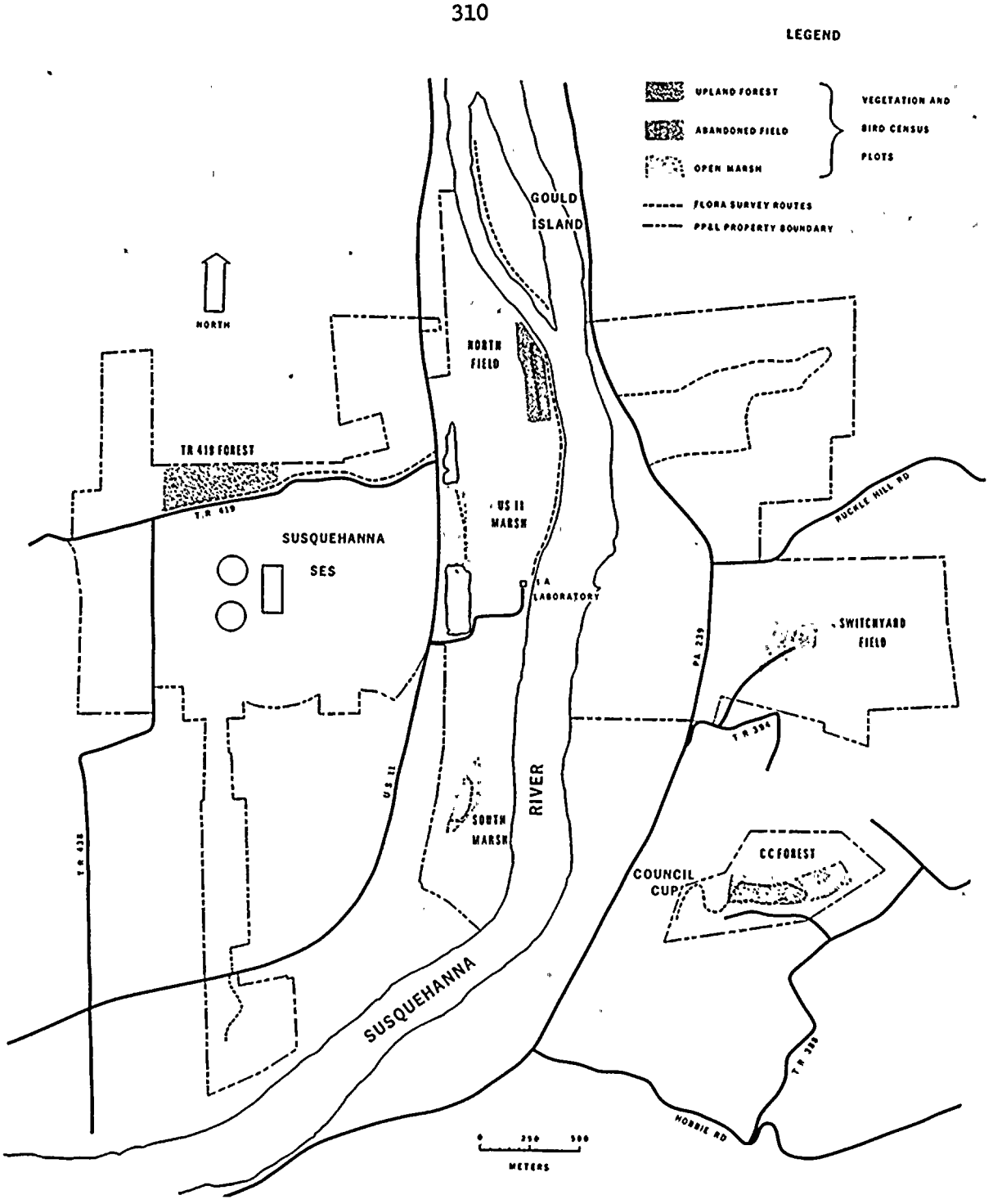

Fig. K-1. Location of vegetation and bird census plots and flora survey routes near the Susquehanna SES, 1977.

BIRDS

by

Robert M. Ruhe

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ABSTRACT

In 1977, 179 species of birds, 42 of which had not been seen previously, were observed near the Susquehanna SES. Included were 18 species of waterfowl seen during the spring and fall migrations. Breeding bird surveys revealed that a total of 26 species maintained territories on three study plots (two wooded, one marsh). Considering other available habitats, an estimated 67 species may nest on the site. In the summer, the wood thrush (Hylocichla mustelina) was the most abundant species on both wooded plots and the red-winged blackbird (Agelaius phoeniceus) was the most abundant species in the marsh. The black-capped chickadee (Parus atricapillus) and the American goldfinch (Spinus tristis) were the two most abundant species in the fall communities on all study plots. The common crow (Corvus brachyrhynchos) was the most frequently observed species during the year. The endangered southern bald eagle (Haliaeetus leucocephalus leucocephalus) was observed locally on 9 and 20 September. Three threatened species were also seen.

INTRODUCTION

Preliminary studies of the bird life on the Susquehanna SES site were begun in 1971 and terminated in 1974. During this period, the literature was surveyed, a species list compiled, and the relative abundance of resident and transient bird species monitored (Ichthyological Associates 1973, 1974; Burton 1976).

The current preoperational studies were begun in January 1977 to gather information on birds with regards to their numbers, behavior, occurrences, and habitats during the final construction of the Susquehanna SES. These baseline data will be compared with similar information which will be collected after the power station begins operation.

PROCEDURES

Study Plots

Three permanent study plots were located in 1977. Two were wooded areas, Council Cup forest (CC) and the hillside above Township Road 419 (TR419), and one was a marsh along U.S. 11 (Fig. K-1). The CC and TR419 plots are identical to the forest plots discussed in the Flora and Vegetation section of this report.

Criteria considered in selection of the plots were: 1) the vegetation be representative of the Susquehanna SES; 2) the areas remain relatively undisturbed throughout construction; and 3) the plots be a minimum of 6 ha of uniform habitat (Hall 1964).

All plots were surveyed and measured using a Brunton pocket transit on a tripod and a 30-m engineer's tape. The boundaries of each plot were marked with flagged stakes. Transect lines were surveyed within each plot at distances dependent upon vegetation density. Enough lines were surveyed to provide coverage of all parts of the plots when sampling by the strip census method (Kendeigh 1961). A polar planimeter was used to calculate plot areas.

Summer Breeding Bird Census

Plots were censused eight times between 1 May and 15 July. Each census began within 30 minutes before sunrise, a period that coincides with the beginning of intense singing by most passerines (Hall 1964). Starting locations were altered on each plot from census to census to minimize bias that might result from changes in singing intensity. Censuses were not conducted during periods of high winds or heavy rains.

During each visit to a plot the locations of singing males were marked on a daily census map. All birds were identified and recorded with a symbol that designated species and behavioral activity (i.e. singing, aggression, nest building, etc.). After a census, data on the daily census map were transferred to a similar map for each species. Breeding densities of a species were estimated by counting the clusters of daily census points on the species map; each cluster represented a territory. This technique is known as territory mapping and is described by Hall (1964) and Oekle (1967).

Relative densities (number of individuals of one species/total number of individuals of all species) were calculated from breeding densities. The frequency of occurrence (number of counts one species was observed/total number of counts) and relative frequency of occurrence (number of observations of one species/total number of observations of all species) were also calculated.

The number of individuals of each species observed on both wooded plots was compared statistically using the nonparametric Spearman Rank

Correlation Coefficient Test (Siegel 1956). This test is a measure of association which requires that the variables be measured in at least an ordinal scale so that the objects or individuals under study may be ranked in two ordered series.

Migrant Bird Census

Migrant bird populations were sampled in the spring (Mar-May) and in the fall (Aug-Dec). Spring populations were sampled from 7 to 11 times/month, using nonsystematic walks. During the fall each study plot was sampled monthly from 4 to 8 times using the strip census method and from 2 to 4 times by nonsystematic walks. Only species identifications were recorded in the spring whereas both the identity and numbers of individuals were recorded in the fall.

Summer and Winter Bird Census

Summer and winter bird populations were studied by conducting nonsystematic walks through various habitats located near the site from 1 January through 28 February. Counts were usually conducted after midmorning. Species observed were recorded and their frequency of occurrences calculated.

River Bird Census

Waterfowl and other water associated birds were censused from a boat on a 16-km section of the Susquehanna River. The census route

extended from the Shickshinny-Mocanaqua Bridge to the Berwick-Nescopeck Bridge.

The identity and number of birds observed on each census were recorded. Censuses were conducted in spring and fall, usually during the morning hours. Data were not collected due to low water levels in the summer (May-Jul) and because of River ice in winter (Jan-Feb). Results are presented as indices of River usage, i.e. birds/km and waterfowl-days (average number of Anatidae on the River for two consecutive counts X the number of days between counts).

RESULTS AND DISCUSSION

A total of 195 species of birds was observed near the Susquehanna SES from 1972 through 1974 and throughout 1977 (Table L-1). During 1977, 179 species were observed on the site. Forty-two of these species had not been reported in 1972-74. The following five familes composed 51.9% of the species observed: Parulidae (27 species), Fringillidae (24), Anatidae (22), Accipitridae (11), and Scolopacidae (9). Data were catagorized by either study plots or seasons.

Study Plots

Summer

CC Forest -- A total of 15 species composing 10 families and 35.5 territories was observed nesting on the CC plot (Table L-2). Four of these species occupied 56.4% of the territories. The wood thrush

(Hylocichla mustelina) occupied seven territories, the ovenbird (Seiurus aurocapillus) was seen on five, and the scarlet tanager (Piranga olivacea) and black-capped chickadee (Parus atricapillus) each occupied four. There were 24 additional species observed on the plot during the summer. These species were considered visitors as they were not observed in any pattern that indicated an occupied nesting territory.

TR419 Forest -- There were 41 species observed on TR419 during the summer; 14 of them representing 9 families, maintained 37.5 territories (Table L-2). The three most abundant species, wood thrush (6.0 territories), blue jay (Cyanocitta cristata) (5.5), and black-capped chickadee (5.5) occupied 45.4% of the territories. Low shrub and ground dwelling species occupied 31.5% of the territories observed; the Paridae occupied 22.7% and the Turdidae 21.3%.

US 11 Marsh -- The marsh supported only 10 nesting species but had the greatest density of territories/km^2 (Table L-2). The red-winged blackbird (Agelaius phoeniceus) was the most abundant species and accounted for 38.9% (14.0) of the territories. The song sparrow (Melospiza melodia) was second in abundance with 13.9% (5.0) of the territories. Each of the other species held no more than three territories. The red-winged blackbird was the most frequently observed species (7.1%) in the marsh. The yellow warbler (Dendroica petechia), American goldfinch (Spinus tristis), and song sparrow were also observed with a relative frequency of 7.1% (Table L-3). Twenty-three other species were observed visiting the area.

Two broods each of mallards and wood ducks were seen utilizing the marsh and surrounding wetlands as brooding habitat; exact locations of nests were not discovered.

Study Plot Analysis -- The avian communities of both wooded plots were similar in species composition during the summer. Of the total birds observed on CC, 66.7% were also seen on TR419; likewise, 63.4% of the birds observed on TR419 were also observed on CC. The blue jay and rufous-sided towhee (Pipilo erythrophthalmus) were the most frequently observed birds on both CC (6.0% each) and TR419 (6.9% each) (Table L-3). There was a significant, positive correlation ($r = 0.39$, $P<0.05$) between the ranking of species by mean number of individuals on each wooded plot. This similarity yields a basis for future comparisons of breeding bird populations on these plots. No comparisons for species similarity were made between either of the wooded plots and the marsh plot.

