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

1984 Annual Report

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CONTENTS

Page

INTRODUCTION..... 1

EXECUTIVE SUMMARY..... 4

PHYSICOCHEMICAL ANALYSES by Walter J. Soya and Theodore V. Jacobsen..... 7

ALGAE by Andrew J. Gurzynski and William F. Gale..... 54

BENTHIC MACROINVERTEBRATES by Lynn S. Zelenak, William G. Deutsch, and William F. Gale..... 77

LARVAL FISHES by William G. Deutsch, Brian P. Mangan, Andrew J. Gurzynski, and Theodore V. Jacobsen..... 112

FISHES by William G. Deutsch, Andrew J. Gurzynski, Brian P. Mangan, and William F. Gale..... 150

ANGLER SURVEY by Walter J. Soya, Andrew J. Gurzynski, and Theodore V. Jacobsen..... 174

FLORA, VEGETATION, AND METEOROLOGY by James D. Montgomery..... 198

BIRDS by Douglas A. Gross and James D. Montgomery..... 286

ACKNOWLEDGMENTS..... 332

PERSONNEL INVOLVED IN THE PROJECT DURING 1984..... 333

ABSTRACTS OF SCIENTIFIC PUBLICATIONS BY THE STAFF OF THE SUSQUEHANNA SES BIOLOGICAL LABORATORY, 1984..... 335

SCIENTIFIC PUBLICATIONS BY THE STAFF OF THE SUSQUEHANNA SES BIOLOGICAL LABORATORY, 1974-84..... 336

TECHNICAL REPORTS BY ICHTHYOLOGICAL ASSOCIATES, INC. AT THE SUSQUEHANNA SES BIOLOGICAL LABORATORY, 1972-84..... 342

INTRODUCTION

The Susquehanna Steam Electric Station (Susquehanna SES) is a nuclear generating station with two boiling water reactors, each with an electrical generating capacity of 1,050 megawatts. It is located on a 450-hectare site in Salem Township, Luzerne County, 8 km northeast of Berwick, Pennsylvania. Under terms of an agreement finalized in January 1978, 90% of the Susquehanna SES is owned by the Pennsylvania Power and Light Company (PP&L) and 10% by the Allegheny Electric Cooperative, Inc.

Ichthyological Associates, Inc. (IA) has conducted ecological studies near the Susquehanna SES since 1971. Aquatic studies have been done in the Susquehanna River each year since then and terrestrial investigations of the Station site were conducted in 1972-74 and 1977-present. The objective of these studies was to establish a preoperational baseline of ecological conditions in the river and on the site prior to fuel load in the Unit 1 reactor. Fuel load was completed on 1 September 1982. As of this date, the preoperational studies were terminated and operational studies were begun using the same procedures. The environmental impact of the Susquehanna SES will be evaluated by comparing operational to preoperational data. Commercial production of electricity at Units 1 and 2 began on 8 June 1983 and 12 February 1985, respectively.

Throughout 1984, both aquatic and terrestrial studies were continued. Various physicochemical characteristics of the river were measured, and its algal, macroinvertebrate, and fish populations were monitored. Terrestrial investigations of the site dealt with studies of flora, vegetation, and birds.

Sampling procedures, data tabulations, and interpretation of the results are presented for each study in this annual progress report for 1984. A detailed description of procedures for sampling and data base management have also been documented (Ichthyological Associates, Inc. 1984).

Most of the aquatic studies were conducted within 2 km of the intake structure and discharge diffuser of the Susquehanna SES. The slope of the riverbed in this stretch is 0.3 m/km and the average width is 300 m. Depth is relatively shallow in most areas (less than 2 m), but some pools may exceed 5 m even during low river flow. During periods of low flow, which normally occur in late summer and early autumn, abandoned eel walls help dam pools, some of which extend several kilometers upriver. In times of high flow, the river level commonly increases 3 m or more, and its flow characteristics resemble an open channel.

Beginning about 50 km upriver from the site, the "Wyoming Region" of the northern anthracite coalfield 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). Throughout this same area, domestic sewage, most of which has undergone primary treatment, also enters the river at several locations.

Terrestrial studies were done on the site or adjacent PP&L properties located within the Ridge and Valley Section of the Appalachian Valley Province (Fenneman 1938). Elevations in the study area ranged from 150 m above mean sea level on the river floodplain to a maximum of 372 m on Council Cup Ridge, 3 km southeast of the site.

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EXECUTIVE SUMMARY

The objective of the environmental studies conducted by Ichthyological Associates, Inc. during 1984 was to assess the impact of the Susquehanna SES upon the ecology of the Susquehanna River and local terrestrial areas. This was accomplished by comparison of preoperational and operational data. Aquatic studies were done at sites upriver from the Susquehanna SES intake structure (SSES) and downriver from the discharge diffuser (Bell Bend). Most terrestrial studies were done on study plots surrounding the generating station. Brief summaries of the results of the 1984 studies follow.

Statistical analyses of physicochemical data collected from the Susquehanna River near the Susquehanna SES showed no significant change in water quality from 1978 through 1984. Suspended sediments from highway construction upriver caused turbid river conditions during the summer. River water quality was not adversely affected by the Susquehanna SES effluent. Levels of all parameters tested were within water quality criteria established by the Pennsylvania Department of Environmental Resources, except for total and dissolved iron which, historically, have exceeded allowable concentrations in the river throughout preoperational studies.

Results of algae (periphyton and phytoplankton) collections at SSES and Bell Bend in 1984 did not indicate any impact from operation of the Susquehanna SES. Overall, mean periphyton density at both sites in 1984 (800 units/mm^2) decreased from the 1,100 units/mm^2 found in 1983; density at both sites peaked in October. Overall, phytoplankton density also decreased at both sites from 11,400 units/ml in 1983 to 3,500 units/ml in 1984. These decreases in algal density were probably a result of unusually high turbidity resulting from the highway construction upriver.

Benthic macroinvertebrates were sampled at SSES and Bell Bend in 1984. Mean macroinvertebrate density (stations combined) was 27,400 organisms/m^2, similar to that found in 1981 and 1982, but 36% less than in 1983. Chironomids composed 45% of the annual mean organisms collected. Annual mean biomass (2.5 g/m^2) was slightly less than the mean of the previous six years. Low mean river temperatures and high flows rather than operation of the Susquehanna SES, probably caused these decreases in density and biomass in 1984.

Larval fish drift sampled at SSES and Bell Bend produced a total of 1,981 larvae (96% prolarvae) of 16 species. Common carp, tessellated darter, quillback, spottail shiner, spotfin shiner, and banded darter composed 96% of the total larvae. Overall, mean density of larval fish at SSES (5.8 fish/10 m^3) and Bell Bend (7.1 fish/10 m^3) was similar and no effect of the Susquehanna SES was found on density or composition of larval fish drift.

Fishes were sampled by electrofishing and seining at SSES and Bell Bend in 1984. While electrofishing, 2,748 specimens (24 species and one hybrid) were observed at both stations; quillback, white sucker, northern hog sucker, shorthead redhorse, and smallmouth bass composed 61% of the total. The annual mean number of fish observed per unit effort at SSES was significantly greater than at Bell Bend. Seining produced 1,214 specimens (19 species) at both stations; spottail shiner, spotfin shiner, and bluntnose minnow composed 87% of the total. There was no significant difference in the annual mean number of fish captured per unit effort at SSES and Bell Bend. Although fewer fishes were found at Bell Bend while electrofishing, no impact was detected from operation of the Susquehanna SES.

During 48 angler surveys on the Susquehanna River near the Susquehanna SES in 1984, 490 anglers were interviewed. Channel catfish was the most frequently

caught fish (25% of the total catch) followed by smallmouth bass, walleye, rock bass, common carp, white sucker, bluegill, and brown bullhead. Projected for 1984, an estimated 2,942 anglers fished 10,329 hours, caught 4,468 fish, and harvested or removed 1,666 of these in the study area. Compared to previous studies in 1981, 1982, and 1983, river angling was suppressed by turbid river conditions from late June through mid-September as a result of highway construction upriver.

Flora and vegetation studies documented 701 species of vascular plants near the Susquehanna SES since 1972. Quantitative vegetation studies in upland forest plots revealed 53 significant changes in 1984. Of those at Susquehanna SES, 30 had been found in previous years. Sixteen significant changes occurred in the river bottom forest, five more than in 1983, and 40 significant changes occurred in two abandoned fields. Most of these changes were normal successional changes and none could be attributed to the operation of the Susquehanna SES.

Studies of bird populations near the Susquehanna SES in 1984 revealed 197 species and two hybrids; an immature bald eagle was the only species sighted that was listed as either threatened or endangered by the U.S. Department of the Interior. Breeding bird studies and seasonal bird counts conducted in the same plots showed that the densities of most species were similar; however, some significant density changes were found in all plots. These changes can be attributed to natural causes rather than operation of the Susquehanna SES. In the bird impaction study of the Unit 1 and 2 cooling towers, 24 birds of at least 11 species were collected during spring and autumn migrations. Fewer impacted birds were collected in 1984 than in previous years.

PHYSICOCHEMICAL ANALYSES

by

Walter J. Soya and Theodore V. Jacobsen

TABLE OF CONTENTS

Page

ABSTRACT..... 9

INTRODUCTION..... 9

PROCEDURES..... 10

RESULTS AND DISCUSSION..... 12

REFERENCES CITED..... 17

LIST OF TABLES

Table

A-1 Physicochemical parameters and methods of analyses, 1984..... 20

A-2 Daily minimum, maximum, and mean temperature (C) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1984... 21

A-3 Daily minimum, maximum, and mean level (m above msl) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1984..... 24

A-4 Daily mean flow (m^3/s) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1984..... 27

A-5 Physicochemical data collected from the Susquehanna River at SSES and Bell Bend, January through December 1984..... 28

A-6 Summary of physicochemical data collected from the Susquehanna River at SSES and Bell Bend, 1984..... 40

Table | Page
A-7 Results of Wilcoxon signed rank test comparing concurrent physicochemical data from the Susquehanna River at SSES and Bell Bend, 1984 41

A-8 Results . . . 1983-84 41

A-9 Summary of physicochemical data collected from the Susquehanna River at SSES (1973-84) and Bell Bend (1978-84) 42

A-10 Results of Friedman's two-way analysis of variance test and Page's distribution-free test for ordered alternatives of physicochemical parameters at SSES and Bell Bend from 1978 through 1984 42

A-11 Summary of water chemistry data collected from four major acid mine drainages upriver from the Susquehanna SES, 1972-84 43

A-12 Physicochemical data collected monthly from the Susquehanna River at SSES and Bell Bend, 1984 44

LIST OF FIGURES

Fig.
A-1 Physicochemical, algae, and benthic macroinvertebrate sampling sites at SSES and Bell Bend on the Susquehanna River, 1984 46

A-2 Monthly mean temperature, level, and flow of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1973-84 47

A-3 Monthly mean dissolved oxygen and total alkalinity of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84 48

A-4 Monthly mean pH and turbidity . . . 1972-84 49

A-5 Monthly mean specific conductance and sulfate . . . 1972-84 50

A-6 Monthly mean total and dissolved iron . . . 1972-84 51

A-7 Monthly mean total and fixed total residue . . . 1972-84 52

A-8 Monthly mean nonfiltrable and filtrable residue . . . 1972-84 53

ABSTRACT

Physicochemical data were collected at a control site (SSES) upriver from the Susquehanna SES intake, a site downriver from the discharge diffuser (Bell Bend), and the Susquehanna SES Biological Laboratory. River temperature ranged from 0.0 to 26.8 C, level from 148.21 to 155.19 m above msl, and flow from 45 to 6,305 m^3/s. A new minimum was recorded at SSES for total iron, and a new maximum for total alkalinity. At Bell Bend, there was a new minimum for Secchi disc depth and new maxima for total iron and total residue. Suspended sediment from highway construction upriver caused turbid conditions near the Susquehanna SES during the summer months. Statistical analyses of the physicochemical data from 1978 through 1984 showed no significant changes in water quality.

Water quality of the Susquehanna River was not adversely affected by the effluent of the Susquehanna SES. River temperature, dissolved oxygen, pH, total alkalinity, and filtrable residue data collected at Bell Bend were within Susquehanna River water quality criteria established by the Pennsylvania Department of Environmental Resources (PDER). Total and dissolved iron concentrations at Bell Bend exceeded the PDER criteria in a majority of samples; however, the concentrations were usually lower than those at the SSES control site. Historically, iron concentrations have exceeded PDER criteria throughout preoperational studies.

INTRODUCTION

This report presents physicochemical data collected from the Susquehanna River near the Susquehanna SES in 1984. The objective from 1971 to

1 September 1982 was to establish a baseline of preoperational water quality data. These data are in annual reports from 1971 through 1982 (Ichthyological Associates 1972; Ichthyological Associates, Inc. 1973-74; Smith and Soya 1976; Jacobsen and Soya 1976-77; Soya and Jacobsen 1978-82; Soya et al. 1983). Operation and testing of the Unit 1 reactor of the Susquehanna SES began on 1 September 1982. Water quality of the river was not adversely affected by the effluent of the Susquehanna SES in 1983 (Soya et al. 1984). The 1984 data were compared to water quality criteria established for the Susquehanna River by the Pennsylvania Department of Environmental Resources (PDER).

PROCEDURES

Physicochemical data were collected from the river at the Susquehanna SES Biological Laboratory and the SSES and Bell Bend sampling sites (Fig. A-1). The laboratory is on the west bank, 495 m upriver from the center of the Susquehanna SES intake structure. The control site, SSES, is 230 m upriver from the intake structure and Bell Bend is 690 m downriver from the Susquehanna SES discharge diffuser; both are about 40 m from the west bank. The sites are 1.14 km apart.

River temperature and level were monitored (Table A-1) at the laboratory. Temperature and depth of the river were recorded continuously on 7-day graphs. Sensors for both recorders were located on the river bottom within 30 m of the bank. Temperature (C) was read directly from the graph, whereas depth (ft) was converted to river level (m) above mean sea level (msl). River level data were used to calculate flow (m^3/s) (Table A-1). Daily means of temperature and level were determined by averaging hourly values from 0100 through 2400 h.

The daily minimum and maximum temperature and level and their respective hour 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 noted.

Physicochemical data were collected at the SSES and Bell Bend sites twice per week from April through September, and once per week from January through March and October through December. The order of sampling and analysis at the two sites was randomly determined. All samples were collected between 1200 and 1400 h. A grab sample and dissolved oxygen sample of surface water were taken while drifting over each site in a boat; air and surface water temperature, Secchi disc depth, and prevailing weather conditions were recorded (Table A-1). Ice cover prevented navigation on 27 January and samples were collected in ice-free areas along the west shore at both sites; Secchi disc depth was not recorded due to shallow water. River level and flow were tabulated with the SSES data.

Samples were immediately transported to the laboratory and analyzed for dissolved oxygen, pH, total alkalinity, specific conductance, sulfate, residues (total, fixed total, and nonfiltrable), and turbidity (Table A-1). Each laboratory analysis was performed at least twice and the mean was reported. All calculations were maintained in bound notebooks. Aliquots of each grab sample were fixed for analyses of total and dissolved iron (Table A-1) performed by personnel at the Pennsylvania Power and Light (PP&L) Water Laboratory, Hazleton, Pennsylvania. All analyses were conducted within the holding time recommended by the U.S. Environmental Protection Agency (EPA 1979).

Physicochemical data collected in 1984 were statistically analyzed. The nonparametric Wilcoxon signed rank test (Siegel 1956) was used to compare differences between data collected at SSES and Bell Bend. Data collected at the laboratory, SSES, and Bell Bend were compared to those obtained in previous years. Nonparametric statistics were used to determine if: 1) year-to-year changes had occurred in each parameter using Friedman's two-way analysis of variance test (S), and 2) a trend among years was present using Page's distribution-free test (L) for ordered alternatives (Hollander and Wolfe 1973). The tests were based on monthly mean values from 1978 through 1984. The 5% probability level was used to determine significance.

Personnel from the Susquehanna SES Biological Laboratory collected river surface water samples monthly at SSES and Bell Bend (Fig. A-1) for analysis at the PP&L Water Laboratory. Water temperature and dissolved oxygen were measured in the field; all other analyses were made at the PP&L Laboratory according to *Standard Methods* (APHA 1980) or *Methods for Chemical Analysis of Water and Wastes* (EPA 1979).

RESULTS AND DISCUSSION

In 1984, the river temperature ranged from 0.0 C, recorded on numerous days in January, February, and March, to 26.8 C on 16 July (Table A-2). The lowest daily mean temperature, also 0.0 C, occurred on several days in January, whereas the highest, 26.0 C, occurred on 9 August. The daily mean temperature varied least in January (Standard Error = 0.02) and most in June (SE = 0.62). The monthly mean temperature was lowest, 0.1 C, in January and highest, 23.9 C, in August. Daily water temperature fluctuations of 0.5 C or

greater occurred in each month. These fluctuations were found in 98% of the days when the daily mean temperature was greater than 10.0 C and 65% of the days when the daily mean temperature was 10.0 C or less. The maximum fluctuation, 3.4 C, occurred on 6 October.

The minimum river level, 148.21 m above msl, occurred on 14, 15, 19, 20, 21, and 22 October (Table A-3). The maximum river level, 155.19 m above msl, was recorded on 7 April. The daily mean level varied least in October (SE = 0.008) and most in February (SE = 0.310). The monthly mean level was highest, 151.14 m above msl, in April and lowest, 148.27 m above msl, in October.

River flow ranged from 45 m^3/s to 6,305 m^3/s (calculated from the minimum and maximum river levels). The daily mean flow was least, 45 m^3/s, on 14, 15, 19, 20, and 21 October and greatest, 5,948 m^3/s, on 7 April (Table A-4). The daily mean flow varied least in October (SE = 1.3) and most in February (SE = 248.2). The monthly mean flow was lowest, 54 m^3/s, in October and highest, 1,559 m^3/s, in April.

Acid mine water enters the river at several abandoned coal mine drainages from the confluence with the Lackawanna River to Nanticoke, Pennsylvania, 48 km and 22 km upriver, respectively. Sewage effluents (raw, primary, and secondary) also flow into the river from several upriver towns and cities from as near as 6 km. Although these pollutants degraded water quality at the Susquehanna SES site in 1984, overall improvement has been documented since 1976 (Soya et al. 1984).

Physicochemical data collected at SSES and Bell Bend were similar throughout 1984 (Table A-5). Annual means were identical at both sites for 7 of 15 parameters (Table A-6). The means of all other parameters at Bell Bend

varied less than ±3.6% of those at SSES. Even though there was little difference in the annual means between the sites, significant patterns occurred in the data. Wilcoxon analysis of the 1984 data showed that dissolved iron was higher at SSES a significantly greater number of times and that total alkalinity, specific conductance, and total, nonfiltrable, and filtrable residues were higher at Bell Bend a significantly greater number of times (Table A-7).

When the Wilcoxon analysis was applied to the physicochemical data collected in 1983 and 1984, we found that turbidity, sulfate, total iron, and dissolved iron were higher at SSES a significantly greater number of times; Secchi disc depth, dissolved oxygen, pH, total alkalinity, specific conductance, total residue, and filtrable residue were higher at Bell Bend a significantly greater number of times (Table A-8). These patterns also occurred in preoperational data collected from 1978 through 1982 (Soya et al. 1983) with the exception of pH and specific conductance.

The pH in all samples collected at Bell Bend throughout 1984 was within the range of the Susquehanna River water quality criteria (6.0-9.0 pH units) established by the Pennsylvania Department of Environmental Resources (PDER 1979). There is no criteria for specific conductance, but the filtrable residue (total dissolved solids), which is directly related to specific conductance in the river (Soya and Jacobsen 1982), did not exceed the PDER criteria in any sample at Bell Bend in 1984. In addition, total alkalinity, dissolved oxygen, and temperature were within PDER criteria in all samples collected at Bell Bend throughout the year.

Total iron concentrations in 1984 exceeded the 1.5 mg/l criteria (PDER 1979) in 51 of 78 samples (65%) at SSES and Bell Bend. For the period 1978 through 1984, there were more total iron samples greater than 1.5 mg/l at SSES (76%) than at Bell Bend (70%); the number has been greater at SSES each year except 1984. These data indicate that there has been a gradual decline in the concentration of total iron, and also support the Wilcoxon analysis of higher total iron concentrations at SSES. The dissolved iron criteria of the PDER, 0.3 mg/l, was exceeded in 61 of 78 samples (78%) at SSES and 57 of 78 samples (73%) at Bell Bend sites in 1984.

Most data collected in 1984 were within ranges established for the SSES and Bell Bend sites since 1972 and 1978, respectively (Table A-9). However, new minima were recorded at SSES for total iron (0.86 mg/l on 30 March) and Bell Bend for Secchi disc depth (3 cm on 16 February). There were new maxima at SSES for total alkalinity (88 mg/l on 21 September) and Bell Bend for total iron (25.4 mg/l on 16 February) and total residue (728 mg/l on 16 February).

Suspended sediment from highway construction on the Chemung River, a major tributary of the Susquehanna River in New York, caused turbid conditions near the Susquehanna SES in June, July, and August. River samples collected on 22 and 26 June, 10 July, and 17 and 21 August had turbidities from 40 to 240 NTU and nonfiltrable residues from 66 to 308 mg/l (Table A-5). The limit of visibility (Secchi disc depth) in all of these samples was less than 20 cm. Water clarity improved between these periods of high turbidity, but the river continued to appear "muddy" throughout much of the summer.

Statistical analyses of the physicochemical data collected from 1978 through 1984 revealed no significant water quality trends at either SSES or

Bell Bend (Table A-10). Prior to 1978, significant improved water quality trends were observed at SSES (Soya et al. 1984). These trends were associated with the termination of pumping coal mine water into the river at several locations upriver from the Susquehanna SES site in 1972 as a result of flooding from Tropical Storm Agnes. Since no trends were observed from 1978 through 1984, it is evident that most improvement occurred between 1972 and 1978. This is supported by PDER data collected at four major upriver mine effluents (Table A-11). The water quality at these effluents improved more from 1972 through 1977 than from 1978 through 1984.

A total of 44 water quality parameters was analyzed by personnel from the PP&L Water Laboratory monthly from samples collected at SSES and Bell Bend (Table A-12). The concentrations of sulfate, iron, aluminum, and manganese show that acid mine drainage pollution persists at the site. Total iron concentrations in 7 of 12 samples at Bell Bend exceeded the PDER limit of 1.5 mg/l; total manganese concentrations did not exceed the PDER limit of 1.0 mg/l in any month. Major cation and anion composition at SSES was similar to that found in previous years (Soya et al. 1984). Calcium was the dominant cation (mean = 29.9 mg/l and 1.49 me/l). The dominant anion in each sample was either bicarbonate (mean = 66.6 mg/l and 1.09 me/l) or sulfate (mean = 42.5 mg/l and 0.88 me/l). There were no discernable or consistent differences between SSES and Bell Bend throughout the PP&L data.

Based on 1984 data, water quality of the Susquehanna River was not adversely affected by the effluent of the Susquehanna SES. River temperature, dissolved oxygen, pH, total alkalinity, and filtrable residue data collected at Bell Bend were within criteria established for the river by the PDER.

Specific conductance was usually greater at Bell Bend during low flow periods. Total and dissolved iron concentrations at Bell Bend exceeded the PDER criteria in a majority of the samples; however, the concentrations were usually lower than those at the SSES control site. Historically, iron concentrations have exceeded PDER criteria throughout preoperational studies.

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Table A-1

Physicochemical parameters and methods of analyses, 1984.

Parameter	Method	Reference
River level	Seven-day continuous recordings from an ACCO Bristol, Model No. G500-15 bubbler-type water level gauge	ACCO (1971)
River flow	River flow = 231.4857 + 321.2703 (river level -149) + 106.6087 (river level -149)^2	Hewlett Packard (1972)
River temperature	Seven-day continuous recordings from a calibrated, Leeds and Northrup Speedomax Thermistor-type, Model R temperature recorder	APHA (1980)
	Calibrated, mercury thermometer	APHA (1980)
Air temperature	Calibrated, mercury thermometer	APHA (1980)
Dissolved oxygen	Azide modification of Winkler	APHA (1980)
pH	Glass electrode	APHA (1980)
Total alkalinity	Potentiometric titration	APHA (1980)
Specific conductance	Self-contained conductivity meter	APHA (1980)
Sulfate	Turbidimetric	APHA (1980)
Total iron	Atomic absorption spectrophotometric determination of extractable iron	APHA (1980)
Dissolved iron	Atomic absorption spectrophotometric determination of dissolved iron	APHA (1980)
Total residue	Evaporation, dried at 105 C	APHA (1980)
Fixed total residue	Ignition of total residue at 550 C	APHA (1980)
Nonfiltrable residue	Residue retained on a glass fiber filter, dried at 105 C	APHA (1980)
Filtrable residue	Calculation; total residues minus nonfiltrable residue	--
Turbidity	Nephelometric	APHA (1980)
Secchi disc depth	Limit of visibility	Welch (1948)

Table A-2

Daily minimum, maximum, and mean temperature (C) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1984.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN					
1	0.0	0100	0.0	0100	0.0
2	0.0	0100	0.0	0100	0.0
3	0.0	0100	0.0	0100	0.0
4	0.0	0100	0.1	1700	0.0
5	0.0	0600	0.1	0100	0.1
6	0.0	0600	0.1	0100	0.1
7	0.0	1800	0.2	1400	0.1
8	0.0	0100	0.0	0100	0.0
9	0.0	0100	0.1	1000	0.1
10	0.1	2100	0.3	1200	0.2
11	0.0	0400	0.3	1300	0.1
12	0.0	0100	0.3	1200	0.1
13	0.0	0100	0.1	1100	0.1
14	0.1	0100	0.3	1400	0.1
15	0.0	0400	0.5	1300	0.1
16	0.0	0100	0.1	1300	0.0
17	0.0	0100	0.3	1500	0.1
18	0.0	0100	0.1	1000	0.1
19	0.1	0100	0.3	1300	0.2
20	0.1	0100	0.3	1500	0.1
21	0.1	0100	0.2	1300	0.1
22	0.1	0100	0.2	1500	0.1
23	0.0	2000	0.2	1300	0.1
24	0.0	0100	0.1	1300	0.0
25	0.0	0100	0.1	1100	0.0
26	0.0	0100	0.2	1300	0.1
27	0.1	0100	0.6	1300	0.3
28	0.2	0100	0.7	1300	0.3
29	0.1	0100	0.3	1200	0.2
30	0.2	0100	0.5	1200	0.3
31	0.2	2400	0.8	1300	0.5
MEAN					0.1
SE					0.02

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
FEB					
1	0.1	0200	0.6	1500	0.2
2	0.1	0100	0.6	1300	0.2
3	0.1	0400	0.8	1300	0.5
4	0.7	0100	1.5	1300	1.1
5	0.7	2100	1.0	0100	0.9
6	0.4	2400	0.9	1200	0.6
7	0.1	2300	0.9	1300	0.4
8	0.0	2400	0.5	1200	0.2
9	0.0	0100	0.9	1300	0.3
10	0.2	0100	1.4	1300	0.8
11	1.0	0100	1.7	1400	1.3
12	1.2	0100	1.9	1300	1.4
13	1.1	1600	1.3	1300	1.2
14	0.0	2300	1.4	0400	1.1
15	0.0	0100	1.2	2300	0.4
16	1.2	0100	1.6	1300	1.4
17	1.5	0100	2.4	2400	2.0
18	2.4	0100	3.0	1400	2.8
19	3.0	0100	3.5	2300	3.2
20	3.3	0700	3.6	1200	3.5
21	3.1	2200	3.4	0100	3.2
22	2.8	0800	3.1	0100	3.0
23	2.7	0700	3.0	2200	2.9
24	3.0	0100	3.8	2200	3.4
25	3.8	0100	4.0	1000	3.9
26	3.3	0800	3.9	0100	3.6
27	3.0	2400	3.6	0100	3.2
28	2.4	2300	3.0	0100	2.8
29	1.7	2300	2.3	0100	2.0
MEAN					1.8
SE					0.23

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR					
1	0.6	2400	1.6	0100	1.1
2	0.3	0600	0.8	1500	0.6
3	0.3	0800	0.8	1500	0.6
4	0.3	0600	1.0	1300	0.8
5	1.0	1100	1.2	0400	1.1
6	1.0	0500	1.6	1600	1.3
7	1.4	0700	2.1	1600	1.8
8	0.9	2200	1.8	1200	1.4
9	0.8	0700	1.7	1300	1.2
10	0.4	0700	1.2	1300	0.8
11	0.2	2300	1.0	1500	0.5
12	0.0	0600	1.1	1400	0.5
13	0.1	1700	0.2	0100	0.2
14	0.1	0100	0.8	1700	0.4
15	0.2	0200	1.8	1400	1.1
16	1.6	0100	2.8	1400	2.4
17	2.4	0700	3.1	1500	2.8
18	2.6	0500	3.1	1600	2.9
19	3.0	0100	3.4	1400	3.1
20	3.1	0100	4.5	1700	3.9
21	4.2	0100	4.8	1500	4.5
22	4.2	2300	4.8	0100	4.5
23	3.0	2200	4.1	0100	3.5
24	2.8	0600	3.6	2400	3.2
25	3.4	0800	3.8	2300	3.6
26	3.8	0100	4.9	1600	4.4
27	4.3	0700	5.3	2400	4.9
28	4.8	2300	5.5	0300	5.1
29	3.2	2200	4.8	0100	3.7
30	2.7	0700	3.2	0100	2.9
31	2.8	0100	3.3	2400	3.0
MEAN					2.3
SE					0.28

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
APR					
1	3.1	0500	4.2	1500	3.7
2	4.2	0100	5.1	1500	4.7
3	5.1	0100	6.1	1600	5.7
4	5.3	2400	6.1	0100	5.8
5	5.0	2400	5.6	0600	5.3
6	4.2	2200	4.9	0100	4.5
7	4.2	0100	4.4	1700	4.3
8	4.4	0400	5.0	1700	4.7
9	4.9	0700	5.7	2000	5.2
10	5.1	0700	6.4	2200	5.8
11	5.9	0700	7.0	2300	6.4
12	6.7	0600	7.9	2200	7.2
13	7.9	0100	8.1	1700	8.0
14	8.1	2400	8.3	1000	8.2
15	8.0	0500	8.3	1500	8.1
16	7.9	0500	8.1	0100	8.0
17	7.9	0100	8.2	1700	8.0
18	7.8	0800	8.6	1700	8.2
19	8.1	0700	8.9	1700	8.6
20	8.9	0100	9.1	1700	9.0
21	8.7	0600	9.2	1600	9.0
22	8.6	0600	9.1	2100	8.9
23	8.6	0700	9.0	0100	8.8
24	8.4	2400	8.9	1000	8.8
25	8.0	1200	8.4	0100	8.1
26	7.9	0500	8.9	1700	8.5
27	8.7	0500	10.0	2200	9.3
28	10.1	0100	11.1	2300	10.5
29	11.1	0100	13.0	1900	12.1
30	12.9	0300	13.3	1900	13.0
MEAN					7.5
SE					0.41

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY					
1	12.8	0600	13.5	1700	13.2
2	13.0	0500	13.8	1200	13.4
3	12.7	2400	13.3	0100	13.1
4	12.0	2400	12.7	0100	12.4
5	11.6	0900	12.0	0100	11.8
6	11.2	0700	12.0	1600	11.8
7	11.7	0900	12.0	0100	11.9
8	11.9	0800	12.4	1700	12.1
9	11.9	0800	12.2	0100	12.0
10	11.4	0800	12.0	1800	11.7
11	11.3	0800	12.7	2100	12.0
12	12.3	0900	13.1	1800	12.7
13	12.5	0700	13.5	2100	13.0
14	13.4	0100	12.3	2300	12.9
15	11.5	2400	12.2	0100	11.9
16	10.7	1200	11.3	0100	10.9
17	10.1	0500	11.0	2300	10.6
18	10.3	2400	10.9	0100	10.6
19	10.2	0400	11.7	2300	10.7
20	11.5	0800	12.2	2200	11.9
21	12.1	0800	13.3	1900	12.6
22	13.0	0100	15.1	2400	13.9
23	15.1	0100	15.9	1800	15.5
24	15.3	0700	16.7	2000	16.0
25	16.2	0600	17.3	1900	16.9
26	17.1	0400	18.1	1800	17.6
27	17.3	0700	18.1	1500	17.9
28	16.8	2400	18.1	0100	17.6
29	14.1	2400	16.8	0100	15.6
30	13.0	2300	14.0	0100	13.4
31	12.9	0300	13.6	1900	13.2
MEAN					13.3
SE					0.38

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUN					
1	12.6	0900	13.3	2100	13.0
2	12.8	0700	14.1	2400	13.4
3	14.1	0100	14.7	0900	13.9
4	13.7	0700	15.0	1600	14.4
5	14.9	0500	16.4	1900	15.6
6	16.2	0100	17.9	1900	17.1
7	18.0	0100	19.5	2400	18.7
8	19.7	0100	20.9	1800	20.3
9	20.9	0100	22.3	1700	21.6
10	22.1	0600	23.8	1700	23.0
11	23.2	0600	24.9	1400	24.0
12	23.8	0700	25.2	1500	24.5
13	24.0	0500	25.8	1400	24.8
14	24.2	2300	25.3	1600	24.8
15	22.5	2400	24.1	0100	23.3
16	21.3	0700	22.8	1400	22.1
17	20.7	2400	21.9	0100	21.2
18	20.1	0600	20.6	0100	20.2
19	19.9	0400	21.9	1500	21.0
20	21.2	0400	22.6	1300	22.0
21	21.4	2400	22.3	1500	21.9
22	20.9	0600	22.2	1700	21.6
23	21.4	0600	22.4	1600	21.9
24	20.9	0400	21.8	0100	21.3
25	20.2	0700	21.4	1500	20.9
26	20.3	0600	22.0	1500	21.2
27	20.3	0600	22.6	1500	21.6
28	21.4	0600	23.1	1500	22.4
29	21.0	0500	23.6	1500	22.8
30	21.2	2400	22.9	0100	22.0
MEAN					20.6
SE					0.62

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL					
1	20.0	2200	21.2	0100	20.6
2	19.5	0600	20.9	1600	20.3
3	20.7	0500	21.7	1400	21.1
4	21.1	0200	21.9	1400	21.5
5	21.1	0200	22.5	1600	21.9
6	22.0	2400	22.4	1700	22.2
7	21.5	0800	22.4	1600	21.9
8	19.9	0800	21.3	0100	20.2
9	19.6	0800	20.3	2000	20.1
10	20.0	0600	20.2	0100	20.1
11	20.1	0100	21.1	1300	20.5
12	21.0	0100	22.5	1700	21.7
13	22.0	0400	23.6	1600	22.7
14	23.0	0500	24.7	1700	23.9
15	24.1	0400	25.9	1500	25.1
16	25.2	0500	26.8	1500	26.0
17	25.1	0800	26.7	1500	25.9
18	24.8	2400	25.9	1500	25.4
19	23.9	0600	25.1	1500	24.5
20	23.1	0500	24.7	1400	24.0
21	23.3	2400	24.1	0100	23.8
22	22.8	0600	24.0	1600	23.5
23	23.3	0600	24.6	1600	23.9
24	23.9	0500	25.7	1500	24.7
25	24.0	0700	25.7	1600	24.7
26	23.6	0600	25.9	1400	24.7
27	22.7	2400	24.4	0100	23.5
28	22.0	0700	22.9	1600	22.4
29	21.8	0500	23.0	1500	22.3
30	22.0	0500	23.4	1700	22.7
31	22.4	0600	24.1	1500	23.3
MEAN					22.9
SE					0.32

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
AUG					
1	23.1	0400	24.9	1900	23.9
2	24.1	0500	25.8	1600	24.8
3	23.8	2400	24.7	0100	24.2
4	23.6	0700	25.1	1500	24.3
5	24.2	0800	24.8	0100	24.5
6	23.9	0600	25.1	1600	24.4
7	24.5	0600	25.8	1600	25.0
8	24.8	0700	26.2	1500	25.4
9	25.0	0600	26.7	1600	25.9
10	24.9	2200	25.7	0100	25.2
11	24.3	0800	25.0	1300	24.7
12	24.0	0600	25.1	1500	24.4
13	24.1	0400	25.4	1600	24.8
14	25.1	0100	26.3	1400	25.2
15	25.3	0800	26.0	0100	25.7
16	24.3	2400	25.2	0100	24.9
17	23.2	2400	24.2	0100	23.9
18	22.6	0800	23.3	1500	23.0
19	22.3	2400	22.9	1300	22.8
20	21.9	0600	23.0	1400	22.4
21	21.3	0600	22.4	1400	21.9
22	21.3	0400	22.7	1400	22.0
23	21.9	0500	23.1	1600	22.4
24	21.8	0800	23.0	1300	22.4
25	21.6	0800	23.1	1500	22.4
26	21.8	0800	23.3	1400	22.6
27	22.0	0700	23.9	1400	23.0
28	22.5	0700	24.3	1500	23.3
29	23.1	0500	24.4	1500	23.7
30	23.1	2400	25.1	1500	24.0
31	23.2	0100	25.7	1400	24.1
MEAN					23.9
SE					0.21

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP					
1	22.8	0700	24.7	1500	23.5
2	22.1	0800	24.0	1500	23.0
3	22.4	0600	24.7	1500	23.5
4	22.1	2400	24.0	1300	23.1
5	20.8	2400	22.8	1400	21.8
6	19.8	2400	21.2	1300	20.4
7	19.0	0800	21.0	1400	19.8
8	18.8	0700	21.0	1400	19.7
9	18.7	0700	20.5	1500	19.5
10	19.0	0200	21.2	1500	20.0
11	19.6	0500	22.3	1500	20.8
12	19.8	0700	22.3	1500	20.9
13	19.7	0800	22.9	1500	21.1
14	20.8	2400	22.0	1500	21.3
15	18.8	2400	20.8	1300	20.0
16	17.8	2400	20.0	1400	18.6
17	16.9	0800	19.3	1500	17.9
18	16.9	0700	19.4	1500	18.6
19	17.2	0800	19.8	1400	18.3
20	17.7	0700	20.5	1500	19.0
21	--	--	--	--	--
22	--	--	--	--	--
23	--	--	--	--	--
24	--	--	--	--	--
25	20.0	0500	23.1	1700	21.3
26	18.9	2400	21.9	1500	20.6
27	17.7	2400	18.8	0100	18.3
28	16.4	2400	17.6	0100	17.2
29	15.4	2400	17.0	1600	16.3
30	14.6	0800	17.3	1700	15.9
MEAN					20.0
SE					0.41

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEA
OCT					
1	14.8	2100	16.2	0100	15.
2	14.1	2400	15.9	1600	15.
3	13.1	0600	15.3	1600	14.
4	12.7	0800	15.4	1700	14.
5	12.7	0800	15.2	1700	13.
6	11.9	0700	15.3	1700	13.
7	11.9	0800	14.4	1600	13.
8	13.1	0800	14.7	1500	13.
9	14.1	0100	15.7	1600	14.
10	14.6	0800	16.2	1700	15.
11	14.8	0500	17.1	1700	15.
12	14.8	0800	17.2	1700	15.
13	15.1	0300	17.2	1700	15.
14	15.0	0600	17.2	1700	15.
15	14.4	0800	16.3	1500	15.
16	14.1	0800	16.7	1600	15.
17	14.8	0800	15.7	1700	15.
18	14.9	0500	16.4	1700	15.
19	15.1	0600	16.8	1500	15.
20	16.1	0400	17.8	1500	16.
21	15.8	0700	17.3	1700	16.
22	17.0	0800	17.9	1500	17.
23	15.9	2300	16.9	0100	16.
24	15.2	2400	15.9	1400	15.
25	14.4	0800	16.4	1500	15.
26	14.9	0400	16.1	1600	15.
27	15.7	0700	17.7	1800	16.
28	16.2	0600	18.3	1600	17.
29	16.1	2400	17.3	0100	16.
30	15.1	0900	17.7	1500	16.
31	15.2	2400	17.0	1500	16.
MEAN					15.
SE					0.1