Fall

CC Forest -- In the fall, a total of 46 species was observed on CC. The three most abundant species, indicated by relative density, were the black-capped chickadee (23.2%), dark-eyed junco (Junco hyemalis) (9.0%), and blue jay (7.9%) (Table L-4). The most frequently observed species (relative frequency) were the black-capped chickadee (8.3%), white-breasted nuthatch (Sitta carolinensis) (7.4%), blue jay (6.5%), and downy woodpecker (Dendrocopos pubescens) (6.5%). Although 17 species of warblers migrated south with the majority passing through between 1 September and 11 October,

relatively few individuals were observed. The eastern wood pewee (Contopus virens) was an early migrant and was not observed after 1 September. The dark-eyed junco was first observed on 11 October in low numbers but by the end of October this common wintering bird was abundant.

TR419 Forest -- Thirty-two species of birds were observed during the fall migration. The most abundant species were the black-capped chickadee (22.3%) and the dark-eyed junco (12.6%). The most frequently observed species were the downy woodpecker, blue jay, and black-capped chickadee; each had a relative frequency of 9.3% (Table L-4). As on CC, few warblers migrated through in September and early October; only seven species were observed. The dark-eyed junco was first observed in large concentrations on 22 November. The sighting of a solitary vireo (Vireo solitarius) on 14 November represented a late date for the species to be in the area.

US 11 Marsh -- The marsh supported fewer bird species (24) during the fall migration than the other plots. The most abundant species were the American goldfinch (18.7%), song sparrow (13.8%), and red-winged blackbird (11.1%). The most frequently observed species were the song sparrow (10.8%), cardinal (Cardinalis cardinalis), American goldfinch, and white-throated sparrow (Zonotrichia albicollis), each 8.1%. The family Fringillidae included 11 (46.0%) of the 24 species observed.

Study Plot Analysis -- Avian communities in the two wooded plots were very similar in the fall as they were in the summer. Of the 46 species of birds observed on CC, 52.2% were also observed on TR419, and of the 32 species observed on TR419, 75.0% were seen on CC. There were

17 and 15 families observed on CC and TR419, respectively, with a total of 19 families observed on both plots. The ranking of species according to mean number of individuals on each wooded plot was also significantly correlated ($r = 0.28$, $P<0.05$) in the fall.

The blue jay, black-capped chickadee, and American goldfinch were the three most frequently observed species on all three plots during the fall and the black-capped chickadee and American goldfinch were the most abundant species. No statistical comparisons were made between the marsh and the wooded plots.

Nonsystematic Counts

Winter

A total of 45 species was observed in the winter. The most common species included the common crow (Corvus brachyrhynchos), downy woodpecker, cardinal, and brown creeper (Certhia familiaris) (Table L-5). Due to the prolonged severe winter weather a few species, including the yellow-rumped warbler (Dendroica coronata) and chipping sparrow (Spizella passerina), were only observed in early January and were not seen again until the spring migration.

Spring

Nearly twice as many species (81) were observed in the spring compared to the winter. Again the common crow was the most common species observed followed by the song sparrow and red-winged blackbird (Table L-5). A

concentration of about 2,000 red-winged blackbirds was observed on 23 March. Four species of warblers migrated north from 7 April through 15 May. The red-tailed hawk (Buteo jamaicensis) was the most common hawk observed during the spring migration; the second most common raptor was the American kestrel (Falco sparverius).

Summer

A total of 76 species was observed in the summer (Table L-5). The catbird (Dumetella carolinensis), robin (Turdus migratorius), yellowthroat (Geothlypsis trichas), red-winged blackbird, indigo bunting (Passerina cyanea), and song sparrow were observed most frequently. There was a dispersal of common crows during the summer as they were observed less often than any other time of the year. A few species including yellow-rumped warbler, brown creeper, and dark-eyed junco probably migrated to a higher altitude or farther north because they were absent only during the summer breeding period.

Fall

The number of species observed in the fall (81) was identical to that observed during the spring migration, but the species differed (Table L-5). The common crow, black-capped chickadee, and white-breasted nuthatch were the most frequently seen species followed by the blue jay, American goldfinch, and song sparrow. Compared to summer, the number of wading birds increased greatly as did red-tailed hawk and broad-winged hawk (Buteo platypterus) sightings.

Nonsystematic Count Analysis

The average number of species observed/count increased from the beginning of January (winter) through May (spring) (Fig. L-1). The numbers decreased slightly in summer as birds became more sedentary. The sudden decrease in species during October probably occurred because fewer counts were made at that time. The number of species observed/hour increased through summer and then decreased slightly until December. The maximum of 15 species/hour observed during the summer was due to the more sedentary populations in the area. Also during the summer individuals were more vocal and easier to observe.

The common crow was the most frequently observed species during the year with an average relative frequency of 5.1%. The song sparrow was the second most frequently observed species with an average relative frequency of 4.2%. Many species (22) were observed throughout the year (Fig. L-2) although the majority (93) were observed during the migration seasons.

Four species of birds, classified as endangered or threatened by the U. S. Department of the Interior (1977) were observed during 1977. The endangered southern bald eagle (Haliaeetus leucocephalus leucocephalus) was seen twice. One immature eagle was observed flying south over the River at Berwick on 9 September, and one adult was observed flying southeast over an abandoned quarry above PA. 239 about 1 km southeast of Gould Island on 20 September. The threatened species, marsh hawk (Circus cyaneus), osprey (Pandion haliaetus), and merlin (Falco columbarius) were each observed several times on the site throughout the year (Fig. L-2).

River Bird Census

Spring

The majority of the 15 species observed (Table L-6) during spring migration counts passed through the area between 11 March and 11 April. A few species, including the canvasback (Aythya valisineria), migrated through in February and others, such as the American bittern (Botaurus lentiginosus), were seen from late April to early May.

Mallards (Anas platyrhynchos) were the most abundant duck on the River in the spring, with greater numbers observed during March. Common mergansers (Mergus merganser) overwintered and remained in the area until 21 March at which time they migrated north. Hooded mergansers (Lophodytes cucullatus) arrived around 18 February and were observed until 15 May. Wood ducks (Aix sponsa) were first observed on 28 February and remained throughout the spring and early summer. Other birds seen commonly in the spring migration included American wigeons (Anas americana), killdeers (Charadrius vociferus), and spotted sandpipers (Actitis macularia).

Large flights of Canada geese (Branta canadensis) were observed on 9 and 10 March and 11 April. In 6 hours of observations, 7,300 geese were counted.

Fall

Of the 21 species observed during the fall migration period (Table L-7), the wood duck made up the majority of the early numbers observed from 19 September through 18 October. Black ducks (Anas rubripes) were

more abundant than mallards during the fall. Common mergansers arrived late in the period, 7 December, and remained throughout the winter. A small migration of sea ducks composed mostly of common scoters (Melanitta nigra) passed through on 10 November.

The peak of the fall migration occurred between 21 October and 20 November. The great blue heron (Ardea herodias) and belted kingfisher (Megaceryle alcyon) were the two most abundant and frequently observed water birds near the Susquehanna SES during this period.

A small concentration of 30 to 37 brant (Branta bernicla) was observed from 7 to 10 November on the River. Approximately 2,200 Canada geese were seen flying overhead on 3, 4, and 6 October.

Phenological Occurrence

Comparisons between both migration seasons revealed that the spring migration was much shorter and more concentrated than the fall migration. The index of birds/km for the River survey was 3.94 in the spring and 3.06 in the fall. There were 2,486 waterfowl-days in the spring and 3,255 in the fall.

Location of birds on the River were similar in both seasons. Ducks tended to concentrate in the shallows along the islands between Beach Haven and Berwick. Of all the waterfowl observed, 65% were seen in this section of the River.

The phenological occurrence of all species of waterfowl and related water birds is included in Fig. L-2. Mallards and black ducks occurred during all seasons, and wood ducks were observed from fall through spring.

Common mergansers overwintered (in flocks of 10-30 individuals) and remained into March. Other species were strictly migrants and appeared in the area only briefly. The Canada goose was the most prominent of these. Although few were seen on the River, thousands flew over during both migration seasons.

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Table L-1. Species of birds observed near the Susquehanna SES site, 1973-74 and 1977. An asterisk denotes new species observed in 1977. Nomenclature follows AOU Checklist (1957).

Gaviidae
- Gavia immer - common loon

Podicipedidae
- Podiceps auritus - horned grebe
- Podilymbus podiceps - pied-billed grebe

Phalacrocoracidae
- Phalacrocorax auritus - double-crested cormorant*

Ardeidae
- Ardea herodias - great blue heron
- Butorides virescens - eastern green heron
- Florida caerulea - little blue heron
- Bubulcus ibis - cattle egret
- Casmerodius albus - common egret
- Egretta thula - snowy egret*
- Nycticorax nycticorax - black-crowned night heron
- Ixobrychus exilis - least bittern*
- Botaurus lentiginosus - American bittern

Anatidae
- Olor columbianus - whistling swan
- Branta canadensis - Canada goose
- B. bernicla - brant*
- Chen hyperborea - snow goose
- Anas platyrhynchos - mallard
- A. rubripes - black duck
- A. acuta - pintail
- A. carolinensis - green-winged teal
- A. discors - blue-winged teal
- A. americana - American wigeon
- Aix sponsa - wood duck
- Aythya americana - redhead
- A. collaris - ring-necked duck
- A. valisineria - canvasback
- A. marila - greater scaup
- A. affinis - lesser scaup
- Bucephala clangula - common goldeneye
- B. albeola - bufflehead
- Clangula hyemalis - oldsquaw
- Melanitta deglandi - white-winged scoter
- M. perspicillata - surf scoter
- M. nigra - black scoter
- Oxyura jamaicensis - ruddy duck
- Lophodytes cucullatus - hooded merganser
- Mergus merganser - American merganser
- M. serrator - red-breasted merganser

Cathartidae
- Cathartes aura - turkey vulture

Accipitridae
- Accipiter cooperii - Cooper's hawk*
- A. striatus - sharp-shinned hawk
- Buteo jamaicensis - red-tailed hawk
- B. lineatus - red-shouldered hawk*
- B. platypterus - broad-winged hawk
- B. lagopus - rough-legged hawk
- Haliaeetus leucocephalus - bald eagle*
- Circus cyaneus - marsh hawk
- Pandion haliaetus - osprey
- Falco columbarius - merlin*
- F. sparverius - American kestrel

Tetraonidae
- Bonasa umbellus - ruffed grouse

Phasianidae
- Phasianus colchicus - ring-necked pheasant

Meleagrididae
- Meleagris gallopavo - turkey

Rallidae
- Porzana carolina - sora
- Fulica americana - American coot

Charadriidae
- Charadrius vociferus - killdeer

Scolopacidae
- Philohela minor - American woodcock
- Capella gallinago - common snipe
- Actitis macularia - spotted sandpiper
- Tringa solitaria - solitary sandpiper
- T. melanoleucus - greater yellowlegs*
- T. flavipes - lesser yellowlegs
- Calidris melanotos - pectoral sandpiper*
- Larus marinus - great black-backed gull
- L. argentatus - herring gull
- L. delawarensis - ring-billed gull
- L. philadelphia - Bonaparte's gull
- Sterna hirundo - common tern

Columbidae
- Columba livia - rock dove
- Zenaidura macroura - mourning dove

Cuculidae
- Coccyzus americanus - yellow-billed cuckoo
- C. erythropthalmus - black-billed cuckoo*

Strigidae
- Otus asio - screech owl
- Bubo virginianus - great-horned owl
- Asio otus - long-eared owl*

Caprimulgidae
- Chordeiles minor - common nighthawk

Apodidae
- Chaetura pelagica - chimney swift

Trochilidae
- Archilochus colubris - ruby-throated hummingbird

Alcedinidae
- Megaceryle alcyon - belted kingfisher

Picidae
- Colaptes auratus - common flicker
- Dryocopus pileatus - pileated woodpecker
- Centurus carolinus - red-bellied woodpecker*
- Sphyrapicus varius - yellow-bellied sapsucker*
- Dendrocopos villosus - hairy woodpecker
- D. pubescens - downy woodpecker

Table L-1 (cont.)