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
NOV					
1	14.9	0500	15.2	1200	15.1
2	13.0	2400	15.5	1300	14.6
3	12.0	2400	13.9	1300	12.8
4	11.5	0700	12.0	1400	11.8
5	11.8	0300	12.5	1400	11.9
6	11.0	2400	12.3	1100	11.7
7	9.8	2400	11.8	1300	10.8
8	9.1	0700	15.2	1300	9.6
9	8.7	0600	9.4	1400	9.1
10	9.0	0100	9.9	1300	9.5
11	9.5	0100	9.9	1100	9.7
12	8.8	2400	9.7	0100	9.3
13	7.6	2400	8.8	0100	8.4
14	6.7	2400	8.1	1200	7.4
15	6.2	0600	7.1	1300	6.8
16	6.3	2400	7.2	1300	6.8
17	6.1	2400	7.0	1300	6.3
18	5.9	0200	6.5	1300	6.2
19	5.2	2200	6.2	0100	5.9
20	4.1	2400	5.2	1300	4.8
21	3.8	2200	4.9	1200	4.2
22	3.6	2400	4.7	1300	4.0
23	3.1	0600	3.9	1400	3.5
24	3.1	0600	4.4	1400	3.6
25	3.1	0800	4.8	1300	3.9
26	3.4	0500	5.0	1300	4.1
27	3.8	0500	5.1	1300	4.4
28	4.9	0100	7.3	1800	6.2
29	6.3	0700	7.0	2100	6.7
30	6.3	2400	6.9	0100	6.7
MEAN					7.9
SE					0.61

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEA
DEC					
1	6.0	2200	6.3	0100	6.
2	5.4	2400	6.0	0100	5.
3	5.2	2400	5.5	1600	5.
4	4.7	2400	5.1	0100	5.
5	4.2	2400	4.7	0100	4.
6	3.3	2400	4.1	0100	3.
7	1.7	2400	3.3	0100	2.
8	1.1	2300	1.7	0100	1.
9	1.1	0100	1.4	1200	1.
10	1.3	0100	1.9	2000	1.
11	1.9	0100	2.3	2100	2.
12	2.3	0100	3.1	2400	2.
13	3.1	0100	3.8	2200	3.
14	3.8	0100	4.2	2100	4.
15	4.2	0100	4.7	1600	4.
16	4.8	0100	5.0	1800	4.
17	5.0	0100	5.6	2300	5.
18	5.3	0800	5.7	0100	5.
19	5.0	1900	5.4	0100	5.
20	4.3	2400	5.0	0100	4.
21	3.9	1900	4.3	0100	4.
22	3.8	0100	4.1	1300	4.
23	3.1	2400	3.9	0100	3.
24	2.8	0800	3.1	0100	3.
25	2.8	2400	3.1	0100	3.
26	2.1	2000	2.7	0100	2.
27	1.5	2400	2.1	0100	1.
28	1.4	0300	1.9	2100	1.
29	2.0	0100	3.7	2400	2.
30	3.9	0100	5.2	1800	4.
31	5.1	0100	5.3	1600	5.
MEAN					3.
SE					0.2

Table A-3

Daily minimum, maximum, and mean level (m above msl) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1984.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN					
1	149.07	1700	149.16	0100	149.12
2	149.10	0100	149.19	1000	149.12
3	149.04	1900	149.10	0100	149.07
4	149.07	0100	149.10	0500	149.08
5	149.04	0100	149.04	0100	149.04
6	148.94	1500	149.04	0100	148.98
7	148.88	1800	148.94	0100	148.91
8	148.85	1600	148.91	0700	148.88
9	148.76	1500	148.85	0100	148.81
10	148.73	0700	148.79	1800	148.76
11	148.70	1700	148.79	0100	148.75
12	148.64	1300	148.73	0200	148.68
13	148.58	1500	148.67	0100	148.61
14	148.49	1900	148.61	0100	148.54
15	148.52	0100	148.58	1100	148.53
16	148.55	0100	148.64	1400	148.60
17	148.55	1700	148.64	0100	148.60
18	148.55	0100	148.64	1100	148.59
19	148.61	0100	148.73	2400	148.64
20	148.73	1600	148.85	0900	148.79
21	148.79	0100	148.85	1100	148.81
22	148.79	0400	148.85	1400	148.81
23	148.73	1600	148.85	1300	148.77
24	148.73	0100	148.79	2400	148.75
25	148.79	0100	148.82	0500	148.80
26	148.82	0100	148.94	0900	148.91
27	148.88	1400	148.91	0100	148.89
28	148.85	0100	148.85	0100	148.85
29	148.85	0100	148.88	2200	148.86
30	148.88	0100	148.91	0700	148.90
31	148.85	1600	148.91	0100	148.88
MEAN					148.82
SE					0.030

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
FEB					
1	148.76	1300	148.85	1900	148.81
2	148.76	1400	148.88	0400	148.82
3	148.67	1300	148.76	0100	148.71
4	148.73	0100	148.91	2200	148.81
5	148.94	0100	149.00	2100	148.97
6	148.97	0400	149.00	0100	148.98
7	149.00	0100	149.00	0100	149.00
8	148.97	0100	149.07	0900	149.01
9	148.91	2300	149.00	0100	148.97
10	148.82	2300	148.88	0100	148.86
11	148.79	0700	148.85	2100	148.82
12	148.85	0100	148.97	2200	148.89
13	149.00	0100	149.31	2400	149.14
14	149.34	0100	151.32	2400	149.85
15	151.38	0100	154.00	2400	152.54
16	154.13	0100	154.92	1500	154.69
17	153.15	2400	154.58	0100	153.84
18	152.45	2400	153.12	0100	152.78
19	151.99	2300	152.42	0100	152.17
20	151.66	2300	151.96	0100	151.80
21	151.47	2200	151.63	0100	151.56
22	151.17	2200	151.44	0100	151.30
23	150.86	2300	151.14	0100	151.01
24	150.50	2400	150.86	0100	150.67
25	150.25	2200	150.50	0100	150.35
26	150.13	2400	150.25	0100	150.20
27	150.04	1900	150.13	0100	150.08
28	149.98	2000	150.04	0100	150.01
29	149.95	1300	149.98	0100	149.96
MEAN					150.30
SE					0.310

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR					
1	149.83	1900	149.95	0100	149.88
2	149.68	2400	149.83	0100	149.77
3	149.55	2400	149.68	0100	149.63
4	149.43	2300	149.55	0100	149.50
5	149.40	0200	149.43	0100	149.42
6	149.37	0600	149.40	0100	149.39
7	149.34	1300	149.37	0100	149.36
8	149.31	1900	149.34	0100	149.33
9	149.22	2300	149.29	0100	149.26
10	149.10	1900	149.22	0100	149.14
11	149.07	0400	149.10	0100	149.07
12	148.94	1100	149.07	0100	149.00
13	148.97	1700	149.04	0100	149.01
14	148.97	0100	149.04	2000	149.00
15	148.94	1200	149.04	0100	148.98
16	148.94	0100	148.97	2300	148.95
17	148.97	0100	149.10	2300	149.00
18	149.13	0100	149.37	2400	149.25
19	149.37	0100	149.43	1200	149.41
20	149.43	0100	149.43	0100	149.43
21	149.46	0100	149.71	2400	149.53
22	149.74	0100	150.96	2400	150.35
23	150.96	2300	151.11	0800	151.04
24	150.62	2300	150.92	0100	150.78
25	150.22	2300	150.59	0100	150.36
26	150.04	2400	150.22	0100	150.12
27	149.95	1900	150.04	0100	149.99
28	149.89	0900	149.95	0100	149.90
29	149.89	0100	149.89	0100	149.89
30	149.83	1500	149.89	0100	149.85
31	149.77	1200	149.80	0100	149.78
MEAN					149.59
SE					0.096

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
APR					
1	149.80	0100	149.80	0100	149.80
2	149.80	0100	149.92	2200	149.83
3	149.92	0100	150.32	2400	150.10
4	150.35	0100	151.02	2400	150.67
5	151.05	0100	153.27	2400	151.91
6	153.39	0100	155.13	2400	154.44
7	154.43	2400	155.19	0500	154.97
8	152.57	2400	154.31	0100	153.33
9	151.90	2400	152.54	0100	152.18
10	151.38	2400	151.87	0100	151.59
11	151.05	2300	151.35	0100	151.18
12	150.71	2400	151.02	0100	150.85
13	150.50	2400	150.71	0100	150.66
14	150.19	2000	150.47	0100	150.28
15	150.22	0100	150.62	2400	150.41
16	150.68	0100	150.96	2400	150.82
17	150.99	0100	151.32	2400	151.15
18	151.32	0100	151.44	1000	151.39
19	151.20	2200	151.29	0100	151.26
20	151.20	0100	151.38	2400	151.27
21	151.20	2400	151.41	0300	151.32
22	150.77	2300	151.20	0100	150.98
23	150.50	2400	150.74	0100	150.62
24	150.28	2100	150.50	0100	150.37
25	150.28	0100	150.62	2400	150.38
26	150.68	0100	151.20	1900	151.03
27	150.56	2400	151.14	0100	150.83
28	150.22	2300	150.56	0100	150.38
29	150.07	2300	150.22	0100	150.13
30	149.92	2400	150.07	0100	149.99
MEAN					151.14
SE					0.223

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY					
1	149.83	2000	149.92	0100	149.88
2	149.68	1900	149.83	0100	149.75
3	149.64	0700	149.68	0100	149.65
4	149.68	0100	149.95	2100	149.83
5	149.95	0100	150.16	2400	150.05
6	150.19	0100	150.32	1500	150.28
7	150.19	2200	150.32	0100	150.25
8	150.07	1600	150.16	0100	150.10
9	150.04	0400	150.10	1600	150.07
10	150.10	0100	150.16	0600	150.14
11	150.04	2400	150.13	0100	150.10
12	149.92	2100	150.04	0100	149.98
13	149.92	0100	150.74	2400	150.25
14	150.74	0100	150.86	2400	150.82
15	150.86	0100	151.47	1700	151.27
16	151.05	2400	151.41	0100	151.21
17	150.56	2300	151.05	0100	150.79
18	150.25	2400	150.53	0100	150.39
19	150.07	2000	150.22	0100	150.14
20	149.98	0800	150.07	0100	150.00
21	150.04	0100	150.25	1700	150.18
22	150.25	0100	150.32	1700	150.28
23	150.07	2400	150.28	0100	150.16
24	150.01	0700	150.10	2300	150.04
25	150.10	0100	150.28	1500	150.23
26	149.95	2400	150.22	0100	150.07
27	149.80	2100	149.95	0100	149.87
28	149.77	0300	149.83	2100	149.78
29	149.86	0100	152.66	2400	151.20
30	152.72	0100	153.12	1100	153.04
31	152.11	2400	152.97	0100	152.55
MEAN					150.40
SE					0.137

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	M
JUN					
1	151.53	2400	152.08	0100	151
2	150.99	2400	151.50	0100	151
3	150.56	2400	150.96	0100	150
4	150.28	2300	150.56	0100	150
5	150.01	2400	150.28	0100	150
6	149.80	2300	149.98	0100	149
7	149.61	2400	149.80	0100	149
8	149.40	2100	149.61	0100	149
9	149.25	2300	149.40	0100	149
10	149.16	2100	149.25	0100	149
11	149.13	0100	149.10	1200	149
12	149.10	0100	149.07	0400	149
13	148.97	2300	149.07	0100	149
14	148.94	0800	148.97	0100	148
15	148.91	0900	148.94	0100	148
16	148.85	2100	148.91	0100	148
17	148.82	0400	148.85	0100	148
18	148.82	0100	148.88	1700	148
19	148.88	0100	149.07	2300	148
20	149.10	0100	149.92	1500	149
21	149.43	2400	149.83	0100	149
22	149.25	2200	149.43	0100	149
23	148.97	2400	149.22	0100	149
24	148.88	1500	148.97	0100	148
25	148.79	2000	148.91	0100	148
26	148.79	0100	148.79	0100	148
27	148.79	0100	148.85	1000	148
28	148.73	0800	148.79	0100	148
29	148.70	1300	148.73	0100	148
30	148.73	0100	149.00	0800	148
MEAN					14
SE					0.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL					
1	149.00	0100	149.71	2400	149.20
2	149.52	2400	149.83	0500	149.73
3	149.28	1900	149.52	0100	149.37
4	149.31	2300	149.46	0600	149.40
5	149.10	2400	149.31	0100	149.18
6	148.97	1700	149.07	0100	149.01
7	148.97	0100	150.41	2400	149.84
8	150.44	0100	150.56	1500	150.50
9	149.98	2300	150.44	0100	150.16
10	149.61	2400	149.95	0100	149.78
11	149.43	2000	149.58	0100	149.49
12	149.28	2200	149.46	0100	149.36
13	149.22	0800	149.25	0100	149.24
14	149.13	2300	149.25	0100	149.20
15	149.04	2200	149.13	0100	149.09
16	148.88	2300	149.04	0100	148.95
17	148.79	2200	148.88	0100	148.85
18	148.79	0100	148.88	1200	148.85
19	148.76	2200	148.85	0100	148.82
20	148.67	2200	148.76	0100	148.71
21	148.67	0100	148.73	2400	148.69
22	148.73	0100	148.73	0100	148.73
23	148.67	1900	148.73	0100	148.70
24	148.61	2200	148.67	0100	148.64
25	148.55	1800	148.61	0100	148.58
26	148.49	1900	148.55	0100	148.52
27	148.49	0100	148.64	2200	148.56
28	148.64	0100	148.79	2300	148.70
29	148.79	0100	149.19	2200	148.98
30	149.07	2100	149.22	0100	149.14
31	148.91	2100	149.04	0100	148.98
MEAN					149.13
SE					0.087

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	M
AUG					
1	148.76	2200	148.91	0100	14
2	148.67	1700	148.76	0100	14
3	148.70	1100	148.79	0200	14
4	148.70	0100	148.76	1500	14
5	148.67	0600	148.70	0100	14
6	148.67	0100	148.79	2200	14
7	148.79	0100	148.82	0200	14
8	148.67	2200	148.76	0100	14
9	148.58	2100	148.67	0100	14
10	148.55	1800	148.61	0100	14
11	148.55	0100	148.55	0100	14
12	148.52	1000	148.55	0100	14
13	148.52	0100	149.10	2400	14
14	149.10	0100	149.34	2400	14
15	149.40	0100	149.64	0900	14
16	149.64	0100	149.89	1800	14
17	149.37	2300	149.86	0100	14
18	149.25	2400	149.34	0100	14
19	149.07	2100	149.25	0100	14
20	148.94	1800	149.07	0100	14
21	149.00	0100	149.13	1000	14
22	148.91	2300	149.10	0100	14
23	148.82	2400	148.91	0100	14
24	148.73	1300	148.82	0100	14
25	148.79	0100	148.82	0500	14
26	148.70	2200	148.79	0100	14
27	148.64	1600	148.70	0100	14
28	148.58	2000	148.64	0100	14
29	148.55	0700	148.58	0100	14
30	148.49	1800	148.52	0100	14
31	148.46	2200	148.52	0100	14
MEAN					14
SE					0

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP					
1	148.43	1300	148.46	0100	149.44
2	148.39	1300	148.43	0100	148.41
3	148.39	0100	148.39	0100	148.39
4	148.39	0100	148.43	0800	148.42
5	148.43	0100	148.52	2400	148.45
6	149.52	0100	148.61	1800	148.57
7	148.52	2200	148.61	0100	148.56
8	143.46	2100	148.52	0100	148.49
9	148.43	1300	148.46	0100	143.47
10	148.43	0100	148.43	0100	148.43
11	148.39	0100	149.39	0100	148.39
12	148.36	0200	149.43	2200	149.39
13	148.36	2100	149.39	0100	148.39
14	143.36	0100	148.36	0100	148.36
15	148.33	0100	148.33	0100	148.33
16	148.33	0100	148.39	1800	148.37
17	148.39	0100	148.49	2000	148.44
18	148.49	0100	148.49	0100	148.49
19	148.46	0100	148.46	0100	148.46
20	148.43	1700	148.46	0100	148.45
21	148.36	2400	148.43	0100	148.40
22	143.33	1600	148.36	0100	148.35
23	148.33	0100	148.33	0100	148.33
24	148.33	0100	148.33	0100	148.33
25	148.33	0100	149.33	0100	148.33
26	148.30	0700	148.33	0100	148.33
27	148.27	1700	148.30	0100	148.29
28	148.24	2400	148.27	0100	148.27
29	149.24	0100	148.24	0100	148.24
30	148.24	0100	148.24	0100	148.24
MEAN					148.39
SE					0.015

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
OCT					
1	148.24	0100	148.30	1500	148.28
2	149.30	0100	148.30	0100	148.30
3	148.30	0100	148.30	0100	148.30
4	148.27	1800	148.30	0100	148.29
5	148.27	0100	148.27	0100	148.27
6	148.24	0700	148.27	0100	148.25
7	148.24	0100	148.24	0100	148.24
8	148.24	0100	148.24	0100	148.24
9	143.27	0100	148.27	0100	148.27
10	148.27	0100	148.27	0100	148.27
11	148.24	0700	148.27	0100	148.25
12	149.24	0100	148.24	0100	148.24
13	148.24	0100	148.24	0100	148.24
14	148.21	0100	149.21	0100	148.21
15	149.21	0100	148.24	1800	148.22
16	148.24	0100	148.24	0100	148.24
17	148.24	0100	148.24	0100	149.24
18	148.24	0100	148.24	0100	148.24
19	148.21	0100	148.21	0100	148.21
20	148.21	0100	148.21	0100	148.21
21	148.21	0100	148.21	0100	149.21
22	148.21	0100	148.30	2200	149.23
23	148.30	0100	148.36	1200	148.32
24	148.33	0100	149.36	0600	148.36
25	148.30	2400	148.33	0100	148.33
26	148.30	0100	149.30	0100	148.30
27	148.30	0100	148.30	0100	149.30
28	148.30	0100	148.30	0100	148.30
29	148.30	0100	148.33	1900	148.31
30	148.33	0100	148.33	0100	148.33
31	148.33	0100	148.36	1300	148.35
MEAN					148.27
SE					0.008

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
NOV					
1	148.36	0100	148.43	2100	148.38
2	148.43	0100	148.49	1300	148.46
3	148.39	1800	148.46	0100	148.47
4	148.39	0100	148.39	0100	148.39
5	149.39	0100	143.43	1300	148.41
6	148.43	0100	148.46	2200	148.43
7	148.46	0100	148.46	0100	148.46
8	148.46	0100	148.55	2100	148.50
9	148.55	0100	148.58	0400	148.57
10	148.55	0300	148.58	0100	148.55
11	148.55	0100	148.55	0100	148.55
12	148.55	0100	148.58	1200	148.56
13	148.58	0100	148.64	2200	148.61
14	148.64	0100	148.64	0100	148.64
15	148.64	0100	148.64	0100	148.64
16	148.61	1500	148.64	0100	148.63
17	148.55	2100	148.61	0100	148.58
18	148.52	1000	148.55	0100	148.53
19	148.52	0100	148.52	0100	148.52
20	148.52	0100	148.52	0100	148.52
21	148.52	0100	148.55	2100	148.52
22	148.52	0900	148.55	0100	148.53
23	149.49	1300	148.52	0100	148.50
24	148.46	0900	148.49	0100	148.47
25	148.46	0100	148.46	0100	148.46
26	148.46	0100	148.46	0100	148.46
27	148.46	0100	148.46	0100	148.46
28	148.46	0100	148.49	2200	148.46
29	148.49	0100	149.00	2400	148.74
30	149.07	0100	149.98	2400	149.66
MEAN					148.55
SE					0.041

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
DEC					
1	150.01	0100	150.16	0700	150.12
2	150.16	0100	150.32	1300	150.26
3	150.07	2400	150.25	0100	150.16
4	150.04	0300	150.07	0100	150.06
5	149.98	2400	150.07	0100	150.06
6	149.83	2100	149.98	0100	149.89
7	149.61	2300	149.83	0100	149.73
8	149.46	2400	149.61	0100	149.53
9	149.37	2000	149.46	0100	149.42
10	149.34	0100	149.34	0100	149.34
11	149.31	0100	149.37	2200	149.32
12	149.37	0100	149.61	2400	149.48
13	149.61	0100	149.74	2400	149.66
14	149.74	0100	149.83	2300	149.76
15	149.83	0100	150.01	1700	149.95
16	149.95	2300	150.01	0100	149.98
17	149.83	1700	149.92	0100	149.86
18	149.71	2000	149.80	0100	149.75
19	149.64	1700	149.68	0100	149.67
20	149.58	1500	149.64	0100	149.60
21	149.58	0900	149.61	0100	149.60
22	149.64	0100	149.83	2400	149.72
23	149.83	0100	150.10	2400	150.00
24	150.10	0100	150.19	1300	150.16
25	149.98	2300	150.16	0100	150.08
26	149.77	2300	149.98	0100	149.86
27	149.58	2400	149.74	0100	149.66
28	149.46	2100	149.58	0100	149.52
29	149.46	0100	149.83	2400	149.57
30	149.83	0100	150.22	2400	150.02
31	150.25	0100	150.41	2200	150.33
MEAN					149.81
SE					0.050

Table A-4

Daily mean flow (m^3/s) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1984.

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	272	173	598	555	595	1963	301	182	85	55	74	727
2	272	177	540	570	530	1482	524	152	79	59	89	807
3	253	146	476	711	485	1123	365	152	76	59	92	749
4	258	173	419	1068	572	903	378	150	80	58	76	691
5	243	221	384	2065	686	730	293	138	87	54	79	690
6	225	224	373	5137	816	593	234	146	112	50	82	604
7	203	233	359	5948	800	507	575	176	111	49	98	521
8	194	235	349	3620	714	412	952	153	95	49	96	433
9	174	223	322	2331	698	343	749	126	91	54	113	384
10	161	187	279	1778	739	301	546	115	82	54	109	353
11	156	177	255	1441	716	268	415	108	76	50	108	344
12	139	199	233	1189	647	255	363	103	75	49	111	412
13	123	279	234	1056	800	243	313	171	75	49	122	488
14	106	582	233	820	1172	217	300	282	70	45	129	536
15	104	2705	224	896	1507	208	261	452	65	45	129	634
16	121	5505	214	1166	1465	197	216	552	71	49	126	648
17	121	4289	232	1413	1148	178	185	452	85	49	115	589
18	118	2970	319	1609	881	185	185	330	95	49	104	534
19	129	2325	382	1504	737	220	178	280	88	45	101	492
20	170	1969	390	1509	662	477	147	230	86	45	101	464
21	175	1748	431	1554	760	468	142	264	77	45	102	462
22	173	1534	856	1285	814	351	153	235	68	48	103	518
23	163	1306	1331	1034	749	266	144	197	65	62	98	662
24	158	1064	1142	869	683	204	131	165	65	69	90	749
25	172	958	867	877	786	186	115	173	65	65	88	703
26	202	772	725	1324	695	169	101	157	64	59	88	589
27	199	701	653	1179	593	179	110	135	58	59	88	491
28	186	665	607	875	546	161	144	121	54	59	89	426
29	187	640	601	730	1456	148	225	113	49	61	154	448
30	201		584	651	3269	213	277	100	49	65	488	671
31	194		549		2711		224	95		68		847
MEAN	179	1113	489	1559	949	438	298	200	77	54	114	570
SE	8.5	248.2	48.7	227.9	109.7	77.2	35.4	20.2	2.8	1.3	13.3	24.6

Table A-5

Physicochemical data collected from the Susquehanna River at SSES and Bell Bend, January through December 1984.

SSES

DATE	5 JAN	11 JAN	18 JAN	27 JAN		
TIME	1327	1256	1253	1200		
RIVER LEVEL(M ABOVE MSL)	149.04	148.73	148.64	148.91		
DISCHARGE(M^3/S)	243	153	129	204		
TEMPERATURE(C)						
AIR	6.0	-5.5	0.5	7.5		
WATER	0.0	0.0	0.0	0.5		
WEATHER	OVERCAST	P.CLOUDY	SNOW	SUNNY		
					MEAN	SE
SECCHI DISC(CM)	205	185	180	--	190	6.6
TURBIDITY(NTU)	3.6	4.7	5.0	6.3	4.9	0.5
OXYGEN						
DISSOLVED(MG/L)	13.80	13.60	12.75	11.80	12.99	0.408
PERCENT SATURATION	95	94	88	81	90	2.9
TOTAL ALKALINITY(MG/L)	61	65	70	64	65	1.7
PH	7.3	7.3	7.2	7.2	7.3	0.03
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	240	310	340	315	301	19.2
SULFATE(MG/L)	52	66	68	52	60	3.9
IRON(MG/L)						
TOTAL	1.42	1.60	1.85	1.42	1.57	0.091
DISSOLVED	1.12	1.24	1.43	0.90	1.17	0.099
PERCENT DISSOLVED	79	78	77	63	74	3.4
RESIDUE(MG/L)						
TOTAL	180	199	210	213	201	6.7
FIXED TOTAL	126	150	126	144	137	5.5
NONFILTRABLE	2	2	2	5	3	0.7
FILTRABLE	178	197	208	208	198	6.3

BELL BEND

DATE	5 JAN	11 JAN	18 JAN	27 JAN		
TIME	1315	1246	1242	1220		
TEMPERATURE(C)						
AIR	6.0	-5.5	0.5	7.5		
WATER	0.0	0.0	0.0	0.5		
WEATHER	OVERCAST	P.CLOUDY	SNOW	SUNNY		
					MEAN	SE
SECCHI DISC(CM)	205	180	186	--	190	6.5
TURBIDITY(NTU)	3.8	4.7	5.1	6.3	5.0	0.5
OXYGEN						
DISSOLVED(MG/L)	13.80	13.85	12.00	11.60	12.81	0.528
PERCENT SATURATION	95	96	83	80	89	3.7
TOTAL ALKALINITY(MG/L)	60	65	69	64	65	1.7
PH	7.3	7.3	7.2	7.2	7.3	0.03
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	240	310	350	330	308	21.4
SULFATE(MG/L)	48	64	69	52	58	4.4
IRON(MG/L)						
TOTAL	1.40	1.51	1.83	1.43	1.54	0.088
DISSOLVED	1.14	1.20	1.31	0.88	1.13	0.082
PERCENT DISSOLVED	81	79	72	62	74	3.8
RESIDUE(MG/L)						
TOTAL	180	200	206	237	206	10.6
FIXED TOTAL	122	144	144	170	145	8.8
NONFILTRABLE	2	2	2	5	3	0.7
FILTRABLE	178	198	204	232	203	10.0

Table A-5 (cont.)

SSES

DATE	3 FEB	10 FEB	16 FEB	23 FEB		
TIME	1232	1223	1300	1345		
RIVER LEVEL (M ABOVE MSL)	148.67	148.85	154.39	150.99		
DISCHARGE (M^3/S)	137	186	5818	1289		
TEMPERATURE (C)						
AIR	7.5	5.0	7.5	9.5		
WATER	0.5	0.5	2.0	3.0		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	OVERCAST		
					MEAN	SE
SECCHI DISC (CM)	185	175	3	20	96	43.7
TURBIDITY (NTU)	4.6	4.1	320	28	89	69.0
OXYGEN						
DISSOLVED (MG/L)	12.05	13.05	12.75	12.60	12.61	0.187
PERCENT SATURATION	84	92	93	93	91	1.9
TOTAL ALKALINITY (MG/L)	63	54	17	28	41	9.7
PH	7.2	7.2	7.2	7.2	7.2	0.00
SPECIFIC CONDUCTANCE						
AT 25 C (µMHOS/CM)	315	280	90	130	204	49.4
SULFATE (MG/L)	61	52	11	23	37	10.6
IRON (MG/L)						
TOTAL	1.55	1.29	27.40	2.18	8.11	5.755
DISSOLVED	1.16	0.94	1.24	0.47	0.95	0.155
PERCENT DISSOLVED	75	73	5	22	44	15.9
RESIDUE (MG/L)						
TOTAL	200	178	745	132	314	129.2
FIXED TOTAL	150	130	678	108	267	122.9
NONFILTRABLE	4	2	648	28	171	142.5
FILTRABLE	196	176	97	104	143	22.4

BELL BEND

DATE	3 FEB	10 FEB	16 FEB	23 FEB		
TIME	1205	1212	1312	1335		
TEMPERATURE (C)						
AIR	7.5	5.0	7.5	9.5		
WATER	0.5	0.5	2.0	3.0		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	OVERCAST		
					MEAN	SE
SECCHI DISC (CM)	190	175	3	20	97	44.3
TURBIDITY (NTU)	4.4	4.1	320	28	89	69.0
OXYGEN						
DISSOLVED (MG/L)	12.30	13.00	13.30	12.65	12.81	0.194
PERCENT SATURATION	85	92	97	93	92	2.2
TOTAL ALKALINITY (MG/L)	60	55	18	28	40	9.1
PH	7.2	7.2	7.2	7.1	7.2	0.02
SPECIFIC CONDUCTANCE						
AT 25 C (µMHOS/CM)	310	280	91	130	203	48.5
SULFATE (MG/L)	60	50	10	21	35	10.6
IRON (MG/L)						
TOTAL	1.51	1.22	25.40	2.25	7.60	5.312
DISSOLVED	1.11	0.92	1.30	0.47	0.95	0.159
PERCENT DISSOLVED	74	75	5	21	44	16.1
RESIDUE (MG/L)						
TOTAL	198	185	728	130	310	125.2
FIXED TOTAL	137	138	534	104	228	91.4
NONFILTRABLE	3	2	620	30	164	136.2
FILTRABLE	195	183	108	100	147	22.1

Table A-5 (cont.)

SSES

DATE	1 MAR	8 MAR	15 MAR	22 MAR	30 MAR		
TIME	1326	1349	1328	1303	1200		
RIVER LEVEL(M ABOVE MSL)	149.86	149.34	148.94	150.38	149.86		
DISCHARGE(M^3/S)	586	353	214	876	586		
TEMPERATURE(C)							
AIR	-2.5	-3.0	8.0	8.0	3.5		
WATER	1.0	1.5	1.5	4.5	2.5		
WEATHER	OVERCAST	OVERCAST	P.CLOUDY	LT.RAIN	SNOW		
						MEAN	SE
SECCHI DISC(CM)	90	150	165	45	120	114	19.7
TURBIDITY(NTU)	6.2	4.4	4.8	13	6.6	7.0	1.4
OXYGEN							
DISSOLVED(MG/L)	13.00	13.00	13.60	12.50	12.55	12.93	0.181
PERCENT SATURATION	91	93	98	95	91	94	1.2
TOTAL ALKALINITY(MG/L)	40	50	57	43	35	45	3.5
PH	7.2	7.3	7.3	7.4	7.3	7.3	0.03
SPECIFIC CONDUCTANCE							
AT 25 C(µMHOS/CM)	175	240	285	200	175	215	19.3
SULFATE(MG/L)	31	36	49	26	28	34	3.8
IRON(MG/L)							
TOTAL	1.06	1.13	1.43	2.20	0.86	1.34	0.214
DISSOLVED	0.57	0.75	1.00	0.36	0.48	0.63	0.102
PERCENT DISSOLVED	54	66	70	16	56	52	8.7
RESIDUE(MG/L)							
TOTAL	119	154	183	162	116	147	11.8
FIXED TOTAL	84	111	142	119	78	107	10.7
NONFILTRABLE	6	2	2	30	4	9	4.9
FILTRABLE	113	152	181	132	112	138	11.9

BELL BEND

DATE	1 MAR	8 MAR	15 MAR	22 MAR	30 MAR		
TIME	1317	1340	1339	1312	1207		
TEMPERATURE(C)							
AIR	-2.5	-3.0	8.0	8.0	3.5		
WATER	1.0	1.5	1.5	4.5	2.5		
WEATHER	OVERCAST	OVERCAST	P.CLOUDY	LT.RAIN	SNOW		
						MEAN	SE
SECCHI DISC(CM)	90	145	165	48	120	114	18.9
TURBIDITY(NTU)	6.2	4.5	4.7	13	6.4	7.0	1.4
OXYGEN							
DISSOLVED(MG/L)	12.60	13.00	13.60	12.60	12.40	12.84	0.195
PERCENT SATURATION	88	93	98	96	90	93	1.7
TOTAL ALKALINITY(MG/L)	41	50	57	43	35	45	3.5
PH	7.3	7.3	7.3	7.4	7.3	7.3	0.02
SPECIFIC CONDUCTANCE							
AT 25 C(µMHOS/CM)	175	240	285	200	175	215	19.3
SULFATE(MG/L)	28	37	49	25	29	34	4.0
IRON(MG/L)							
TOTAL	1.07	1.13	1.39	2.34	0.89	1.36	0.234
DISSOLVED	0.55	0.73	0.98	0.36	0.48	0.62	0.099
PERCENT DISSOLVED	51	65	71	15	54	51	8.9
RESIDUE(MG/L)							
TOTAL	120	141	180	168	118	145	11.4
FIXED TOTAL	82	106	144	118	73	105	11.6
NONFILTRABLE	8	2	3	36	5	11	5.8
FILTRABLE	112	139	177	132	113	135	10.8

Table A-5 (cont.)

SSES

	3 APR	6 APR	10 APR	13 APR	17 APR	20 APR	24 APR	27 APR	MEAN	SE
DATE										
TIME	1341	1339	1233	1329	1244	1205	1304	1315		
RIVER LEVEL (M ABOVE MSL)	150.13	154.64	151.60	150.62	151.14	151.26	150.35	150.80		
DISCHARGE (M^3/S)	732	5440	1783	1032	1406	1502	857	1157		
TEMPERATURE (C)										
AIR	14.0	7.0	11.0	12.0	14.0	12.0	9.5	22.5		
WATER	6.0	5.0	6.0	8.0	8.0	9.0	8.5	9.5		
WEATHER	SUNNY	OVERCAST	SUNNY	OVERCAST	P.CLOUDY	OVERCAST	OVERCAST	SUNNY		
SECCHI DISC (CM)	125	5	20	47	35	50	65	18	46	12.5
TURBIDITY (NTU)	6.4	200	36	18	23	15	10	38	43	21.4
OXYGEN										
DISSOLVED (MG/L)	12.45	11.65	11.90	10.80	10.60	11.00	11.90	10.90	11.40	0.221
PERCENT SATURATION	101	90	96	91	88	95	99	96	95	1.5
TOTAL ALKALINITY (MG/L)	35	17	26	31	29	26	33	30	28	1.9
PH	7.4	7.2	7.2	7.2	7.1	7.3	7.3	7.3	7.3	0.03
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	190	94	120	155	135	125	150	140	139	9.4
SULFATE (MG/L)	27	22	37	27	24	22	26	32	27	1.7
IRON (MG/L)										
TOTAL	0.94	18.20	2.99	1.79	2.17	1.81	1.21	3.50	4.08	1.923
DISSOLVED	0.45	0.43	0.48	0.44	0.34	0.25	0.41	0.37	0.40	0.025
PERCENT DISSOLVED	48	2	16	25	16	14	34	11	21	4.8
RESIDUE (MG/L)										
TOTAL	138	602	164	131	144	132	108	166	198	54.8
FIXED TOTAL	92	550	131	96	120	86	72	130	160	53.1
NONFILTRABLE	7	537	54	25	40	34	13	67	97	59.6
FILTRABLE	131	65	110	106	104	98	95	99	101	6.1

BELL BEND

	3 APR	6 APR	10 APR	13 APR	17 APR	20 APR	24 APR	27 APR	MEAN	SE
DATE										
TIME	1329	1324	1225	1315	1301	1213	1312	1308		
TEMPERATURE (C)										
AIR	14.0	7.0	11.0	12.0	14.0	12.0	9.5	22.5		
WATER	6.0	5.0	6.0	8.0	8.0	9.0	8.5	9.5		
WEATHER	SUNNY	OVERCAST	SUNNY	LT.RAIN	P.CLOUDY	OVERCAST	OVERCAST	SUNNY		
SECCHI DISC (CM)	125	5	20	53	35	50	63	17	46	12.5
TURBIDITY (NTU)	6.2	220	36	17	24	15	10	39	46	23.8
OXYGEN										
DISSOLVED (MG/L)	12.55	11.60	12.10	10.85	11.15	11.00	11.80	11.05	11.51	0.202
PERCENT SATURATION	102	89	97	91	92	95	99	97	95	1.5
TOTAL ALKALINITY (MG/L)	36	16	26	30	31	28	33	30	29	2.0
PH	7.4	7.1	7.2	7.3	7.2	7.3	7.3	7.3	7.3	0.03
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	190	94	120	150	140	125	150	140	139	9.1
SULFATE (MG/L)	26	24	38	26	23	20	24	27	26	1.8
IRON (MG/L)										
TOTAL	0.93	17.00	3.12	1.73	2.15	1.75	1.16	3.43	3.91	1.787
DISSOLVED	0.41	0.46	0.51	0.42	0.33	0.28	0.38	0.35	0.39	0.025
PERCENT DISSOLVED	44	3	16	24	15	16	33	10	20	4.4
RESIDUE (MG/L)										
TOTAL	136	612	165	137	144	144	108	168	202	55.6
FIXED TOTAL	88	560	129	102	109	101	74	128	161	54.0
NONFILTRABLE	7	496	57	24	37	33	17	70	93	54.8
FILTRABLE	129	116	108	113	107	111	91	98	109	3.8

Table A-5 (cont.)