Tyrannidae
- Tyrannus tyrannus - eastern kingbird
- Myiarchus crinitus - great crested flycatcher
- Sayornis phoebe - eastern phoebe
- Empidonax flaviventris - yellow-bellied flycatcher*
- E. virescens - acadian flycatcher*
- E. traillii - willow flycatcher*
- E. minimus - least flycatcher
- Contopus virens - eastern wood pewee

Hirundinidae
- Iridoprocne bicolor - tree swallow
- Riparia riparia - bank swallow
- Stelgidopteryx ruficollis - rough-winged swallow
- Hirundo rustica - barn swallow
- Petrochelidon pyrrhonota - cliff swallow
- Progne subis - purple martin

Corvidae
- Cyanocitta cristata - blue jay
- Corvus brachyrhynchos - common crow
- C. ossifragus - fish crow

Paridae
- Parus atricapillus - black-capped chickadee
- P. bicolor - tufted titmouse

Sittidae
- Sitta carolinensis - white-breasted nuthatch
- S. canadensis - red-breasted nuthatch*

Certhiidae
- Certhia familiaris - brown creeper

Troglodytidae
- Troglodytes aedon - house wren
- T. troglodytes - winter wren
- Thryothorus ludovicianus - Carolina wren
- Telmatodytes palustris - long-billed marsh wren*

Mimidae
- Mimus polyglottos - mockingbird
- Dumetella carolinensis - catbird
- Toxostoma rufum - brown thrasher

Turdidae
- Turdus migratorius - robin
- Hylocichla mustelina - wood thrush
- Catharus guttata - hermit thrush
- C. ustulata - Swainson's thrush
- C. minima - gray-cheeked thrush
- C. fuscescens - veery
- Sialia sialis - eastern bluebird

Sylviidae
- Polioptila caerulea - blue-gray gnatcatcher
- Regulus satrapa - golden-crowned kinglet
- R. calendula - ruby-crowned kinglet

Motacillidae
- Anthus spinoletta - water pipit*

Bombycillidae
- Bombycilla cedrorum - cedar waxwing

Sturnidae
- Sturnus vulgaris - starling

Vireonidae
- Vireo griseus - white-eyed vireo*
- V. flavifrons - yellow-throated vireo
- V. solitarius - solitary vireo*
- V. olivaceus - red-eyed vireo
- V. gilvus - warbling vireo

Parulidae
- Mniotilta varia - black and white warbler
- Helmitheros vermivorus - worm-eating warbler*
- Vermivora pinus - blue-winged warbler*
- V. peregrina - Tennessee warbler*
- V. ruficapilla - Nashville warbler
- Dendroica petechia - yellow warbler
- D. magnolia - magnolia warbler
- D. tigrina - Cape May warbler
- D. caerulescens - black-throated blue warbler
- D. coronata - yellow-rumped warbler
- D. virens - black-throated green warbler*
- D. cerulea - Cerulean warbler*
- D. fusca - blackburnian warbler
- D. dominica - yellow-throated warbler
- D. pensylvanica - chestnut-sided warbler
- D. castanea - bay-breasted warbler
- D. striata - blackpoll warbler*
- D. discolor - prairie warbler*
- D. palmarum - palm warbler
- Seiurus aurocapillus - ovenbird
- S. noveboracensis - northern waterthrush
- S. motacilla - Louisiana waterthrush*
- Oporonis agilis - Connecticut warbler*
- O. philadelphia - mourning warbler
- Geothlypis trichas - yellowthroat
- Wilsonia citrina - hooded warbler*
- W. canadensis - Canada warbler*
- Setophaga ruticilla - American redstart

Ploceidae
- Passer domesticus - house sparrow

Icteridae
- Dolichonyx oryzivorus - bobolink
- Sturnella magna - eastern meadowlark
- Agelaius phoeniceus - red-winged blackbird
- Icterus spurius - orchard oriole*
- I. galbula - northern oriole
- Euphagus carolinus - rusty blackbird
- Quiscalus quiscula - common grackle
- Molothrus ater - brown-headed cowbird

Thraupidae
- Piranga olivacea - scarlet tanager

Fringillidae
- Cardinalis cardinalis - cardinal
- Pheucticus ludovicianus - rose-breasted grosbeak
- Guiraca caerulea - blue grosbeak*
- Passerina cyanea - indigo bunting
- Hesperiphona vespertina - evening grosbeak
- Carpodacus purpureus - purple finch
- C. mexicanus - house finch*

Table L-1 (cont.)

Fringillidae (cont.)
- Acanthis flammea - common redpoll*
- Spinus pinus - pine siskin*
- S. tristis - American goldfinch
- Pipilo erythrophthalmus - rufous-sided towhee
- Passerculus sandwichensis - savannah sparrow*
- Ammodramus savannarum - grasshopper sparrow*
- Pooecetes gramineus - vesper sparrow
- Junco hyemalis - dark-eyed junco
- Spizella arborea - tree sparrow
- S. passerina - chipping sparrow
- S. pusilla - field sparrow
- Zonothrichia leucophrys - white-crowned sparrow
- Z. albicollis - white-throated sparrow
- Passerella iliaca - fox sparrow
- Melospiza georgiana - swamp sparrow*
- M. melodia - song sparrow
- Plectrophenax nivalis - snow bunting*

Table L-2. Number, density (No./km^2), and relative density (R.D.) of breeding bird territories observed on Council Cup and Township Road 419 forests, and US 11 marsh during the breeding bird survey, May through July 1977.

Family/species	CC Forest			TR419 Forest			US 11 Marsh		
Territories	No.	No./km^2	R.D.	No.	No./km^2	R.D.	No.	No./km^2	R.D.
Tetraonidae									
ruffed grouse	1.0	16.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0
Picidae									
common flicker	2.0	33.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0
downy woodpecker	2.0	33.0	5.6	1.0	9.0	2.7	0.0	0.0	0.0
Tyrannidae									
great crested flycatcher	0.5	8.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0
willow flycatcher	0.0	0.0	0.0	0.0	0.0	0.0	3.0	57.6	8.3
eastern wood pewee	0.5	8.0	1.4	0.5	4.5	1.3	0.0	0.0	0.0
Corvidae									
blue jay	3.5	58.0	9.8	5.5	49.5	14.7	0.0	0.0	0.0
Paridae									
black-capped chickadee	4.0	66.5	11.3	5.5	49.5	14.7	0.0	0.0	0.0
tufted titmouse	0.0	0.0	0.0	3.0	27.0	8.0	0.0	0.0	0.0
Sittidae									
white-breasted nuthatch	1.0	16.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0
Mimidae									
catbird	0.0	0.0	0.0	0.0	0.0	0.0	2.0	38.4	5.6
Turdidae									
robin	1.0	16.5	2.8	2.0	18.0	5.3	2.5	48.0	6.9
wood thrush	7.0	116.5	19.7	6.0	54.0	16.0	0.0	0.0	0.0
Sylviidae									
blue-gray gnatcatcher	0.0	0.0	0.0	1.0	9.0	2.7	0.0	0.0	0.0
Parulidae									
yellow warbler	0.0	0.0	0.0	0.0	0.0	0.0	3.0	57.6	8.3
ovenbird	5.0	83.0	14.1	2.0	18.0	5.3	0.0	0.0	0.0
yellowthroat	0.0	0.0	0.0	1.0	9.0	2.7	2.0	38.4	5.6
Icteridae									
red-winged blackbird	0.0	0.0	0.0	0.0	0.0	0.0	14.0	268.8	38.9
northern oriole	0.0	0.0	0.0	0.0	0.0	0.0	2.0	38.4	5.6
Thraupidae									
scarlet tanager	4.0	66.5	11.3	3.0	27.0	8.0	0.0	0.0	0.0
Fringillidae									
cardinal	0.0	0.0	0.0	3.5	31.5	9.3	0.0	0.0	0.0
rose-breasted grosbeak	1.0	16.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0
indigo bunting	1.0	16.5	2.8	1.0	9.0	2.7	0.5	9.6	1.4
rufous-sided towhee	2.0	33.0	5.6	2.5	22.5	6.7	0.0	0.0	0.0
swamp sparrow	0.0	0.0	0.0	0.0	0.0	0.0	2.0	38.4	5.6
song sparrow	0.0	0.0	0.0	0.0	0.0	0.0	5.0	96.0	13.9
Totals	35.5	588.0	99.8	37.5	337.5	100.1	36.0	691.2	100.1

Table L-3. Mean density (No./km^2), relative density (%), frequency of occurrence (%), and relative frequency (%) of birds observed on Council Cup and Township Road 419 forests, and US 11 marsh during the breeding bird survey, May through July 1977.