SSES

DATE	1 MAY	4 MAY	8 MAY	11 MAY	15 MAY	18 MAY	22 MAY	25 MAY	29 MAY		
TIME	1359	1249	1253	1250	1323	1412	1307	1327	1257		
RIVER LEVEL (M ABOVE MSL)	149.86	149.83	150.10	150.13	151.38	150.38	150.28	150.28	151.29		
DISCHARGE (M^3/S)	586	570	715	732	1602	876	820	820	1527		
TEMPERATURE (C)											
AIR	17.0	18.0	14.0	17.0	12.0	11.5	22.0	25.5	17.5		
WATER	13.5	13.0	12.0	12.5	12.0	10.5	14.5	17.0	16.0		
WEATHER	P.CLOUDY	OVERCAST	LT.RAIN	SUNNY	P.CLOUDY	OVERCAST	P.CLOUDY	SUNNY	LT.RAIN		
										MEAN	SE
SECCHI DISC (CM)	80	68	105	130	52	90	90	125	30	86	10.3
TURBIDITY (NTU)	7.6	9.3	5.4	4.8	20	8.7	6.3	4.2	25	10	2.3
OXYGEN											
DISSOLVED (MG/L)	9.90	9.85	10.25	10.50	9.80	9.70	10.00	9.90	8.60	9.83	0.166
PERCENT SATURATION	94	91	94	98	91	87	97	102	86	93	1.6
TOTAL ALKALINITY (MG/L)	41	42	40	39	37	35	41	44	41	40	0.9
PH	7.5	7.4	7.4	7.4	7.4	7.3	7.3	7.4	7.2	7.4	0.03
SPECIFIC CONDUCTANCE											
AT 25 C (µMHOS/CM)	190	205	170	165	130	140	170	175	160	167	7.3
SULFATE (MG/L)	27	30	29	30	19	22	27	27	24	26	1.2
IRON (MG/L)											
TOTAL	1.42	1.71	1.12	1.03	1.60	0.88	1.17	0.92	3.14	1.44	0.221
DISSOLVED	0.51	0.52	0.50	0.51	0.21	0.37	0.42	0.41	0.22	0.41	0.038
PERCENT DISSOLVED	36	30	45	50	13	42	36	45	7	34	4.7
RESIDUE (MG/L)											
TOTAL	140	148	110	119	144	144	116	134	176	137	6.4
FIXED TOTAL	100	107	82	80	113	96	92	84	132	98	5.3
NONFILTRABLE	12	19	10	7	40	8	8	7	65	20	6.3
FILTRABLE	128	129	100	112	104	136	108	127	111	117	4.1

BELL BEND

DATE	1 MAY	4 MAY	8 MAY	11 MAY	15 MAY	18 MAY	22 MAY	25 MAY	29 MAY		
TIME	1353	1241	1243	1301	1330	1420	1314	1319	1248		
TEMPERATURE (C)											
AIR	17.0	18.0	14.0	17.0	12.0	11.5	22.0	25.5	17.5		
WATER	13.5	13.0	12.0	12.5	12.0	10.5	14.5	17.0	16.0		
WEATHER	P.CLOUDY	OVERCAST	LT.RAIN	SUNNY	P.CLOUDY	OVERCAST	P.CLOUDY	SUNNY	LT.RAIN		
										MEAN	SE
SECCHI DISC (CM)	82	70	110	130	50	90	90	129	31	87	10.6
TURBIDITY (NTU)	7.6	8.9	5.2	4.9	20	7.6	6.3	3.4	32	11	3.0
OXYGEN											
DISSOLVED (MG/L)	9.80	9.90	10.25	10.50	9.80	10.00	9.80	9.70	8.60	9.82	0.165
PERCENT SATURATION	93	91	94	98	91	90	96	100	86	93	1.4
TOTAL ALKALINITY (MG/L)	41	44	40	40	36	35	40	44	41	40	1.0
PH	7.4	7.5	7.4	7.4	7.4	7.3	7.3	7.4	7.2	7.4	0.03
SPECIFIC CONDUCTANCE											
AT 25 C (µMHOS/CM)	190	205	170	165	130	140	170	175	160	167	7.3
SULFATE (MG/L)	28	33	26	32	19	22	26	28	18	26	1.7
IRON (MG/L)											
TOTAL	1.37	1.56	1.09	1.04	2.22	1.04	1.08	0.85	4.07	1.59	0.321
DISSOLVED	0.48	0.49	0.46	0.49	0.20	0.41	0.39	0.38	0.21	0.39	0.036
PERCENT DISSOLVED	35	31	42	47	9	39	36	45	5	32	4.8
RESIDUE (MG/L)											
TOTAL	144	149	109	122	161	140	124	132	216	144	9.9
FIXED TOTAL	103	103	79	83	131	94	91	82	172	104	9.5
NONFILTRABLE	13	16	10	8	54	14	10	7	123	28	12.1
FILTRABLE	131	133	99	114	107	126	114	125	93	116	4.5

Table A-5 (cont.)

SSES

DATE	1 JUN	5 JUN	8 JUN	12 JUN	15 JUN	19 JUN	22 JUN	26 JUN	29 JUN		
TIME	1316	1304	1212	1257	1319	1250	1312	1333	1219		
RIVER LEVEL (M ABOVE MSL)	151.78	150.13	149.37	149.07	148.91	148.97	149.31	148.79	148.73		
DISCHARGE (M^3/S)	1947	732	365	253	204	223	341	169	153		
TEMPERATURE (C)											
AIR	21.5	25.5	27.5	24.0	15.5	31.0	25.0	26.5	27.0		
WATER	13.5	16.0	21.0	25.0	24.0	21.5	21.5	22.0	23.5		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	SUNNY	P.CLOUDY	P.CLOUDY	P.CLOUDY	P.CLOUDY	P.CLOUDY		
										MEAN	SE
SECCHI DISC (CM)	40	90	105	68	60	42	8	12	33	51	10.4
TURBIDITY (NTU)	20	7.2	4.3	6.4	8.2	9.2	130	80	17	31	13.9
OXYGEN											
DISSOLVED (MG/L)	9.60	9.40	10.10	10.00	9.50	9.40	6.85	7.15	10.00	9.11	0.388
PERCENT SATURATION	91	94	113	120	113	105	77	81	116	101	5.0
TOTAL ALKALINITY (MG/L)	46	38	48	58	62	67	53	61	73	56	3.5
PH	6.9	7.2	7.6	8.0	7.7	7.5	7.3	7.3	7.7	7.5	0.10
SPECIFIC CONDUCTANCE											
AT 25 C (µMHOS/CM)	110	150	218	278	320	330	230	305	350	255	26.4
SULFATE (MG/L)	23	28	46	51	44	59	50	68	52	47	4.4
IRON (MG/L)											
TOTAL	2.22	1.40	1.32	1.72	1.91	2.04	7.02	5.01	2.11	2.75	0.614
DISSOLVED	0.27	0.54	0.72	0.18	0.43	0.32	0.54	0.56	0.29	0.43	0.055
PERCENT DISSOLVED	12	39	55	10	23	16	8	11	14	21	5.0
RESIDUE (MG/L)											
TOTAL	138	142	156	206	210	253	306	294	247	217	19.9
FIXED TOTAL	81	94	98	124	139	155	234	207	162	144	16.4
NONFILTRABLE	46	13	8	16	12	13	138	67	26	38	13.4
FILTRABLE	92	119	148	190	198	240	168	227	221	178	16.0

BELL BEND

DATE	1 JUN	5 JUN	8 JUN	12 JUN	15 JUN	19 JUN	22 JUN	26 JUN	29 JUN		
TIME	1326	1313	1218	1307	1325	1259	1325	1337	1224		
TEMPERATURE (C)											
AIR	21.5	25.5	27.5	24.0	15.5	31.0	25.0	26.5	27.0		
WATER	13.5	16.0	21.0	25.0	24.0	21.5	21.5	22.0	23.5		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	SUNNY	P.CLOUDY	P.CLOUDY	P.CLOUDY	P.CLOUDY	P.CLOUDY		
										MEAN	SE
SECCHI DISC (CM)	40	90	95	68	60	40	5	12	33	49	10.0
TURBIDITY (NTU)	22	6.6	4.7	6.5	7.7	8.9	120	80	19	31	13.0
OXYGEN											
DISSOLVED (MG/L)	9.60	9.30	10.00	10.10	9.20	9.70	6.90	7.10	9.85	9.08	0.385
PERCENT SATURATION	91	93	112	121	109	109	78	80	115	101	5.0
TOTAL ALKALINITY (MG/L)	46	38	49	58	62	67	54	61	73	56	3.4
PH	6.9	7.2	7.6	8.0	7.6	7.5	7.3	7.3	7.7	7.5	0.10
SPECIFIC CONDUCTANCE											
AT 25 C (µMHOS/CM)	110	155	216	275	318	335	230	310	350	255	26.5
SULFATE (MG/L)	25	27	40	53	44	57	43	64	66	47	4.7
IRON (MG/L)											
TOTAL	2.37	2.21	1.30	1.34	1.68	1.92	7.82	5.08	2.23	2.88	0.686
DISSOLVED	0.27	0.49	0.69	0.15	0.41	0.35	0.21	0.47	0.30	0.37	0.052
PERCENT DISSOLVED	11	22	53	11	24	18	3	9	13	18	4.6
RESIDUE (MG/L)											
TOTAL	139	144	156	204	220	242	304	303	270	220	20.5
FIXED TOTAL	82	89	102	129	134	145	232	212	170	144	16.6
NONFILTRABLE	46	15	10	13	14	15	138	68	28	39	13.3
FILTRABLE	93	129	146	191	206	227	166	235	242	182	16.3

Table A-5 (cont.)

SSES

	3 JUL	6 JUL	10 JUL	13 JUL	17 JUL	20 JUL	24 JUL	27 JUL	31 JUL	MEAN	SE
DATE	3 JUL	6 JUL	10 JUL	13 JUL	17 JUL	20 JUL	24 JUL	27 JUL	31 JUL		
TIME	1316	1203	1319	1323	1255	1200	1320	1319	1326		
RIVER LEVEL (M ABOVE MSL)	149.34	149.00	149.77	149.22	148.82	148.70	148.64	148.55	148.97		
DISCHARGE (M^3/S)	353	233	540	306	178	145	129	108	223		
TEMPERATURE (C)											
AIR	26.5	22.5	21.0	27.0	29.0	24.5	26.0	18.5	26.5		
WATER	22.5	22.5	20.0	23.0	26.0	23.5	25.0	23.5	23.5		
WEATHER	OVERCAST	OVERCAST	LT.RAIN	SUNNY	P.CLOUDY	P.CLOUDY	SUNNY	LT.RAIN	P.CLOUDY		
SECCHI DISC (CM)	32	30	19	41	52	60	62	83	69	50	6.6
TURBIDITY (NTU)	18	25	42	18	12	9.8	8.7	7.3	7.7	17	3.6
OXYGEN											
DISSOLVED (MG/L)	7.80	7.15	7.50	8.10	7.80	7.15	6.70	6.90	8.85	7.55	0.212
PERCENT SATURATION	89	82	82	93	95	84	80	80	104	88	2.6
TOTAL ALKALINITY (MG/L)	41	53	43	49	56	58	63	65	67	55	3.0
PH	7.2	7.2	7.3	7.4	7.4	7.2	7.3	7.3	7.5	7.3	0.03
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	220	270	190	241	295	295	295	355	295	273	15.6
SULFATE (MG/L)	45	58	52	46	61	71	81	78	66	62	4.1
IRON (MG/L)											
TOTAL	2.98	3.03	4.07	2.58	2.00	2.07	1.99	1.35	1.59	2.41	0.268
DISSOLVED	0.79	0.78	0.48	0.76	0.86	0.85	0.68	0.20	0.46	0.65	0.071
PERCENT DISSOLVED	27	26	12	29	43	41	34	15	29	28	3.3
RESIDUE (MG/L)											
TOTAL	182	223	217	194	214	226	260	266	201	220	8.9
FIXED TOTAL	122	159	153	142	153	148	160	171	128	148	4.9
NONFILTRABLE	33	33	66	28	14	13	10	8	11	24	5.9
FILTRABLE	149	190	151	166	200	213	250	258	190	196	12.4

BELL BEND

	3 JUL	6 JUL	10 JUL	13 JUL	17 JUL	20 JUL	24 JUL	27 JUL	31 JUL	MEAN	SE
DATE	3 JUL	6 JUL	10 JUL	13 JUL	17 JUL	20 JUL	24 JUL	27 JUL	31 JUL		
TIME	1325	1209	1311	1332	1302	1206	1327	1326	1318		
TEMPERATURE (C)											
AIR	26.5	22.5	21.0	27.0	29.0	24.5	26.0	18.5	26.5		
WATER	22.5	22.5	20.0	23.0	26.0	23.5	25.0	23.5	23.5		
WEATHER	OVERCAST	OVERCAST	LT.RAIN	SUNNY	P.CLOUDY	P.CLOUDY	SUNNY	LT.RAIN	P.CLOUDY		
SECCHI DISC (CM)	36	30	19	40	56	64	65	87	70	52	6.9
TURBIDITY (NTU)	18	25	40	18	12	9.8	9.1	6.9	7.7	16	3.4
OXYGEN											
DISSOLVED (MG/L)	7.95	7.15	7.40	8.05	7.70	7.15	6.65	6.80	8.75	7.51	0.211
PERCENT SATURATION	91	82	81	93	94	84	79	79	103	87	2.6
TOTAL ALKALINITY (MG/L)	42	52	44	50	56	57	64	66	67	55	2.9
PH	7.2	7.3	7.3	7.4	7.4	7.2	7.3	7.3	7.5	7.3	0.03
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	225	270	190	241	290	300	300	365	295	275	16.2
SULFATE (MG/L)	43	56	39	49	57	66	70	78	62	58	4.0
IRON (MG/L)											
TOTAL	2.75	3.24	4.18	2.45	2.02	2.08	1.96	1.29	1.56	2.39	0.282
DISSOLVED	0.76	0.78	0.49	0.78	0.84	0.83	0.67	0.20	0.47	0.65	0.068
PERCENT DISSOLVED	28	24	12	32	42	40	34	16	30	29	3.2
RESIDUE (MG/L)											
TOTAL	183	229	218	186	211	225	249	256	198	217	8.1
FIXED TOTAL	122	168	150	140	156	157	154	166	128	149	5.0
NONFILTRABLE	33	35	67	29	16	15	10	9	11	25	5.9
FILTRABLE	150	194	151	157	195	210	239	247	187	192	11.3

Table A-5 (cont.)

SSES

DATE	3 AUG	7 AUG	10 AUG	14 AUG	17 AUG	21 AUG	24 AUG	27 AUG	30 AUG	MEAN	SE
TIME	1305	1326	1336	1330	1331	1327	1308	1325	1300		
RIVER LEVEL (M ABOVE MSL)	148.70	148.82	148.58	149.10	149.55	149.13	148.73	148.64	148.49		
DISCHARGE (M^3/S)	145	173	115	263	442	274	153	129	95		
TEMPERATURE (C)											
AIR	24.5	27.0	24.0	28.5	23.0	20.0	22.5	26.5	27.0		
WATER	24.5	25.0	25.5	26.5	24.5	22.5	23.0	23.5	24.5		
WEATHER	LT.RAIN	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	SUNNY	P.CLOUDY	SUNNY	P.CLOUDY		
SECCHI DISC(CM)	60	70	75	51	4	10	24	34	38	41	8.0
TURBIDITY(NTU)	9.8	8.2	7.1	10	240	90	28	18	13	47	24.3
OXYGEN											
DISSOLVED(MG/L)	7.70	6.65	6.60	7.85	6.50	7.20	7.55	10.20	11.20	7.94	0.525
PERCENT SATURATION	92	79	80	97	77	83	87	119	132	94	6.1
TOTAL ALKALINITY(MG/L)	52	56	60	70	57	62	60	69	72	62	2.2
PH	7.2	7.3	7.2	7.7	7.4	7.5	7.4	7.8	8.5	7.6	0.13
SPECIFIC CONDUCTANCE											
AT 25 C(µMHOS/CM)	281	295	320	298	215	245	290	309	345	289	12.3
SULFATE(MG/L)	56	57	65	47	36	46	54	57	65	54	3.0
IRON(MG/L)											
TOTAL	1.72	1.66	1.41	1.34	16.20	6.07	2.82	2.17	1.60	3.89	1.533
DISSOLVED	0.70	0.69	0.40	0.32	0.40	0.54	0.52	0.47	0.11	0.46	0.058
PERCENT DISSOLVED	41	42	28	24	2	9	18	22	7	21	4.5
RESIDUE(MG/L)											
TOTAL	225	207	255	206	474	278	226	232	240	260	26.3
FIXED TOTAL	146	118	172	142	402	213	151	174	171	188	26.8
NONFILTRABLE	6	12	7	16	308	90	32	25	24	58	30.7
FILTRABLE	219	195	248	190	166	188	194	207	216	203	7.4

BELL BEND

DATE	3 AUG	7 AUG	10 AUG	14 AUG	17 AUG	21 AUG	24 AUG	27 AUG	30 AUG	MEAN	SE
TIME	1311	1333	1326	1338	1337	1333	1300	1333	1252		
TEMPERATURE (C)											
AIR	24.5	27.0	24.0	28.5	23.0	20.0	22.5	26.5	27.0		
WATER	24.5	25.0	25.5	26.5	24.5	22.5	23.0	23.5	24.5		
WEATHER	LT.RAIN	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	SUNNY	P.CLOUDY	SUNNY	P.CLOUDY		
SECCHI DISC(CM)	66	70	78	51	4	10	25	33	38	42	8.4
TURBIDITY(NTU)	9.2	8.2	6.5	8.8	230	90	32	19	14	46	23.3
OXYGEN											
DISSOLVED(MG/L)	7.85	6.85	6.85	8.00	6.50	7.15	7.50	10.20	11.20	8.01	0.512
PERCENT SATURATION	93	81	83	98	77	83	87	119	132	95	5.9
TOTAL ALKALINITY(MG/L)	55	58	61	71	58	62	62	71	72	63	2.0
PH	7.2	7.3	7.3	7.7	7.4	7.5	7.4	7.8	8.5	7.6	0.13
SPECIFIC CONDUCTANCE											
AT 25 C(µMHOS/CM)	290	300	325	298	215	255	290	311	345	292	12.1
SULFATE(MG/L)	60	63	65	48	35	47	56	56	64	55	3.1
IRON(MG/L)											
TOTAL	1.62	1.67	1.13	1.36	15.60	6.34	3.08	2.19	1.62	3.85	1.483
DISSOLVED	0.64	0.67	0.34	0.32	0.51	0.28	0.50	0.46	0.11	0.43	0.057
PERCENT DISSOLVED	40	40	30	24	3	4	16	21	7	21	4.5
RESIDUE(MG/L)											
TOTAL	222	208	255	199	460	284	238	246	242	264	26.9
FIXED TOTAL	142	120	164	138	412	212	157	178	168	188	27.8
NONFILTRABLE	6	11	7	12	294	92	36	28	24	57	29.4
FILTRABLE	216	197	248	187	186	192	202	218	218	207	6.3

Table A-5 (cont.)

SSES

DATE	4 SEP	7 SEP	11 SEP	14 SEP	18 SEP	21 SEP	24 SEP	27 SEP		
TIME	1325	1330	1310	1211	1332	1326	1323	1345		
RIVER LEVEL (M ABOVE MSL)	148.43	148.55	148.39	148.36	148.49	148.39	148.33	148.30		
DISCHARGE (M^3/S)	82	108	76	70	95	76	65	59		
TEMPERATURE (C)										
AIR	20.5	19.5	23.5	18.0	19.0	20.0	25.0	11.0		
WATER	23.5	20.5	20.5	21.0	18.5	19.5	20.5	19.5		
WEATHER	P.CLOUDY	SUNNY	P.CLOUDY	OVERCAST	SUNNY	SUNNY	P.CLOUDY	OVERCAST		
									MEAN	SE
SECCHI DISC (CM)	41	41	40	46	49	45	50	58	46	2.0
TURBIDITY (NTU)	16	15	13	13	12	12	11	10	13	0.7
OXYGEN										
DISSOLVED (MG/L)	8.45	9.95	9.70	8.95	9.60	10.70	9.20	8.30	9.36	0.266
PERCENT SATURATION	98	111	107	100	103	116	102	91	104	2.6
TOTAL ALKALINITY (MG/L)	68	72	82	78	80	88	83	84	79	2.2
PH	7.6	7.8	7.7	7.6	7.6	7.8	7.6	7.5	7.7	0.04
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	375	345	395	410	395	415	420	425	398	8.9
SULFATE (MG/L)	74	60	69	80	79	77	80	89	76	2.9
IRON (MG/L)										
TOTAL	2.11	2.00	1.94	1.78	1.91	1.65	1.60	1.50	1.81	0.071
DISSOLVED	0.23	0.21	0.22	0.28	0.36	0.16	0.15	0.18	0.22	0.023
PERCENT DISSOLVED	11	10	11	16	19	10	9	12	12	1.2
RESIDUE (MG/L)										
TOTAL	264	254	272	270	280	286	290	296	277	4.7
FIXED TOTAL	190	192	208	196	218	186	205	215	201	4.0
NONFILTRABLE	18	18	18	16	13	15	14	11	15	0.9
FILTRABLE	246	235	254	254	267	271	276	285	261	5.5

BELL BEND

DATE	4 SEP	7 SEP	11 SEP	14 SEP	18 SEP	21 SEP	24 SEP	27 SEP		
TIME	1332	1336	1316	1205	1325	1318	1329	1352		
TEMPERATURE (C)										
AIR	20.0	19.5	23.5	18.0	18.5	20.0	25.0	11.0		
WATER	23.5	20.5	20.5	21.0	18.5	19.5	20.5	19.5		
WEATHER	P.CLOUDY	SUNNY	P.CLOUDY	OVERCAST	SUNNY	SUNNY	P.CLOUDY	OVERCAST		
									MEAN	SE
SECCHI DISC (CM)	41	44	40	46	50	45	52	60	47	2.2
TURBIDITY (NTU)	15	15	13	12	12	12	11	10	13	0.6
OXYGEN										
DISSOLVED (MG/L)	8.60	9.95	10.00	9.05	9.45	10.60	9.10	8.30	9.38	0.257
PERCENT SATURATION	100	111	110	101	101	115	101	91	104	2.6
TOTAL ALKALINITY (MG/L)	70	74	82	79	80	88	84	84	80	1.9
PH	7.7	7.8	7.8	7.6	7.6	7.8	7.6	7.5	7.7	0.04
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	390	365	410	425	410	425	435	450	414	8.9
SULFATE (MG/L)	74	66	69	83	86	74	83	90	78	2.9
IRON (MG/L)										
TOTAL	1.93	2.03	1.87	1.74	2.04	1.68	1.62	1.46	1.80	0.069
DISSOLVED	0.23	0.20	0.22	0.29	0.34	0.15	0.14	0.18	0.22	0.023
PERCENT DISSOLVED	12	10	12	17	17	9	9	12	12	1.1
RESIDUE (MG/L)										
TOTAL	264	269	276	290	298	307	300	316	290	6.2
FIXED TOTAL	196	204	212	202	217	201	224	227	210	3.8
NONFILTRABLE	17	20	18	16	15	16	15	12	16	0.8
FILTRABLE	247	249	252	274	283	291	285	304	273	7.2

Table A-5 (cont.)

SSES

DATE	3 OCT	10 OCT	18 OCT	25 OCT		
TIME	1332	1307	1247	1305		
RIVER LEVEL (M ABOVE MSL)	148.30	148.27	148.24	148.33		
DISCHARGE (M^3/S)	59	54	49	65		
TEMPERATURE (C)						
AIR	16.0	18.5	18.5	18.5		
WATER	14.5	15.5	15.5	15.5		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	SUNNY		
					MEAN	SE
SECCHI DISC (CM)	51	50	60	63	56	2.9
TURBIDITY (NTU)	12	11	12	9.1	11	0.6
OXYGEN						
DISSOLVED (MG/L)	8.90	8.70	7.45	7.00	8.01	0.416
PERCENT SATURATION	86	87	74	71	80	3.7
TOTAL ALKALINITY (MG/L)	82	83	83	75	81	1.7
PH	7.4	7.3	7.3	7.3	7.3	0.02
SPECIFIC CONDUCTANCE						
AT 25 C (µMHOS/CM)	440	455	470	410	444	11.5
SULFATE (MG/L)	94	99	97	74	91	5.2
IRON (MG/L)						
TOTAL	2.10	1.83	1.92	1.94	1.95	0.050
DISSOLVED	0.31	0.26	0.31	0.49	0.34	0.045
PERCENT DISSOLVED	15	14	16	25	18	2.3
RESIDUE (MG/L)						
TOTAL	293	321	316	285	304	7.8
FIXED TOTAL	216	242	240	208	227	7.6
NONFILTRABLE	12	10	10	14	12	0.9
FILTRABLE	281	311	306	271	292	8.6

BELL BEND

DATE	3 OCT	10 OCT	18 OCT	25 OCT		
TIME	1324	1313	1254	1316		
TEMPERATURE (C)						
AIR	16.0	18.5	18.5	18.5		
WATER	14.5	15.5	15.5	15.5		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	SUNNY		
					MEAN	SE
SECCHI DISC (CM)	50	52	62	63	57	3.0
TURBIDITY (NTU)	12	11	9.4	8.9	10	0.6
OXYGEN						
DISSOLVED (MG/L)	8.70	8.60	7.45	7.00	7.94	0.377
PERCENT SATURATION	84	86	74	71	79	3.3
TOTAL ALKALINITY (MG/L)	81	84	83	76	81	1.6
PH	7.4	7.3	7.3	7.3	7.3	0.02
SPECIFIC CONDUCTANCE						
AT 25 C (µMHOS/CM)	440	465	480	435	455	9.5
SULFATE (MG/L)	91	103	97	79	93	4.6
IRON (MG/L)						
TOTAL	1.99	1.70	1.68	1.77	1.79	0.064
DISSOLVED	0.30	0.23	0.28	0.48	0.32	0.049
PERCENT DISSOLVED	15	14	17	27	18	2.7
RESIDUE (MG/L)						
TOTAL	304	341	329	304	320	8.3
FIXED TOTAL	225	243	243	220	233	5.4
NONFILTRABLE	12	11	9	12	11	0.6
FILTRABLE	292	330	320	292	309	8.7

Table A-5 (cont.)

SSES

DATE	1 NOV	8 NOV	14 NOV	21 NOV	28 NOV		
TIME	1256	1219	1212	1348	1209		
RIVER LEVEL (M ABOVE MSL)	148.39	148.49	148.64	148.52	148.46		
DISCHARGE (M^3/S)	76	95	129	101	88		
TEMPERATURE (C)							
AIR	14.5	8.5	8.0	3.5	4.0		
WATER	15.0	10.0	7.0	3.5	6.0		
WEATHER	OVERCAST	SUNNY	SUNNY	SUNNY	LT.RAIN		
						MEAN	SE
SECCHI DISC (CM)	48	75	113	140	85	92	14.5
TURBIDITY (NTU)	10	9.2	5.8	6.0	8.6	7.9	0.8
OXYGEN							
DISSOLVED (MG/L)	8.50	10.50	10.90	12.95	12.05	10.98	0.690
PERCENT SATURATION	84	94	90	99	96	93	2.4
TOTAL ALKALINITY (MG/L)	85	82	76	71	66	76	3.2
PH	7.5	7.5	7.5	7.5	7.5	7.5	0.00
SPECIFIC CONDUCTANCE							
AT 25 C (μMHOS/CM)	420	360	320	310	300	342	20.1
SULFATE (MG/L)	77	60	40	50	56	57	5.6
IRON (MG/L)							
TOTAL	1.97	1.79	1.45	1.36	1.76	1.67	0.103
DISSOLVED	0.25	0.70	0.74	0.84	0.75	0.66	0.095
PERCENT DISSOLVED	13	39	51	62	43	42	7.4
RESIDUE (MG/L)							
TOTAL	286	240	208	203	198	227	15.0
FIXED TOTAL	203	175	156	134	149	164	11.6
NONFILTRABLE	12	8	6	3	7	7	1.3
FILTRABLE	274	232	202	200	191	220	13.9

BELL BEND

DATE	1 NOV	8 NOV	14 NOV	21 NOV	28 NOV		
TIME	1249	1209	1203	1358	1200		
TEMPERATURE (C)							
AIR	14.5	8.5	8.0	3.5	4.0		
WATER	15.0	10.0	7.0	3.5	6.0		
WEATHER	OVERCAST	SUNNY	SUNNY	SUNNY	LT.RAIN		
						MEAN	SE
SECCHI DISC (CM)	49	75	110	140	80	91	14.3
TURBIDITY (NTU)	10	9.2	6.3	6.0	9.7	8.2	0.8
OXYGEN							
DISSOLVED (MG/L)	8.40	10.40	10.90	12.95	12.10	10.95	0.711
PERCENT SATURATION	83	93	90	99	96	92	2.5
TOTAL ALKALINITY (MG/L)	85	83	77	73	64	76	3.4
PH	7.5	7.5	7.5	7.5	7.5	7.5	0.00
SPECIFIC CONDUCTANCE							
AT 25 C (μMHOS/CM)	425	385	330	320	305	353	20.5
SULFATE (MG/L)	80	64	40	51	54	58	6.2
IRON (MG/L)							
TOTAL	1.94	1.83	1.44	1.41	1.89	1.70	0.105
DISSOLVED	0.23	0.66	0.70	0.85	0.71	0.63	0.096
PERCENT DISSOLVED	12	36	49	60	41	40	7.3
RESIDUE (MG/L)							
TOTAL	288	270	212	212	194	235	16.8
FIXED TOTAL	208	195	160	127	146	167	13.8
NONFILTRABLE	12	7	8	3	9	8	1.3
FILTRABLE	276	263	204	209	185	227	16.2

Table A-5 (cont.)

SSES

DATE	5 DEC	12 DEC	19 DEC	26 DEC		
TIME	1307	1311	1352	1303		
RIVER LEVEL(M ABOVE MSL)	150.07	149.49	149.68	149.86		
DISCHARGE(M^3/S)	698	415	497	586		
TEMPERATURE(C)						
AIR	2.0	5.0	3.5	0.0		
WATER	3.5	2.5	5.0	2.0		
WEATHER	SUNNY	OVERCAST	HVY.RAIN	OVERCAST		
					MEAN	SE
SECCHI DISC(CM)	57	125	82	81	86	12.7
TURBIDITY(NTU)	13	5.0	7.1	7.7	8.2	1.5
OXYGEN						
DISSOLVED(MG/L)	13.00	14.00	12.75	14.30	13.51	0.337
PERCENT SATURATION	99	102	99	106	102	1.5
TOTAL ALKALINITY(MG/L)	36	44	40	36	39	1.7
PH	7.4	7.4	7.4	7.5	7.4	0.02
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	165	195	180	160	175	7.1
SULFATE(MG/L)	18	28	26	23	24	1.9
IRON(MG/L)						
TOTAL	1.46	0.94	1.10	0.98	1.12	0.106
DISSOLVED	0.32	0.41	0.32	0.34	0.35	0.019
PERCENT DISSOLVED	22	44	29	35	33	4.2
RESIDUE(MG/L)						
TOTAL	132	120	122	115	122	3.2
FIXED TOTAL	85	84	82	76	82	1.8
NONFILTRABLE	17	8	12	10	12	1.7
FILTRABLE	115	112	110	105	111	1.9

BELL BEND

DATE	5 DEC	12 DEC	19 DEC	26 DEC		
TIME	1317	1300	1343	1315		
TEMPERATURE(C)						
AIR	2.0	5.0	3.5	0.0		
WATER	3.5	2.5	5.0	2.0		
WEATHER	SUNNY	OVERCAST	HVY.RAIN	OVERCAST		
					MEAN	SE
SECCHI DISC(CM)	57	125	80	82	86	12.7
TURBIDITY(NTU)	12	5.2	7.4	7.7	8.1	1.3
OXYGEN						
DISSOLVED(MG/L)	13.00	14.00	12.85	14.45	13.58	0.347
PERCENT SATURATION	99	102	100	107	102	1.6
TOTAL ALKALINITY(MG/L)	36	44	40	36	39	1.7
PH	7.4	7.4	7.4	7.5	7.4	0.02
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	165	195	180	160	175	7.1
SULFATE(MG/L)	18	28	26	22	24	2.0
IRON(MG/L)						
TOTAL	1.47	0.95	1.18	1.03	1.16	0.102
DISSOLVED	0.30	0.41	0.32	0.31	0.34	0.023
PERCENT DISSOLVED	20	43	27	30	30	4.3
RESIDUE(MG/L)						
TOTAL	132	120	123	114	122	3.4
FIXED TOTAL	87	85	89	74	84	3.0
NONFILTRABLE	17	6	13	10	12	2.1
FILTRABLE	115	114	110	104	111	2.2

Table A-6

Summary of physicochemical data collected from the Susquehanna River at SSES and Bell Bend, 1984.

PARAMETER	SSES				BELL BEND			
	MINIMUM	MAXIMUM	MEAN	SE	MINIMUM	MAXIMUM	MEAN	SE
SECCHI DISC (CM)	3	205	79	12.3	3	205	80	12.2
TURBIDITY (NTU)	3.6	320	24	7.2	3.4	320	24	7.3
OXYGEN								
DISSOLVED (MG/L)	6.50	14.30	10.52	0.626	6.50	14.45	10.52	0.629
PERCENT SATURATION	71	132	93	1.9	71	132	93	2.0
TOTAL ALKALINITY (MG/L)	17	88	56	5.0	16	88	56	5.1
PH	6.9	8.5	7.4	0.04	6.9	8.5	7.4	0.04
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	90	470	267	27.2	91	480	271	28.6
SULFATE (MG/L)	11	99	49	6.1	10	103	49	6.3
IRON								
TOTAL (MG/L)	0.86	27.40	2.68	0.566	0.85	25.40	2.63	0.524
DISSOLVED (MG/L)	0.11	1.43	0.56	0.080	0.11	1.31	0.54	0.079
PERCENT DISSOLVED	2	79	33	5.1	3	81	32	5.0
RESIDUE (MG/L)								
TOTAL	108	745	219	18.1	108	728	223	18.8
FIXED TOTAL	72	678	160	15.6	73	560	160	14.0
NONFILTRABLE	2	648	39	14.3	2	620	39	13.5
FILTRABLE	65	311	180	17.4	91	330	184	18.6

Table A-7

Results of Wilcoxon signed rank test comparing concurrent physicochemical data from the Susquehanna River at SSES and Bell Bend, 1984.

PARAMETER	NO. OF SAMPLES WITH UNEQUAL VALUES	NO. OF SAMPLE VALUES GREATER AT SSES	NO. OF SAMPLE VALUES GREATER AT BELL BEND	Z SCORE
SECCHI DISC (CM)	40	14	26	1.85
TURBIDITY (NTU)	44	24	20	0.67
OXYGEN				
DISSOLVED (MG/L)	56	30	26	0.32
PERCENT SATURATION	47	25	22	0.25
TOTAL ALKALINITY (MG/L)	42	11	31	3.08 **
PH	12	4	8	1.15
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	38	6	32	4.71 **
SULFATE (MG/L)	64	36	28	0.89
IRON (MG/L)				
TOTAL	77	41	36	0.93
DISSOLVED	65	51	14	4.25 **
PERCENT DISSOLVED	65	44	21	3.47 **
RESIDUE (MG/L)				
TOTAL	70	23	47	3.33 **
FIXED TOTAL	75	35	40	1.82
NONFILTRABLE	54	16	38	2.47 *
FILTRABLE	72	28	44	2.69 **

* = P<0.05
** = P<0.01

Table A-8

Results of Wilcoxon signed rank test comparing concurrent physicochemical data from the Susquehanna River at SSES and Bell Bend, 1983-84.

PARAMETER	NO. OF SAMPLES WITH UNEQUAL VALUES	NO. OF SAMPLE VALUES GREATER AT SSES	NO. OF SAMPLE VALUES GREATER AT BELL BEND	Z SCORE
WATER TEMPERATURE (C)	3	0	3	1.63
SECCHI DISC (CM)	77	28	49	2.59 **
TURBIDITY (NTU)	105	75	30	4.05 **
OXYGEN				
DISSOLVED (MG/L)	110	46	64	2.63 **
PERCENT SATURATION	95	39	56	2.92 **
TOTAL ALKALINITY (MG/L)	82	20	62	4.51 **
PH	38	8	30	3.46 **
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	84	16	68	6.77 **
SULFATE (MG/L)	120	67	53	0.63
IRON (MG/L)				
TOTAL	151	91	60	3.36 **
DISSOLVED	134	100	34	5.27 **
PERCENT DISSOLVED	126	69	57	0.90
RESIDUE (MG/L)				
TOTAL	145	40	105	6.39 **
FIXED TOTAL	145	68	77	1.89
NONFILTRABLE	107	44	63	1.58
FILTRABLE	147	46	101	5.81 **

** = P<0.01

Table A-9

Summary of physicochemical data collected from the Susquehanna River at SSES (1973-84) and Bell Bend (1978-84).

PARAMETER	SSES				BELL BEND			
	MINIMUM	MAXIMUM	MEAN	SE	MINIMUM	MAXIMUM	MEAN	SE
SECCHI DISC (CM)	2	235	70	2.7	3	225	73	3.9
TURBIDITY (NTU)	3.0	1600	27	2.3	3.1	450	17	1.9
OXYGEN								
DISSOLVED (MG/L)	5.20	14.95	10.78	0.144	5.00	14.50	10.74	0.193
PERCENT SATURATION	60	177	97	0.8	58	157	97	1.0
TOTAL ALKALINITY (MG/L)	12	88	46	1.6	16	88	54	1.5
PH	6.4	9.0	7.3	0.02	6.6	8.9	7.4	0.02
SPECIFIC CONDUCTANCE AT 25 C (µMHOS/CM)	76	575	272	7.9	74	540	285	11.0
SULFATE (MG/L)	8	224	60	2.3	9	158	59	3.3
IRON								
TOTAL (MG/L)	0.86	52.80	2.67	0.113	0.72	25.40	2.29	0.131
DISSOLVED (MG/L)	0.01	5.88	0.53	0.035	0.01	2.23	0.58	0.038
PERCENT DISSOLVED	0	98	27	1.6	0	92	33	2.1
RESIDUE (MG/L)								
TOTAL	100	1490	195	7.0	104	728	219	7.2
FIXED TOTAL	68	1380	147	5.4	68	670	161	5.3
NONFILTRABLE	1	1090	34	3.6	1	649	28	3.8
FILTRABLE	54	363	109	8.8	55	368	188	7.6

Table A-10

Results of Friedman's two-way analysis of variance test and Page's distribution-free test for ordered alternatives of physicochemical parameters at SSES and Bell Bend from 1978 through 1984.