	CC FOREST				TR419 FOREST				US 11 MARSH			
	DENSITY		FREQUENCY		DENSITY		FREQUENCY		DENSITY		FREQUENCY	
	MEAN	REL.	OCC.	REL.	MEAN	REL.	OCC.	REL.	MEAN	REL.	OCC.	REL.
EASTERN GREEN HERON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	1.0	28.6	2.0
MALLARD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2	2.3	57.1	4.1
WOOD DUCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	1.3	57.1	4.1
TURKEY VULTURE	4.8	0.8	14.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RUFFED GROUSE	7.1	1.3	42.9	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RING-NECK PHEASANT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
SORA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
KILLDEER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
GREATER YELLOWLEGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
PECTORAL SANDPIPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
MOURNING DOVE	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
YELLOW-BILLED CUCKOO	11.9	2.1	42.9	2.6	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
BLACK-BILLED CUCKOO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
RUBY-THROATED HUMMINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
BELTED KINGFISHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	1.0	42.9	3.1
COMMON FLICKER	23.8	4.2	85.7	5.2	3.9	1.1	28.6	2.0	2.7	0.3	14.3	1.0
PILEATED WOODPECKER	4.8	0.8	28.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HAIRY WOODPECKER	2.4	0.4	14.3	0.9	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
DOWNY WOODPECKER	16.7	3.0	100.0	6.0	6.5	1.9	57.1	3.9	0.0	0.0	0.0	0.0
CREAT CRESTED FLYCATCHER	9.5	1.7	57.1	3.4	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
ACADIAN FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
WILLOW FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0	5.3	71.4	5.1
LEAST FLYCATCHER	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
EASTERN WOOD PEWEE	7.1	1.3	28.6	1.7	9.0	2.7	28.6	2.0	2.7	0.3	14.3	1.0
BLUE JAY	45.2	8.0	100.0	6.0	45.2	13.4	100.0	6.9	0.0	0.0	0.0	0.0
COMMON CROW	2.4	0.4	14.3	0.9	6.5	1.9	42.9	2.9	0.0	0.0	0.0	0.0
BLACK-CAPPED CHICKADEE	52.4	9.3	85.7	5.2	33.6	10.0	85.7	5.9	2.7	0.3	14.3	1.0
TUFTED TITMOUSE	7.1	1.3	14.3	0.9	22.0	6.5	57.1	3.9	0.0	0.0	0.0	0.0
WHITE-BREASTED NUTHATCH	21.4	3.8	71.4	4.3	2.6	0.8	28.6	2.0	0.0	0.0	0.0	0.0
CATBIRD	2.4	0.4	14.3	0.9	1.3	0.4	14.3	1.0	11.0	1.3	42.9	3.1
BROWN THRASHER	2.4	0.4	14.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROBIN	9.5	1.7	28.6	1.7	9.0	2.7	57.1	3.9	44.0	5.3	85.7	6.1
WOOD THRUSH	81.0	14.3	85.7	5.2	47.8	14.2	100.0	6.9	0.0	0.0	0.0	0.0
VEERY	2.4	0.4	14.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUE-GRAY GNATCATCHER	2.4	0.4	14.3	0.9	6.5	1.9	57.1	3.9	0.0	0.0	0.0	0.0
RUBY-CROWNED KINGLET	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
CEDAR WAXWING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	1.0	42.9	3.1
RED-EYED VIREO	14.3	2.5	42.9	2.6	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
BLACK-AND-WHITE WARBLER	9.5	1.7	57.1	3.4	5.2	1.5	28.6	2.0	0.0	0.0	0.0	0.0
WORM-EATING WARBLER	0.0	0.0	0.0	0.0	2.6	0.8	28.6	2.0	0.0	0.0	0.0	0.0
TENNESSEE WARBLER	0.0	0.0	0.0	0.0	19.4	5.7	28.6	2.0	0.0	0.0	0.0	0.0
NASHVILLE WARBLER	0.0	0.0	0.0	0.0	2.6	0.8	14.3	1.0	0.0	0.0	0.0	0.0
YELLOW WARBLER	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	46.7	5.6	100.0	7.1
CAPE MAY WARBLER	0.0	0.0	0.0	0.0	2.6	0.8	28.6	2.0	0.0	0.0	0.0	0.0
YELLOW-RUMPED WARBLER	9.5	1.7	14.3	0.9	2.6	0.8	14.3	1.0	0.0	0.0	0.0	0.0
CERULEAN WARBLER	2.4	0.4	14.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACKBURNIAN WARBLER	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
CHESTNUT-SIDED WARBLER	2.4	0.4	14.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAY-BREASTED WARBLER	0.0	0.0	0.0	0.0	3.9	1.1	28.6	2.0	0.0	0.0	0.0	0.0
BLACKPOLL WARBLER	11.9	2.1	28.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRAIRIE WARBLER	4.8	0.8	14.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVENBIRD	40.5	7.2	71.4	4.3	11.6	3.4	42.9	2.9	0.0	0.0	0.0	0.0
YELLOWTHROAT	0.0	0.0	0.0	0.0	3.9	1.1	42.9	2.9	52.2	6.3	85.7	6.1
HOODED WARBLER	4.8	0.8	28.6	1.7	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
AMERICAN REDSTART	9.5	1.7	42.9	2.6	2.6	0.8	14.3	1.0	0.0	0.0	0.0	0.0
REDWINGED BLACKBIRD	9.5	1.7	42.9	2.6	0.0	0.0	0.0	0.0	294.0	35.2	100.0	7.1
ORCHARD ORIOLE	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
NORTHERN ORIOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	1.0	42.9	3.1
RUSTY BLACKBIRD	7.1	1.3	28.6	1.7	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
COMMON GRACKLE	7.1	1.3	28.6	1.7	0.0	0.0	0.0	0.0	19.2	2.3	57.1	4.1
BROWN-HEADED COWBIRD	0.0	0.0	0.0	0.0	1.3	0.4	14.3	1.0	0.0	0.0	0.0	0.0
SCARLET TANAGER	45.2	8.0	85.7	5.2	15.5	4.6	71.4	4.9	0.0	0.0	0.0	0.0
CARDINAL	9.5	1.7	28.6	1.7	22.0	6.5	100.0	6.9	5.5	0.7	28.6	2.0
ROSE-BREASTED GROSBEAK	7.1	1.3	42.9	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUE GROSBEAK	0.0	0.0	0.0	0.0	2.6	0.8	14.3	1.0	0.0	0.0	0.0	0.0
INDIGO BUNTING	16.7	3.0	85.7	5.2	2.6	0.8	14.3	1.0	16.5	2.0	57.1	4.1
AMERICAN GOLDFINCH	2.4	0.4	14.3	0.9	1.3	0.4	14.3	1.0	57.7	6.9	100.0	7.1
RUFOUS-SIDED TOWHEE	33.3	5.9	100.0	6.0	18.1	5.4	100.0	6.9	0.0	0.0	0.0	0.0
SAVANNAH SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
CHIPPING SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
WHITE-CROWNED SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.3	14.3	1.0
WHITE-THROATED SPARROW	0.0	0.0	0.0	0.0	9.0	2.7	42.9	2.9	0.0	0.0	0.0	0.0
SWAMP SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.2	3.6	85.7	6.1
SONG SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109.9	13.2	100.0	7.1

Table L-4. Mean density (No./km^2), relative density (%), frequency of occurrence (%), and relative frequency (%) of birds observed on Council Cup and Township Road 419 forests, and US 11 marsh during the fall migration census, August through December 1977.

SPECIES	CC FOREST				TR419 FOREST				US 11 MARSH			
	DENSITY		FREQUENCY		DENSITY		FREQUENCY		DENSITY		FREQUENCY	
	MEAN	REL.	OCC.	REL.	MEAN	REL.	OCC.	REL.	MEAN	REL.	OCC.	REL.
RED-TAILED HAWK	1.9	0.3	11.1	0.9	1.8	0.5	20.0	1.9	4.8	0.4	25.0	2.7
RUFFED GROUSE	0.0	0.0	0.0	0.0	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
RING-NECK PHEASANT	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	24.0	2.2	25.0	2.7
YELLOW-BILLED CUCKOO	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMON FLICKER	3.7	0.6	11.1	0.9	5.4	1.5	20.0	1.9	0.0	0.0	0.0	0.0
YELLOW-BELLIED SAPSUCKER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HAIRY WOODPECKER	3.7	0.6	11.1	0.9	3.6	1.0	20.0	1.9	0.0	0.0	0.0	0.0
DOWNY WOODPECKER	25.9	4.0	77.8	6.5	18.1	4.9	100.0	9.3	0.0	0.0	0.0	0.0
EASTERN PHOEBE	0.0	0.0	0.0	0.0	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
YELLOW-BELLIED FLYCATCHER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEAST FLYCATCHER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN WOOD PEWEE	20.4	3.1	44.4	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TREE SWALLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.4	25.0	2.7
PURPLE MARTIN	3.7	0.6	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUE JAY	51.9	7.9	77.8	6.5	27.1	7.3	100.0	9.3	4.8	0.4	25.0	2.7
COMMON CROW	0.0	0.0	0.0	0.0	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
BLACK-CAPPED CHICKADEE	151.9	23.2	100.0	8.3	83.3	22.3	100.0	9.3	38.5	3.6	50.0	5.4
TUFTED TITMOUSE	14.8	2.3	44.4	3.7	7.2	1.9	20.0	1.9	0.0	0.0	0.0	0.0
WHITE-BREASTED NUTHATCH	40.7	6.2	88.9	7.4	18.1	4.9	80.0	7.4	0.0	0.0	0.0	0.0
BROWN CREEPER	11.1	1.7	33.3	2.8	9.0	2.4	40.0	3.7	0.0	0.0	0.0	0.0
WINTER WREN	3.7	0.6	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LONG-BILLED MARSH WREN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.4	25.0	2.7
ROBIN	7.4	1.1	22.2	1.9	19.9	5.3	80.0	7.4	4.8	0.4	25.0	2.7
SWAINSON'S THRUSH	5.6	0.8	22.2	1.9	3.6	1.0	20.0	1.9	0.0	0.0	0.0	0.0
VEERY	7.4	1.1	22.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUE-GRAY GNATCATCHER	3.7	0.6	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GOLDEN-CROWNED KINGLET	0.0	0.0	0.0	0.0	10.9	2.9	20.0	1.9	0.0	0.0	0.0	0.0
RUBY-CROWNED KINGLET	3.7	0.6	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CEDAR WAXWING	0.0	0.0	0.0	0.0	16.3	4.4	20.0	1.9	33.7	3.1	25.0	2.7
STARLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.7	3.1	25.0	2.7
SOLITARY VIREO	3.7	0.6	11.1	0.9	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
RED-EYED VIREO	9.3	1.4	33.3	2.8	5.4	1.5	20.0	1.9	0.0	0.0	0.0	0.0
BLACK-AND-WHITE WARBLER	11.1	1.7	22.2	1.9	3.6	1.0	20.0	1.9	0.0	0.0	0.0	0.0
WORM-EATING WARBLER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TENNESSEE WARBLER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NASHVILLE WARBLER	3.7	0.6	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAGNOLIA WARBLER	14.8	2.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPE MAY WARBLER	13.0	2.0	22.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-THROATED BLUE WARBLER	7.4	1.1	33.3	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW-RUMPED WARBLER	38.9	5.9	22.2	1.9	5.4	1.5	20.0	1.9	0.0	0.0	0.0	0.0
BLACK-THROATED GREEN WARBLER	5.6	0.8	11.1	0.9	5.4	1.5	20.0	1.9	0.0	0.0	0.0	0.0
BLACKBURNIAN WARBLER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAY-BREASTED WARBLER	13.0	2.0	22.2	1.9	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
BLACKPOLL WARBLER	18.5	2.8	22.2	1.9	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
PRAIRIE WARBLER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVENBIRD	7.4	1.1	33.3	2.8	5.4	1.5	20.0	1.9	0.0	0.0	0.0	0.0
CONNECTICUT WARBLER	1.9	0.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWTHROAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.9	25.0	2.7
CANADA WARBLER	7.4	1.1	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN REDSTART	1.9	0.3	11.1	0.9	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
EASTERN MEADOWLARK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.4	25.0	2.7
REDWINGED BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120.2	11.1	50.0	5.4
COMMON GRACKLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.1	4.4	25.0	2.7
SCARLET TANAGER	7.4	1.1	22.2	1.9	1.8	0.5	20.0	1.9	0.0	0.0	0.0	0.0
CARDINAL	0.0	0.0	0.0	0.0	3.6	1.0	40.0	3.7	28.8	2.7	75.0	8.1
INDIGO BUNTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	2.2	25.0	2.7
EVENING GROSBEAK	14.8	2.3	11.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PURPLE FINCH	0.0	0.0	0.0	0.0	5.4	1.5	20.0	1.9	0.0	0.0	0.0	0.0
PINE SISKIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.1	4.4	25.0	2.7
AMERICAN GOLDFINCH	13.0	2.0	44.4	3.7	12.7	3.4	40.0	3.7	201.9	18.7	75.0	8.1
RUFOUS-SIDED TOWHEE	11.1	1.7	44.4	3.7	3.6	1.0	20.0	1.9	0.0	0.0	0.0	0.0
SAVANNAH SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.9	25.0	2.7
DARK-EYED JUNCO	59.3	9.0	33.3	2.8	47.1	12.6	20.0	1.9	0.0	0.0	0.0	0.0
TREE SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.1	4.4	25.0	2.7
FIELD SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.9	25.0	2.7
WHITE-CROWNED SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	2.2	25.0	2.7
WHITE-THROATED SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.3	8.4	75.0	8.1
FOX SPARROW	0.0	0.0	0.0	0.0	18.1	4.9	20.0	1.9	0.0	0.0	0.0	0.0
SWAMP SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.2	8.9	50.0	5.4
SONG SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	149.0	13.8	100.0	10.8

Table L-5. Frequency of occurrence and relative frequency of birds observed on nonsystematic counts near the Susquehanna SES, 1977.

SPECIES	WINTER		SPRING		SUMMER		FALL	
	OCC.	REL.	OCC.	REL.	OCC.	REL.	OCC.	REL.
HORNED GREBE	14.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0
PIED-BILLED GREBE	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
GREAT BLUE HERON	0.0	0.0	5.0	0.2	0.0	0.0	16.7	0.9
EASTERN GREEN HERON	0.0	0.0	0.0	0.0	8.3	0.3	16.7	0.9
BLACK-CROWNED NIGHT HERON	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
CANADA GOOSE	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
MALLARD	7.1	0.6	80.0	3.5	41.7	1.7	16.7	0.9
BLACK DUCK	0.0	0.0	40.0	1.7	0.0	0.0	8.3	0.4
PINTAIL	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
GREEN-WINGED TEAL	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
BLUE-WINGED TEAL	0.0	0.0	25.0	1.1	0.0	0.0	0.0	0.0
AMERICAN WIDGEON	0.0	0.0	55.0	2.4	0.0	0.0	0.0	0.0
WOOD DUCK	7.1	0.6	80.0	3.5	41.7	1.7	0.0	0.0
CANVASBACK	7.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0
BUFFLEHEAD	7.1	0.6	5.0	0.2	0.0	0.0	0.0	0.0
HOODED MERGANSER	14.3	1.1	20.0	0.9	0.0	0.0	0.0	0.0
COMMON MERGANSER	64.3	5.1	20.0	0.9	0.0	0.0	8.3	0.4
RED-BREASTED MERGANSER	7.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0
TURKEY VULTURE	0.0	0.0	25.0	1.1	8.3	0.3	0.0	0.0
SHARP-SHINNED HAWK	0.0	0.0	15.0	0.6	8.3	0.3	8.3	0.4
RED-TAILED HAWK	28.6	2.3	55.0	2.4	8.3	0.3	41.7	2.2
RED-SHOULDERED HAWK	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
BROAD-WINGED HAWK	0.0	0.0	5.0	0.2	0.0	0.0	16.7	0.9
MARSH HAWK	0.0	0.0	10.0	0.4	0.0	0.0	8.3	0.4
OSPREY	0.0	0.0	10.0	0.4	0.0	0.0	8.3	0.4
MERLIN	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
AMERICAN KESTREL	14.3	1.1	30.0	1.3	8.3	0.3	25.0	1.3
RUFFED GROUSE	28.6	2.3	5.0	0.2	8.3	0.3	8.3	0.4
RING-NECK PHEASANT	35.7	2.8	45.0	1.9	8.3	0.3	8.3	0.4
KILLDEER	0.0	0.0	55.0	2.4	33.3	1.4	8.3	0.4
COMMON SNIPE	7.1	0.6	45.0	1.9	0.0	0.0	8.3	0.4
SPOTTED SANDPIPER	0.0	0.0	5.0	0.2	16.7	0.7	8.3	0.4
SOLITARY SANDPIPER	0.0	0.0	0.0	0.0	8.3	0.3	8.3	0.4
GREATER YELLOWLEGS	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
HERRING GULL	14.3	1.1	5.0	0.2	0.0	0.0	0.0	0.0
RING-BILLED GULL	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
ROCK DOVE	14.3	1.1	30.0	1.3	16.7	0.7	8.3	0.4
MOURNING DOVE	35.7	2.8	75.0	3.2	75.0	3.1	41.7	2.2
YELLOW-BILLED CUCKOO	0.0	0.0	0.0	0.0	25.0	1.0	8.3	0.4
CHIMNEY SWIFT	0.0	0.0	0.0	0.0	16.7	0.7	16.7	0.9
RUBY-THROATED HUMMINGBIRD	0.0	0.0	0.0	0.0	8.3	0.3	16.7	0.9
BELTED KINGFISHER	0.0	0.0	10.0	0.4	33.3	1.4	25.0	1.3
COMMON FLICKER	21.4	1.7	55.0	2.4	58.3	2.4	25.0	1.3
PILEATED WOODPECKER	7.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0
RED-BELLIED WOODPECKER	7.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW-BELLIED SAPSUCKER	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
HAIRY WOODPECKER	7.1	0.6	10.0	0.4	0.0	0.0	0.0	0.0
DOWNY WOODPECKER	92.9	7.3	80.0	3.5	25.0	1.0	66.7	3.5
EASTERN KINGBIRD	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
GREAT CRESTED FLYCATCHER	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
EASTERN PHOEBE	0.0	0.0	15.0	0.6	16.7	0.7	16.7	0.9
YELLOW-BELLIED FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
ACADIAN FLYCATCHER	0.0	0.0	0.0	0.0	33.3	1.4	0.0	0.0
WILLOW FLYCATCHER	0.0	0.0	0.0	0.0	16.7	0.7	8.3	0.4
LEAST FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
EASTERN WOOD PEWEE	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
TREE SWALLOW	0.0	0.0	25.0	1.1	16.7	0.7	0.0	0.0
BANK SWALLOW	0.0	0.0	0.0	0.0	33.3	1.4	0.0	0.0
ROUGH-WINGED SWALLOW	0.0	0.0	0.0	0.0	33.3	1.4	0.0	0.0
BARN SWALLOW	0.0	0.0	5.0	0.2	83.3	3.4	16.7	0.9
CLIFF SWALLOW	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
BLUE JAY	57.1	4.5	80.0	3.5	58.3	2.4	75.0	3.9
COMMON CROW	100.0	7.9	100.0	4.3	75.0	3.1	91.7	4.8
BLACK-CAPPED CHICKADEE	42.9	3.4	65.0	2.8	25.0	1.0	91.7	4.8
TUFTED TITMOUSE	28.6	2.3	40.0	1.7	8.3	0.3	41.7	2.2
WHITE-BREASTED NUTHATCH	64.3	5.1	40.0	1.7	50.0	2.1	75.0	3.9
RED-BREASTED NUTHATCH	14.3	1.1	5.0	0.2	0.0	0.0	0.0	0.0
BROWN CREEPER	71.4	5.6	45.0	1.9	0.0	0.0	8.3	0.4

Table L-5 (cont.)

SPECIES	WINTER		SPRING		SUMMER		FALL	
	OCC.	REL.	OCC.	REL.	OCC.	REL.	OCC.	REL.
HOUSE WREN	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
WINTER WREN	21.4	1.7	0.0	0.0	0.0	0.0	8.3	0.4
MOCKINGBIRD	7.1	0.6	0.0	0.0	16.7	0.7	8.3	0.4
CATBIRD	0.0	0.0	0.0	0.0	100.0	4.1	50.0	2.6
BROWN THRASHER	0.0	0.0	10.0	0.4	8.3	0.3	0.0	0.0
ROBIN	7.1	0.6	85.0	3.7	91.7	3.8	41.7	2.2
WOOD THRUSH	0.0	0.0	0.0	0.0	25.0	1.0	16.7	0.9
HERMIT THRUSH	0.0	0.0	10.0	0.4	0.0	0.0	8.3	0.4
GRAY-CHEEKED THRUSH	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
VEERY	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
EASTERN BLUEBIRD	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
BLUE-GRAY GNATCATCHER	0.0	0.0	5.0	0.2	8.3	0.3	0.0	0.0
GOLDEN-CROWNED KINGLET	42.9	3.4	30.0	1.3	0.0	0.0	0.0	0.0
RUBY-CROWNED KINGLET	14.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0
WATER PIPET	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
CEDAR WAXWING	0.0	0.0	0.0	0.0	58.3	2.4	33.3	1.7
STARLING	14.3	1.1	25.0	1.1	16.7	0.7	41.7	2.2
WHITE-EYED VIREO	0.0	0.0	5.0	0.2	16.7	0.7	0.0	0.0
YELLOW-THROATED VIREO	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
RED-EYED VIREO	0.0	0.0	0.0	0.0	50.0	2.1	25.0	1.3
WARBLING VIREO	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
BLACK-AND-WHITE WARBLER	0.0	0.0	5.0	0.2	8.3	0.3	8.3	0.4
WORM-EATING WARBLER	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
BLUE-WINGED WARBLER	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
TENNESSEE WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.9
YELLOW WARBLER	0.0	0.0	0.0	0.0	50.0	2.1	8.3	0.4
MAGNOLIA WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
YELLOW-RUMPED WARBLER	7.1	0.6	15.0	0.6	0.0	0.0	16.7	0.9
BLACK-THROATED GREEN WARBLER	0.0	0.0	0.0	0.0	8.3	0.3	8.3	0.4
BLACKBURNIAN WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
BAY-BREASTED WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
PRAIRIE WARBLER	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
OVENBIRD	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
NORTHERN WATERTHRUSH	0.0	0.0	5.0	0.2	8.3	0.3	0.0	0.0
LOUISIANA WATERTHRUSH	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
MOURNING WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
YELLOWTHROAT	0.0	0.0	0.0	0.0	91.7	3.8	58.3	3.1
AMERICAN REDSTART	0.0	0.0	0.0	0.0	25.0	1.0	25.0	1.3
HOUSE SPARROW	7.1	0.6	5.0	0.2	0.0	0.0	0.0	0.0
EASTERN MEADOWLARK	0.0	0.0	15.0	0.6	16.7	0.7	0.0	0.0
REDWINGED BLACKBIRD	14.3	1.1	90.0	3.9	91.7	3.8	50.0	2.6
ORCHARD ORIOLE	0.0	0.0	0.0	0.0	8.3	0.3	0.0	0.0
NORTHERN ORIOLE	0.0	0.0	0.0	0.0	66.7	2.7	8.3	0.4
RUSTY BLACKBIRD	0.0	0.0	25.0	1.1	16.7	0.7	8.3	0.4
COMMON GRACKLE	14.3	1.1	85.0	3.7	75.0	3.1	8.3	0.4
BROWN-HEADED COWBIRD	0.0	0.0	0.0	0.0	16.7	0.7	8.3	0.4
SCARLET TANAGER	0.0	0.0	0.0	0.0	8.3	0.3	8.3	0.4
CARDINAL	71.4	5.6	80.0	3.5	66.7	2.7	41.7	2.2
ROSE-BREASTED GROSBEAK	0.0	0.0	0.0	0.0	16.7	0.7	16.7	0.9
INDIGO BUNTING	0.0	0.0	0.0	0.0	91.7	3.8	33.3	1.7
EVENING GROSBEAK	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
PURPLE FINCH	0.0	0.0	10.0	0.4	0.0	0.0	0.0	0.0
PINE SISKIN	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.4
AMERICAN GOLDFINCH	42.9	3.4	50.0	2.2	66.7	2.7	83.3	4.4
RUFOUS-SIDED TOWHEE	0.0	0.0	5.0	0.2	41.7	1.7	16.7	0.9
SAVANNAH SPARROW	0.0	0.0	25.0	1.1	8.3	0.3	25.0	1.3
GRASSHOPPER SPARROW	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
VESPER SPARROW	0.0	0.0	20.0	0.9	0.0	0.0	0.0	0.0
DARK-EYED JUNCO	28.6	2.3	40.0	1.7	0.0	0.0	25.0	1.3
TREE SPARROW	57.1	4.5	35.0	1.5	0.0	0.0	16.7	0.9
CHIPPING SPARROW	7.1	0.6	30.0	1.3	66.7	2.7	25.0	1.3
FIELD SPARROW	0.0	0.0	30.0	1.3	75.0	3.1	33.3	1.7
WHITE-CROWNED SPARROW	0.0	0.0	5.0	0.2	0.0	0.0	0.0	0.0
WHITE-THROATED SPARROW	28.6	2.3	20.0	0.9	0.0	0.0	33.3	1.7
FOX SPARROW	0.0	0.0	15.0	0.6	0.0	0.0	0.0	0.0
SWAMP SPARROW	0.0	0.0	25.0	1.1	25.0	1.0	16.7	0.9
SONG SPARROW	57.1	4.5	95.0	4.1	100.0	4.1	75.0	3.9