Parameter	SSES			BELL BEND		
	DF	FRIEDMAN'S STATISTIC	PAGE'S "L" STATISTIC	DF	FRIEDMAN'S STATISTIC	PAGE'S "L" STATISTIC
RIVER TEMPERATURE	6	9.589	1393.5	--	--	--
RIVER LEVEL	6	10.848	1319.0	--	--	--
RIVER FLOW	6	9.991	1312.5	--	--	--
TURBIDITY	6	8.821	1377.0	6	10.268	1386.0
DISSOLVED OXYGEN	6	9.045	1237.0	6	6.518	1265.0
TOTAL ALKALINITY	6	9.286	1391.0	6	10.393	1405.5
PH	6	10.384	1360.5	6	11.196	1364.0
SPECIFIC CONDUCTANCE	6	8.134	1393.5	6	6.250	1381.0
SULFATE	6	15.304*	1416.5	6	16.107*	1412.0
IRON						
TOTAL	6	5.000	1405.0	6	6.750	1404.0
DISSOLVED	6	6.804	1422.5	6	8.464	1435.0
RESIDUE						
TOTAL	6	8.366	1341.0	6	10.241	1315.5
FIXED TOTAL	6	7.679	1346.0	6	8.795	1340.5
NONFILTRABLE	6	6.438	1356.0	6	7.205	1362.0
FILTRABLE	6	12.375*	1377.0	6	7.438	1321.5

* = $P<0.05$

Table A-11

Summary of water chemistry data collected from four major acid mine drainages upriver from the Susquehanna SES, 1972-84. Data were provided by the Pennsylvania Department of Environmental Resources, Wilkes-Barre, Pennsylvania

Year	No. of Samples	pH	Alkalinity (mg/l)	Acidity (mg/l) (at pH 8)	Sulfate (mg/l)	Total Iron (mg/l)
				OLD FORGE BOREHOLE (50 km)*		
1972	9	5.5	--	136	1010	74
1973	2-8	5.2	35	300	1500	175
1974	5-6	5.6	63	191	968	59
1975	2	5.6	47	44	739	44
1976	7	5.0	44	59	664	42
1977	8	6.2	94	84	671	36
1978	12	6.0	78	37	965	30
1979	11	6.1	69	31	645	33
1980	10	6.1	82	17	660	37
1981	9	6.1	72	9	591	35
1982	11	6.2	75	26	515	28
1983	9-10	6.2	80	20	416	18
1984	10	6.2	90	13	608	20
				DURYEA OUTFALL (49 km) *		
1972	11	5.8	--	110	970	70
1973	2-8	5.5	35	315	1450	160
1974	1-5	5.8	87	53	904	47
1975	3	5.7	51	70	749	44
1976	6	6.1	51	46	582	40
1977	8	6.5	77	71	572	34
1978	12	5.9	70	44	571	38
1979	11	6.1	68	31	605	32
1980	10	6.1	82	23	630	39
1981	11	6.1	77	17	589	37
1982	11	6.1	75	23	478	30
1983	11-12	6.2	76	29	483	22
1984	10	6.2	91	14	547	27
				SOUTH WILKES-BARRE OUTFALL (29 km) *		
1972	6	4.9	--	700	2420	257
1973	5-13	4.0	10	705	2410	330
1974	1-6	4.9	20	586	2440	267
1975	7	4.9	40	384	1789	178
1976	7	5.8	47	181	1121	123
1977	7	6.1	59	228	1420	127
1978	12	5.9	54	452	1629	152
1979	11	6.0	56	285	1350	128
1980	10	5.9	67	251	1321	148
1981	11	6.1	99	118	1247	100
1982	11	6.0	82	127	1053	87
1983	12	6.1	91	129	904	71
1984	11	5.9	71	143	1057	72
				BUTTONWOOD TUNNEL (28 km) *		
1972	10	5.5	--	350	1850	168
1973	2-11	5.0	35	440	1840	220
1974	1-5	5.4	41	265	1571	147
1975	6	5.7	51	311	1523	142
1976	7	5.6	54	191	1210	102
1977	9	5.9	64	204	1221	73
1978	12	5.9	67	133	1090	79
1979	11	5.9	73	170	971	80
1980	10	6.1	86	156	1118	94
1981	11	6.1	95	100	1243	92
1982	11	6.0	84	88	1029	90
1983	12	6.1	99	95	802	59
1984	10-11	6.0	82	129	1022	[illegible]

*Distance upriver from Susquehanna SES intake.

Table A-12

Physicochemical data collected monthly from the Susquehanna River at SSES and Bell Bend, 1984. Samples were analyzed at the Pennsylvania Power and Light Company Water Laboratory, Hazleton, Pennsylvania.

	SSES											
SAMPLE NUMBER	248	250	252	254	256	258	260	262	264	266	268	270
DATE	9 JAN	6 FEB	19 MAR	18 APR	14 MAY	11 JUN	17 JUL	15 AUG	10 SEP	9 OCT	12 NOV	10 DEC
TIME	920	1102	1332	1158	--	1150	1255	1033	1151	1220	1200	1214
RIVER TEMPERATURE (F)	32.0	33.0	38.0	47.3	55.4	77.0	79.0	78.0	68.0	59.0	49.0	34.7
COLOR (PT-CO UNITS)	--	—	—	—	—	—	—	—	—	—	—	—
TURBIDITY (FTU)	4.2	6.9	8.5	21	19	6.0	12	37	13	10	7.3	5.1
PH AT 25 C	7.1	7.0	7.3	7.3	7.2	7.8	7.1	6.9	7.7	7.4	7.6	7.4
SPECIFIC CONDUCTANCE (µMHOS)	310	294	272	142	160	260	290	240	396	460	350	195
ANALYSIS (MG/L)												
SUSPENDED MATTER	1.8	5.6	9.0	59.8	41.2	12.1	17.9	84.2	16.6	9.3	10.2	6.8
AMMONIA NITROGEN	0.64	0.64	0.33	0.15	0.16	0.34	0.12	0.22	0.08	0.09	0.08	0.27
NITRATE NITROGEN	1.50	1.35	1.13	0.66	0.58	0.48	1.04	0.99	0.89	1.28	1.25	1.00
M. O. ALKALINITY	58	48	54	28	33	55	53	53	77	79	79	38
HARDNESS	111.2	93.4	97.3	53.0	59.4	103.8	113.7	89.8	156.9	183.1	137.8	71.8
TOTAL DISSOLVED SOLIDS	—	—	—	—	—	—	—	—	—	—	—	—
LOSS ON IGNITION	—	—	—	—	—	—	—	—	—	—	—	—
SILICON DIOXIDE	4.78	3.74	3.96	4.01	2.83	0.48	4.29	3.62	0.68	1.81	1.58	4.46
CALCIUM	32.1	27.3	28.7	15.6	17.5	29.5	31.3	25.7	42.0	48.5	39.3	20.8
MAGNESIUM	7.5	6.1	6.2	3.4	3.8	7.3	8.6	6.2	12.6	15.0	9.6	4.8
SODIUM	11.9	16.3	11.7	5.8	6.2	9.0	10.6	9.9	17.6	19.3	14.7	7.8
POTASSIUM	1.6	2.1	1.8	1.1	1.3	1.4	1.9	2.5	2.4	2.5	2.1	1.6
BICARBONATE	70.8	58.6	65.9	34.2	40.3	67.1	64.7	64.7	93.9	96.4	96.4	46.4
SULFATE	43.5	36.7	31.5	18.6	19.3	42.0	51.8	29.1	69.2	91.9	48.6	27.6
CHLORIDE	18.8	28.5	19.4	9.1	8.5	12.7	13.4	14.0	24.3	29.7	22.5	11.5
NITRATE	6.64	5.96	5.01	2.94	2.56	2.12	4.59	4.37	3.94	5.67	5.52	4.44
PHOSPHATE	0.08	0.26	0.15	0.19	0.18	0.16	0.21	0.42	0.02	0.21	0.08	0.15
TOTAL MINERAL SOLIDS	197.7	185.5	174.3	94.9	102.4	171.8	191.3	160.4	266.6	311.0	240.3	129.5
DISSOLVED OXYGEN	13.5	12.6	12.9	11.3	9.4	11.1	7.8	6.0	9.7	8.9	10.5	14.3
ANALYSIS (ME/L)												
POSITIVE IONS												
CALCIUM	1.60	1.36	1.43	0.78	0.87	1.47	1.56	1.28	2.10	2.42	1.96	1.04
MAGNESIUM	0.62	0.50	0.51	0.28	0.31	0.60	0.71	0.51	1.04	1.23	0.79	0.39
SODIUM	0.52	0.71	0.51	0.25	0.27	0.39	0.46	0.43	0.77	0.84	0.64	0.34
POTASSIUM	0.04	0.05	0.05	0.03	0.03	0.04	0.05	0.06	0.06	0.06	0.05	0.04
TOTAL	2.78	2.63	2.50	1.34	1.49	2.50	2.78	2.29	3.96	4.56	3.44	1.81
NEGATIVE IONS												
BICARBONATE	1.16	0.96	1.08	0.56	0.66	1.10	1.06	1.06	1.54	1.58	1.58	0.76
SULFATE	0.91	0.76	0.66	0.39	0.40	0.87	1.08	0.61	1.44	1.91	1.01	0.57
CHLORIDE	0.53	0.80	0.55	0.26	0.24	0.36	0.38	0.39	0.69	0.94	0.63	0.32
NITRATE	0.11	0.10	0.08	0.05	0.04	0.03	0.07	0.07	0.06	0.09	0.09	0.07
PHOSPHATE	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00
TOTAL	2.71	2.63	2.37	1.26	1.35	2.37	2.60	2.14	3.73	4.43	3.32	1.74
TRACE METAL ANALYSIS (MG/L)												
IRON, TOTAL	1.55	1.35	1.32	2.08	1.80	1.32	1.82	3.42	1.80	1.61	1.54	0.85
IRON, DISSOLVED	0.78	0.69	0.32	0.11	0.14	<0.05	0.35	0.11	<0.05	<0.05	0.09	0.37
ALUMINUM, TOTAL	<0.3	<0.3	<0.3	0.8	0.7	<0.3	0.3	1.0	<0.3	<0.3	<0.3	<0.3
ALUMINUM, DISSOLVED	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
MANGANESE, TOTAL	0.29	0.23	0.17	0.14	0.11	0.21	0.24	0.28	0.37	0.46	0.26	0.14
MANGANESE, DISSOLVED	0.29	0.21	0.17	0.08	0.07	0.12	0.19	0.07	0.24	0.41	0.22	0.13
COPPER, TOTAL	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.04	0.02	0.02
COPPER, DISSOLVED	0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	0.01	0.01	0.02	<0.01	0.01
ZINC, TOTAL	0.02	0.02	0.01	0.01	0.02	0.01	0.08	0.03	0.08	0.01	0.01	0.01
ZINC, DISSOLVED	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
NICKEL, TOTAL	<0.03	<0.03	0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03
NICKEL, DISSOLVED	<0.03	<0.03	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03

Table A-12 (cont.)

BELL BEND											
SAMPLE NUMBER	249	251	253	255	257	259	261	263	265	267	269
DATE	9 JAN	6 FEB	19 MAR	18 APR	14 MAY	11 JUN	17 JUL	15 AUG	10 SEP	9 OCT	12 NOV
TIME	935	1053	1337	1207	—	1157	1302	1037	1157	1227	1200
RIVER TEMPERATURE (F)	32.0	33.0	38.0	47.3	55.4	77.0	79.0	78.0	68.0	59.0	49.0
COLOR (PT-CO UNITS)	—	—	—	—	—	—	—	—	—	—	—
TURBIDITY (FTU)	4.5	6.8	8.0	21	19	5.7	11	37	13	11	7.9
PH AT 25°C	6.8	7.0	7.3	7.3	7.2	7.8	7.1	6.9	7.7	7.4	7.6
SPECIFIC CONDUCTANCE (μMHOS)	312	294	272	143	159	260	290	245	400	475	359
ANALYSIS (MG/L)											
SUSPENDED MATTER	1.4	6.0	8.0	64.4	42.0	12.7	19.1	88.6	15.7	10.8	12.6
AMMONIA NITROGEN	0.63	0.67	0.37	0.14	0.21	0.40	0.14	0.26	0.09	0.09	0.08
NITRATE NITROGEN	1.41	1.26	1.14	0.66	0.53	0.48	0.99	0.92	0.86	1.35	1.25
M. O. ALKALINITY	59	47	54	30	33	55	53	54	77	81	78
HARDNESS	111.8	92.1	97.8	52.6	59.7	104.1	113.9	91.5	158.3	188.5	140.8
TOTAL DISSOLVED SOLIDS	—	—	—	—	—	—	—	—	—	—	—
LOSS ON IGNITION	—	—	—	—	—	—	—	—	—	—	—
SILICON DIOXIDE	4.89	3.64	3.84	4.07	2.83	0.48	4.35	3.73	0.62	1.86	1.53
CALCIUM	32.2	26.8	28.9	15.6	17.6	29.6	31.4	26.2	42.4	49.7	40.0
MAGNESIUM	7.6	6.1	6.2	3.3	3.8	7.3	8.6	6.3	12.7	15.6	9.9
SODIUM	12.0	16.0	11.8	5.8	6.1	9.1	10.6	10.1	18.0	20.2	15.4
POTASSIUM	1.6	2.1	1.8	1.2	1.3	1.5	1.9	2.5	2.4	2.7	2.3
BICARBONATE	72.0	57.3	65.9	36.6	40.3	67.1	64.7	65.9	93.9	98.8	95.2
SULFATE	43.5	36.7	31.5	18.6	18.9	47.6	51.8	29.9	68.1	101.2	53.0
CHLORIDE	18.2	26.7	18.8	8.5	8.5	12.7	14.6	14.6	24.9	30.3	23.7
NITRATE	6.24	5.56	5.04	2.94	2.36	2.12	4.37	4.08	3.80	5.96	5.52
PHOSPHATE	0.17	0.21	0.15	0.18	0.21	0.17	0.20	0.47	0.01	0.06	0.25
TOTAL MINERAL SOLIDS	198.4	181.1	173.9	96.8	101.9	177.7	192.4	163.7	266.8	326.4	246.7
DISSOLVED OXYGEN	13.6	11.6	13.2	11.3	9.5	11.2	7.7	6.1	9.7	8.8	10.5
ANALYSIS (ME/L)											
POSITIVE IONS											
CALCIUM	1.61	1.34	1.44	0.78	0.88	1.48	1.57	1.31	2.12	2.48	2.00
MAGNESIUM	0.63	0.50	0.51	0.27	0.31	0.60	0.71	0.52	1.04	1.28	0.81
SODIUM	0.52	0.70	0.51	0.25	0.27	0.40	0.46	0.44	0.78	0.88	0.67
POTASSIUM	0.04	0.05	0.05	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.06
TOTAL	2.79	2.59	2.51	1.33	1.49	2.51	2.78	2.33	4.00	4.71	3.54
NEGATIVE IONS											
BICARBONATE	1.18	0.94	1.08	0.60	0.66	1.10	1.06	1.08	1.54	1.62	1.56
SULFATE	0.91	0.76	0.66	0.39	0.39	0.99	1.08	0.62	1.42	2.11	1.10
CHLORIDE	0.51	0.75	0.53	0.24	0.24	0.36	0.41	0.41	0.70	0.85	0.67
NITRATE	0.10	0.09	0.08	0.05	0.04	0.03	0.07	0.07	0.06	0.10	0.09
PHOSPHATE	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01
TOTAL	2.71	2.55	2.35	1.28	1.34	2.49	2.63	2.19	3.72	4.68	3.43
TRACE METAL ANALYSIS (MG/L)											
IRON, TOTAL	1.45	1.36	1.23	2.06	1.60	1.34	1.82	3.40	1.82	1.72	1.63
IRON, DISSOLVED	0.59	0.70	0.31	0.11	0.12	<0.05	0.29	0.11	<0.05	<0.05	0.05
ALUMINUM, TOTAL	<0.3	<0.3	<0.3	0.8	0.6	<0.3	0.3	1.0	<0.3	0.3	<0.3
ALUMINUM, DISSOLVED	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
MANGANESE, TOTAL	0.37	0.22	0.17	0.14	0.11	0.21	0.23	0.28	0.36	0.46	0.26
MANGANESE, DISSOLVED	0.31	0.20	0.17	0.08	0.07	0.11	0.18	0.06	0.23	0.40	0.22
COPPER, TOTAL	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.02
COPPER, DISSOLVED	0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01
ZINC, TOTAL	0.02	0.02	0.02	0.02	0.02	0.05	0.04	0.03	0.06	0.01	0.02
ZINC, DISSOLVED	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NICKEL, TOTAL	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03
NICKEL, DISSOLVED	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03

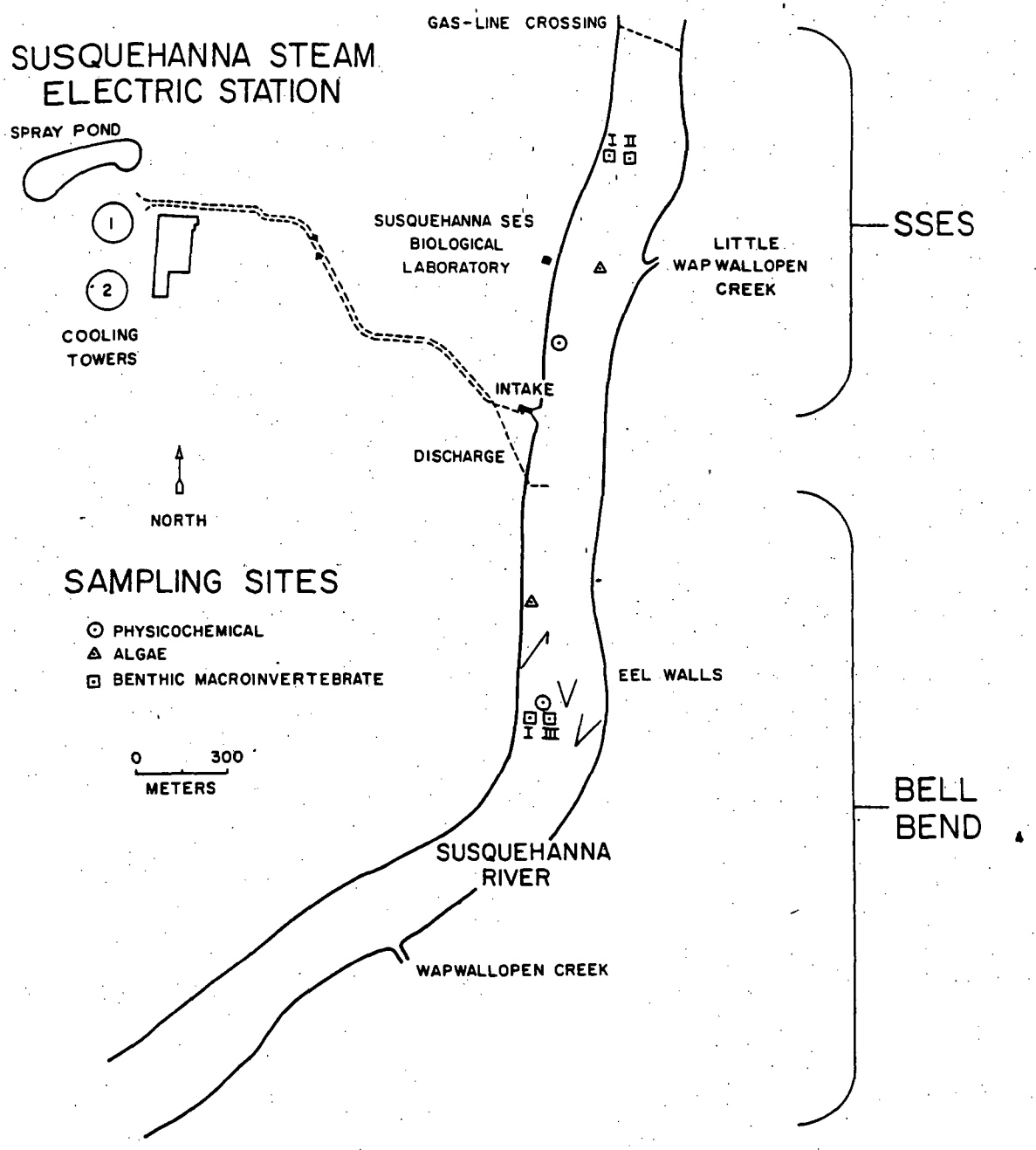

Fig. A-1

Physicochemical, algae, and benthic macroinvertebrate sampling sites at SSES and Bell Bend on the Susquehanna River, 1984.

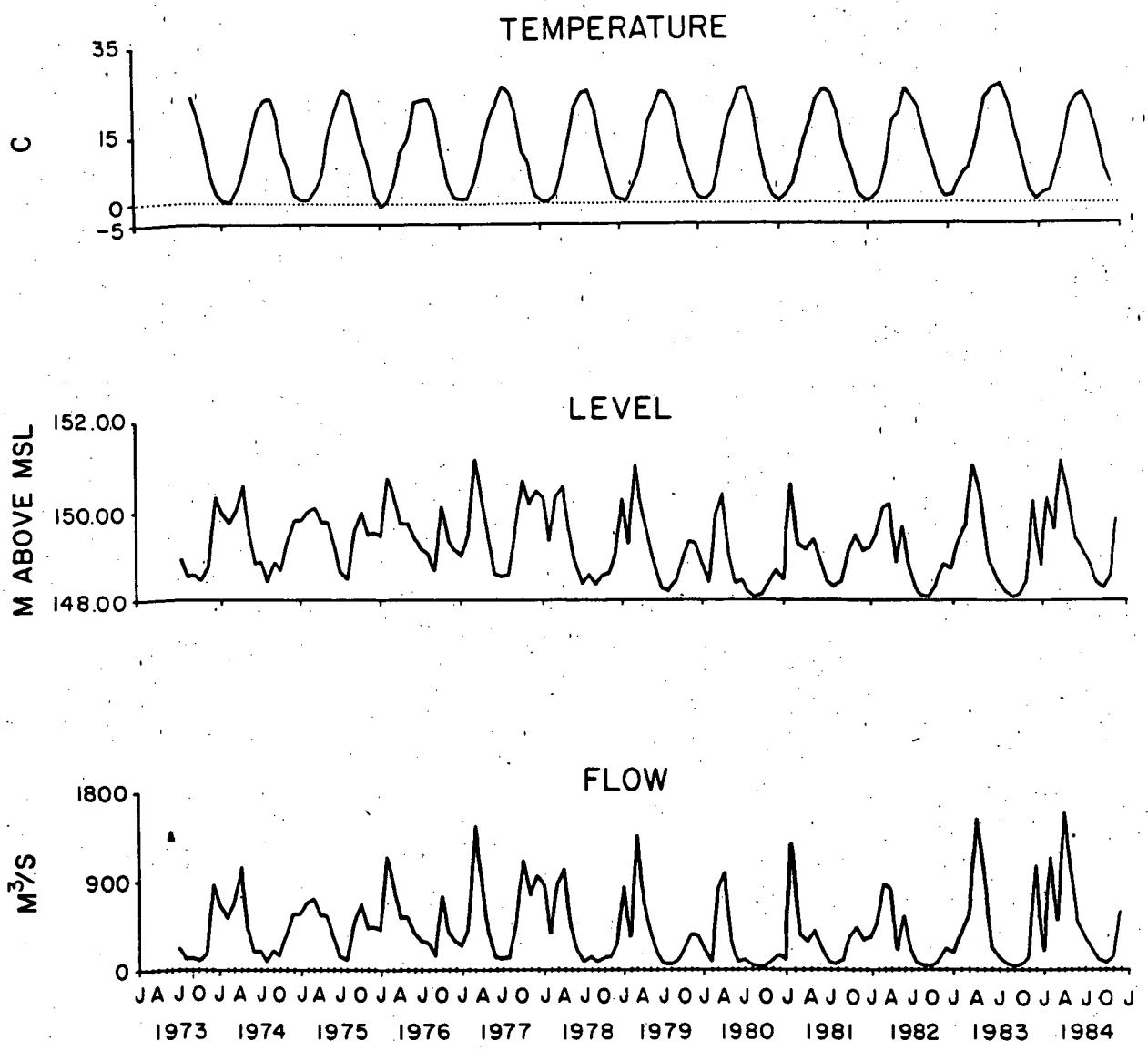

Fig. A-2

Monthly mean temperature, level, and flow of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1973-84.

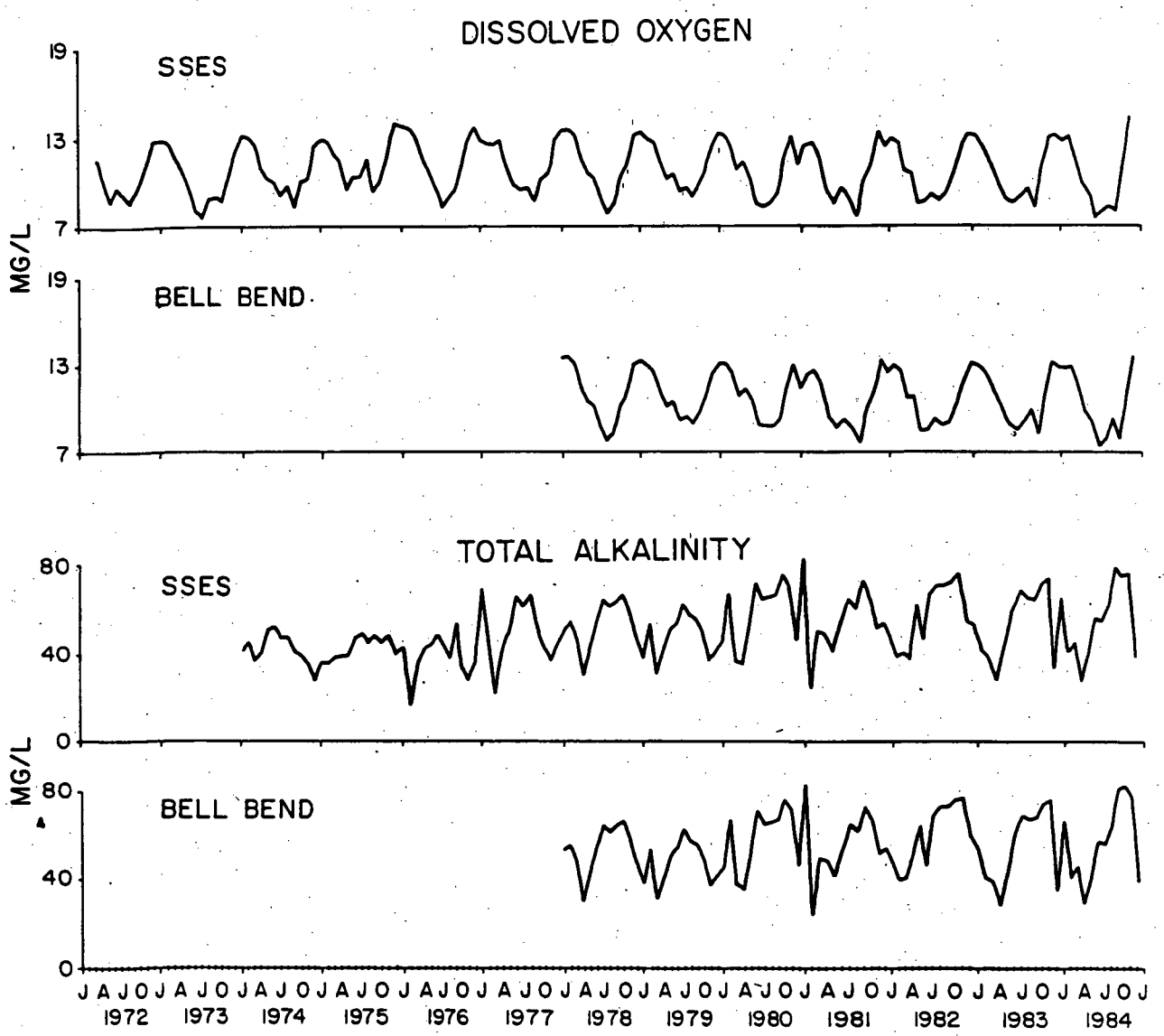

Fig. A-3

Monthly mean dissolved oxygen and total alkalinity of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84.

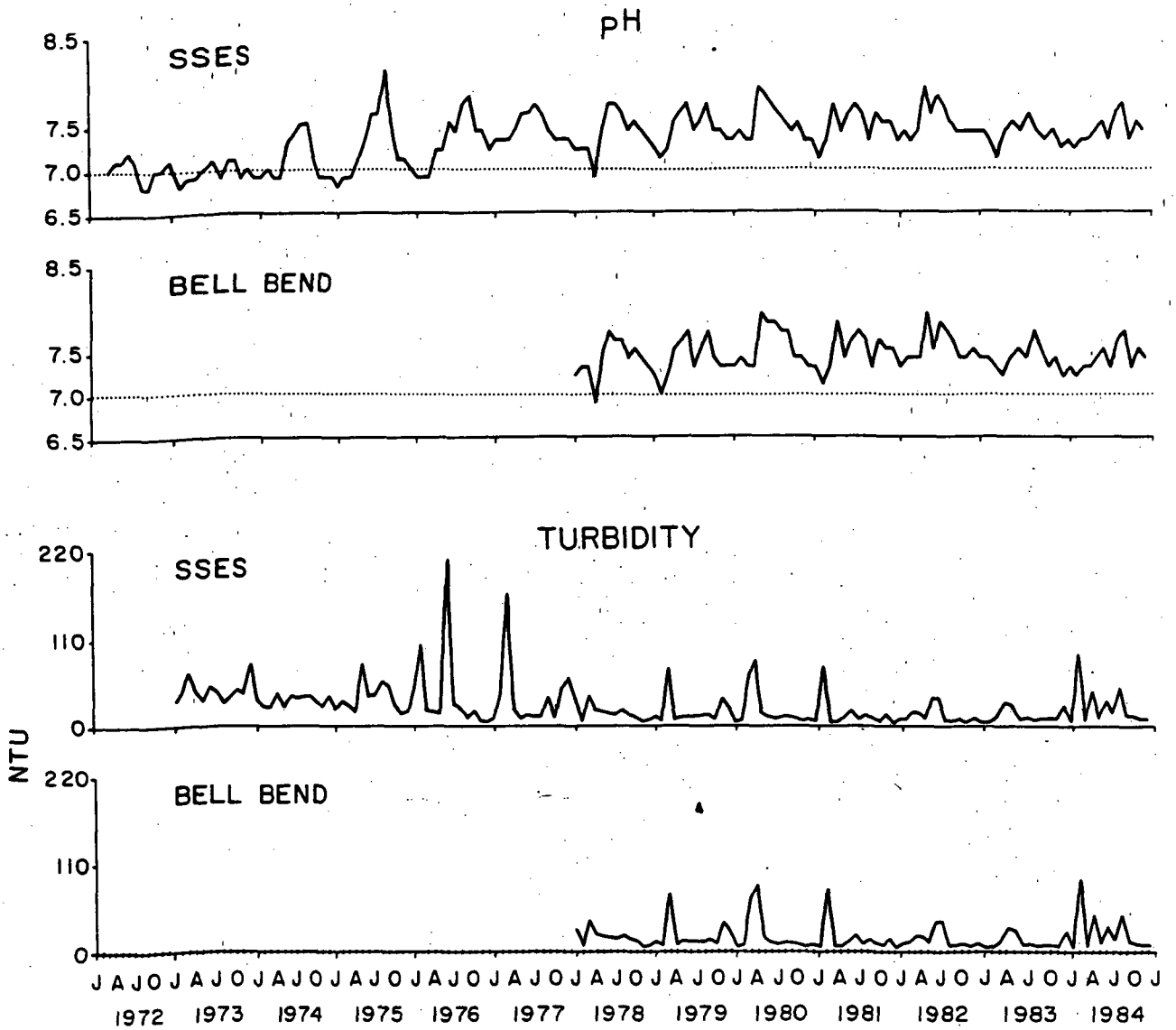

Fig. A-4

Monthly mean pH and turbidity of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84.

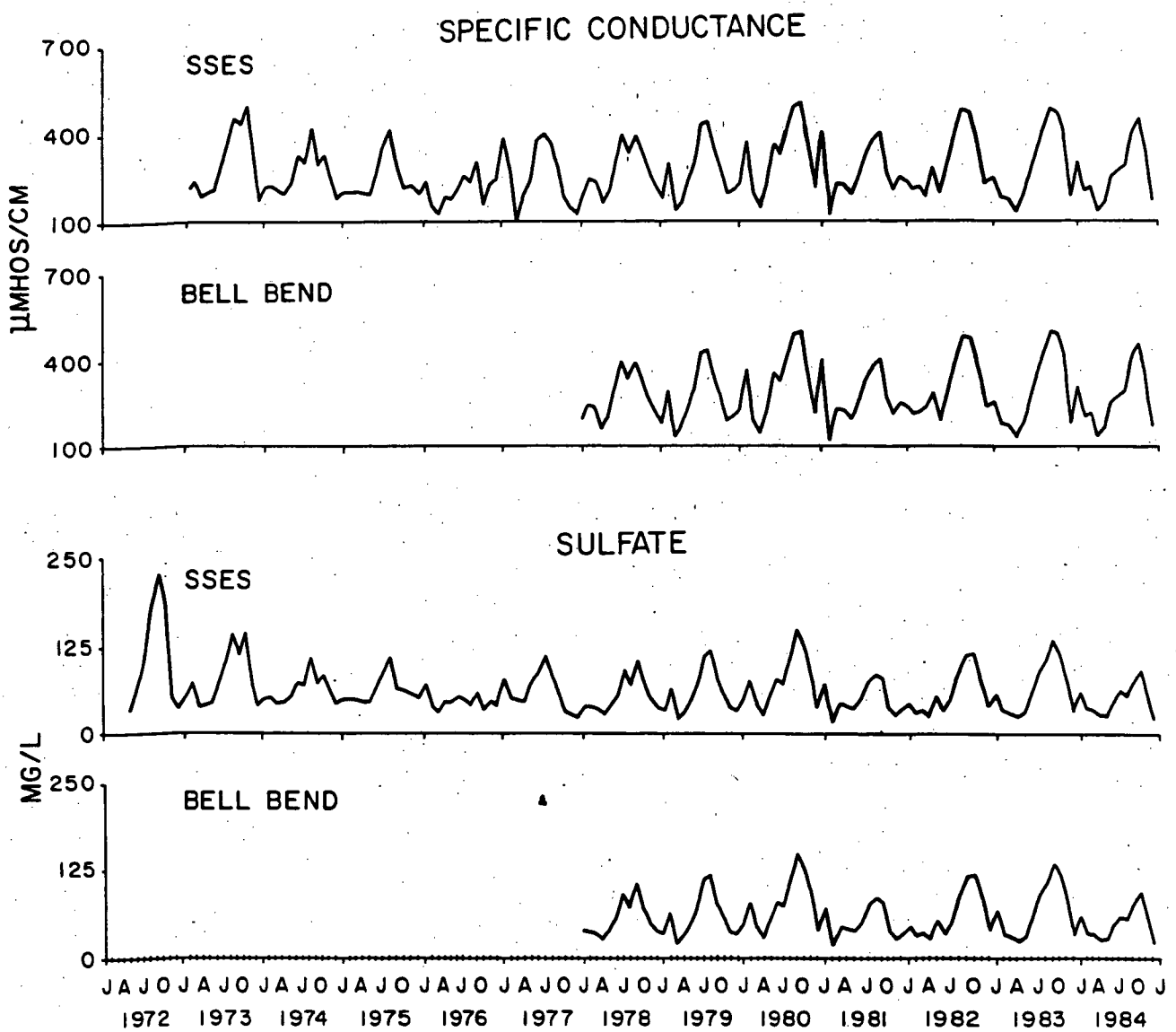

Fig. A-5

Monthly mean specific conductance and sulfate of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84.

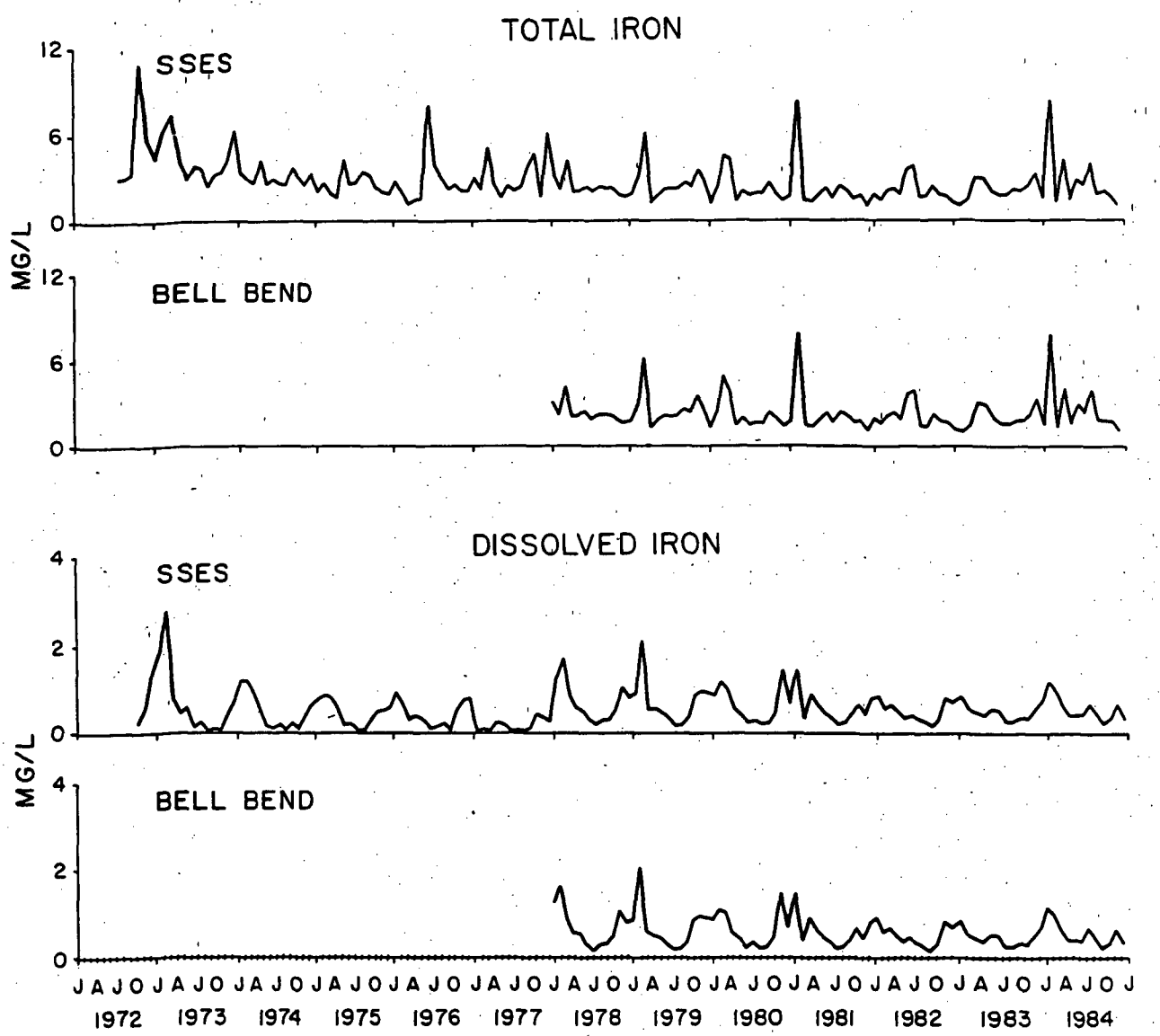

Fig. A-6

Monthly mean total and dissolved iron of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84.