Table L-6. Number of birds observed during five censuses on the Susquehanna River, 11 March through 19 April 1977.

DATE	11 MAR	21 MAR	1 APR	11 APR	19 APR		
SPECIES	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
BLACK-CROWNED NIGHT HERON	0	0	0	0	2	0.4	0.7
CANADA GOOSE	1	20	0	0	1	4.4	7.3
DUCK SP.	4	2	2	0	0	1.6	2.7
MALLARD	28	44	16	16	14	23.6	39.3
BLACK DUCK	6	7	11	8	2	6.8	11.3
PINTAIL	0	1	0	0	0	0.2	0.3
BLUE-WINGED TEAL	0	0	3	0	2	1.0	1.7
AMERICAN WIDGEON	4	7	25	7	0	8.6	14.3
WOOD DUCK	4	12	2	12	4	6.8	11.3
RING-NECKED DUCK	5	0	0	0	0	1.0	1.7
GREATER SCAUP	0	0	0	0	3	0.6	1.0
LESSER SCAUP	0	0	0	3	0	0.6	1.0
HOODED MERGANSER	2	2	0	4	4	2.4	4.0
COMMON MERGANSER	5	2	0	0	0	1.4	2.3
OSPREY	0	0	0	0	1	0.2	0.3
RING-BILLED GULL	0	2	0	0	0	0.4	0.7
TOTAL INDIVIDUALS	59	99	59	50	33	60.0	
TOTAL SPECIES	9	10	6	6	9	8.0	

Table L-7. Number of birds observed during 11 censuses on the Susquehanna River, 21 September through 19 December 1977.

DATE	21 SEP	30 SEP	18 OCT	21 OCT	4 NOV	7 NOV	9 NOV	10 NOV	20 NOV	7 DEC	19 DEC		
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	NO.	MEAN	% TOTAL
HORNED GREBE	0	0	1	0	0	0	0	0	0	0	1	0.2	0.5
DOUBLE-CRESTED CORMORANT	0	0	0	1	0	0	0	0	0	0	0	0.1	0.2
GREAT BLUE HERON	1	2	5	0	3	3	2	4	0	0	0	1.8	4.6
EASTERN GREEN HERON	2	0	0	0	0	0	0	0	0	0	0	0.2	0.5
ATLANTIC BRANT	0	0	0	0	0	31	37	30	0	0	0	8.9	22.4
DUCK SP.	12	0	13	0	0	1	0	0	1	1	11	3.5	8.9
MALLARD	0	0	3	3	0	0	2	1	4	2	9	2.2	5.5
BLACK DUCK	0	0	12	8	2	1	3	10	4	0	21	5.5	13.9
GREEN-WINGED TEAL	0	0	1	0	0	0	0	0	0	0	0	0.1	0.2
BLUE-WINGED TEAL	0	0	0	0	2	0	0	0	0	0	0	0.2	0.5
WOOD DUCK	18	15	32	5	0	2	7	1	0	0	0	7.3	18.3
GREATER SCAUP	0	0	0	0	0	1	0	0	0	0	0	0.1	0.2
RUFFLEHEAD	0	0	0	0	0	3	1	3	0	2	0	0.8	2.1
OLDSQUAW	0	0	0	0	0	0	0	1	0	0	1	0.2	0.5
COMMON SCOTER	0	0	0	0	0	1	0	40	0	0	0	3.7	9.4
RUDDY DUCK	0	0	0	0	0	0	0	3	0	0	0	0.3	0.7
COMMON MERGANSER	0	0	0	0	0	0	0	0	0	12	14	2.4	5.9
AMERICAN COOT	0	0	1	0	0	0	0	0	0	0	0	0.1	0.2
KILLDEER	0	2	0	0	0	0	0	0	0	0	0	0.2	0.5
SPOTTED SANDPIPER	1	0	0	0	0	0	0	0	0	0	0	0.1	0.2
GULL SP.	0	0	0	0	0	0	0	0	0	1	0	0.1	0.2
HERRING GULL	0	0	0	0	0	0	2	0	0	0	0	0.2	0.5
BELTED KINGFISHER	4	2	2	0	1	3	2	3	1	0	1	1.7	4.3
TOTAL INDIVIDUALS	38	21	70	17	8	46	56	96	10	18	58	39.8	
TOTAL SPECIES	6	4	9	4	4	9	8	10	4	5	7	6.4	

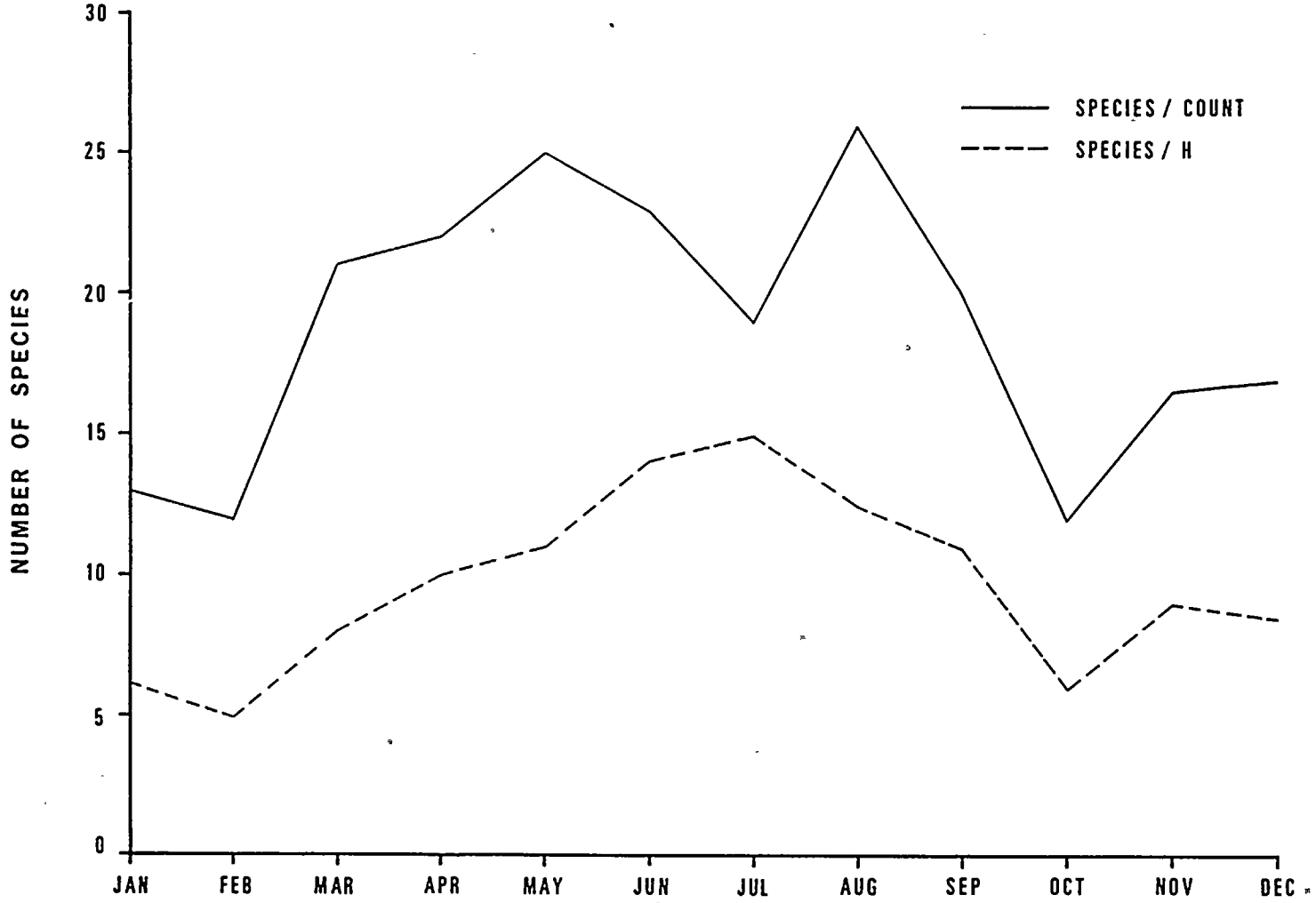

Fig. L-1. Mean number of species/count and species/h observed on nonsystematic bird counts (4-11/mo) near the Susquehanna SES, 1977.

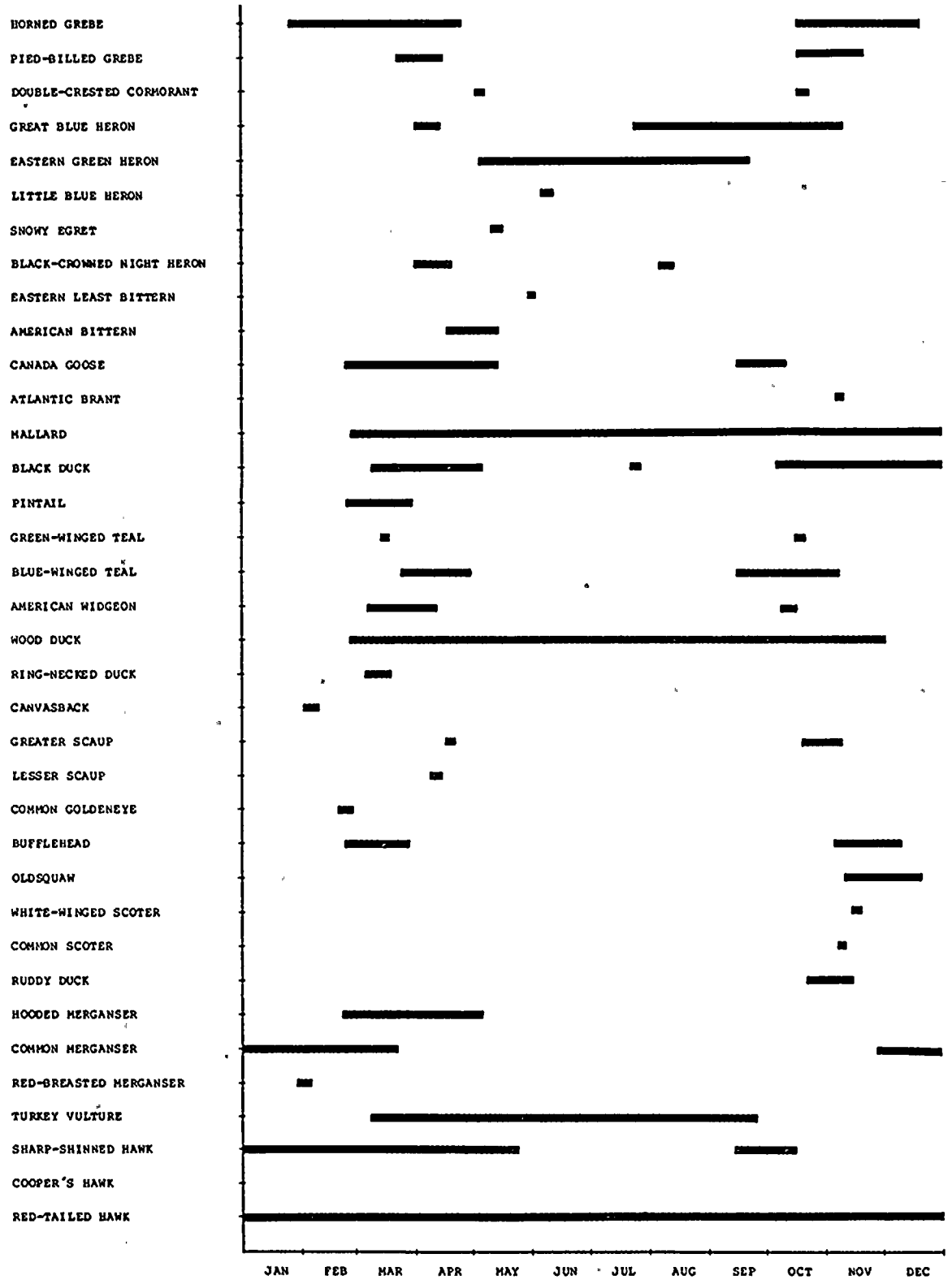

Fig. L-2. Phenological occurrence of birds observed near the Susquehanna SES, 1977.

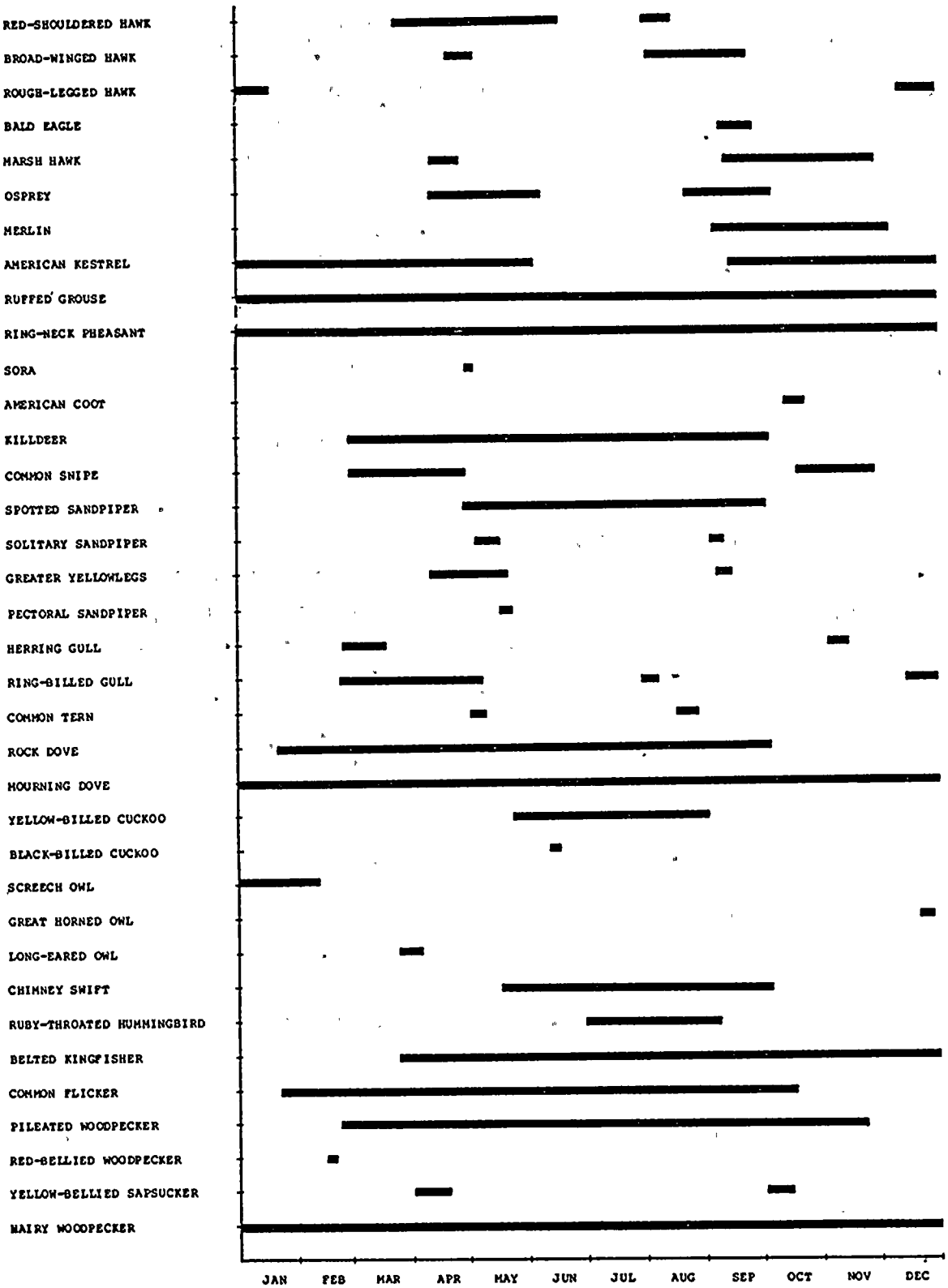
RED-SHOULDERED HAWK
BROAD-WINGED HAWK
ROUGH-LEGGED HAWK
BALD EAGLE
MARSH HAWK
OSPREY
MERLIN
AMERICAN KESTREL
RUFFED GROUSE
RING-NECK PHEASANT
SORA
AMERICAN COOT
KILLDEER
COMMON SNIPE
SPOTTED SANDPIPER
SOLITARY SANDPIPER
GREATER YELLOWLEGS
PECTORAL SANDPIPER
HERRING GULL
RING-BILLED GULL
COMMON TERN
ROCK DOVE
MOURNING DOVE
YELLOW-BILLED CUCKOO
BLACK-BILLED CUCKOO
SCREECH OWL
GREAT HORNED OWL
LONG-EARED OWL
CHIMNEY SWIFT
RUBY-THROATED HUMMINGBIRD
BELTED KINGFISHER
COMMON FLICKER
PILEATED WOODPECKER
RED-BELLIED WOODPECKER
YELLOW-BELLIED SAPSUCKER
HAIRY WOODPECKER
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. L-2 (cont.)

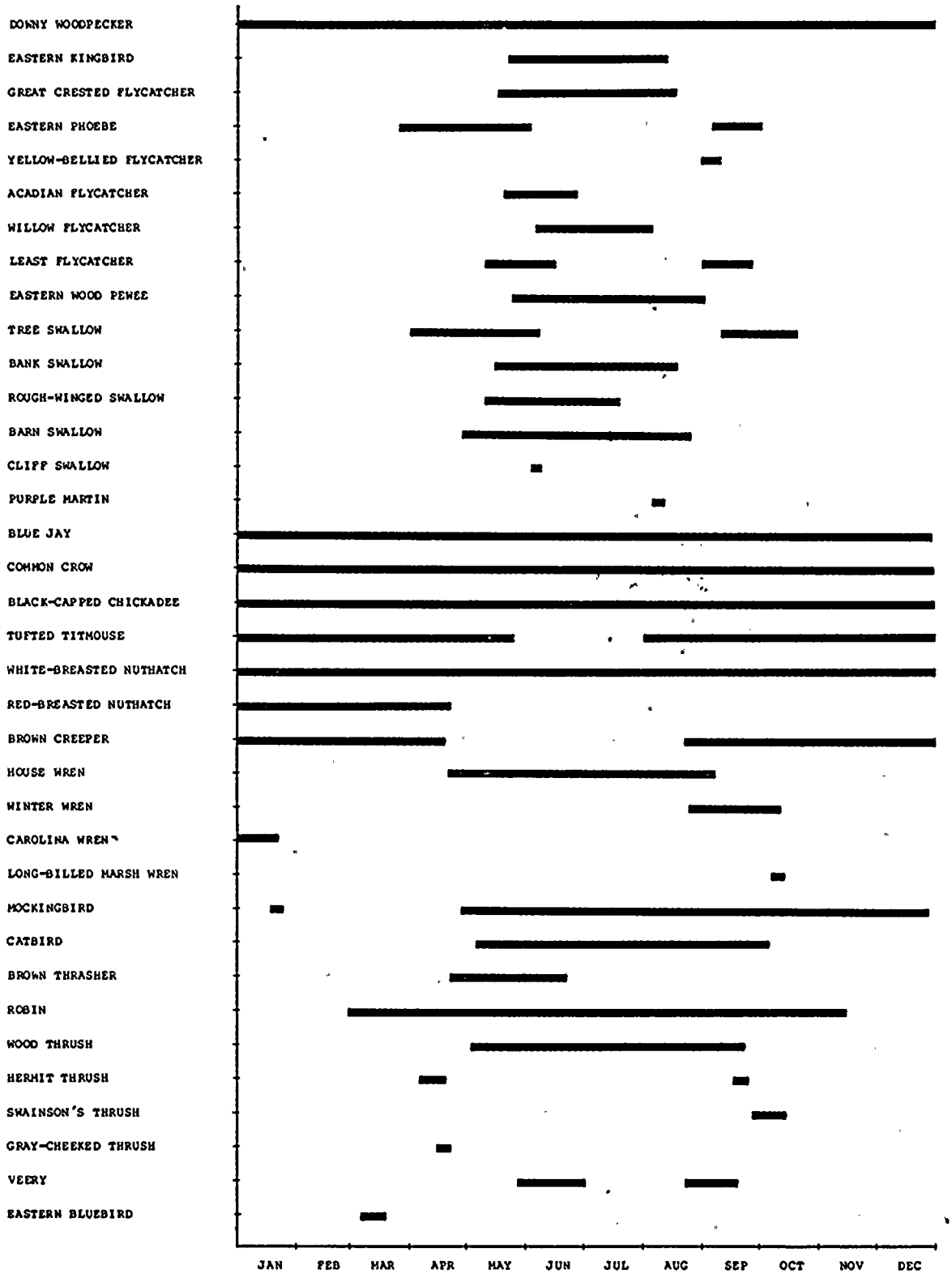
DOWNY WOODPECKER
EASTERN KINGBIRD
GREAT CRESTED FLYCATCHER
EASTERN PHOEBE
YELLOW-BELLIED FLYCATCHER
ACADIAN FLYCATCHER
WILLOW FLYCATCHER
LEAST FLYCATCHER
EASTERN WOOD PEWEE
TREE SWALLOW
BANK SWALLOW
ROUGH-WINGED SWALLOW
BARN SWALLOW
CLIFF SWALLOW
PURPLE MARTIN
BLUE JAY
COMMON CROW
BLACK-CAPPED CHICKADEE
TUFTED TITMOUSE
WHITE-BREASTED NUTHATCH
RED-BREASTED NUTHATCH
BROWN CREEPER
HOUSE WREN
WINTER WREN
CAROLINA WREN
LONG-BILLED MARSH WREN
MOCKINGBIRD
CATBIRD
BROWN THRASHER
ROBIN
WOOD THRUSH
HERMIT THRUSH
SWAINSON'S THRUSH
GRAY-CHEEKED THRUSH
VEERY
EASTERN BLUEBIRD
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
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Fig. L-2 (cont.)