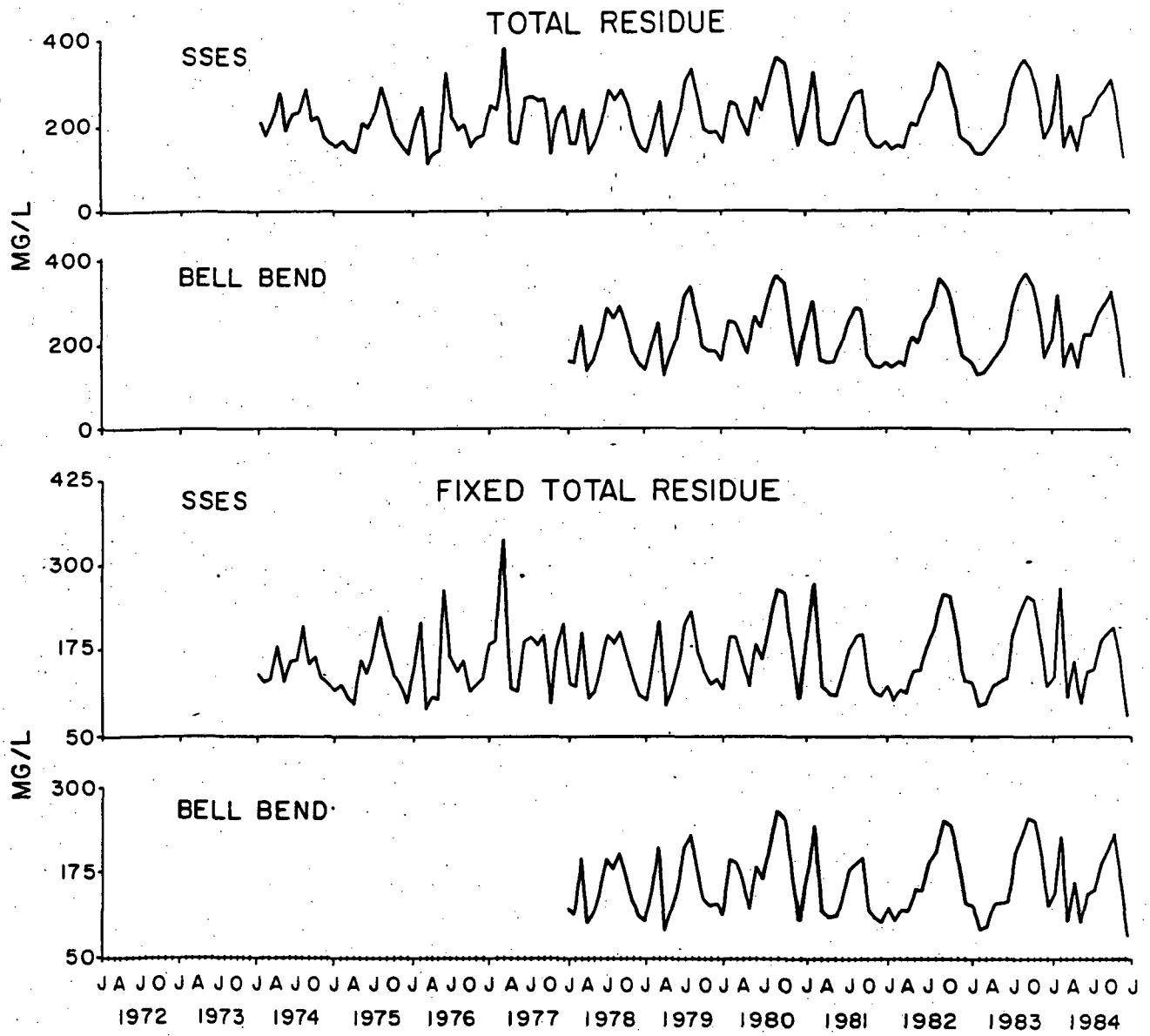

Fig. A-7

Monthly mean total and fixed total residue of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84.

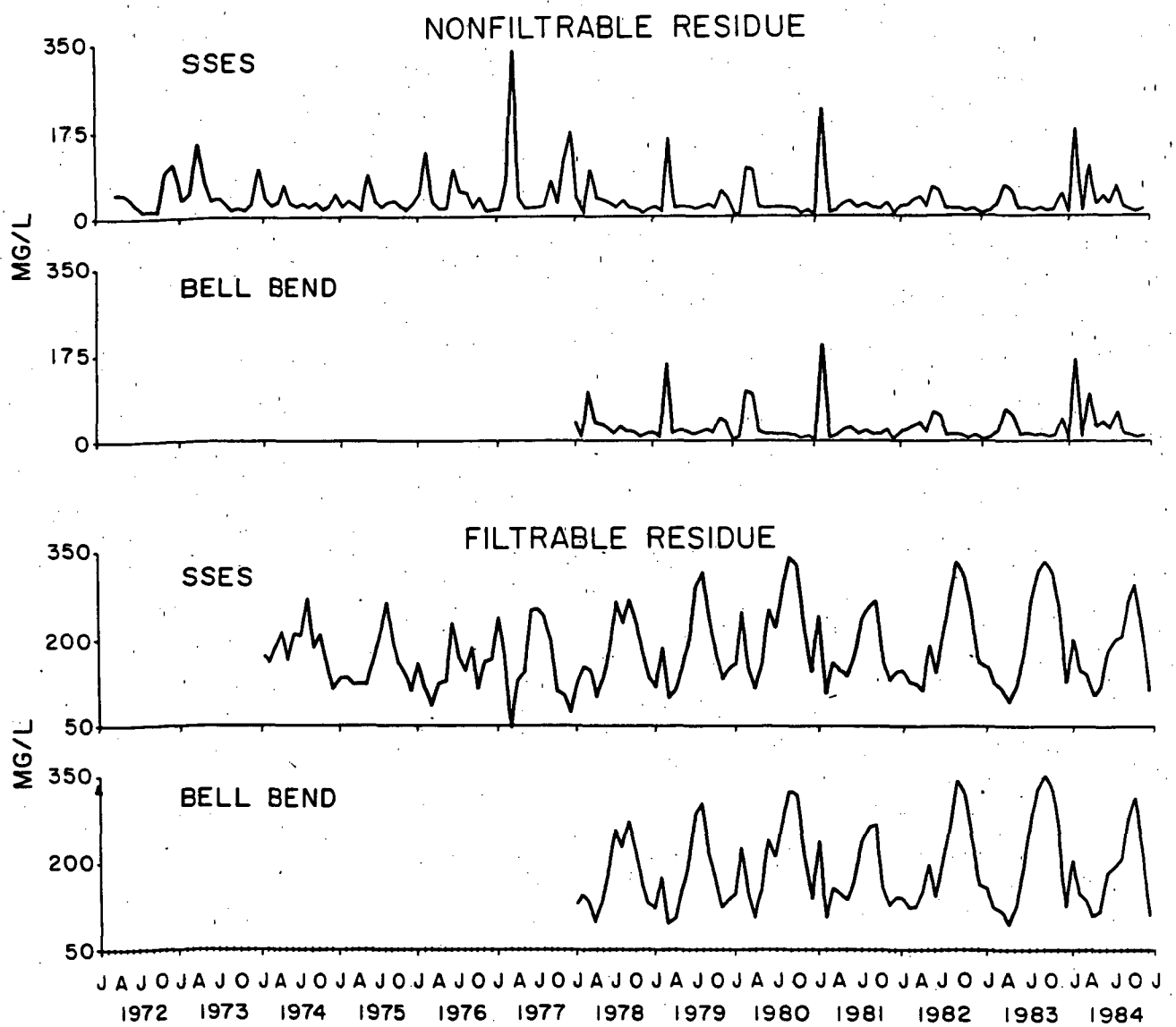

Fig. A-8

Monthly mean nonfiltrable and filtrable residue of the Susquehanna River at the SSES and Bell Bend sampling sites, 1972-84.

ALGAE

by

Andrew J. Gurzynski and William F. Gale

TABLE OF CONTENTS

Page

ABSTRACT 56

INTRODUCTION 56

PROCEDURES
- Periphyton 57
- Phytoplankton 58

RESULTS AND DISCUSSION
- Periphyton 59
- Phytoplankton 62

REFERENCES CITED 63

LIST OF TABLES

Table

B-1 Mean density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 1984... 65

B-2 Mean . . . at Bell Bend . . . 1984 66

B-3 Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 30 April 1984 67

B-4 Density . . . at Bell Bend . . . 30 April 1984 67

B-5 Density . . . at SSES . . . 15 June 1984 68

Table		Page
B-6	Density . . . at Bell Bend . . . 15 June 1984	68
B-7	Density . . . at SSES . . . 20 August 1984	69
B-8	Density . . . at Bell Bend . . . 20 August 1984	69
B-9	Density . . . at SSES . . . 15 October 1984	70
B-10	Density . . . at Bell Bend . . . 15 October 1984	70
B-11	Species of periphytic algae composing 5% or more of the total units counted in at least one replicate sample from SSES or Bell Bend on the Susquehanna River, 1984	71
B-12	Density (units/ml) of phytoplankton in bimonthly samples (indicated by date and collection number) at SSES on the Susquehanna River, 1984	72
B-13	Density . . . at Bell Bend . . . 1984	73
B-14	Species of phytoplankton composing 5% or more of the total units counted in at least one sample from SSES or Bell Bend on the Susquehanna River, 1984	74

LIST OF FIGURES

Fig.		
B-1	Standing crop of periphytic algae (units/mm^2) on cumulative acrylic plates at SSES and Bell Bend on the Susquehanna River, 1977-84	75
B-2	Standing crop of phytoplankton (units/ml) from bimonthly samples taken at SSES and Bell Bend on the Susquehanna River, 1977-84	76

ABSTRACT

Samples of algae (periphyton and phytoplankton) were collected upriver from the Susquehanna SES intake structure (SSES) and downriver from the discharge diffuser (Bell Bend) in April, June, August, and October 1984. Overall, the mean periphyton density at SSES and Bell Bend in 1984 (800 units/mm^2) decreased from the 1,100 units/mm^2 found in 1983. Periphyton density peaked at both sites in October. Green algae, which in 1983 composed 50% of the periphyton collected at the two sites combined, decreased in 1984 to only 14%; diatoms composed 82% and blue-green algae 4% of the 1984 total. Overall, phytoplankton density decreased from 11,400 units/ml in 1983 to only 3,500 units/ml in 1984. Density was highest in June when there was an average of 6,600 units/ml. Green algae composed 65% of the phytoplankton collected; diatoms composed 31% and blue-greens composed 4%. Results did not reveal any impact upon the algal community at Bell Bend from operation of the Susquehanna SES. The decrease in algal density in 1984 was probably a result of unusually high turbidity resulting from construction on the watershed.

INTRODUCTION

The basic objective in 1984, as it has been since February 1977, was to describe seasonal changes in the periphyton and phytoplankton communities at two sites (Fig. A-1) near the Susquehanna SES (data collected prior to September 1, 1982 are considered "preoperational" and data since that date are "operational"). One sampling site (SSES) was 460 m upriver from the Susquehanna SES intake structure and 135 m from the west bank; the other site (Bell

Bend) was 400 m downriver from the discharge diffuser and 30 m from the west bank.

PROCEDURES

Periphyton

Periphyton substrates consisted of 8 sandblasted plates of clear acrylic (22 x 30 cm) in "detritus-free" holders similar to those of Gale et al. (1976). Two holders with four plates each were placed on the river bottom at each site near the main channel, where depths ranged at SSES in 1984 from 1.9 to 8.9 m. From April through October 1984, two plates were sampled bimonthly at each site. Each plate was exposed to colonization for 12 months. Three replicate samples were taken from each plate by a scuba diver using a bar-clamp sampler (Gale 1975). Sampled plates were replaced with clean plates to be sampled later. The schedule for plate removal was a continuation of a plan established in 1977 by random selection.

The 415 mm^2 area of the plate delimited by each bar-clamp sampler was cleaned by scraping and vibration (Gale 1975) with an ultrasonic dental cleaning probe for 10 minutes. Dislodged cells were carried to a collection jar by water sprayed inside the collecting cup through the cleaning probe. As a result, loosened cells were not subjected to unnecessary vibration. Vibration may have destroyed some cells, but Gale (1975) reported that more cells per unit area were obtained by scraping and vibration than by scraping and brushing. Samples (250 ml) were preserved with formalin and, after settling 10 days, were concentrated to 50 ml by siphoning. 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 of algae. The other half of the concentrate was placed in a reference collection to be retained for at least 12 months.

Phytoplankton

A 1-liter phytoplankton sample was collected near the river surface at each periphyton sampling site on the same days that periphyton samples were collected. After the samples were preserved with formalin and allowed to settle for 10 days, the algae in them was concentrated in a similar manner tc that used for periphyton samples. The main difference in procedures was that phytoplankton samples, because of their greater initial volume, were siphoned three times instead of once (10 days settling time was allowed between each siphoning).

Algal cells in periphyton and phytoplankton samples that contained chloroplasts were enumerated as "units" (Gale and Lowe 1971). In most instances, at least 1,500 units were enumerated and identified in each sample (about 500 per each of 3 subsamples). Extremely low algal densities in some subsamples made it impractical to count 500 units and fewer were counted. Counts were made using a microscope (430X) and a Palmer counting cell. Higher magnification, including electron microscopy, was used for some identifications. Algae were identified by Dr. Lowe to genus and the more abundant forms to species using keys by Hustedt (1930) and Prescott (1962).

RESULTS AND DISCUSSION

Periphyton

In 1984, a total of 42 genera of algae was collected in 24 samples from acrylic plates upstream from the intake (SSES); 44 genera were found in 24 samples taken downstream from the discharge (Bell Bend). Thirty-six of the genera were found at both sites. None of the 14 genera that occurred at only one site composed more than 1% of the total units counted in any replicate. These data are summarized in Tables B-1 and B-2. Raw data are in Tables B-3 through B-10.

At SSES and Bell Bend, 30 species of periphytic algae were identified that composed 5% or more of the total units counted in at least one replicate sample (Table B-11). For the third consecutive year, green algae (Chlorophyta) was less abundant than it was in 1981 (Fig. B-1), and it was relatively less abundant in 1984 (14% of the total standing crop) than it was in 1983, when it composed 50% of the total. The mean standing crop of green algae decreased from 1,400 units/mm^2 in 1981 to 600 units/mm^2 in 1982 and remained at the same level in 1983. In 1984, mean standing crop was only 100 units/mm^2. One of the main causes of the high standing crop of green algae in 1981 was due to an unexpected abundance (55% of the total) of *Oocystis* spp. (primarily *O. parva*), a species that usually occurs in lakes (Prescott 1962). From 1977 through 1980, *O. parva* composed less than 1% of the total standing crop annually. In 1982, *Oocystis* spp. remained the most abundant green alga, but composed just 16% of the total algae found. In 1984, as in 1983, the genus once again composed less than 1% of the total standing crop. The most abundant species of green algae were *Scenedesmus* spp. (mostly *S. quadricauda*)

and *Ankistrodesmus* spp. (mostly *A. falcatus*), which composed 7% and 2% of the total standing crop at the two sites combined, respectively.

The mean standing crop of diatoms (Bacillariophyta) fluctuated again in 1984 as it has throughout the study. In 1981, for example, the standing crop was 800 units/ mm^2; it increased slightly to 900 units/mm^2 in 1982 and then decreased to 500 units/mm^2 in 1983. In 1984, diatom density increased to 600 units/mm^2. Diatoms were relatively more abundant at SSES in 1984 (86% of the total) than at Bell Bend (76% of the total). Overall, diatoms composed 82% of the total periphyton at the two sites. In 1981, diatoms composed 37% of the total algae collected (Gurzynski and Gale 1982); in 1982 they composed 58% (Gurzynski and Gale 1983), and in 1983, 42% (Gurzynski and Gale 1984). The most abundant forms included *Cyclotella* spp. and *Navicula* spp., which each composed 29% and 23% of the total standing crop at the two sites, respectively. *Cyclotella* spp. was much more abundant at SSES (44%) than at Bell Bend (6%). *Navicula* spp., on the other hand, was much more abundant at Bell Bend (42%) than at SSES (11%).

Numbers of blue-green algae (Cyanophyta) decreased from 9% of the total standing crop in 1983 to 4% in 1984. In 1981 and 1982, blue-greens composed less than 1% of the total. *Schizothrix calcicola* was the most abundant species in 1984 (Table B-11).

Most of the algae found were "clean water" forms and only seven of the 30 abundant species in the samples were among the top 20 species listed by Palmer (1969) as being most tolerant of heavy organic pollution. These were *Nitzschia palea*, *N. acicularis*, *Scenedesmus quadricauda*, *Ankistrodesmus falcatus*, *Melosira varians*, *Navicula cryptocephala*, and *Gomphonema parvulum*.

Nearly one-half of the 25 species of abundant diatoms (Table B-11) were rated as "alkaliphilous" by Lowe (1974); one was acidophilous, five were rated "indifferent," and eight were "unknown."

In 1982, periphyton abundance on acrylic plates was about equal at Bell Bend and SSES, with an average of 1,500 units/mm^2. In 1983, much more periphyton occurred at Bell Bend (1,700 units/mm^2) than at SSES (600 units/mm^2). In 1984, periphyton density was higher at SSES (1,000 units/mm^2) than at Bell Bend (600 units/mm^2). Density peaked at SSES in October at 3,700 units/mm^2. The largest differences in standing crop occurred in October when there was over 2-fold more algae at SSES than at Bell Bend. Such large differences are not unusual and have occurred many times since the study began (Fig. B-1).

Overall, the mean density of periphyton at SSES and Bell Bend in 1984 (800 units/mm^2) decreased from the 1,100 units/mm^2 found in 1983 (Fig. B-1); the 1984 mean was the lowest recorded since the study began in 1977. The results of the 1984 sampling program do not indicate any impact upon the periphyton community resulting from operation of the Susquehanna SES; the decrease in abundance of periphyton at both sites was probably due to the periodic high turbidity resulting from major highway reconstruction on the Chemung River, a major tributary of the Susquehanna River (see "Physico-chemical Analyses"). High turbidity can affect the periphyton community by shading (i.e. reduction of cell growth and lowered reproduction) and by providing a silty, less stable substrate for colonization (Patrick et al. 1954). In previous years (Gurzynski and Gale 1978), it was observed that periods of high river discharge, prior to sampling, washed away much of the periphyton which had colonized soft, silty sediments on river stones.

Phytoplankton

Phytoplankton in samples collected at SSES in 1984 was nearly identical to that in samples taken at Bell Bend, as it has been in previous years (Fig. B-2). There was a total of 41 genera of algae in 4 samples at SSES and 43 genera in 4 samples from Bell Bend (Tables B-12 and B-13). Thirty-four genera were found at both sites. None of the 16 genera that occurred at only one site composed more than 1% of the total units counted.

In 1984, as in 1983, green algae was the major component of the phytoplankton composing 65% of the total standing crop. *Scenedesmus* spp. was the most abundant green alga at both sites in 1984 with a mean density of 600 units/ml (Tables B-12 and B-13). *Scenedesmus* composed about 16% of the total standing crop; *S. quadricauda* was the most abundant species. *Ankistrodesmus* spp. was also abundant (11% of the total) with a mean density of 400 units/ml at Bell Bend and SSES; *A. falcatus* was the most abundant species.

Diatoms composed 31% of the total standing crop. *Cyclotella* spp. and *Nitzschia* spp. were the main diatoms at both sites and composed about 16% of the total standing crop.

In 1984, blue-green algae were less abundant at SSES and Bell Bend (4% of the total standing crop) than they were in 1983 (23% of the total).

Fourteen species of phytoplankton composed 5% or more of the total units counted in at least one sample from the two sites (Table B-14). Phytoplankton was much less abundant in 1984 (3,500 units/ml) than in 1983 (11,400 units/ml).

Most of the phytoplankton found were "clean water" forms and only five of the abundant species (*N. palea, S. quadricauda, A. falcatus, C. meneghiniana,*

and *N. acicularis*) were among the top 20 species listed by Palmer (1969) as being most tolerant of heavy organic pollution. Most of the species of abundant diatoms were rated as "alkaliphilous" by Lowe (1974); two were rated "indifferent," and three were rated "unknown."

No impact upon the phytoplankton community was detected due to operation of the Susquehanna SES, although the 1984 mean was only about one-half as great as the previous low (6,400 units/ml in 1982). Much of the decline in standing crop in 1984 may have been caused by high turbidity from highway reconstruction upriver. Clay and silt particles can act as a "nucleus" which aggregates phytoplankton into such a large mass that it settles from the water column (Gale et al. 1976). Some of the phytoplankton lost in this way could accumulate on the river bottom and be collected in the periphyton sample.

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Table B-1

Mean density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 1984.

TAXON	30 APR	15 JUN	20 AUG	15 OCT	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	0.0	10.8	0.0	1.1	0.3
ANKISTRODESMUS	0.0	15.4	0.0	58.4	1.9
ARTHRODESMUS	0.0	1.9	0.0	0.0	<0.1
CHLAMYDOMONAS	0.1	0.9	0.0	2.7	0.1
COELASTRUM	0.0	0.0	0.0	24.4	0.6
COSMARIUM	0.0	0.0	0.0	1.1	<0.1
CRUCIGENIA	0.0	0.3	0.0	1.1	<0.1
DICTYOSPHAERIUM	0.0	3.4	0.0	0.0	0.1
KIRCHNERIELLA	0.0	0.0	0.0	1.1	<0.1
MICRACTINIUM	0.0	4.0	0.0	0.0	0.1
OOCYSTIS	0.0	0.3	0.0	4.3	0.1
PEDIASTRUM	0.0	0.0	0.1	1.6	<0.1
SCENEDESMUS	0.0	12.6	0.1	254.3	6.9
SCHROEDERIA	0.0	0.0	0.0	0.6	<0.1
STAURASTRUM	0.0	0.0	0.0	1.1	<0.1
TETRAEDRON	0.0	0.3	0.0	0.0	<0.1
TETRASTRUM	0.0	0.0	0.0	4.8	0.1
UNIDENTIFIED CHLOROPHYTA	0.0	6.8	0.1	92.2	2.6
BACILLARIOPHYTA					
ACHNANTHES	0.0	1.5	0.0	0.0	<0.1
ASTERIONELLA	1.3	0.6	0.0	0.0	0.1
COCCONEIS	0.0	0.0	0.3	50.3	1.3
CYCLOTELLA	0.0	4.6	0.1	1678.5	43.7
CYMBELLA	0.0	0.3	0.0	13.2	0.4
DIATOMA	0.0	0.0	0.0	3.7	0.1
EPITHEMIA	0.0	0.0	0.0	1.1	<0.1
FRAGILARIA	0.1	0.0	0.4	0.0	<0.1
GOMPHONEMA	0.3	0.6	1.2	40.3	1.1
GYROSIGMA	0.0	0.0	0.1	17.1	0.4
MELOSIRA	0.3	0.0	4.5	40.8	1.2
MERIDION	0.1	0.0	0.0	0.0	<0.1
NAVICULA	0.5	9.3	3.3	409.4	11.0
NITZSCHIA	0.5	18.8	4.3	213.9	6.2
PINNULARIA	0.1	0.0	0.0	0.0	<0.1
RHIZOSOLENIA	0.0	0.3	0.0	0.0	<0.1
RHOICOSPHENIA	0.0	0.0	0.0	16.4	0.4
STEPHANODISCUS	0.0	15.1	0.0	287.1	7.9
SURIRELLA	0.2	0.0	0.0	1.1	<0.1
SYNEDRA	0.1	17.3	0.1	2.1	0.5
THALASSIOSIRA	0.0	0.0	0.0	442.8	11.5
CYANOPHYTA					
CHROOCOCCUS	0.0	3.7	0.0	2.1	0.2
OSCILLATORIA	0.0	0.0	0.0	24.3	0.6
SCHIZOTHRIX	0.0	2.2	0.0	5.8	0.2
RHODOPHYTA					
RHODOCHORTON	0.1	0.0	0.0	0.0	<0.1
TOTAL	3.6	131.0	14.8	3698.4	

Table B-2

Mean density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at Bell Bend on the Susquehanna River, 1984.

TAXON	30 APR	15 JUN	20 AUG	15 OCT	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	0.0	41.3	0.0	0.0	1.7
ANKISTRODESMUS	0.0	46.6	0.6	16.7	2.6
CHLAMYDOMONAS	0.0	0.9	0.0	3.0	0.2
CLADOPHORA	0.0	0.0	0.3	0.0	<0.1
COELASTRUM	0.0	0.0	0.0	3.1	0.1
COSMARIUM	0.0	0.0	1.5	0.7	0.1
CRUCIGENIA	0.0	0.0	1.2	4.8	0.2
DICTYOSPHAERIUM	0.0	0.3	0.0	0.0	<0.1
GOLENKINIA	0.0	0.3	0.0	0.0	<0.1
KIRCHNERIELLA	0.0	3.1	0.3	2.2	0.2
MICRACTINIUM	0.0	0.6	0.0	0.0	<0.1
OOCYSTIS	0.0	0.3	0.0	22.9	0.9
PEDIASTRUM	0.0	0.3	0.6	0.7	0.1
POLYEDRIOPSIS	0.0	0.9	0.0	0.0	<0.1
SCENEDESMUS	0.0	92.2	2.5	57.1	6.2
SELENASTRUM	0.0	0.3	0.0	0.0	<0.1
STAURASTRUM	0.0	0.0	0.3	0.0	<0.1
TETRAEDRON	0.0	0.6	0.0	0.0	<0.1
TETRASTRUM	0.0	2.2	0.0	1.3	0.1
UNIDENTIFIED CHLOROPHYTA	0.1	18.8	3.1	24.0	1.9
BACILLARIOPHYTA					
ACHNANTHES	0.0	3.4	0.9	23.3	1.1
AMPHORA	0.0	0.0	0.0	0.6	<0.1
ASTERIONELLA	1.3	0.0	0.0	0.0	0.1
COCCONEIS	0.0	0.3	6.8	4.2	0.5
CYCLOTELLA	0.0	49.3	6.2	94.7	6.1
CYMBELLA	0.0	5.6	3.7	5.4	0.6
EUNOTIA	0.0	0.0	0.6	0.0	<0.1
FRAGILARIA	0.1	0.0	0.0	0.0	<0.1
FRUSTULIA	0.0	0.0	0.3	0.0	<0.1
GOMPHONEMA	0.3	1.5	19.4	13.9	1.4
GYROSIGMA	0.0	0.0	0.6	10.7	0.5
MELOSIRA	0.0	0.6	19.1	1.7	0.9
MERIDION	0.0	0.3	0.3	0.0	<0.1
NAVICULA	0.7	51.2	40.7	949.8	42.4
NITZSCHIA	0.4	104.2	43.2	147.0	12.0
PINNULARIA	0.0	0.0	0.3	0.0	<0.1
RHOICOSPHENIA	0.0	0.3	0.9	0.7	0.1
STEPHANODISCUS	0.0	115.3	0.9	61.4	7.2
SURIRELLA	0.1	0.0	0.3	0.0	<0.1
SYNEDRA	0.1	68.1	0.6	2.4	2.9
THALASSIOSIRA	0.0	0.0	0.0	16.8	0.7
CYANOPHYTA					
CHROOCOCCUS	0.0	3.7	0.0	1.1	0.2
OSCILLATORIA	0.0	0.0	3.7	3.5	0.3
SCHIZOTHRIX	0.0	113.2	38.2	58.0	8.5
CHRYSOPHYTA					
MALLOMONAS	0.0	0.3	0.0	0.0	<0.1
TOTAL	3.1	726.1	197.3	1531.6	

Table B-3

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 30 April 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-005	AJG-84-006	AJG-84-007	AJG-84-008	AJG-84-009	AJG-84-010	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
CHLAMYDOMONAS	0.0	0.4	0.0	0.0	0.0	0.0	0.1	1.9
BACILLARIOPHYTA								
ASTERIONELLA	0.0	1.6	0.0	0.0	0.0	6.4	1.3	37.0
FRAGILARIA	0.0	0.4	0.0	0.0	0.0	0.0	0.1	1.9
GOMPHONEMA	1.2	0.0	0.4	0.0	0.0	0.0	0.3	7.4
MELOSIRA	1.6	0.0	0.0	0.0	0.0	0.0	0.3	7.4
MERIDION	0.0	0.0	0.0	0.0	0.0	0.8	0.1	3.7
NAVICULA	2.0	0.0	0.0	0.4	0.4	0.4	0.5	14.8
NITZSCHIA	1.6	0.0	0.4	0.0	0.0	0.8	0.5	13.0
PINNULARIA	0.4	0.0	0.0	0.0	0.0	0.0	0.1	1.9
SURIRELLA	0.0	0.0	0.0	0.4	0.4	0.4	0.2	5.6
SYNEDRA	0.4	0.0	0.0	0.4	0.0	0.0	0.1	3.7
RHODOPHYTA								
RHODOCHORTON	0.0	0.0	0.0	0.4	0.0	0.0	0.1	1.9
TOTAL	7.2	2.4	0.8	1.6	0.8	8.8	3.6	

Table B-4

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at Bell Bend on the Susquehanna River, 30 April 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-011	AJG-84-012	AJG-84-013	AJG-84-014	AJG-84-015	AJG-84-016	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
UNIDENTIFIED CHLOROPHYTA	0.4	0.0	0.0	0.0	0.4	0.0	0.1	4.3
BACILLARIOPHYTA								
ASTERIONELLA	0.0	0.0	6.4	1.6	0.0	0.0	1.3	43.5
FRAGILARIA	0.4	0.0	0.0	0.0	0.0	0.0	0.1	2.2
GOMPHONEMA	0.0	0.0	0.0	0.4	0.4	0.8	0.3	8.7
NAVICULA	1.2	0.0	0.4	0.0	2.0	0.4	0.7	21.7
NITZSCHIA	0.0	0.4	0.0	0.8	0.4	0.8	0.4	13.0
SURIRELLA	0.0	0.0	0.0	0.0	0.0	0.4	0.1	2.2
SYNEDRA	0.0	0.4	0.0	0.4	0.0	0.0	0.1	4.3
TOTAL	2.0	0.8	6.8	3.2	3.2	2.4	3.1	

Table B-5

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 15 June 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-027	AJG-84-028	AJG-84-029	AJG-84-030	AJG-84-031	AJG-84-032	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
ACTINASTRUM	9.3	16.7	3.7	7.4	16.7	11.1	10.8	8.2
ANKISTRODESMUS	16.7	18.5	22.2	0.0	5.6	29.6	15.4	11.8
ARTHRODESMUS	0.0	0.0	0.0	11.1	0.0	0.0	1.9	1.4
CHLAMYDOMONAS	0.0	3.7	0.0	1.9	0.0	0.0	0.9	0.7
CRUCIGENIA	0.0	1.9	0.0	0.0	0.0	0.0	0.3	0.2
DICTYOSPHAERIUM	5.6	3.7	5.6	3.7	0.0	1.9	3.4	2.6
MICRACTINIUM	3.7	7.4	13.0	0.0	0.0	0.0	4.0	3.1
OOCYSTIS	0.0	1.9	0.0	0.0	0.0	0.0	0.3	0.2
SCENEDESMUS	14.8	18.5	9.3	11.1	14.8	7.4	12.6	9.6
TETRAEDRON	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.2
UNIDENTIFIED CHLOROPHYTA	3.7	11.1	5.6	5.6	11.1	3.7	6.8	5.2
BACILLARIOPHYTA								
ACHNANTHES	0.0	7.4	1.9	0.0	0.0	0.0	1.5	1.2
ASTERIONELLA	0.0	1.9	0.0	0.0	1.9	0.0	0.6	0.5
CYCLOTELLA	5.6	5.6	3.7	5.6	0.0	7.4	4.6	3.5
CYMBELLA	0.0	0.0	0.0	0.0	0.0	1.9	0.3	0.2
GOMPHONEMA	3.7	0.0	0.0	0.0	0.0	0.0	0.6	0.5
NAVICULA	7.4	1.9	5.6	13.0	11.1	16.7	9.3	7.1
NITZSCHIA	18.5	29.6	13.0	16.7	13.0	22.2	18.8	14.4
RHIZOSOLENIA	1.9	0.0	0.0	0.0	0.0	0.0	0.3	0.2
STEPHANODISCUS	14.8	16.7	11.1	18.5	11.1	18.5	15.1	11.5
SYNEDRA	18.5	16.7	27.8	13.0	14.8	13.0	17.3	13.2
CYANOPHYTA								
CHROOCOCCUS	1.9	1.9	7.4	5.6	3.7	1.9	3.7	2.8
SCHIZOTHRIX	1.9	0.0	1.9	0.0	5.6	3.7	2.2	1.6
TOTAL	127.7	164.7	133.2	112.9	109.2	138.8	131.0	

Table B-6

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at Bell Bend on the Susquehanna River, 15 June 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-019	AJG-84-020	AJG-84-021	AJG-84-022	AJG-84-023	AJG-84-024	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
ACTINASTRUM	18.5	57.4	62.9	57.4	33.3	18.5	41.3	5.7
ANKISTRODESMUS	50.0	53.7	55.5	75.9	20.4	24.1	46.6	6.4
CHLAMYDOMONAS	0.0	1.9	3.7	0.0	0.0	0.0	0.9	0.1
DICTYOSPHAERIUM	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.0
GOLENKINIA	0.0	0.0	0.0	0.0	0.0	1.9	0.3	0.0
KIRCHNERIELLA	1.9	1.9	5.6	0.0	1.9	7.4	3.1	0.4
MICRACTINIUM	0.0	0.0	1.9	0.0	0.0	1.9	0.6	0.1
OOCYSTIS	1.9	0.0	0.0	0.0	0.0	0.0	0.3	0.0
PEDIASTRUM	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.0
POLYEDRIOPSIS	1.9	0.0	3.7	0.0	0.0	0.0	0.9	0.1
SCENEDESMUS	59.2	105.5	99.9	144.3	77.7	66.6	92.2	12.7
SELENASTRUM	0.0	0.0	0.0	1.9	0.0	0.0	0.3	0.0
TETRAEDRON	1.9	0.0	0.0	0.0	1.9	0.0	0.6	0.1
TETRASTRUM	0.0	5.6	0.0	5.6	0.0	1.9	2.2	0.3
UNIDENTIFIED CHLOROPHYTA	16.7	18.5	13.0	33.3	16.7	14.8	18.8	2.6
BACILLARIOPHYTA								
ACHNANTHES	1.9	1.9	3.7	0.0	7.4	5.6	3.4	0.5
COCCONEIS	0.0	0.0	0.0	0.0	0.0	1.9	0.3	0.0
CYCLOTELLA	35.2	42.6	66.6	62.9	51.8	37.0	49.3	6.8
CYMBELLA	1.9	13.0	7.4	11.1	0.0	0.0	5.6	0.8
GOMPHONEMA	0.0	0.0	1.9	3.7	0.0	3.7	1.5	0.2
MELOSIRA	0.0	0.0	0.0	0.0	0.0	3.7	0.6	0.1
MERIDION	1.9	0.0	0.0	0.0	0.0	0.0	0.3	0.0
NAVICULA	48.1	57.4	64.8	40.7	50.0	46.3	51.2	7.0
NITZSCHIA	81.4	140.6	125.8	101.8	99.9	75.9	104.2	14.4
RHOICOSPHENIA	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.0
STEPHANODISCUS	81.4	99.9	159.1	146.2	118.4	87.0	115.3	15.9
SYNEDRA	44.4	55.5	99.9	99.9	66.6	42.6	68.1	9.4
CYANOPHYTA								
CHROOCOCCUS	5.6	3.7	7.4	3.7	0.0	1.9	3.7	0.5
SCHIZOTHRIX	140.6	92.5	57.4	96.2	122.1	170.2	113.2	15.6
CHRYSOPHYTA								
MALLOMONAS	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.0
TOTAL	593.9	751.1	847.3	884.3	667.9	612.4	726.1	

Table B-7

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 20 August 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-053	AJG-84-054	AJG-84-055	AJG-84-056	AJG-84-057	AJG-84-058	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
PEDIASTRUM	0.0	0.0	0.0	0.0	0.8	0.0	0.1	0.9
SCENEDESMUS	0.0	0.8	0.0	0.0	0.0	0.0	0.1	0.9
UNIDENTIFIED CHLOROPHYTA	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.9
BACILLARIOPHYTA								
COCCONEIS	0.0	0.0	1.6	0.0	0.0	0.0	0.3	1.8
CYCLOTELLA	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.9
FRAGILARIA	0.0	0.0	0.0	0.0	0.0	2.4	0.4	2.7
GOMPHONEMA	3.2	0.0	0.8	0.8	0.8	1.6	1.2	8.1
GYROSIGMA	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.9
MELOSIRA	4.8	8.0	0.0	0.8	6.4	7.2	4.5	30.6
NAVICULA	0.0	3.2	3.2	4.8	4.8	4.0	3.3	22.5
NITZSCHIA	5.6	7.2	1.6	4.0	4.8	2.4	4.3	28.8
SYNEDRA	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.9
TOTAL	15.2	19.2	7.2	10.4	17.6	19.2	14.8	

Table B-8

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at Bell Bend on the Susquehanna River, 20 August 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-045	AJG-84-046	AJG-84-047	AJG-84-048	AJG-84-049	AJG-84-050	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
ANKISTRODESMUS	0.0	0.0	1.9	1.9	0.0	0.0	0.6	0.3
CLADOPHORA	0.0	0.0	0.0	0.0	1.9	0.0	0.3	0.2
COSMARIUM	0.0	0.0	0.0	0.0	9.3	0.0	1.5	0.8
CRUCIGENIA	7.4	0.0	0.0	0.0	0.0	0.0	1.2	0.6
KIRCHNERIELLA	0.0	0.0	0.0	0.0	1.9	0.0	0.3	0.2
PEDIASTRUM	0.0	0.0	1.9	0.0	0.0	1.9	0.6	0.3
SCENEDESMUS	0.0	7.4	0.0	1.9	5.6	0.0	2.5	1.2
STAURASTRUM	0.0	1.9	0.0	0.0	0.0	0.0	0.3	0.2
UNIDENTIFIED CHLOROPHYTA	9.3	0.0	3.7	0.0	5.6	0.0	3.1	1.6
BACILLARIOPHYTA								
ACHNANTHES	0.0	0.0	5.6	0.0	0.0	0.0	0.9	0.5
COCCONEIS	1.9	9.3	7.4	0.0	18.5	3.7	6.8	3.4
CYCLOTELLA	0.0	5.6	11.1	0.0	13.0	7.4	6.2	3.1
CYMBELLA	0.0	3.7	0.0	0.0	5.6	13.0	3.7	1.9
EUNOTIA	3.7	0.0	0.0	0.0	0.0	0.0	0.6	0.3
FRUSTULIA	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.2
GOMPHONEMA	5.6	33.3	20.4	0.0	38.9	18.5	19.4	9.8
GYROSIGMA	0.0	0.0	0.0	1.9	0.0	1.9	0.6	0.3
MELOSIRA	0.0	3.7	11.1	0.0	74.0	25.9	19.1	9.7
MERIDION	0.0	0.0	0.0	0.0	0.0	1.9	0.3	0.2
NAVICULA	37.0	18.5	33.3	11.1	118.4	25.9	40.7	20.6
NITZSCHIA	27.8	57.4	29.6	29.6	77.7	37.0	43.2	21.9
PINNULARIA	0.0	0.0	1.9	0.0	0.0	0.0	0.3	0.2
RHOICOSPHENIA	0.0	0.0	1.9	0.0	3.7	0.0	0.9	0.5
STEPHANODISCUS	0.0	0.0	1.9	1.9	1.9	0.0	0.9	0.5
SURIRELLA	0.0	0.0	0.0	1.9	0.0	0.0	0.3	0.2
SYNEDRA	0.0	0.0	0.0	0.0	1.9	1.9	0.6	0.3
CYANOPHYTA								
OSCILLATORIA	0.0	0.0	5.6	0.0	16.7	0.0	3.7	1.9
SCHIZOTHRIX	59.2	64.8	38.9	31.5	5.6	29.6	38.2	19.4
TOTAL	151.7	205.4	177.6	81.4	399.6	168.4	197.3	

Table B-9

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at SSES on the Susquehanna River, 15 October 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-096	AJG-84-097	AJG-84-098	AJG-84-099	AJG-84-100	AJG-84-101	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
ACTINASTRUM	0.0	0.0	0.0	6.3	0.0	0.0	1.1	0.0
ANKISTRODESMUS	50.7	26.8	0.0	114.1	126.8	31.7	58.4	1.6
CHLAMYDOMONAS	0.0	3.4	0.0	12.7	0.0	0.0	2.7	0.1
COELASTRUM	6.3	6.7	0.0	57.1	31.7	44.4	24.4	0.7
COSMARIUM	0.0	0.0	0.0	0.0	6.3	0.0	1.1	0.0
CRUCIGENIA	6.3	0.0	0.0	0.0	0.0	0.0	1.1	0.0
KIRCHNERIELLA	0.0	0.0	0.0	0.0	6.3	0.0	1.1	0.0
OOCYSTIS	0.0	6.7	0.0	12.7	0.0	6.3	4.3	0.1
PEDIASTRUM	0.0	3.4	6.3	0.0	0.0	0.0	1.6	0.0
SCENEDESMUS	196.5	73.7	298.0	259.9	475.5	221.9	254.3	6.9
SCHROEDERIA	0.0	3.4	0.0	0.0	0.0	0.0	0.6	0.0
STAURASTRUM	6.3	0.0	0.0	0.0	0.0	0.0	1.1	0.0
TETRASTRUM	12.7	3.4	0.0	12.7	0.0	0.0	4.8	0.1
UNIDENTIFIED CHLOROPHYTA	107.8	26.8	120.5	114.1	120.5	63.4	92.2	2.5
BACILLARIOPHYTA								
COCCONEIS	50.7	16.8	120.5	38.0	38.0	38.0	50.3	1.4
CYCLOTELLA	2637.4	472.4	1832.3	2028.8	2111.2	989.0	1678.5	45.4
CYMBELLA	12.7	3.4	12.7	12.7	25.4	12.7	13.2	0.4
DIATOMA	0.0	3.4	12.7	0.0	0.0	6.3	3.7	0.1
EPITHEMIA	0.0	0.0	0.0	6.3	0.0	0.0	1.1	0.0
GOMPHONEMA	50.7	20.1	63.4	19.0	50.7	38.0	40.3	1.1
GYROSIGMA	0.0	20.1	25.4	44.4	6.3	6.3	17.1	0.5
MELOSIRA	44.4	10.1	38.0	38.0	57.1	57.1	40.8	1.1
NAVICULA	361.4	174.2	456.5	767.1	374.1	323.3	409.4	11.1
NITZSCHIA	177.5	110.6	418.4	215.6	202.9	158.5	213.9	5.8
RHOICOSPHENIA	12.7	3.4	50.7	19.0	6.3	6.3	16.4	0.4
STEPHANODISCUS	456.5	80.4	317.0	348.7	355.0	164.8	287.1	7.8
SURIRELLA	0.0	0.0	0.0	6.3	0.0	0.0	1.1	0.0
SYNEDRA	0.0	0.0	0.0	0.0	6.3	6.3	2.1	0.1
THALASSIOSIRA	729.1	120.6	475.5	519.9	551.6	259.9	442.8	12.0
CYANOPHYTA								
CHROOCOCCUS	0.0	0.0	0.0	12.7	0.0	0.0	2.1	0.1
OSCILLATORIA	19.0	0.0	50.7	76.1	0.0	0.0	24.3	0.7
SCHIZOTHRIX	0.0	3.4	12.7	0.0	6.3	12.7	5.8	0.2
TOTAL	4938.9	1192.6	4311.2	4742.3	4558.5	2447.2	3698.3	

Table B-10

Density (units/mm^2) of periphytic algae on two acrylic plates submerged for 12 months at Bell Bend on the Susquehanna River, 15 October 1984.

ACRYLIC PLATE	1			2				
COLLECTION NO.	AJG-84-104	AJG-84-105	AJG-84-106	AJG-84-107	AJG-84-108	AJG-84-109	MEAN	% TOTAL
TAXON								
CHLOROPHYTA								
ANKISTRODESMUS	26.8	0.0	20.1	12.9	23.5	17.2	16.7	1.1
CHLAMYDOMONAS	0.0	3.4	6.7	4.3	3.4	0.0	3.0	0.2
COELASTRUM	0.0	0.0	0.0	0.0	10.1	8.6	3.1	0.2
COSMARIUM	0.0	0.0	0.0	4.3	0.0	0.0	0.7	0.0
CRUCIGENIA	0.0	6.7	13.4	0.0	0.0	8.6	4.8	0.3
KIRCHNERIELLA	0.0	0.0	6.7	0.0	6.7	0.0	2.2	0.1
OOCYSTIS	6.7	10.1	0.0	12.9	60.3	47.3	22.9	1.5
PEDIASTRUM	0.0	0.0	0.0	0.0	0.0	4.3	0.7	0.0
SCENEDESMUS	30.2	26.8	53.6	98.9	46.9	86.0	57.1	3.7
TETRASTRUM	3.4	0.0	0.0	0.0	0.0	4.3	1.3	0.1
UNIDENTIFIED CHLOROPHYTA	46.9	20.1	0.0	38.7	16.8	21.5	24.0	1.6
BACILLARIOPHYTA								
ACHNANTHES	0.0	0.0	0.0	51.6	83.8	4.3	23.3	1.5
AMPHORA	0.0	0.0	3.4	0.0	0.0	0.0	0.6	0.0
COCCONEIS	6.7	3.4	6.7	8.6	0.0	0.0	4.2	0.3
CYCLOTELLA	46.9	80.4	150.8	94.6	53.6	141.9	94.7	6.2
CYMBELLA	0.0	0.0	0.0	25.8	6.7	0.0	5.4	0.4
GOMPHONEMA	13.4	16.8	10.1	21.5	0.0	21.5	13.9	0.9
GYROSIGMA	20.1	10.1	13.4	8.6	3.4	8.6	10.7	0.7
MELOSIRA	0.0	0.0	0.0	0.0	10.1	0.0	1.7	0.1
NAVICULA	572.9	716.9	907.9	1449.1	603.0	1449.1	949.8	62.0
NITZSCHIA	67.0	77.1	174.2	180.6	150.8	232.2	147.0	9.6
RHOICOSPHENIA	0.0	0.0	0.0	0.0	0.0	4.3	0.7	0.0
STEPHANODISCUS	33.5	43.6	67.0	73.1	43.6	107.5	61.4	4.0
SYNEDRA	3.4	3.4	0.0	0.0	3.4	4.3	2.4	0.2
THALASSIOSIRA	6.7	13.4	26.8	21.5	6.7	25.8	16.8	1.1
CYANOPHYTA								
CHROOCOCCUS	0.0	0.0	6.7	0.0	0.0	0.0	1.1	0.1
OSCILLATORIA	16.8	0.0	0.0	4.3	0.0	0.0	3.5	0.2
SCHIZOTHRIX	87.1	40.2	50.3	64.5	80.4	25.8	58.0	3.8
TOTAL	988.3	1072.0	1517.6	2175.8	1212.7	2223.1	1531.6	

Table B-11

Species of periphytic algae composing 5% or more of the total units counted in at least one replicate sample from SSES or Bell Bend on the Susquehanna River, 1984; pH affinity as rated by Lowe (1974): 1 = alkaliphilous, 2 = acidophilous, 3 = indifferent, and 4 = unknown.

Species	pH Affinity	SSES	Bell Bend
CHLOROPHYTA			
Actinastrum hantzschii		Jun	Jun
Ankistrodesmus falcatus		Jun	Jun
Chlamydomonas sp.		Apr	
Micractinium pusillum		Jun	
Scenedesmus quadricauda		Jun, Oct	Jun
BACILLARIOPHYTA			
Achnanthes minutissima	(1,3)		Oct
Asterionella formosa	(1)	Apr	Apr
Cocconeis placentula	(1)	Aug	
Cyclotella atomus	(4)	Oct	Oct
C. pseudostelligera	(1,3)	Oct	Jun
Fragilaria crotonensis	(1)		Apr
F. vaucheriae	(1,2)	Apr	
Gomphonema angustatum	(1,4)	Apr	
G. olivaceum	(1)	Aug	
G. parvulum	(1,4)		Apr
Gomphonema sp.			Apr
Melosira granulata	(1)	Apr	
M. varians	(1)	Aug	Aug
Meridion circulare	(1)	Apr	
Navicula cryptocephala	(1)		Apr
N. gregaria	(4)		Aug
N. salinarum var. *intermedia*	(4)	Oct	Aug, Oct
N. symmetrica	(4)		Oct
N. viridula	(1,3)	Apr, Jun	Apr, Jun
Nitzschia acicularis	(1)	Jun	Jun
N. dissipata	(1)	Apr	Apr
N. palea	(1,3)	Aug	Aug, Oct
Pinnularia sp.		Apr	
Stephanodiscus invisitatus	(4)	Jun, Oct	Jun
Surirella ovata	(1)	Apr	Apr
Synedra acus	(1,4)	Apr	Apr
Synedra sp.		Jun	Jun
Thalassiosira pseudonana	(3)	Oct	
CYANOPHYTA			
Schizothrix calcicola			Jun, Aug, Oct
RHODOPHYTA			
Rhodochorton sp.		Apr	

Table B-12

Density (units/ml) of phytoplankton in bimonthly samples (indicated by date and collection number) at SSES on the Susquehanna River, 1984.

TAXON	16 APR AJG-84-001	15 JUN AJG-84-025	20 AUG AJG-84-051	15 OCT AJG-84-102	MEAN	% TOTAL
CHLOROPHYTA						
ACTINASTRUM	0	240	0	94	83.4	2.5
ANKISTRODESMUS	2	510	42	854	351.9	10.5
CHLAMYDOMONAS	2	20	22	1115	289.6	8.7
COELASTRUM	0	20	0	52	18.0	0.5
COSMARIUM	0	0	3	0	0.7	<0.1
CRUCIGENIA	2	0	3	21	6.3	0.2
DICTYOSPHAERIUM	0	430	6	156	148.0	4.4
GOLENKINIA	0	150	0	0	37.5	1.1
KIRCHNERIELLA	2	10	0	0	2.9	0.1
MICRACTINIUM	0	240	0	42	70.4	2.1
OOCYSTIS	0	60	6	10	19.0	0.6
POLYEDRIOPSIS	0	20	0	0	5.0	0.1
SCENEDESMUS	5	1060	142	1115	580.2	17.4
SCHROEDERIA	0	0	6	0	1.4	<0.1
SELENASTRUM	0	10	0	0	2.5	0.1
STAURASTRUM	0	0	0	83	20.8	0.6
TREUBARIA	0	790	0	0	197.5	5.9
UNIDENTIFIED CHLOROPHYTA	6	420	150	729	326.3	9.8
BACILLARIOPHYTA						
ACHNANTHES	6	0	19	0	6.4	0.2
AMPHORA	0	0	11	0	2.8	0.1
ASTERIONELLA	5	0	0	0	1.2	<0.1
COCCONEIS	0	0	42	0	10.4	0.3
CYCLOTELLA	5	60	103	917	271.0	8.1
CYMBELLA	25	0	0	0	6.2	0.2
FRAGILARIA	12	0	0	0	3.1	0.1
GOMPHONEMA	78	10	25	0	28.4	0.9
MELOSIRA	32	0	86	42	40.0	1.2
MERIDION	25	0	0	0	6.2	0.2
NAVICULA	23	0	117	73	53.2	1.6
NITZSCHIA	75	590	231	146	260.4	7.8
RHOICOSPHENIA	0	0	47	0	11.8	0.4
STEPHANODISCUS	18	460	86	104	167.2	5.0
SURIRELLA	2	0	3	0	1.1	<0.1
SYNEDRA	11	550	0	0	140.2	4.2
THALASSIOSIRA	0	0	0	73	18.2	0.5
CYANOPHYTA						
CHROOCOCCUS	0	30	3	458	122.8	3.7
MICROCYSTIS	0	60	0	0	15.0	0.4
OSCILLATORIA	0	0	6	0	1.4	<0.1
SCHIZOTHRIX	0	0	17	0	4.2	0.1
CHRYSOPHYTA						
DINOBYRON	0	0	3	0	0.7	<0.1
SYNURA	2	0	0	0	0.4	<0.1
RHODOPHYTA						
RHODOCHORTON	0	10	0	0	2.5	0.1
TOTAL	335	5750	1175	6084	3336.0	

Table B-13

Density (units/ml) of phytoplankton in bimonthly samples (indicated by date and collection number) at Bell Bend on the Susquehanna River, 1984.

TAXON	16 APR AJG-84-003	15 JUN AJG-84-017	20 AUG AJG-84-043	15 OCT AJG-84-094	MEAN	% TOTAL
CHLOROPHYTA						
ACTINASTRUM	0	280	3	21	75.9	2.1
ANKISTRODESMUS	3	900	25	792	429.9	11.9
CHLAMYDOMONAS	2	40	22	1281	336.3	9.3
COELASTRUM	0	10	0	0	2.5	0.1
CRUCIGENIA	0	0	11	0	2.8	0.1
DICTYOSPHAERIUM	0	550	6	73	157.1	4.4
GOLENKINIA	0	200	0	10	52.6	1.5
KIRCHNERIELLA	0	70	6	0	18.9	0.5
MICRACTINIUM	0	140	0	52	48.0	1.3
OOCYSTIS	0	60	0	0	15.0	0.4
PANDORINA	0	0	3	0	0.7	<0.1
POLYEDRIOPSIS	0	10	0	10	5.1	0.1
SCENEDESMUS	6	1140	128	938	552.9	15.4
SCHROEDERIA	0	20	0	0	5.0	0.1
SELENASTRUM	0	20	0	0	5.0	0.1
TETRAEDRON	0	20	0	0	5.0	0.1
TETRASTRUM	0	20	3	146	42.2	1.2
TREUBARIA	0	850	0	0	212.5	5.9
UNIDENTIFIED CHLOROPHYTA	3	640	83	760	371.7	10.3
BACILLARIOPHYTA						
ACHNANTHES	0	0	19	10	7.5	0.2
ASTERIONELLA	5	0	0	0	1.2	<0.1
COCCONEIS	0	0	81	0	20.1	0.6
CYCLOTELLA	2	100	175	792	267.1	7.4
CYMBELLA	17	0	8	0	6.3	0.2
DIATOMA	5	0	0	0	1.2	<0.1
FRAGILARIA	17	0	0	0	4.2	0.1
GOMPHONEMA	58	0	11	21	22.6	0.6
GYROSIGMA	0	0	3	0	0.7	<0.1
MELOSIRA	3	0	36	21	15.0	0.4
MERIDION	43	0	0	0	10.8	0.3
NAVICULA	45	0	100	31	44.0	1.2
NEIDIUM	0	0	3	0	0.7	<0.1
NITZSCHIA	88	700	272	63	280.6	7.8
RHOICOSPHENIA	0	0	31	0	7.6	0.2
STEPHANODISCUS	0	770	106	94	242.3	6.7
SURIRELLA	8	0	0	0	1.9	0.1
SYNEDRA	0	670	0	0	167.5	4.7
THALASSIOSIRA	0	0	0	52	13.0	0.4
CYANOPHYTA						
CHROOCOCCUS	0	70	0	354	106.0	2.9
MERISMOPEDIA	0	10	3	0	3.2	0.1
MICROCYSTIS	0	120	0	0	30.0	0.8
SCHIZOTHRIX	0	0	6	0	1.4	<0.1
CHRYSOPHYTA						
MALLOMONAS	0	10	0	0	2.5	0.1
EUGLENOPHYTA						
TRACHELOMONAS	2	0	6	0	1.8	<0.1
TOTAL	305	7420	1147	5521	3598.2	

Table B-14

Species of phytoplankton composing 5% or more of the total units counted in at least one sample from SSES or Bell Bend on the Susquehanna River, 1984; pH affinity as rated by Lowe (1974): 1 = alkaliphilous, 2 = acidophilous, 3 = indifferent to pH, and 4 = unknown.

Species	pH Affinity	SSES	Bell Bend
CHLOROPHYTA			
Ankistrodesmus falcatus		Jun, Oct	Jun, Oct
Chlaymdomonas sp.		Oct	Oct
Dictyosphaerium pulchellum		Jun	Jun
Scenedesmus quadricauda		Jun, Aug, Oct	Jun, Aug, Oct
Treubaria crassispina		Jun	Jun
BACILLARIOPHYTA			
Cocconeis placentula			Aug
Cyclotella atomus	(4)	Oct	Oct
C. meneghiniana	(1)	Aug	Aug
Gomphonema olivaceum	(1)	Apr	Apr
Meridion circulare	(1)	Apr	Apr
Navicula viridula	(1,3)		Apr
Nitzschia acicularis	(1)	Apr, Jun	Apr, Jun
N. palea	(1,3)	Aug	Aug
Stephanodiscus invisitatus	(4)	Jun, Aug	Jun, Aug
Synedra acus	(1,4)	Jun	Jun

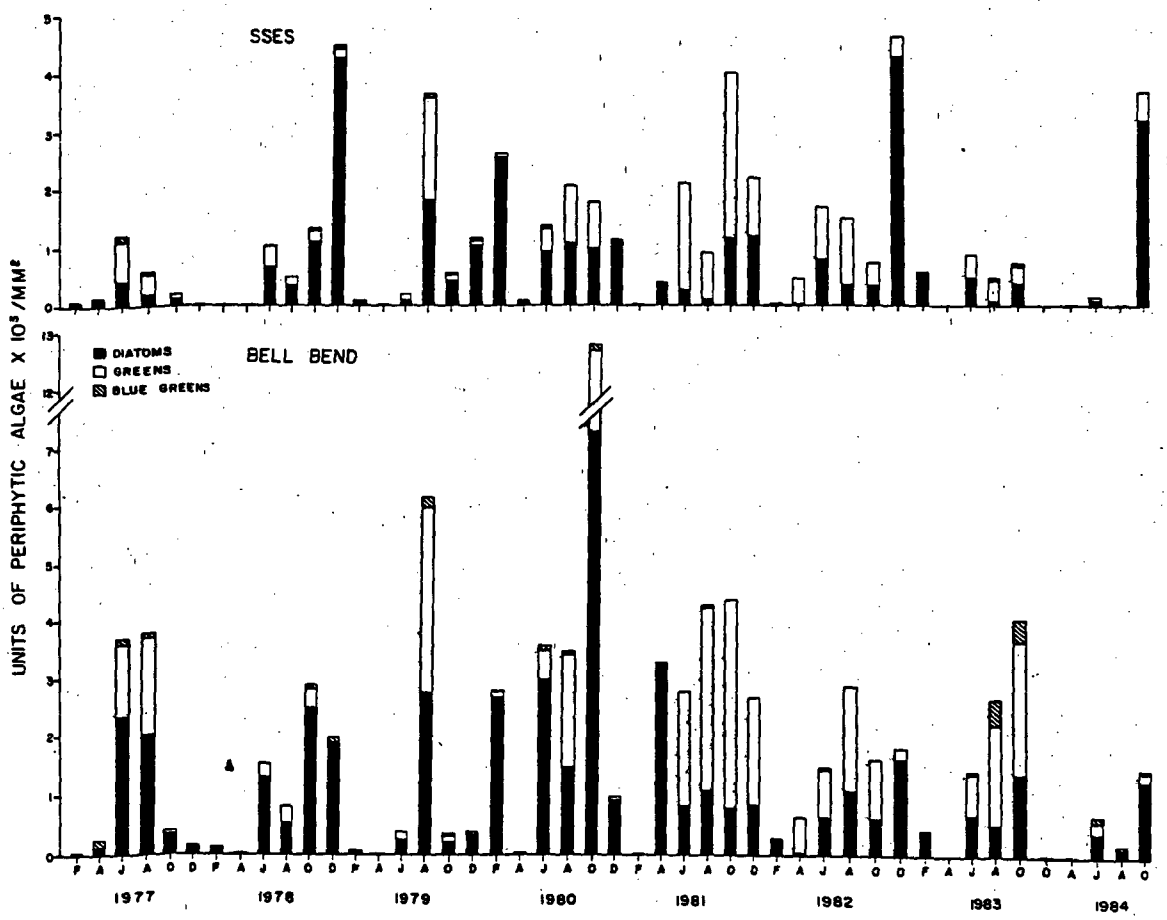

Fig. B-1

Standing crop of periphytic algae (units/mm^2) on cumulative acrylic plates at SSES and Bell Bend on the Susquehanna River, 1977-84.

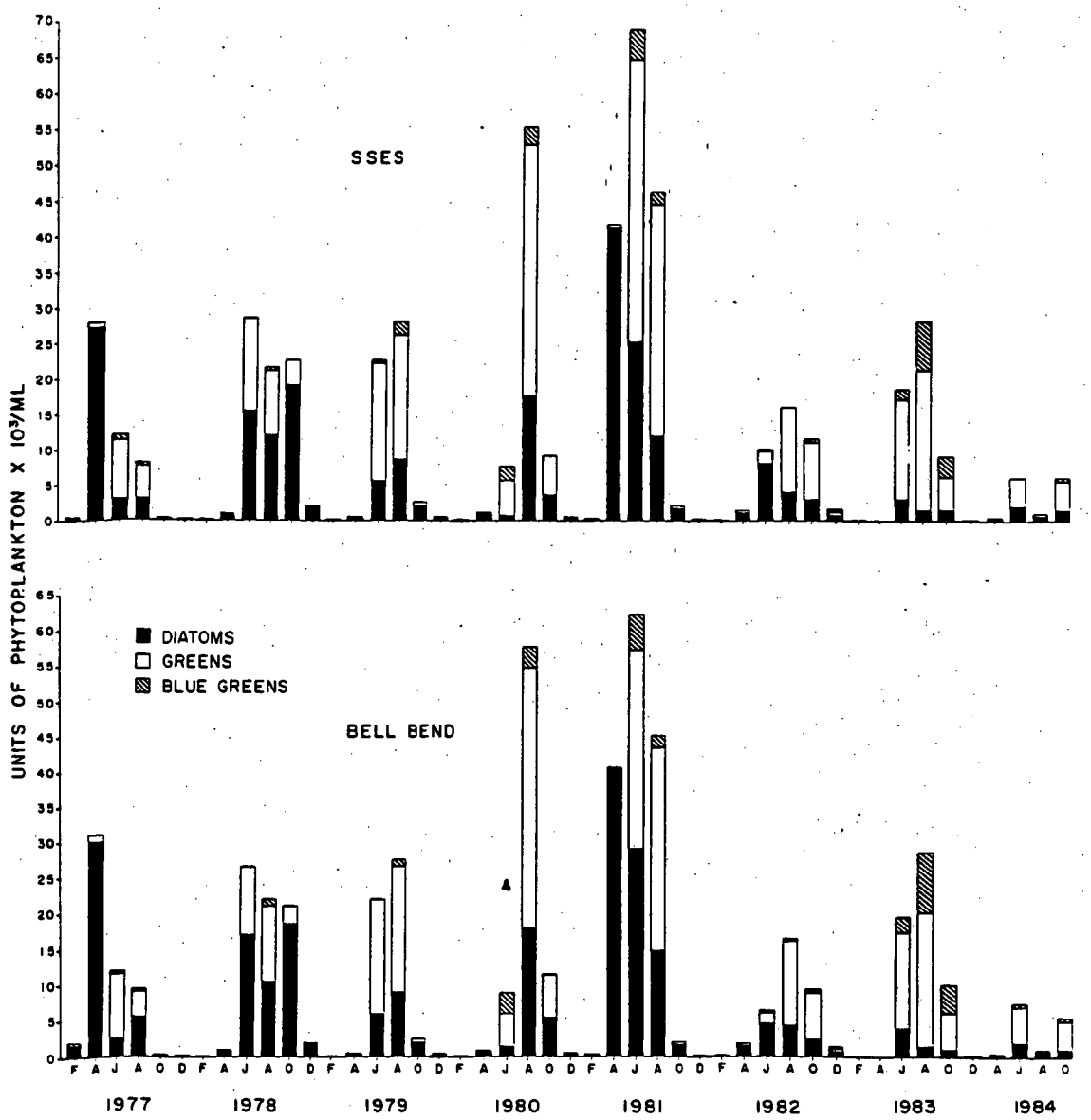

Fig. B-2

Standing crop of phytoplankton (units/ml) from bimonthly samples taken at SSES and Bell Bend on the Susquehanna River, 1977-84.

BENTHIC MACROINVERTEBRATES

by

Lynn S. Zelenak, William G. Deutsch, and William F. Gale

TABLE OF CONTENTS

Page

ABSTRACT..... 79

INTRODUCTION..... 79

PROCEDURES..... 80

RESULTS AND DISCUSSION
Density and Taxonomic Composition..... 82
Station Similarity..... 86
Biomass..... 86

REFERENCES CITED..... 88

LIST OF TABLES

Table

C-1 Description and location of benthic macroinvertebrate sampling sites on the Susquehanna River, 1984..... 92

C-2 Density (org/m^2) and percent total of major groups of benthic macroinvertebrates collected in four dome samples at each station on the Susquehanna River in June and October, 1984..... 93

C-3 Mean density of benthic macroinvertebrates (org/m^2) collected in dome samples at SSES and Bell Bend on the Susquehanna River in June and October, 1978-84..... 93

C-4 Mean density (org/m^2) and percent total of benthic macroinvertebrates collected in four dome samples at each site on the Susquehanna River, 1984..... 94

Table | Page
C-5 Density (org/m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 12 June 1984 96

C-6 Density . . . at SSES II . . . 11 June 1984 97

C-7 Density . . . at Bell Bend I . . . 13 June 1984 98

C-8 Density . . . at Bell Bend III . . . 13 June 1984 99

C-9 Density . . . at SSES I . . . 9 October 1984 100

C-10 Density . . . at SSES II . . . 8 October 1984 101

C-11 Density . . . at Bell Bend I . . . 10 October 1984 102

C-12 Density . . . at Bell Bend III . . . 11 October 1984 103

C-13 Benthic macroinvertebrates collected in dome samples at SSES (SS) and Bell Bend (BB) on the Susquehanna River, 1975-84 104

C-14 Dry weight (g/m^2) and percent total of major groups of benthic macroinvertebrates collected in two dome samples at each station on the Susquehanna River in June and October, 1984 107

C-15 Mean dry weight of benthic macroinvertebrates (g/m^2) collected with a dome sampler at SSES and Bell Bend on the Susquehanna River in June and October, 1978-84 107

C-16 Dry weight of benthic macroinvertebrates (mg/m^2) collected with a dome sampler at SSES I and II on the Susquehanna River in June and October, 1984 108

C-17 Dry . . . at Bell Bend I and III . . . June and October, 1984 108

LIST OF FIGURES

Fig.
C-1 Annual mean biomass (g/m^2) and density (org/m^2) of benthic macroinvertebrates at SSES and Bell Bend on the Susquehanna River, 1976-84 109

C-2 Annual mean density (org/m^2) of benthic macroinvertebrates at SSES and Bell Bend on the Susquehanna River, 1975-84 110

C-3 Dendrogram of the cluster analysis of Bray-Curtis similarity matrices for 1984 benthic macroinvertebrate data at SSES I (S1), SSES II (S2), Bell Bend I (B1), and Bell Bend III (B3) on the Susquehanna River in June and October, 1984 111

ABSTRACT

Benthic macroinvertebrates were sampled with a dome sampler at SSES (sites I and II) and Bell Bend (sites I and III) on the Susquehanna River on 11-13 June and 8-11 October 1984. Mean macroinvertebrate density (stations combined) was 27,400 organisms/m^2, similar to that found in 1981 and 1982, but 36% less than in 1983. Mean density at SSES (26,300 org/m^2) was less than at Bell Bend (28,600 org/m^2), for the first time since 1977. Mean density in June (stations combined) was 63% less than in June 1983, perhaps due to low mean river temperatures and high flows that occurred in May and early June. Chironomids composed 45% of the annual mean number of organisms collected; hydropsychids and heptageniids composed 27% and 9% of the total, respectively. Annual mean biomass (2.5 g/m^2) was slightly less than the mean of the previous six years. The Susquehanna SES had no detectable impact on the macroinvertebrate community downriver from the discharge diffuser.

INTRODUCTION

Density and biomass of benthic macroinvertebrates in the Susquehanna River near the Susquehanna SES were monitored since 1972 and 1975, respectively, to establish a baseline of preoperational conditions (Ichthyological Associates, Inc. 1973-74; Deutsch 1976a-b, 1977-78; Sabin et al. 1979; Sabin-Zelenak et al. 1980; Deutsch et al. 1981-82). Unit 1 of the Susquehanna SES became operational in September 1982. Data collected after that date were considered operational (Deutsch et al. 1983-84). The objective of the operational studies was to determine if the power plant had any impact on the macroinvertebrate community downriver from the discharge diffuser.

PROCEDURES

From 1978 through 1982, benthic macroinvertebrates were collected in April, June, and October at two stations (four sites) near the Susquehanna SES (Fig. A-1). Two sites (SSES I and II) are 850 m upriver from the intake structure, and two (Bell Bend I and III) are 710 m downriver from the discharge diffuser (Table C-1). Sampling schedule and sites in 1983 and 1984 were the same as those since 1978, except that samples were not collected in April 1983 and 1984 because of high river level.

In 1984, three samples were collected by a scuba diver at each site on 11-13 June and 8-11 October, using a dome suction sampler (Gale and Thompson 1975). After the sampler was lowered from a boat to the river substrate, a scuba diver moved it upriver to the first undisturbed area where an adequate seal between the sampler and the substrate could be established. The diver then vacuumed the substrate inside the sampler (0.163 m^2) for five minutes with a screened intake nozzle leading to the sampler's pump. Sediments (silt, sand, and fine gravel) and organisms were pumped into a nylon net (216-μ mesh). The diver carefully vacuumed large stones within the dome sampler and then discarded them.

One replicate from each site was used for biomass estimates. It was washed and sieved through a U.S. Standard No. 20 sieve (841-μ mesh). The biomass sample was refrigerated (or kept in ice water) until organisms were sorted. Processing was completed within 12 hours of collection. By chilling the sample, it was possible to avoid the use of preservatives which distort organism weight (Howmiller 1972, Wiederholm and Eriksson 1977). Before molluscs were weighed, their shells were decalcified in 1% HCl. Sorted

organisms were dried in aluminum foil containers at 100 C for at least 12 hours, then cooled to room temperature, and weighed on a Mettler H10W balance.

The other two replicates from each site were used for density estimates. Soon after collection, they were washed, sieved (U.S. Standard No. 60, 250-μ mesh), and preserved (10% buffered formalin) for storage. Later, the residue was placed in white pans for sorting. Readily visible specimens (except naidids and chironomids) were removed, identified, and counted.

Estimates of the number of naidids, chironomids, and other organisms left in the sample were obtained by counting organisms in a subsample of the total residue using a dissecting microscope (10-70X). Naidids and chironomids were counted from 1/23 of the residue; other organisms were counted from 1/4 of the residue. Both the 1/23 and 1/4 subsamples were a composite of three randomly selected portions of the total residue. The number of organisms found in the subsample was multiplied by the appropriate conversion factor (23 or 4) and then added to the total number of organisms previously sorted from pans. The number of organisms per square meter was determined by multiplying the number of organisms per sample by 6.1.

Invertebrates were identified (usually to genus or species) with the keys of Brown (1976), Edmunds et al. (1976), Resh (1976), Wiggins (1977), Lewis (1978), Merritt and Cummins (1978), Pennak (1978), Schuster and Etnier (1978), Hiltunen and Klemm (1980), Simpson and Bode (1980), Brigham et al. (1982), and Stimpson et al. (1982). Some naidids and chironomids had to be mounted on microscope slides and examined with a compound microscope (40-1000X) for identification; Mark J. Wetzel, Illinois Natural History Survey (naidids) and Dr. Robert W. Bode, New York State Department of Health (chironomids) verified identifications of some organisms.

Macroinvertebrate sample similarity was analyzed according to abundance and taxonomic composition using BASIC computer programs and a Hewlett-Packard 9830-A computer. Chance and Deutsch (1980) found that the Bray and Curtis index (1957) was the best of four similarity indexes for analysis of Susquehanna River macroinvertebrate samples. The Bray-Curtis index is as follows:

$$1 - \frac{\sum_{j=1}^{N} \left| X_{1j} - X_{2j} \right|}{\sum_{j=1}^{N} (X_{1j} + X_{2j})}$$

It was used to calculate a between-sample similarity matrix, where X_{1j} and X_{2j} represent the abundance of taxon j in samples 1 and 2, respectively, and N represents the total number of taxa. The similarity matrix was then subjected to a cluster analysis by a group-average sorting technique (Clifford and Stephenson 1975).

RESULTS AND DISCUSSION

Density and Taxonomic Composition

The mean macroinvertebrate density in June and October 1984 (stations combined) was 27,400 org/m^2 (Table C-2), similar to that found in 1981 (27,400 org/m^2) and 1982 (28,500 org/m^2) but 16% less than the mean density found from 1978 to 1983 (32,800 org/m^2; Table C-3). The 1984 density was 36% less than that collected in 1983 (42,600 org/m^2). Chironomids composed 45% of the total number of organisms collected in 1984; hydropsychid caddisflies and

heptageniid mayflies composed 27% and 9% of the total, respectively (Table C-4). Raw data are presented in Tables C-5 through C-12.

Mean density at SSES (26,300 org/m^2) was less than at Bell Bend (28,600 org/m^2) for the first time since 1977 (Fig. C-1). At SSES, the total number of organisms was composed primarily of hydropsychids (39%) and chironomids (34%; Fig. C-2). At Bell Bend, 54% of the total organisms was composed of chironomids; hydropsychids and heptageniids composed 16% and 10% of the total, respectively.

A listing of the macroinvertebrates collected in dome samples since 1975 is in Table C-13. Six taxa were found or identified for the first time in 1984. Changes in nomenclature of several taxa were also made this year. In Deutsch et al. (1981), the subgenus *Symphitopsyche* was elevated to generic status in accordance with Schuster and Etnier (1978). Many biologists believe that this elevation was premature (Patricia W. Schefter, Royal Ontario Museum, personal communication, 8 March 1985). Therefore, *Symphitopsyche* was redesignated as *Hydropsyche*. *Macronema*, another hydropsychid, has been reclassified as *Macrostemum* (Flint and Bueno-Soria 1982). The chironomid genus *Eukiefferiella* has been divided; *E. bavarica* gr. and *E. discoloripes* gr. now belong to the genus *Tvetenia* (Bode 1983).

June

Mean macroinvertebrate density in June (12,200 org/m^2) was 63% less than in June 1983 (33,000 org/m^2; Table C-3). One of the factors responsible for this may have been low river temperatures in the spring of 1984. Mean river temperature for the 30-day period preceding June sampling (15 May-13 June) was

16.0 C, the lowest mean in the past ten years. From 1975 to 1983, the mean river temperature for this period was 19.7 C (range = 18.2 to 22.3 C). High flows which occurred in late May may have caused catostrophic drift of macroinvertebrates, lowering benthic density.

Chironomids were the most abundant macroinvertebrates, composing 62% of the total number collected at both stations combined (Table C-2). *Rheotanytarsus* spp. was the most numerous chironomid at all sites (17% of total macroinvertebrate density). *Microtendipes* sp. and *Tanytarsus* spp. each composed 10% (1,200 org/m^2) of the total density. An additional 21% of the total number of macroinvertebrates was composed of heptageniids (1,100 org/m^2), naidids (900 org/m^2), and tubificids (600 org/m^2). In 1983, hydropsychids composed 7% of the June total; in 1984, they composed less than 1% at each station.

At SSES, mean June density (5,800 org/m^2) was less than 20% of the mean density of the previous six years (30,100 org/m^2; Table C-3). Chironomids composed 52% of the total density; *Rheotanytarsus* spp. (1,100 org/m^2) and *Cricotopus* spp. (500 org/m^2) were the most abundant genera. Naidids (primarily *Nais behningi* and *Piguetiella michiganensis*) composed 11% of the total. Mean hydropsychid density was only 37 org/m^2, much lower than in previous years. In 1983, for example, mean hydropsychid density was 3,600 org/m^2. Both Rhame and Stewart (1976) and Deutsch (1984) found that river temperatures of 15-17 C initiated emergence of hydropsychid adults. Low mean river temperatures in the spring of 1984 probably delayed emergence, thereby reducing oviposition and subsequent larval density. The large number of hydropsychids collected in October dome samples, however, revealed that the delay was short-term.

At Bell Bend, density in June (18,700 org/m^2) was only slightly less than the mean for the previous six years (19,800 org/m^2; Table C-3). Chironomids composed 65% of the June density; *Rheotanytarsus* spp. (3,000 org/m^2), *Microtendipes* sp. (2,200 org/m^2), and *Tanytarsus* spp. (2,100 org/m^2) were the most abundant types. As in 1982 and 1983, *Microtendipes* sp. was more abundant at site III (2,800 org/m^2) than at site I (1,600 org/m^2). Heptageniids and naidids (primarily *N. behningi* and *N. communis*) composed 9% and 6% of the total, respectively.

October

In October, mean macroinvertebrate density (42,600 org/m^2) was over 3-fold greater than in June (Table C-2), but was less than in October 1983 (52,200 org/m^2). It was slightly greater than the 1978-83 mean (40,600 org/m^2; Table C-3). Chironomids (16,900 org/m^2) and hydropsychids (14,700 org/m^2) composed almost 75% of the total number of macroinvertebrates. *Rheotanytarsus* spp. (5,900 org/m^2), *Thienemannimyia* gr. (5,500 org/m^2), and *Microtendipes* sp. (2,900 org/m^2) composed almost 75% of the chironomids; *Cheumatopsyche* spp. composed 95% of the hydropsychids.

At SSES, mean density (46,800 org/m^2) in October was 16% less than the mean of the previous six years (55,900 org/m^2; Table C-3). Hydropsychids (20,300 org/m^2) and chironomids (14,800 org/m^2) composed 75% of the total. *Rheotanytarsus* spp. (8,500 org/m^2), *Cricotopus* spp. (2,500 org/m^2), and *Thienemannimyia* gr. (2,200 org/m^2) were the most abundant chironomids. Heptageniids composed 9% of the total density.

At Bell Bend, mean October density (38,400 org/m^2) was 52% greater than the mean of the previous six years (25,300 org/m^2; Table C-3). Chironomids composed 50% of the total density; *Microtendipes* sp. (5,400 org/m^2), *Thienemannimyia* gr. (4,700 org/m^2), and *Rheotanytarsus* spp. (3,800 org/m^2) were most abundant. Hydropsychids (9,000 org/m^2) and heptageniids (4,100 org/m^2) composed 23% and 11% of the total, respectively.

Station Similarity

In the cluster analysis, samples were grouped by season before they were grouped by station or site (Fig. C-3), indicating that seasonal differences in the macroinvertebrate community were more important than station and site differences. As in 1982 and 1983 (Deutsch et al. 1983-84), the October samples were more distinctly grouped by station and site than were those in June, meaning that there was less variability in October replicates. Since 1979, the cluster analysis usually segregated SSES samples from those at Bell Bend within a sampling period, suggesting that macroinvertebrate communities at the two stations were seasonally distinct.

Biomass

The mean macroinvertebrate biomass in June and October 1984 (2.5 g/m^2; Table C-14) was slightly less than the mean of the previous six years (2.8 g/m^2; Table C-15). Trichopterans (especially *Cheumatopsyche* spp.) and ephemeropterans (mainly *Potamanthus* sp. and heptageniids) composed 61% and 28%, respectively, of the 1984 mean biomass (Table C-14). Raw data are presented in Tables C-16 and C-17.

Biomass in June 1984 averaged 0.8 g/m^2 (Table C-14). Organism weight at SSES (1.0 g/m^2) was twice that at Bell Bend (0.5 g/m^2). Ephemeropterans made up 63% (0.6 g/m^2) and 86% (0.5 g/m^2) of total weight at SSES and Bell Bend, respectively. Oligochaetes and trichopterans composed 33% of the biomass at SSES; oligochaetes and dipterans made up 8% at Bell Bend.