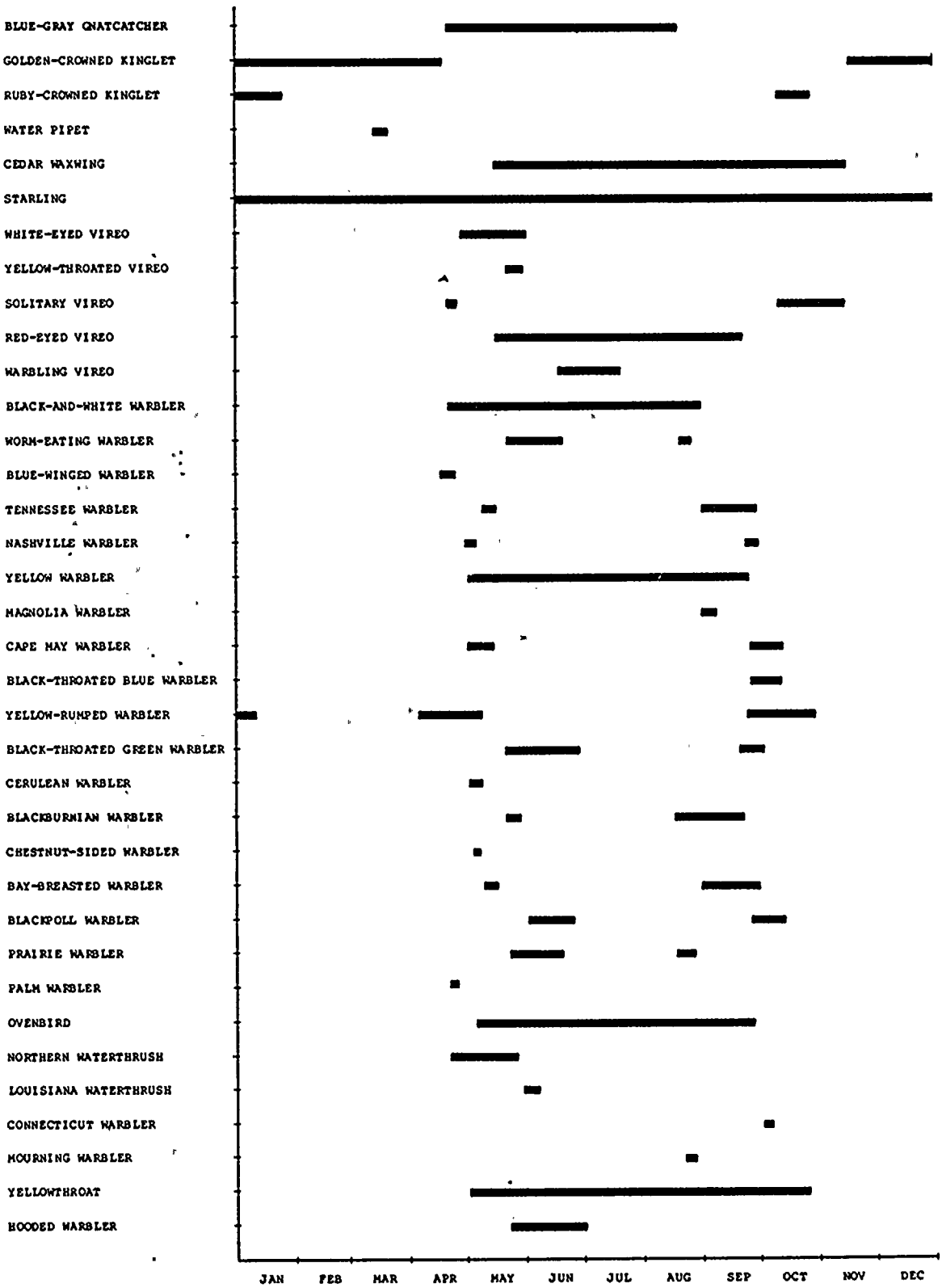
BLUE-GRAY GNATCATCHER
GOLDEN-CROWNED KINGLET
RUBY-CROWNED KINGLET
WATER PIPET
CEDAR WAXWING
STARLING
WHITE-EYED VIREO
YELLOW-THROATED VIREO
SOLITARY VIREO
RED-EYED VIREO
WARBLING VIREO
BLACK-AND-WHITE WARBLER
WORM-EATING WARBLER
BLUE-WINGED WARBLER
TENNESSEE WARBLER
NASHVILLE WARBLER
YELLOW WARBLER
MAGNOLIA WARBLER
CAPE MAY WARBLER
BLACK-THROATED BLUE WARBLER
YELLOW-RUMPED WARBLER
BLACK-THROATED GREEN WARBLER
CERULEAN WARBLER
BLACKBURNIAN WARBLER
CHESTNUT-SIDED WARBLER
BAY-BREASTED WARBLER
BLACKPOLL WARBLER
PRAIRIE WARBLER
PALM WARBLER
OVENBIRD
NORTHERN WATERTHRUSH
LOUISIANA WATERTHRUSH
CONNECTICUT WARBLER
MOURNING WARBLER
YELLOWTHROAT
HOODED WARBLER
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. L-2 (cont.)

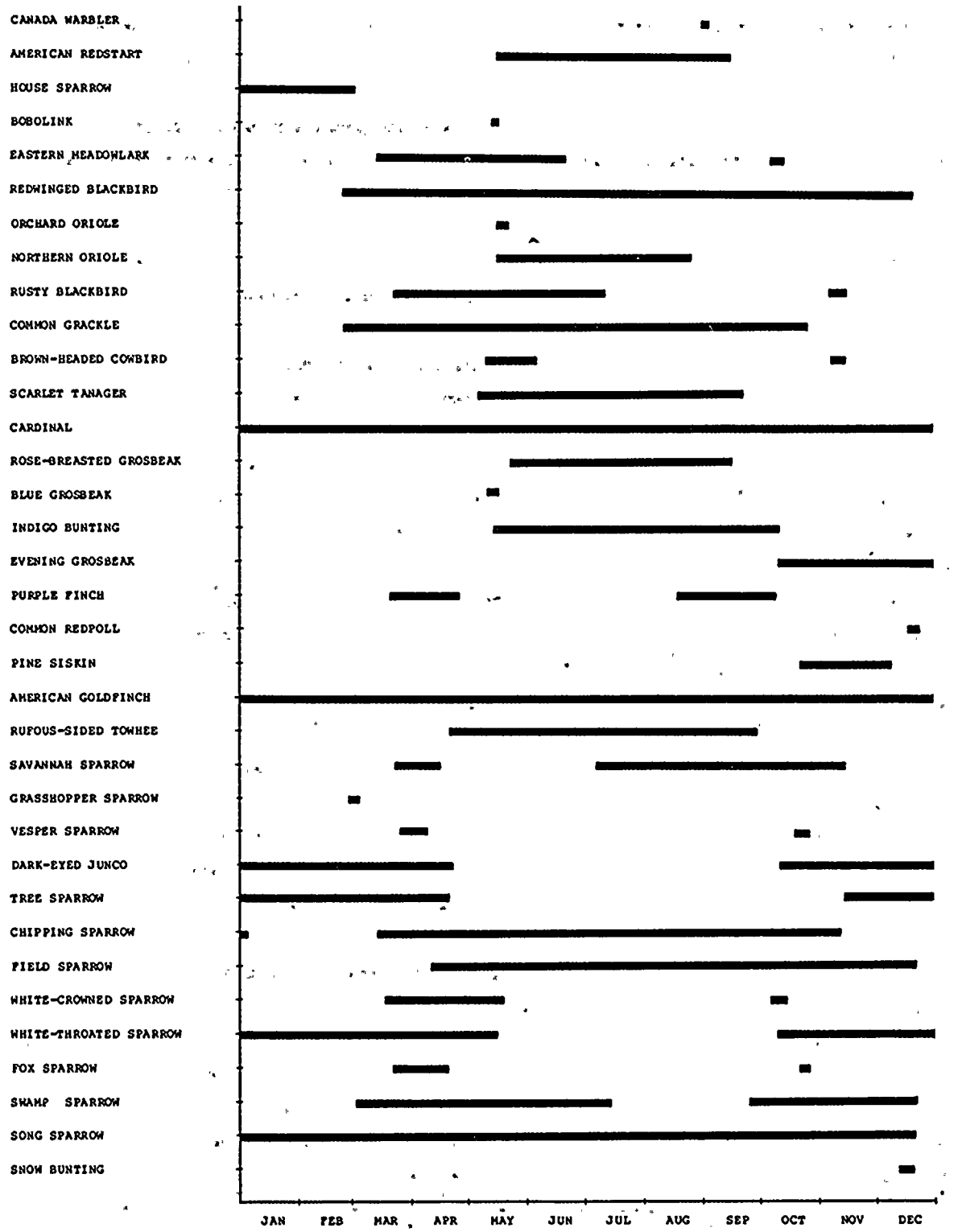
CANADA WARBLER
AMERICAN REDSTART
HOUSE SPARROW
BOBOLINK
EASTERN MEADOWLARK
REDWINGED BLACKBIRD
ORCHARD ORIOLE
NORTHERN ORIOLE
RUSTY BLACKBIRD
COMMON GRACKLE
BROWN-HEADED COWBIRD
SCARLET TANAGER
CARDINAL
ROSE-BREASTED GROSBEAK
BLUE GROSBEAK
INDIGO BUNTING
EVENING GROSBEAK
PURPLE FINCH
COMMON REDPOLL
PINE SISKIN
AMERICAN GOLDFINCH
RUFOUS-SIDED TOWHEE
SAVANNAH SPARROW
GRASSHOPPER SPARROW
VESPER SPARROW
DARK-EYED JUNCO
TREE SPARROW
CHIPPING SPARROW
FIELD SPARROW
WHITE-CROWNED SPARROW
WHITE-THROATED SPARROW
FOX SPARROW
SWAMP SPARROW
SONG SPARROW
SNOW BUNTING
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. L-2 (cont.)

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