Biomass of macroinvertebrates in October (4.1 g/m^2) was more than 5-fold greater than in June (Table C-14). Weight of organisms at SSES (5.5 g/m^2) was almost twice that at Bell Bend (2.8 g/m^2). Trichopterans and ephemeropterans composed more than 90% of the biomass at both stations.

Biomass at SSES in 1984 averaged 3.2 g/m^2 (Table C-14); trichopterans (2.1 g/m^2) and ephemeropterans (0.8 g/m^2) composed almost 90% of the total. Biomass at Bell Bend in 1984 was 1.7 g/m^2, and has remained relatively stable during the past seven years (Fig. C-1). As at SSES, trichopterans (0.9 g/m^2) and ephemeropterans (0.6 g/m^2) composed most of the biomass. However, at Bell Bend, the mean weight of trichopterans was less than half that at SSES. Since 1978 annual mean biomass at SSES has been between 2- and 5-fold greater than at Bell Bend. Differences in macroinvertebrate biomass at the two stations were largely attributed to differences in substrate and river current. For example, SSES is located in a riffle area which is more suitable than Bell Bend for rheophilic organisms, such as hydropsychids.

Macroinvertebrate density and biomass steadily increased at both stations between 1977 and 1980 (Fig. C-1). This followed a six-year period of significant ($P<0.05$) improvement in Susquehanna River water quality (Soya and Jacobsen 1979). In particular, there was a decrease in acid mine drainage, which was found to suppress the macroinvertebrate community in the study area

(Deutsch 1981). Since 1978, no significant trends in water quality improvement have been observed at either SSES or Bell Bend (see Physico-chemical Analyses). Macroinvertebrate density and biomass at both stations also seem to have stabilized since 1980 (Fig. C-1). The Susquehanna SES has had no detectable impact on the macroinvertebrate community downriver from the discharge diffuser.

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Table C-1

Description and location of benthic macroinvertebrate sampling sites on the Susquehanna River, 1984.

Station	SSES		BELL BEND	
Site	I	II	I	III
Depth[a]	0.6	1.0	1.3	1.3
Substrate Type[b]	gravel-pebble	pebble-cobble	gravel-pebble with boulders[c]	gravel-pebble with boulders[c]
Location	850 m upriver from the center of the intake structure; 30 m from the west bank	850 m upriver from the center of the intake structure; 100 m from the west bank	710 m downriver from the center of the discharge diffuser; 40 m from the west bank	710 m downriver from the center of the discharge diffuser; 70 m from the west bank

[a]Site depth (m) when river surface elevation is 148.6 m above mean sea level (river discharge about 120 m^3/s) at the Susquehanna SES Biological Laboratory.

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

[c]There tended to be accumulations of fine sediments downstream from boulders.

Table C-2

Density (org/m²) and percent total of major groups of benthic macroinvertebrates collected in four dome samples at each station on the Susquehanna River in June and October, 1984.

SITE TAXA	JUN ORG/M²	JUN % TOTAL	OCT ORG/M²	OCT % TOTAL	MEAN ORG/M²	MEAN % TOTAL
SSES						
OLIGOCHAETA	1139.5	19.7	1450.9	3.1	1295.2	4.9
EPHEMEROPTERA	1059.8	18.3	6622.3	14.2	3841.0	14.6
HYDROPSYCHIDAE	36.8	0.6	20340.3	43.5	10188.6	38.8
CHIRONOMIDAE	3010.7	52.0	14772.6	31.6	8891.6	33.8
OTHER	544.4	9.4	3570.1	7.6	2057.3	7.8
TOTAL	5791.4		46757.7		26274.5	
BELL BEND						
OLIGOCHAETA	1935.6	10.4	1343.5	3.5	1639.5	5.7
EPHEMEROPTERA	3453.8	18.5	5829.5	15.2	4641.6	16.3
HYDROPSYCHIDAE	96.6	0.5	9003.0	23.4	4549.8	15.9
CHIRONOMIDAE	12067.0	64.7	19004.1	49.5	15535.6	54.4
OTHER	1111.9	6.0	3255.9	8.5	2183.9	7.7
TOTAL	18665.6		38437.1		28551.4	
COMBINED						
OLIGOCHAETA	1537.5	12.6	1397.2	3.3	1467.4	5.4
EPHEMEROPTERA	2256.7	18.5	6225.8	14.6	4241.2	15.5
HYDROPSYCHIDAE	66.7	0.5	14671.3	34.5	7369.0	26.9
CHIRONOMIDAE	7538.8	61.7	16887.3	39.7	12213.1	44.6
OTHER	828.2	6.8	3412.6	8.0	2120.4	7.7
TOTAL	12228.5		42597.4		27413.0	

Table C-3

Mean density of benthic macroinvertebrates (org/m²) collected in dome samples at SSES and Bell Bend on the Susquehanna River in June and October, 1978-84.

YEAR	JUN SSES	JUN BELL BEND	JUN COMBINED	OCT SSES	OCT BELL BEND	OCT COMBINED	MEAN
1978	16131	9459	12795	40473	15465	27969	20382
1979	22968	17241	20104	67546	35647	51596	35850
1980	54359	36037	45198	58593	18629	38611	41905
1981	36080	12199	24139	41377	20129	30753	27446
1982	18084	10897	14490	60251	24655	42453	28472
1983	33089	32979	33034	66919	37436	52177	42605
MEAN (1978-83)	30118	19802	24960	55860	25327	40593	32777
1984	5791	18666	12228	46758	38437	42597	27413

Table C-4

Mean density (org/m²) and percent total of benthic macroinvertebrates collected in four dome samples at each site on the Susquehanna River, 1984.

STATION	SSES		PERCENT	BELL BEND		PERC
SITE	I	II	TOTAL	I	III	TOT
TAXON						
HYDRA SP.	6	0	<0.1	0	0	0.
ALLOEOCOELA	9	21	<0.1	17	8	<0.
TRICLADIDA	8	5	<0.1	8	8	<0.
PROSTOMA SP.	44	51	0.2	81	34	0.
NEMATODA	179	345	1.0	709	319	1.
NAIDIDAE	0	0	0.0	35	107	0.
NAIS SPP.	0	0	0.0	106	35	0.
NAIS BEHNINGI	396	1113	2.9	540	468	1.
NAIS COMMUNIS	35	0	<0.1	107	359	0.
PIGUETIELLA MICHIGANENSIS	0	110	0.2	0	0	0.
TUBIFICIDAE	385	495	1.7	753	732	2.
BOTHRIONEURUM VEJDOVSKYANUM	2	0	<0.1	0	2	<0.
ISOCHAETIDES FREYI	2	0	<0.1	0	0	0.
LIMNODRILUS HOFFMEISTERI	2	2	<0.1	0	6	<0.
QUISTADRILUS MULTISETOSUS	2	0	<0.1	2	6	<0.
LUMBRICULIDAE	34	11	<0.1	5	17	<0.
STYLODRILUS HERINGIANUS	3	0	<0.1	0	0	0.
GLOSSIPHONIIDAE	0	2	<0.1	3	0	<0.
ASELLIDAE	0	0	0.0	6	0	<0.
AMPHIPODA	0	0	0.0	0	6	<0.
GAMMARIDAE	2	0	<0.1	0	0	0.
CRANGONYX SP.	0	0	0.0	2	0	<0.
PLECOPTERA	20	0	<0.1	35	0	<0.
NEMOURIDAE	2	0	<0.1	0	0	0.
LEUCTRA SP.	0	0	0.0	3	0	<0.
PERLIDAE	67	17	0.2	9	8	<0.
ACRONEURIA SPP.	5	2	<0.1	2	21	<0.
NEOPERLA SP.	2	0	<0.1	0	0	0.
PHASGANOPHORA SP.	26	31	0.1	0	5	<0.
PERLESTA SP.	2	0	<0.1	0	0	0.
EPHEMEROPTERA	2	0	<0.1	0	0	0.
EPHORON SP.	144	103	0.5	212	482	1.
POTAMANTHUS SPP.	1267	916	4.2	807	1104	3.
CAENIS SP.	130	74	0.4	400	304	1.
EPHEMERELLIDAE	6	6	<0.1	25	0	<0.
DRUNELLA WALKERI	8	0	<0.1	2	6	<0.
EPHEMERELLA SPP.	0	0	0.0	0	2	<0.
EPHEMERELLA INVARIA	3	0	<0.1	0	0	0.
SERRATELLA DEFICIENS	11	12	<0.1	5	0	<0.
BAETIDAE	52	2	0.1	6	2	<0.
BAETIS SP.	14	2	<0.1	0	0	0.
ISONYCHIA SP.	328	55	0.7	78	61	0.
HEPTAGENIIDAE	1210	541	3.3	1038	1287	4.
HEPTAGENIA SPP.	97	90	0.4	233	179	0.
RHITHROGENA SP.	9	0	<0.1	0	0	0.
STENACRON SPP.	0	11	<0.1	58	31	0.
STENACRON INTERPUNCTATUM	41	23	0.1	9	2	<0.
STENONEMA SPP.	48	6	0.1	14	6	<0.
STENONEMA ITHACA	29	14	<0.1	3	20	<0.
STENONEMA PULCHELLUM	1416	730	4.1	787	1675	4.
STENONEMA TERMINATUM	221	58	0.5	150	296	0.
STENONEMA VICARIUM	5	0	<0.1	2	0	<0.
GOMPHIDAE	0	0	0.0	3	0	<0.
COENAGRIONIDAE	15	8	<0.1	5	3	<0.
SIALIS SP.	8	2	<0.1	9	17	<0.
CORYDALUS SP.	5	0	<0.1	0	0	0.
GLOSSOSOMATIDAE	3	0	<0.1	0	0	0.
CHIMARRA SP.	72	0	0.1	2	0	<0.
POLYCENTROPODIDAE	0	0	0.0	6	6	<0.
NEURECLIPSIS SP.	233	15	0.5	57	18	0.
POLYCENTROPUS SP.	0	2	<0.1	2	0	<0.
HYDROPSYCHIDAE (PUPAE)	0	2	<0.1	0	2	<0.
CHEUMATOPSYCHE SPP.	11305	7778	36.3	2479	6419	15.
CHEUMATOPSYCHE SPP.(PUPAE)	0	2	<0.1	2	0	<0.
HYDROPSYCHE SPP.	20	5	<0.1	2	0	<0.
HYDROPSYCHE SPP.(PUPAE)	0	2	<0.1	17	0	<0.
HYDROPSYCHE BIFIDA GR.	15	5	<0.1	0	0	0.
HYDROPSYCHE MOROSA	52	9	0.1	0	2	<0.
HYDROPSYCHE PHALERATA	675	486	2.2	49	130	0.
MACROSTEMUM SPP.	12	9	<0.1	0	0	0.
MACROSTEMUM SPP.(PUPAE)	0	2	<0.1	0	0	0.
HYDROPTILA SPP.	0	0	0.0	0	6	<0.

Table C-4 (cont.)

STATION	SSES		PERCENT	BELL BEND		PERCENT
SITE	I	II	TOTAL	I	III	TOTAL
TAXON						
LEPTOCERIDAE	2	14	<0.1	18	34	<0.1
CERACLEA SPP.	8	11	<0.1	46	23	0.1
CERACLEA ANCYLUS	0	3	<0.1	2	0	<0.1
CERACLEA MENTIEA	0	8	<0.1	2	0	<0.1
MYSTACIDES SPP.	0	0	0.0	6	6	<0.1
NECTOPSYCHE SP.	123	256	0.7	281	414	1.2
OECETIS SPP.	14	40	0.1	60	58	0.2
OECETIS AVARA	29	15	<0.1	25	12	<0.1
OECETIS CINERASCENS	2	6	<0.1	55	71	0.2
LEPIDOSTOMA SP.	0	0	0.0	0	3	<0.1
BEROSUS SP.	2	0	<0.1	0	0	0.0
PSEPHENUS SP.	8	0	<0.1	0	0	0.0
DUBIRAPHIA SP.	8	5	<0.1	9	2	<0.1
OPTIOSERVUS SP.	28	15	<0.1	6	14	<0.1
STENELMIS SP.	673	592	2.4	434	566	1.8
STENELMIS SP.(ADULTS)	26	11	<0.1	2	3	<0.1
TIPULIDAE	0	2	<0.1	0	0	0.0
SIMULIIDAE	9	6	<0.1	0	0	0.0
HEMERODROMIA SP.	482	163	1.2	80	140	0.4
CERATOPOGONIDAE	15	0	<0.1	55	21	0.1
CHIRONOMIDAE	0	35	<0.1	0	0	0.0
CHIRONOMIDAE (PUPAE)	143	216	0.7	216	396	1.1
TANYPODINAE	0	0	0.0	35	71	0.2
ABLABESMYIA SPP.	0	0	0.0	35	35	0.1
ABLABESMYIA MALLOCHI	143	107	0.5	143	360	0.9
NILOTANYPUS SP.	35	0	<0.1	0	35	<0.1
PROCLADIUS SP.	0	35	<0.1	0	0	0.0
THIENEMANNIMYIA GR.	719	1546	4.3	2121	3018	9.0
CHIRONOMINAE	0	0	0.0	0	35	<0.1
CHIRONOMUS SPP.	0	0	0.0	468	0	0.8
CRYPTOCHIRONOMUS SPP.	0	0	0.0	1115	179	2.3
DICROTENDIPES SPP.	0	35	<0.1	647	143	1.4
DICROTENDIPES NEOMODESTUS	0	0	0.0	35	0	<0.1
ENDOCHIRONOMUS SPP.	0	0	0.0	107	35	0.2
GLYPTOTENDIPES SP.	0	0	0.0	215	143	0.6
MICROTENDIPES SP.	143	431	1.1	4745	2876	13.3
PARACHIRONOMUS ABORTIVUS	35	0	<0.1	0	35	<0.1
POLYPEDILUM CONVICTUM	35	107	0.3	178	178	0.6
POLYPEDILUM NR. SCALAENUM	0	72	0.1	216	35	0.4
RHEOTANYTARSUS SPP.	4926	4710	18.3	2121	4747	12.0
STENOCHIRONOMUS SP.	0	35	<0.1	0	0	0.0
TANYTARSUS SPP.	71	143	0.4	755	1546	4.0
ZAVRELIA GR.	35	0	<0.1	575	791	2.4
SYMPOTTHASTIA SP.	0	0	0.0	35	0	<0.1
ORTHOCLADIINAE	0	0	0.0	71	35	0.2
CORYNONEURA SPP.	35	107	0.3	0	215	0.4
CRICOTOPUS SPP.	971	1115	4.0	466	683	2.0
CRICOTOPUS BICINCTUS	466	468	1.8	179	179	0.6
EUKIEFFERIELLA SPP.	216	0	0.4	0	0	0.0
EUKIEFFERIELLA COERULESCENS GR.	72	0	0.1	0	0	0.0
NANOCLADIUS SPP.	0	107	0.2	322	429	1.3
THIENEMANNIELLA SPP.	0	35	<0.1	35	0	<0.1
TVETENIA DISCOLORIPES GR.	324	107	0.8	35	0	<0.1
HELISOMA SP.	0	0	0.0	2	0	<0.1
FERRISSIA SP.	23	58	0.2	17	40	<0.1
PISIDIUM SP.	20	12	<0.1	60	40	0.2
SPHAERIUM SPP.	73	152	0.4	190	158	0.6

Table C-5

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 12 June 1984. Replicates are indicated by collection number.

TAXON	LSZ-84-002	LSZ-84-003	MEAN	PERCENT TOTAL
NEMATODA	73.6	104.3	89.0	1.4
NAIS BEHNINGI	141.1	288.3	214.7	3.5
NAIS COMMUNIS	141.1	0.0	70.6	1.1
TUBIFICIDAE	730.1	368.1	549.1	8.9
BOTHRIONEURUM VEJDOVSKYANUM	6.1	0.0	3.1	<0.1
ISOCHAETIDES FREYI	6.1	0.0	3.1	<0.1
LIMNODRILUS HOFFMEISTERI	0.0	6.1	3.1	<0.1
QUISTADRILUS MULTISETOSUS	6.1	0.0	3.1	<0.1
LUMBRICULIDAE	85.9	49.1	67.5	1.1
STYLODRILUS HERINGIANUS	6.1	0.0	3.1	<0.1
GAMMARIDAE	6.1	0.0	3.1	<0.1
PLECOPTERA	24.5	0.0	12.3	0.2
NEMOURIDAE	0.0	6.1	3.1	<0.1
PERLIDAE	24.5	0.0	12.3	0.2
ACRONEURIA SPP.	12.3	0.0	6.1	0.1
NEOPERLA SP.	6.1	0.0	3.1	<0.1
EPHEMEROPTERA	0.0	6.1	3.1	<0.1
EPHORON SP.	331.3	245.4	288.3	4.7
POTAMANTHUS SPP.	269.9	153.4	211.7	3.4
CAENIS SP.	227.0	79.8	153.4	2.5
DRUNELLA WALKERI	12.3	18.4	15.3	0.2
EPHEMERELLA INVARIA	12.3	0.0	6.1	0.1
SERRATELLA DEFICIENS	24.5	0.0	12.3	0.2
BAETIDAE	110.4	24.5	67.5	1.1
BAETIS SP.	55.2	0.0	27.6	0.4
ISONYCHIA SP.	92.0	0.0	46.0	0.7
HEPTAGENIIDAE	478.5	85.9	282.2	4.6
HEPTAGENIA SPP.	282.2	85.9	184.0	3.0
RHITHROGENA SP.	24.5	6.1	15.3	0.2
STENACRON INTERPUNCTATUM	6.1	0.0	3.1	<0.1
SIALIS SP.	24.5	0.0	12.3	0.2
CHEUMATOPSYCHE SPP.	6.1	79.8	42.9	0.7
CERACLEA SPP.	6.1	0.0	3.1	<0.1
OECETIS SPP.	24.5	0.0	12.3	0.2
BEROSUS SP.	6.1	0.0	3.1	<0.1
PSEPHENUS SP.	30.7	0.0	15.3	0.2
OPTIOSERVUS SP.	6.1	12.3	9.2	0.1
STENELMIS SP.	454.0	184.0	319.0	5.2
STENELMIS SP.(ADULTS)	6.1	0.0	3.1	<0.1
HEMERODROMIA SP.	0.0	30.7	15.3	0.2
CERATOPOGONIDAE	6.1	0.0	3.1	<0.1
CHIRONOMIDAE (PUPAE)	141.1	288.3	214.7	3.5
ABLABESMYIA MALLOCHI	429.4	141.1	285.3	4.6
NILOTANYPUS SP.	141.1	0.0	70.6	1.1
MICROTENDIPES SP.	141.1	0.0	70.6	1.1
RHEOTANYTARSUS SPP.	1582.8	1582.8	1582.8	25.6
TANYTARSUS SPP.	141.1	141.1	141.1	2.3
ZAVRELIA GR.	141.1	0.0	70.6	1.1
CORYNONEURA SPP.	141.1	0.0	70.6	1.1
CRICOTOPUS SPP.	0.0	717.8	358.9	5.8
CRICOTOPUS BICINCTUS	288.3	0.0	144.2	2.3
EUKIEFFERIELLA COERULESCENS GR.	0.0	288.3	144.2	2.3
TVETENIA DISCOLORIPES GR.	141.1	288.3	214.7	3.5
PISIDIUM SP.	24.5	0.0	12.3	0.2
SPHAERIUM SPP.	0.0	6.1	3.1	<0.1
TOTAL	7079.5	5288.2	6183.8	

Table C-6

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 11 June 1984. Replicates are indicated by collection number.

TAXON	LSZ-84-005	LSZ-84-006	MEAN	PERCENT TOTAL
NEMATODA	165.6	55.2	110.4	2.0
NAIS BEHNINGI	1435.6	141.1	783.3	14.6
PIGUETIELLA MICHIGANENSIS	300.6	141.1	220.9	4.1
TUBIFICIDAE	447.9	220.9	334.4	6.2
LIMNODRILUS HOFFMEISTERI	6.1	0.0	3.1	0.1
LUMBRICULIDAE	30.7	0.0	15.3	0.3
PERLIDAE	24.5	0.0	12.3	0.2
ACRONEURIA SPP.	6.1	0.0	3.1	0.1
EPHORON SP.	171.8	239.3	205.5	3.8
POTAMANTHUS SPP.	171.8	30.7	101.2	1.9
CAENIS SP.	135.0	0.0	67.5	1.3
SERRATELLA DEFICIENS	24.5	0.0	12.3	0.2
BAETIS SP.	6.1	0.0	3.1	0.1
HEPTAGENIIDAE	312.9	85.9	199.4	3.7
HEPTAGENIA SPP.	312.9	42.9	177.9	3.3
STENACRON INTERPUNCTATUM	24.5	12.3	18.4	0.3
STENONEMA SPP.	24.5	0.0	12.3	0.2
STENONEMA ITHACA	12.3	0.0	6.1	0.1
NEUROCLIPSIS SP.	6.1	0.0	3.1	0.1
POLYCENTROPUS SP.	6.1	0.0	3.1	0.1
HYDROPSYCHIDAE (PUPAE)	6.1	0.0	3.1	0.1
CHEUMATOPSYCHE SPP.	12.3	0.0	6.1	0.1
CHEUMATOPSYCHE SPP.(PUPAE)	0.0	6.1	3.1	0.1
HYDROPSYCHE SPP.(PUPAE)	6.1	0.0	3.1	0.1
HYDROPSYCHE PHALERATA	0.0	24.5	12.3	0.2
MACROSTEMUM SPP.(PUPAE)	0.0	6.1	3.1	0.1
CERACLEA SPP.	6.1	0.0	3.1	0.1
CERACLEA ANCYLUS	12.3	0.0	6.1	0.1
CERACLEA MENTIEA	12.3	12.3	12.3	0.2
NECTOPSYCHE SP.	135.0	0.0	67.5	1.3
OECETIS SPP.	79.8	55.2	67.5	1.3
OECETIS AVARA	0.0	6.1	3.1	0.1
DOBIRAPHIA SP.	6.1	0.0	3.1	0.1
STENELMIS SP.	288.3	85.9	187.1	3.5
STENELMIS SP.(ADULTS)	6.1	0.0	3.1	0.1
HEMERODROMIA SP.	6.1	0.0	3.1	0.1
CHIRONOMIDAE	141.1	0.0	70.6	1.3
CHIRONOMIDAE (PUPAE)	141.1	6.1	73.6	1.4
ABLABESMYIA MALLOCHI	0.0	288.3	144.2	2.7
THIENEMANNIMYIA GR.	429.4	0.0	214.7	4.0
MICROTENDIPES SP.	288.3	141.1	214.7	4.0
RHEOTANYTARSUS SPP.	1006.1	288.3	647.2	12.0
TANYTARSUS SPP.	429.4	141.1	285.3	5.3
CORYNONEURA SPP.	0.0	429.4	214.7	4.0
CRICOTOPUS SPP.	575.7	288.3	432.5	8.0
CRICOTOPUS BICINCTUS	141.1	0.0	70.6	1.3
NANOCLADIUS SPP.	429.4	0.0	214.7	4.0
THIENEMANNIELLA SPP.	0.0	141.1	70.6	1.3
PISIDIUM SP.	30.7	6.1	18.4	0.3
SPHAERIUM SPP.	49.1	36.8	42.9	0.8
TOTAL	7864.8	2932.4	5398.5	

Table C-7

Density (org/m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 13 June 1984. Replicates are indicated by collection number.

TAXON	LSZ-84-008	LSZ-84-009	MEAN	PERCENT TOTAL
ALLOEOCOELA	6.1	0.0	3.1	<0.1
NEMATODA	245.4	1245.4	745.4	5.1
NAIS SPP.	0.0	141.1	70.6	0.5
NAIS BEHNINGI	576.7	288.3	432.5	2.9
NAIS COMMUNIS	141.1	298.3	214.7	1.5
TUBIFICIDAE	319.0	822.1	570.6	3.9
QUISTADRILUS MULTISETOSUS	6.1	0.0	3.1	<0.1
LUMBRICULIDAE	6.1	0.0	3.1	<0.1
ASELLIDAE	0.0	24.5	12.3	0.1
CRANGONYX SP.	6.1	0.0	3.1	<0.1
PLECOPTERA	55.2	85.9	70.6	0.5
LEUCTRA SP.	12.3	0.0	6.1	<0.1
PERLIDAE	0.0	24.5	12.3	0.1
ACRONEURIA SPP.	6.1	0.0	3.1	<0.1
EPHORON SP.	454.0	392.6	423.3	2.9
POTAMANTHUS SPP.	184.0	312.9	248.5	1.7
CAENIS SP.	969.3	546.0	757.7	5.1
EPHEMERELLIDAE	24.5	24.5	24.5	0.2
DRUNELLA WALKERI	0.0	6.1	3.1	<0.1
SERRATELLA DEFICIENS	18.4	0.0	9.2	0.1
BAETIDAE	24.5	0.0	12.3	0.1
ISONYCHIA SP.	196.3	110.4	153.4	1.0
HEPTAGENIIDAE	1638.0	969.3	1303.7	8.9
HEPTAGENIA SPP.	564.4	368.1	466.3	3.2
STENACRON INTERPUNCTATUM	24.5	12.3	18.4	0.1
STENONEMA SPP.	6.1	6.1	6.1	<0.1
SIALIS SP.	24.5	0.0	12.3	0.1
CHIMARRA SP.	6.1	0.0	3.1	<0.1
POLYCENTROPUS SP.	6.1	0.0	3.1	<0.1
CHEUMATOPSYCHE SPP.	177.9	30.7	104.3	0.7
CHEUMATOPSYCHE SPP.(PUPAE)	6.1	0.0	3.1	<0.1
HYDROPSYCHE SPP.(PUPAE)	6.1	61.3	33.7	0.2
LEPTOCERIDAE	0.0	24.5	12.3	0.1
CERACLEA SPP.	0.0	24.5	12.3	0.1
CERACLEA ANCYLUS	6.1	0.0	3.1	<0.1
CERACLEA MENTIEA	6.1	0.0	3.1	<0.1
NECTOPSYCHE SP.	116.6	104.3	110.4	0.8
OECETIS SPP.	18.4	24.5	21.5	0.1
STENELMIS SP.	110.4	165.6	138.0	0.9
HEMERODROMIA SP.	0.0	24.5	12.3	0.1
CERATOPOGONIDAE	0.0	116.6	58.3	0.4
CHIRONOMIDAE (PUPAE)	576.7	288.3	432.5	2.9
ABLABESMYIA MALLOCHI	141.1	429.4	285.3	1.9
THIENEMANNIMYIA GR.	429.4	288.3	358.9	2.4
CRYPTOCHIRONOMUS SPP.	0.0	288.3	144.2	1.0
DICROTENDIPES SPP.	0.0	141.1	70.6	0.5
MICROTENDIPES SP.	865.0	2300.6	1582.8	10.8
POLYPEDILUM CONVICTUM	141.1	141.1	141.1	1.0
RHEOTANYTARSUS SPP.	1723.9	3165.6	2444.8	16.6
TANYTARSUS SPP.	1294.5	1006.1	1150.3	7.8
ZAVRELIA GR.	576.7	1006.1	791.4	5.4
SYMPOTTHASTIA SP.	0.0	141.1	70.6	0.5
ORTHOCLADIINAE	141.1	141.1	141.1	1.0
CRICOTOPUS SPP.	576.7	141.1	358.9	2.4
NANOCLADIUS SPP.	141.1	865.0	503.1	3.4
THIENEMANNIELLA SPP.	0.0	141.1	70.6	0.5
TVETENIA DISCOLORIPES GR.	0.0	141.1	70.6	0.5
TOTAL	12576.2	16370.7	14723.2	

Table C-8

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend III on the Susquehanna River, 13 June 1984. Replicates are indicated by collection number.

TAXON	L3Z-84-011	L3Z-84-012	MEAN	PERCENT TOTAL
NEMATODA	404.9	539.9	472.4	2.1
NAIDIDAE	0.0	288.3	144.2	0.6
NAIS SPP.	141.1	0.0	70.6	0.3
NAIS BEHNINGI	717.3	576.7	647.2	2.9
NAIS COMMUNIS	429.4	1006.1	717.8	3.2
TUBIFICIDAE	546.0	1331.3	938.6	4.2
BOTHRIONEURUM VEJDOVSKYANUM	0.0	6.1	3.1	<0.1
LIMNODRILUS HOFFMEISTERI	24.5	0.0	12.3	0.1
QUISTADRILUS MULTISETOSUS	0.0	24.5	12.3	0.1
LUMBRICULIDAE	24.5	36.8	30.7	0.1
AMPHIPODA	24.5	0.0	12.3	0.1
ACRONEURIA SPP.	0.0	85.9	42.9	0.2
EPHORON SP.	613.5	1312.9	963.2	4.3
POTAMANTHUS SPP.	214.7	294.5	254.6	1.1
CAENIS SP.	300.6	858.9	579.8	2.6
DRUNELLA WALKERI	12.3	12.3	12.3	0.1
EPHEMERELLA SPP.	0.0	6.1	3.1	<0.1
BAETIDAE	0.0	6.1	3.1	<0.1
ISONYCHIA SP.	0.0	165.6	82.8	0.4
HEPTAGENIIDAE	613.5	1809.8	1211.7	5.4
HEPTAGENIA SPP.	392.6	325.2	358.9	1.6
STENACRON INTERPUNCTATUM	0.0	6.1	3.1	<0.1
STENONEMA PULCHELLUM	0.0	18.4	9.2	<0.1
SIALIS SP.	55.2	6.1	30.7	0.1
HYDROPSYCHIDAE (PUPAE)	0.0	6.1	3.1	<0.1
CHEUMATOPSYCHE SPP.	12.3	85.9	49.1	0.2
NECTOPSYCHE SP.	24.5	104.3	64.4	0.3
OECETIS SPP.	61.3	147.2	104.3	0.5
OPTIOSERVUS SP.	30.7	24.5	27.6	0.1
STENELMIS SP.	165.6	165.6	165.6	0.7
STENELMIS SP.(ADULTS)	6.1	0.0	3.1	<0.1
CERATOPOGONIDAE	0.0	61.3	30.7	0.1
CHIRONOMIDAE (PUPAE)	576.7	576.7	576.7	2.6
ABLABESMYIA SPP.	141.1	0.0	70.6	0.3
ABLABESMYIA MALLOCHI	576.7	865.0	720.9	3.2
NILOTANYPUS SP.	0.0	141.1	70.6	0.3
THIENEMANNIMYIA GR.	429.4	576.7	503.1	2.2
CHIRONOMINAE	0.0	141.1	70.5	0.3
CRYPTOCHIRONOMUS SPP.	288.3	141.1	214.7	0.9
ENDOCHIRONOMUS SPP.	141.1	0.0	70.6	0.3
GLYPTOTENDIPES SP.	141.1	0.0	70.6	0.3
MICROTENDIPES SP.	2441.7	3165.6	2803.7	12.4
POLYPEDILUM CONVICTUM	288.3	141.1	214.7	0.9
POLYPEDILUM NR. SCALAENUM	141.1	0.0	70.6	0.3
RHEOTANYTARSUS SPP.	3306.7	3883.4	3595.1	15.9
TANYTARSUS SPP.	3018.4	3165.6	3092.0	13.7
ZAVRELIA GR.	1294.5	1871.2	1582.8	7.0
CORYNONEURA SPP.	429.4	429.4	429.4	1.9
CRICOTOPUS SPP.	576.7	429.4	503.1	2.2
CRICOTOPUS BICINCTUS	141.1	141.1	141.1	0.6
NANOCLADIUS SPP.	717.8	717.8	717.8	3.2
SPHAERIUM SPP.	18.4	30.7	24.5	0.1
TOTAL	19484.1	25729.3	22606.6	

Table C-9

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 9 October 1984. Replicates are indicated by collection number.

TAXON	LSZ-84-014	LSZ-84-015	MEAN	PERCENT TOTAL
HYDRA SP.	24.5	0.0	12.3	<0.1
ALLOEOCOELA	6.1	30.7	18.4	<0.1
TRICLADIDA	6.1	24.5	15.3	<0.1
PROSTOMA SP.	73.6	104.3	89.0	0.2
NEMATODA	171.8	368.1	269.9	0.5
NAIS BEHNINGI	0.0	1153.4	576.7	1.1
TUBIFICIDAE	227.0	214.7	220.9	0.4
STYLODRILUS HERINGIANUS	6.1	0.0	3.1	<0.1
PLECOPTERA	55.2	0.0	27.6	0.1
PERLIDAE	220.9	24.5	122.7	0.2
ACRONEURIA SPP.	6.1	0.0	3.1	<0.1
PHASGANOPHORA SP.	79.8	24.5	52.1	0.1
PERLESTA SP.	6.1	0.0	3.1	<0.1
POTAMANTHUS SPP.	2362.0	2282.2	2322.1	4.6
CAENIS SP.	153.4	61.3	107.4	0.2
EPHEMERELLIDAE	24.5	0.0	12.3	<0.1
SERRATELLA DEFICIENS	18.4	0.0	9.2	<0.1
BAETIDAE	49.1	24.5	36.8	0.1
ISONYCHIA SP.	1141.1	79.8	610.4	1.2
HEPTAGENIIDAE	3944.8	331.3	2138.0	4.2
HEPTAGENIA SPP.	6.1	12.3	9.2	<0.1
RHITHROGENA SP.	0.0	6.1	3.1	<0.1
STENACRON INTERPUNCTATUM	153.4	6.1	79.8	0.2
STENONEMA SPP.	159.5	30.7	95.1	0.2
STENONEMA ITHACA	85.9	30.7	58.3	0.1
STENONEMA PULCHELLUM	4042.9	1619.6	2831.3	5.6
STENONEMA TERMINATUM	527.6	355.8	441.7	0.9
STENONEMA VICARIUM	12.3	6.1	9.2	<0.1
COENAGRIONIDAE	49.1	12.3	30.7	0.1
SIALIS SP.	6.1	0.0	3.1	<0.1
CORYDALUS SP.	18.4	0.0	9.2	<0.1
GLOSSOSOMATIDAE	0.0	12.3	6.1	<0.1
CHIMARRA SP.	251.5	36.8	144.2	0.3
NEURECLIPSIS SP.	822.1	110.4	466.3	0.9
CHEUMATOPSYCHE SPP.	29938.6	15196.3	22567.4	44.2
HYDROPSYCHE SPP.	79.8	0.0	39.9	0.1
HYDROPSYCHE BIFIDA GR.	30.7	30.7	30.7	0.1
HYDROPSYCHE MOROSA	165.6	42.9	104.3	0.2
HYDROPSYCHE PHALERATA	2128.8	570.6	1349.7	2.6
MACROSTEMUM SPP.	36.8	12.3	24.5	<0.1
LEPTOCERIDAE	0.0	6.1	3.1	<0.1
CERACLEA SPP.	6.1	18.4	12.3	<0.1
NECTOPSYCHE SP.	251.5	239.3	245.4	0.5
OECETIS SPP.	24.5	6.1	15.3	<0.1
OECETIS AVARA	116.6	0.0	58.3	0.1
OECETIS CINERASCENS	6.1	0.0	3.1	<0.1
DUBIRAPHIA SP.	6.1	24.5	15.3	<0.1
OPTIOSERVUS SP.	55.2	36.8	46.0	0.1
STENELMIS SP.	1049.1	1006.1	1027.6	2.0
STENELMIS SP.(ADULTS)	92.0	6.1	49.1	0.1
SIMULIIDAE	30.7	6.1	18.4	<0.1
HEMERODROMIA SP.	1269.9	625.8	947.8	1.9
CERATOPOGONIDAE	55.2	0.0	27.6	0.1
CHIRONOMIDAE (PUPAE)	141.1	0.0	70.6	0.1
THIENEMANNIMYIA GR.	1294.5	1582.8	1438.6	2.8
MICROTENDIPES SP.	141.1	288.3	214.7	0.4
PARACHIRONOMUS ABORTIVUS	0.0	141.1	70.6	0.1
POLYPEDILUM CONVICTUM	0.0	141.1	70.6	0.1
RHEOTANYTARSUS SPP.	9490.8	7049.1	8269.9	16.2
CRICOTOPUS SPP.	1006.1	2159.5	1582.8	3.1
CRICOTOPUS BICINCTUS	1435.6	141.1	788.3	1.5
EUKIEFFERIELLA SPP.	576.7	288.3	432.5	0.8
TVETENIA DISCOLORIPES GR.	576.7	288.3	432.5	0.8
FERRISSIA SP.	36.8	55.2	46.0	0.1
PISIDIUM SP.	12.3	42.9	27.6	0.1
SPHAERIUM SPP.	171.8	110.4	141.1	0.3
TOTAL	64936.8	37078.6	51007.2	

Table C-10

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 8 October 1984. Replicates are indicated by collection number.

TAXON	LSZ-84-017	LSZ-84-018	MEAN	PERCENT TOTAL
ALLOEOCOELA	36.8	49.1	42.9	0.1
TRICLADIDA	0.0	18.4	9.2	<0.1
PROSTOMA SP.	135.0	67.5	101.2	0.2
NEMATODA	496.9	662.6	579.8	1.4
NAIS BEHNINGI	1723.9	1153.4	1438.6	3.4
TUBIFICIDAE	245.4	1067.5	656.4	1.5
LUMBRICULIDAE	0.0	12.3	6.1	<0.1
GLOSSIPHONIIDAE	6.1	0.0	3.1	<0.1
PERLIDAE	6.1	36.8	21.5	0.1
PHASGANOPHORA SP.	24.5	98.2	61.3	0.1
POTAMANTHUS SPP.	1639.0	1822.1	1730.1	4.1
CAENIS SP.	79.8	79.8	79.8	0.2
EPHEMERELLIDAE	24.5	0.0	12.3	<0.1
SERRATELLA DEFICIENS	24.5	0.0	12.3	<0.1
BAETIDAE	6.1	0.0	3.1	<0.1
ISONYCHIA SP.	42.9	177.9	110.4	0.3
HEPTAGENIIDAE	748.5	1018.4	883.4	2.1
HEPTAGENIA SPP.	6.1	0.0	3.1	<0.1
STENACRON SPP.	42.9	0.0	21.5	0.1
STENACRON INTERPUNCTATUM	0.0	55.2	27.6	0.1
STENONEMA ITHACA	30.7	12.3	21.5	0.1
STENONEMA PULCHELLUM	1190.2	1730.1	1460.1	3.4
STENONEMA TERMINATUM	79.8	153.4	116.6	0.3
COENAGRIONIDAE	0.0	30.7	15.3	<0.1
SIALIS SP.	0.0	6.1	3.1	<0.1
NEURECLIPSIS SP.	12.3	42.9	27.6	0.1
CHEUMATOPSYCHE SPP.	17674.8	13423.3	15549.0	36.6
HYDROPSYCHE SPP.	18.4	0.0	9.2	<0.1
HYDROPSYCHE BIFIDA GR.	18.4	0.0	9.2	<0.1
HYDROPSYCHE MOROSA	30.7	6.1	18.4	<0.1
HYDROPSYCHE PHALERATA	1441.7	478.5	960.1	2.3
MACROSTEMUM SPP.	36.8	0.0	18.4	<0.1
LEPTOCERIDAE	0.0	55.2	27.6	0.1
CERACLEA SPP.	6.1	30.7	18.4	<0.1
CERACLEA MENTIEA	6.1	0.0	3.1	<0.1
NECTOPSYCHE SP.	386.5	503.1	444.8	1.0
OECETIS SPP.	0.0	24.5	12.3	<0.1
OECETIS AVARA	55.2	0.0	27.6	0.1
OECETIS CINERASCENS	18.4	6.1	12.3	<0.1
DUBIRAPHIA SP.	6.1	6.1	6.1	<0.1
OPTIOSERVUS SP.	24.5	36.8	30.7	0.1
STENELMIS SP.	1282.2	711.7	996.9	2.3
STENELMIS SP.(ADULTS)	30.7	6.1	18.4	<0.1
TIPULIDAE	6.1	0.0	3.1	<0.1
SIMULIIDAE	24.5	0.0	12.3	<0.1
HEMERODROMIA SP.	380.4	263.8	322.1	0.8
CHIRONOMIDAE (PUPAE)	429.4	288.3	358.9	0.8
ABLABESMYIA MALLOCHI	0.0	141.1	70.6	0.2
PROCLADIUS SP.	141.1	0.0	70.6	0.2
THIENEMANNIMYIA GR.	2300.6	3454.0	2877.3	6.8
DICROTENDIPES SPP.	0.0	141.1	70.6	0.2
MICROTENDIPES SP.	288.3	1006.1	647.2	1.5
POLYPEDILUM CONVICTUM	141.1	288.3	214.7	0.5
POLYPEDILUM NR. SCALAENUM	288.3	0.0	144.2	0.3
RHEOTANYTARSUS SPP.	9490.8	9055.2	8773.0	20.6
STENOCHIRONOMUS SP.	0.0	141.1	70.6	0.2
CRICOTOPUS SPP.	2589.0	1006.1	1797.5	4.2
CRICOTOPUS BICINCTUS	1153.4	576.7	865.0	2.0
TVETENIA DISCOLORIPES GR.	141.1	288.3	214.7	0.5
FERRISSIA SP.	104.3	128.8	116.6	0.3
PISIDIUM SP.	0.0	12.3	6.1	<0.1
SPHAERIUM SPP.	251.5	269.9	260.7	0.6
TOTAL	45366.9	39643.0	42504.3	

Table C-11

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 10 October 1984. Replicates are indicated by collection number.

TAXON	L32-84-020	L32-84-021	MEAN	PERCENT TOTAL
ALLOEOCOELA	36.8	24.5	30.7	0.1
TRICLADIDA	0.0	30.7	15.3	<0.1
PROSTOMA SP.	159.5	165.6	162.6	0.5
NEMATODA	950.9	392.6	671.8	1.9
NAIDIDAE	0.0	141.1	70.6	0.2
NAIS SPP.	141.1	141.1	141.1	0.4
NAIS BEHNINGI	576.7	717.8	647.2	1.8
TUBIFICIDAE	1067.5	803.7	935.6	2.6
LUMBRICULIDAE	6.1	6.1	6.1	<0.1
GLOSSIPHONIIDAE	6.1	6.1	6.1	<0.1
PERLIDAE	6.1	6.1	6.1	<0.1
POTAMANTHUS SPP.	1006.1	1723.9	1365.0	3.8
CAENIS SP.	36.8	49.1	42.9	0.1
EPHEMERELLIDAE	24.5	24.5	24.5	0.1
ISONYCHIA SP.	0.0	6.1	3.1	<0.1
HEPTAGENIIDAE	656.4	889.6	773.0	2.2
STENACRON SPP.	171.8	61.3	116.6	0.3
STENONEMA SPP.	24.5	18.4	21.5	0.1
STENONEMA ITHACA	6.1	6.1	6.1	<0.1
STENONEMA PULCHELLUM	1147.2	2000.0	1573.6	4.4
STENONEMA TERMINATUM	196.3	404.9	300.6	0.8
STENONEMA VICARIUM	0.0	6.1	3.1	<0.1
GOMPHIDAE	6.1	6.1	6.1	<0.1
COENAGRIONIDAE	12.3	6.1	9.2	<0.1
SIALIS SP.	12.3	0.0	6.1	<0.1
POLYCENTROPODIDAE	24.5	0.0	12.3	<0.1
NEURECLIPSIS SP.	104.3	122.7	113.5	0.3
CHEUMATOPSYCHE SPP.	2177.9	7527.6	4852.8	13.7
HYDROPSYCHE SPP.	0.0	6.1	3.1	<0.1
HYDROPSYCHE PHALERATA	36.8	159.5	98.2	0.3
LEPTOCERIDAE	0.0	49.1	24.5	0.1
CERACLEA SPP.	67.5	92.0	79.8	0.2
MYSTACIDES SPP.	24.5	0.0	12.3	<0.1
NECTOPSYCHE SP.	196.3	705.5	450.9	1.3
OECETIS SPP.	147.2	49.1	98.2	0.3
OECETIS AVARA	24.5	73.6	49.1	0.1
OECETIS CINERASCENS	30.7	190.2	110.4	0.3
DUBIRAPHIA SP.	6.1	30.7	18.4	0.1
OPTIOSERVUS SP.	24.5	0.0	12.3	<0.1
STENELMIS SP.	914.1	546.0	730.1	2.1
STENELMIS SP.(ADULTS)	0.0	6.1	3.1	<0.1
HEMERODROMIA SP.	98.2	196.3	147.2	0.4
CERATOPOGONIDAE	104.3	0.0	52.1	0.1
TANYPODINAE	141.1	0.0	70.6	0.2
ABLABESMYIA SPP.	0.0	141.1	70.6	0.2
THIENEMANNIMYIA GR.	4460.1	3306.7	3883.4	10.9
CHIRONOMUS SPP.	1153.4	717.8	935.6	2.6
CRYPTOCHIRONOMUS SPP.	2012.3	2159.5	2085.9	5.9
DICROTENDIPES SPP.	1294.5	1153.4	1223.9	3.4
DICROTENDIPES NEOMODESTUS	141.1	0.0	70.6	0.2
ENDOCHIRONOMUS SPP.	288.3	141.1	214.7	0.6
GLYPTOTENDIPES SP.	429.4	429.4	429.4	1.2
MICROTENDIPES SP.	7908.0	7908.0	7908.0	22.3
POLYPEDILUM CONVICTUM	0.0	429.4	214.7	0.6
POLYPEDILUM NR. SCALAENUM	288.3	576.7	432.5	1.2
RHEOTANYTARSUS SPP.	1435.6	2159.5	1797.5	5.1
TANYTARSUS SPP.	141.1	576.7	358.9	1.0
ZAVRELIA GR.	0.0	717.8	358.9	1.0
CRICOTOPUS SPP.	429.4	717.8	573.6	1.6
CRICOTOPUS BICINCTUS	717.8	0.0	358.9	1.0
NANOCLADIUS SP.	141.1	141.1	141.1	0.4
HELISOMA SP.	0.0	6.1	3.1	<0.1
FERRISSIA SP.	36.8	30.7	33.7	0.1
PISIDIUM SP.	128.8	110.4	119.6	0.3
SPHAERIUM SPP.	533.7	227.0	380.4	1.1
TOTAL	31912.9	39041.3	35476.4	

Table C-12

Density (org/m²) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend III on the Susquehanna River, 11 October 1984. Replicates are indicated by collection number.

TAXON	LSZ-84-023	LSZ-84-024	MEAN	PERCENT TOTAL
ALLOEOCOELA	0.0	30.7	15.3	<0.1
TRICLADIDA	0.0	30.7	15.3	<0.1
PROSTOMA SP.	55.2	79.8	67.5	0.2
NEMATODA	220.9	110.4	165.6	0.4
NAIDIDAE	141.1	0.0	70.6	0.2
NAIS BEHNINGI	288.3	298.3	289.3	0.7
TUBIFICIDAE	496.9	552.1	524.5	1.3
LUMBRICULIDAE	0.0	6.1	3.1	<0.1
PERLIDAE	24.5	6.1	15.3	<0.1
PHASGANOPHORA SP.	18.4	0.0	9.2	<0.1
POTAMANTHUS SPP.	1883.4	2024.5	1954.0	4.7
CAENIS SP.	24.5	30.7	27.6	0.1
ISONYCHIA SP.	79.8	0.0	39.9	0.1
HEPTAGENIIDAE	1251.5	1472.4	1362.0	3.3
STENACRON SPP.	36.8	85.9	61.3	0.1
STENONEMA SPP.	12.3	12.3	12.3	<0.1
STENONEMA ITHACA	42.9	36.8	39.9	0.1
STENONEMA PULCHELLUM	2858.9	3822.1	3340.5	8.1
STENONEMA TERMINATUM	435.6	748.5	592.0	1.4
COENAGRIONIDAE	12.3	0.0	6.1	<0.1
SIALIS SP.	0.0	6.1	3.1	<0.1
POLYCENTROPODIDAE	24.5	0.0	12.3	<0.1
NEURECLIPSIS SP.	36.8	36.8	36.8	0.1
CHEUMATOPSYCHE SPP.	16049.0	9527.6	12788.3	30.9
HYDROPSYCHE MOROSA	6.1	0.0	3.1	<0.1
HYDROPSYCHE PHALERATA	220.9	300.6	260.7	0.6
HYDROPTILA SPP.	0.0	24.5	12.3	<0.1
LEPTOCERIDAE	55.2	79.8	67.5	0.2
CERACLEA SPP.	24.5	67.5	46.0	0.1
MYSTACIDES SPP.	0.0	24.5	12.3	<0.1
NECTOPSYCHE SP.	515.3	1012.3	763.8	1.8
OECETIS SPP.	0.0	24.5	12.3	<0.1
OECETIS AVARA	24.5	24.5	24.5	0.1
OECETIS CINERASCENS	67.5	214.7	141.1	0.3
LEPIDOSTOMA SP.	6.1	6.1	6.1	<0.1
DUBIRAPHIA SP.	0.0	6.1	3.1	<0.1
STENELMIS SP.	828.2	1104.3	966.3	2.3
STENELMIS SP.(ADULTS)	6.1	0.0	3.1	<0.1
HEMERODROMIA SP.	306.7	251.5	279.1	0.7
CERATOPOGONIDAE	0.0	24.5	12.3	<0.1
CHIRONOMIDAE (PUPAE)	429.4	0.0	214.7	0.5
TANYPODINAE	141.1	141.1	141.1	0.3
THIENEMANNIMYIA GR.	5030.7	6036.8	5533.7	13.4
CRYPTOCHIRONOMUS SPP.	0.0	288.3	144.2	0.3
DICROTENDIPES SPP.	141.1	429.4	285.3	0.7
GLYPTOTENDIPES SP.	288.3	141.1	214.7	0.5
MICROTENDIPES SP.	2441.7	3454.0	2947.8	7.1
PARACHIRONOMUS ABORTIVUS	141.1	0.0	70.6	0.2
POLYPEDILUM CONVICTUM	141.1	141.1	141.1	0.3
RHEOTANYTARSUS SPP.	7478.5	4319.0	5898.8	14.3
ORTHOCLADIINAE	141.1	0.0	70.6	0.2
CRICOTOPUS SPP.	1723.9	0.0	862.0	2.1
CRICOTOPUS BICINCTUS	429.4	0.0	214.7	0.5
NANOCLADIUS SP.	141.1	141.1	141.1	0.3
PERRISSIA SP.	128.8	30.7	79.8	0.2
PISIDIUM SP.	24.5	135.0	79.8	0.2
SPHAERIUM SPP.	135.0	447.9	291.4	0.7
TOTAL	45011.1	37777.9	41393.9	

Table C-13

Benthic macroinvertebrates collected in dome samples at SSES (SS) and Bell Bend (BB) on the Susquehanna River, 1975-84. An asterisk (*) denotes macroinvertebrates collected or identified for the first time in 1984.

	SS	BB
Coelenterata		
Hydroida		
Hydridae		
Hydra sp.	X	X
Platyhelminthes		
Turbellaria		
Alloeocoela	X	X
Tricladida	X	X
Nemertinea		
Tetrastemmatidae		
Prostoma sp.	X	X
Nematoda	X	X
Entoprocta		
Urnatella gracilis	X	X
Annelida		
Oligochaeta		
Lumbricidae	X	
Naididae		
Nais behningi	X	X
N. bretscheri	X	X
N. communis	X	X
N. elinguis	X	
N. pardalis	X	
N. simplex	X	X
Nais spp.	X	X
Pigustiella michiganensis	X	X
Slavina appendiculata	X	X
Tubificidae		
Aulodrilus limnobius	X	
Bothrioneurum vejdovskyanum	X *	X *
Isochaetides freyi	X *	
Limnodrilus hoffmeisteri	X	X
Quistadrilus multisetosus	X	X
Lumbriculidae		
Lumbriculus sp.	X	X
Stylodrilus heringianus	X	X
Hirudinea		
Glossiphoniidae		
Actinobdella inequiannulata		X
Erpobdellidae	X	
Arthropoda		
Crustacea		
Isopoda		
Asellus sp.	X	X
Amphipoda		
Crangonx sp.		X*
Gammarus sp.	X	X
Decapoda		
Astacidae	X	X
Insecta		
Collembola		
Isotomidae		
Isotomurus palustris	X	X
Plecoptera		
Nemouridae	X*	
Taeniopterygidae		
Strophopteryx fasciata	X	
Taeniopteryx sp.	X	X
Leuctridae		
Leuctra sp.	X	X*
Perlidae		
Acroneuria abnormis	X	
A. lycorias	X	
Acroneuria spp.	X	X
Neoperla clymene	X	X
Neoperla sp.	X	X
Phasganophora capitata	X	X
Phasganophora sp.	X	X
Perlesta sp.	X	
Perlodidae	X	
Ephemeroptera		
Ephemeridae		
Ephemera sp.		X
Hexagenia limbata	X	X
Hexagenia sp.	X	X
Polymitarcidae		
Ephoron sp.	X	X
Potamanthidae		
Potamanthus spp.	X	X
Caenidae		
Caenis sp.	X	X
Tricorythidae		
Tricorythodes albilineatus gr.	X	
Tricorythodes sp.	X	X
Ephemerellidae		
Drunella cornutella	X	X
D. walkeri	X	X
Drunella spp.	X	X
Ephemerella dorothea	X	X
E. excrucians		X
E. invaria	X	X
E. needhami	X	
E. septentrionalis	X	
Ephemerella spp.	X	X
Eurylophella bicolor	X	X
E. coxalis		X
E. lutulenta		X
Eurylophella spp.	X	X
Serratella deficiens	X	X
S. sordida	X	
Serratella spp.	X	X
Leptophlebiidae		
Paraleptophlebia adoptiva		X
Paraleptophlebia sp.		X
Baetidae		
Baetis macdunnoughi		X
B. nr. *propinquus*	X	
B. tricaudatus	X	
Baetis spp.	X	X
Heterocloeon curiosum	X	
Pseudocloeon carolina	X	
Pseudocloeon sp.	X	X
Siphlonuridae		
Isonychia sp.	X	X
Heptageniidae		
Epeorus sp.	X	X
Heptagenia spp.	X	X
Rhithrogena sp.	X	X
Stenacron interpunctatum	X	X
Stenacron spp.	X	X
Stenonema ithaca	X	X
S. mediopunctatum	X	X
S. modestum	X	X
S. pulchellum	X	X
S. terminatum	X	X
S. vicarium	X	X
Stenonema spp.	X	X
Odonata		
Anisoptera		
Gomphidae		X*
Stylogomphus albistylus	X	
Zygoptera		
Coenagrionidae		
Argia sp.	X	X
Hemiptera		X
Veliidae		
Microvelia sp.	X	
Megaloptera		
Sialidae		
Sialis sp.	X	X
Corydalidae		
Chauliodes sp.	X	
Corydalus cornutus	X	
Corydalus sp.	X	X

Table C-13 (cont.)

	SS	BB
Trichoptera		
Glossosomatidae		
Agapetus sp.	X	
Glossosoma sp.	X	
Protoptila sp.	X	
Philopotamidae		
Chimarra obscura	X	X
Chimarra sp.	X	X
Polycentropodidae		
Neureclipsis sp.	X	X
Polycentropus sp.	X	X
Hydropsychidae		
Cheumatopsyche spp.	X	X
Hydropsyche bifida gr.	X	X
H. hageni	X	
H. morosa	X	X
H. phalerata	X	X
H. simulans	X	
H. sparna	X	
H. valanis	X	
Hydropsyche spp.	X	X
Macrostemum carolina	X	
M. zebratum	X	X
Macrostemum spp.	X	X
Hydroptilidae		
Agraylea sp.	X	
Hydroptila sp.	X	X
Ochrotrichia sp.	X	
Phryganeidae		
Ptilostomis sp.	X	
Leptoceridae		
Ceraclea alagma	X	X
C. ancylus	X	X*
C. flava	X	X
C. maculata	X	X
C. mentiea	X	X
C. neffi	X	X
C. nepha	X	X
C. tarsipunctata	X	X
Ceraclea sp. #1	X	X
Ceraclea spp.	X	X
Mystacides nr. *alafimbriata*		X
Mystacides spp.	X	X
Nectopsyche sp.	X	X
Oecetis avara	X	X
O. cinerascens	X	X
O. inconspicua	X	X
O. nocturna		X
Oecetis spp.	X	X
Lepidostomatidae		
Lepidostoma sp.	X	X
Lepidoptera	X	X
Noctuidae	X	
Coleoptera		
Gyrinidae	X	X
Dineutus sp.		X
Hydrophilidae	X	X
Berosus sp.	X	X
Psephenidae		
Psephenus herricki	X	
Psephenus sp.	X	X
Elmidae		
Dubiraphia vittata	X	X
Dubiraphia sp.	X	X
Macronychus sp.	X	
Optioservus trivittatus	X	
Optioservus sp.	X	X
Stenelmis bicarinata	X	X
S. mera	X	
Stenelmis spp.	X	X
Diptera		
Tipulidae	X	X
Antocha saxicola	X	X
Antocha sp.	X	X
Hexatoma sp.	X	
Psychodidae		X
Simuliidae	X	X
Simulium spp.	X	X

	SS	BB
Diptera (cont.)		
Tabanidae	X	X
Athericidae		
Atherix sp.	X	
Empididae	X	X
Hemerodromia spp.	X	X
Ceratopogonidae	X	X
Chironomidae		
Tanypodinae		
Ablabesmyia mallochi	X	X
A. ornata	X	X
A. peleensis	X	
A. rhamphe	X	X
Ablabesmyia spp.	X	X
Labrundinia sp.	X	X
Macropelopia sp.	X	
Nilotanypus sp.	X	X
Procladius sp.	X	X
Psectrotanypus sp.	X	
Thienemannimyia gr.	X	X
Chironominae		
Chironomus decorus gr.		X
Chironomus spp.	X	X
Cryptochironomus blarina	X	X
C. fulvus gr.	X	X
Cryptochironomus spp.	X	X
Demicryptochironomus sp.		X
Dicrotendipes neomodestus	X	X
Dicrotendipes spp.	X	X
Endochironomus nigricans	X	X
Endochironomus sp.	X	X
Glyptotendipes sp.	X	X
Harnischia gr.		X
Microtendipes sp.	X	X
Nilothauma sp.		X
Parachironomus abortivus	X	X
P. carinatus	X	X
P. frequens	X	X
Parachironomus spp.	X	X
Paralauterborniella elachista	X	
Phaenopsectra sp.	X	X
Polypedilum convictum	X	X
P. fallax gr.	X	X
P. illinoense	X	
P. nr. *scalaenum*	X	X
Polypedilum spp.	X	X
Rheotanytarsus distinctissimus gr.	X	X
R. exiguus gr.	X	X
Rheotanytarsus spp.	X	X
Stenochironomus sp.	X	
Stictochironomus sp.		X
Tanytarsus coffmani	X	
Tanytarsus spp.	X	X
Tribelos fusicornis	X	X
T. jucundus	X	X
Zavrelia gr.	X	X
Diamesinae		
Diamesa sp.		X
Pseudodiamesa sp.	X	
Sympotthastia sp.	X	X
Orthocladiinae		
Brillia sp.	X	
Cardiocladius sp.	X	
Corynoneura celeripes	X	X
C. taris	X	X
Corynoneura spp.	X	X
Cricotopus bicinctus	X	X
C. tremulus	X	X
Cricotopus spp.	X	X
Eukiefferiella coerulescens gr.	X*	
Eukiefferiella spp.	X	
Heterotrissocladius gr.	X	X
Nanocladius spp.	X	X
Orthocladius sp.	X	X

Table C-13 (cont.)

	SS	BB
Orthocladiinae (cont.)		
Parametriocnemus sp.	X	X
Rheocricotopus spp.	X	X
Synorthocladius sp.	X	X
Thienemanniella spp.	X	X
Tvetenia bavarica gr.	X	X
T. discoloripes gr.	X	X
Tvetenia spp.	X	X
Mollusca		
Gastropoda		
Physidae		
Physa sp.	X	X
Lymnaeidae		
Lymnaea sp.	X	X
Planorbidae		
Gyraulus sp.	X	X
Helisoma ancepts	X	
Helisoma sp.	X	X
Ancylidae		
Ferrissia sp.	X	X
Pleuroceridae		
Goniobasis virginica	X	
Pelecypoda		
Sphaeriidae		
Pisidium casertanum	X	X
Pisidium sp.	X	X
Sphaerium transversum	X	X
Sphaerium spp.	X	X
Unionidae		X

Table C-14

Dry weight (g/m²) and percent total of major groups of benthic macroinvertebrates collected in two dome samples at each station on the Susquehanna River in June and October, 1984.

SITE TAXA	JUN G/M²	JUN % TOTAL	OCT G/M²	OCT % TOTAL	MEAN G/M²	MEAN % TOTAL
SSES						
OLIGOCHAETA	0.2	19.6	<0.1	0.5	0.1	3.4
EPHEMEROPTERA	0.6	62.8	0.9	16.1	0.8	23.3
TRICHOPTERA	0.1	13.0	4.1	75.4	2.1	65.7
DIPTERA	<0.1	1.4	<0.1	0.9	<0.1	1.0
OTHER	<0.1	3.2	0.4	7.1	0.2	6.6
TOTAL	1.0		5.5		3.2	
BELL BEND						
OLIGOCHAETA	<0.1	4.0	<0.1	0.9	<0.1	1.4
EPHEMEROPTERA	0.5	86.2	0.8	28.8	0.6	38.2
TRICHOPTERA	<0.1	1.1	1.7	61.7	0.9	51.8
DIPTERA	<0.1	4.4	0.1	4.5	<0.1	4.5
OTHER	<0.1	4.3	0.1	4.1	<0.1	4.1
TOTAL	0.5		2.8		1.7	
COMBINED						
OLIGOCHAETA	0.1	14.1	<0.1	0.6	<0.1	2.7
EPHEMEROPTERA	0.6	71.1	0.8	20.4	0.7	28.4
TRICHOPTERA	<0.1	8.8	2.9	70.7	1.5	61.0
DIPTERA	<0.1	2.5	<0.1	2.1	<0.1	2.2
OTHER	<0.1	3.5	0.3	6.2	0.1	5.7
TOTAL	0.8		4.1		2.5	

Table C-15

Mean dry weight of benthic macroinvertebrates (g/m²) collected with a dome sampler at SSES and Bell Bend on the Susquehanna River in June and October, 1978-84.

YEAR	JUN SSES	JUN BELL BEND	JUN COMBINED	OCT SSES	OCT BELL BEND	OCT COMBINED	MEAN
1978	0.8	0.5	0.7	3.9	1.0	2.4	1.6
1979	0.5	0.7	0.6	8.5	2.9	5.7	3.2
1980	1.3	1.5	1.4	4.6	1.6	3.1	2.2
1981	2.7	1.1	1.9	4.5	2.2	3.4	2.6
1982	2.7	1.4	2.0	9.7	2.4	6.0	4.0
1983	2.1	1.4	1.8	6.6	2.3	4.5	3.1
MEAN (1978-83)	1.7	1.1	1.4	6.3	2.1	4.2	2.8
1984	1.0	0.5	0.8	5.5	2.8	4.1	2.5

Table C-16

Dry weight of benthic macroinvertebrates (mg/m²) collected with a dome sampler at SSES I and II on the Susquehanna River in June and October, 1984.

SITE	SSES I			PERCENT	SSES II			PERCENT
MONTH	APR	JUN	OCT	TOTAL	APR	JUN	OCT	TOTAL
TAXON								
OLIGOCHAETA	--	349.7	5.5	4.1	--	41.7	46.6	2.1
PLECOPTERA	--	0.0	44.8	0.5	--	8.6	155.8	3.8
EPHEMEROPTERA	--	476.1	922.1	16.2	--	776.7	830.1	37.5
TRICHOPTERA	--	9.8	6420.9	74.6	--	249.1	1806.7	48.0
COLEOPTERA	--	11.0	134.4	1.7	--	19.6	104.9	2.9
DIPTERA	--	11.0	29.4	0.5	--	17.8	69.9	2.0
MOLLUSCA	--	1.8	192.0	2.2	--	20.9	100.0	2.8
OTHER	--	0.0	13.5	0.2	--	0.0	37.4	0.9
TOTAL	--	859.5	7762.6		--	1134.4	3151.5	

Table C-17

Dry weight of benthic macroinvertebrates (mg/m²) collected with a dome sampler at Bell Bend I and III on th Susquehanna River in June and October, 1984.

SITE	BB I			PERCENT	BB III			PERCENT
MONTH	APR	JUN	OCT	TOTAL	APR	JUN	OCT	TOTAL
TAXON								
OLIGOCHAETA	--	16.0	47.2	2.6	--	27.6	0.6	0.7
CRUSTACEA	--	<0.1	0.0	<0.1	--	4.3	0.0	<0.1
PLECOPTERA	--	0.0	0.0	<0.1	--	0.0	3.1	<0.1
EPHEMEROPTERA	--	550.3	1056.4	67.2	--	395.7	558.9	22.1
TRICHOPTERA	--	6.7	367.5	15.6	--	5.5	3093.3	71.8
COLEOPTERA	--	8.6	35.6	1.8	--	22.1	36.8	1.4
DIPTERA	--	26.4	123.9	6.3	--	22.1	130.1	3.5
MOLLUSCA	--	6.7	27.0	1.4	--	0.0	11.7	0.3
OTHER	--	2.5	117.8	5.0	--	3.1	3.1	0.1
TOTAL	--	617.2	1775.5		--	480.4	3837.4	

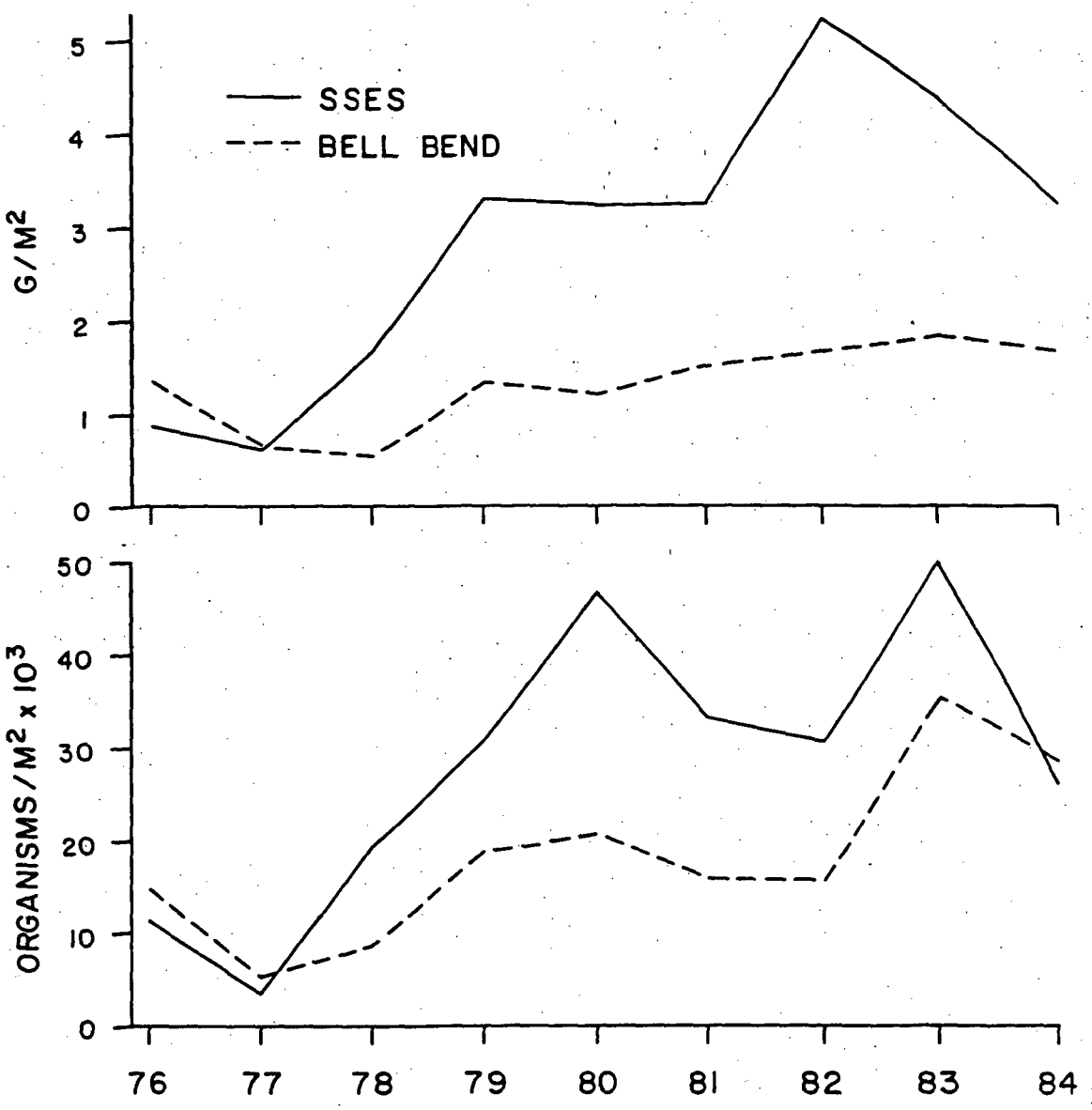

Fig. C-1

Annual mean biomass (g/m^2) and density (org/m^2) of benthic macroinvertebrates at SSES and Bell Bend on the Susquehanna River, 1976-84. The 1983 and 1984 means are based on June and October samples.

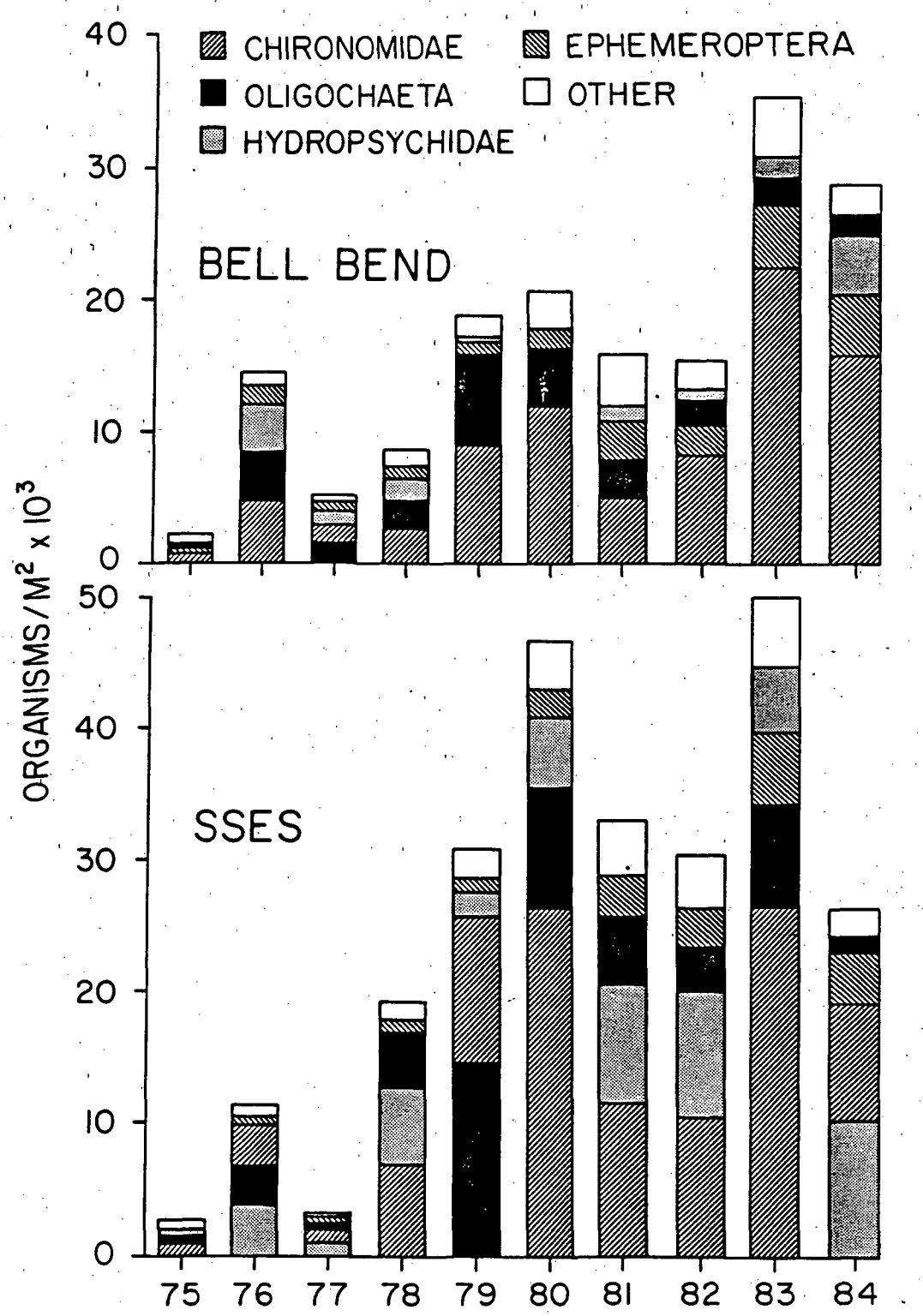

Fig. C-2

Annual mean density (org/m²) of benthic macroinvertebrates at SSES and Bell Bend on the Susquehanna River, 1975-84. At Bell Bend, only site I was sampled from 1975-77.

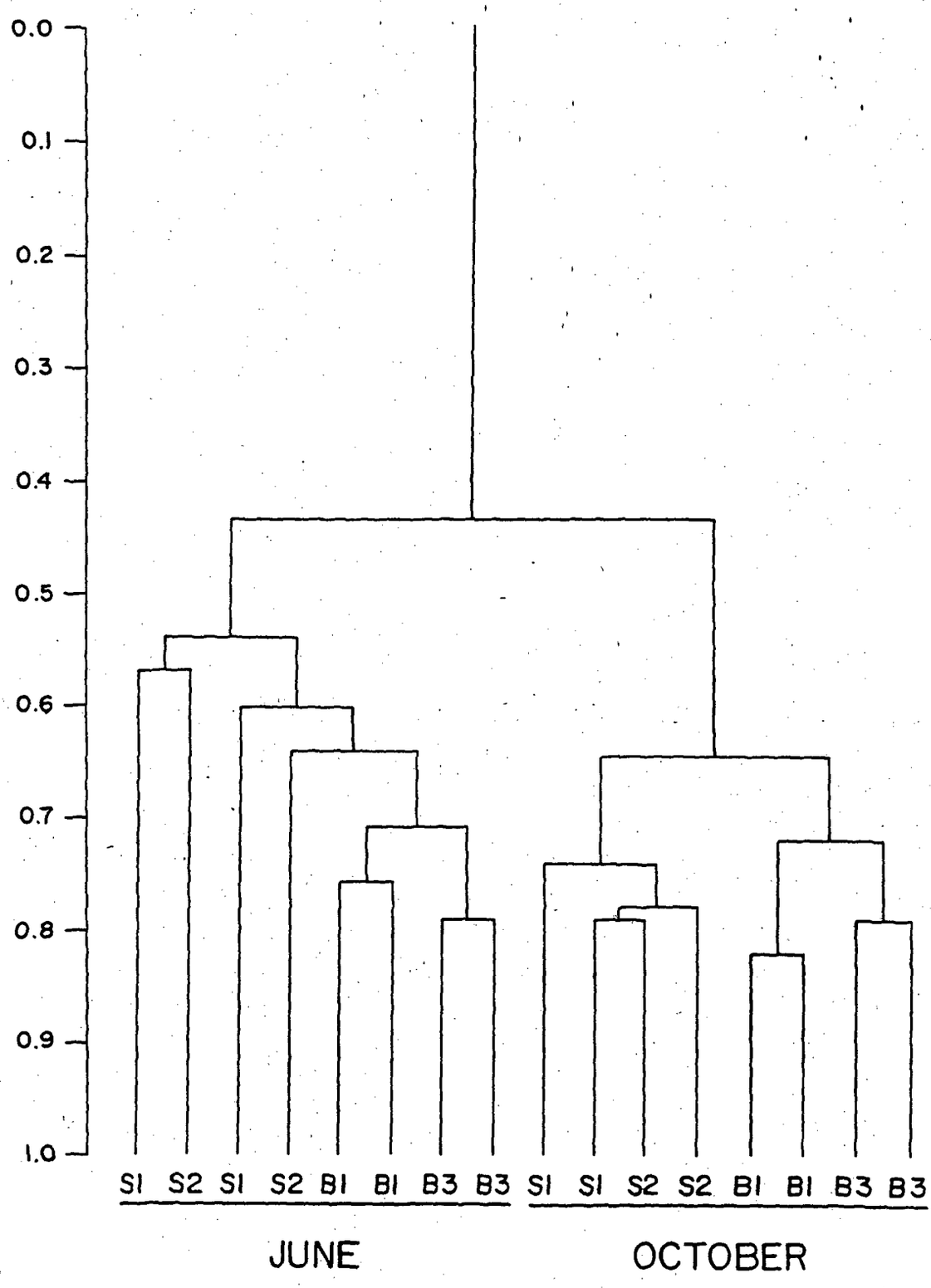

Fig. C-3

Dendrogram of the cluster analysis of Bray-Curtis similarity matrices for 1984 benthic macroinvertebrate data at SSES I (S1), SSES II (S2), Bell Bend I (B1), and Bell Bend III (B3) on the Susquehanna River in June and October, 1984.

LARVAL FISHES

by

William G. Deutsch, Brian P. Mangan, Andrew J. Gurzynski,
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TABLE OF CONTENTS

Page

ABSTRACT 115

INTRODUCTION 115

PROCEDURES 116

RESULTS AND DISCUSSION
Density and Relative Abundance 117
Temporal and Spatial Distribution 120

REFERENCES CITED 121

LIST OF TABLES

Table

D-1 Larval fishes collected in pump samples at SSES and Bell Bend on the Susquehanna River, 1978-84 123

D-2 Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 3 May 1984 124

D-3 Number . . . 9 May 1984 124

D-4 Number . . . 18 May 1984 125

D-5 Number . . . 23 May 1984 126

D-6 Number . . . 5 June 1984 127

D-7 Number . . . 12 June 1984 128

Table		Page
D-8	Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 19 June 1984	129
D-9	Number . . . 26 June 1984	130
D-10	Number . . . 3 July 1984	131
D-11	Number . . . 17 July 1984	132
D-12	Number . . . 31 July 1984	133
D-13	Number . . . 14 August 1984	134
D-14	Number . . . 28 August 1984	134
D-15	Mean density (no./10 m^3) of larval fish captured at SSES on the Susquehanna River, 1984	135
D-16	Mean . . . at Bell Bend . . . 1984	136
D-17	Mean . . . at SSES and Bell Bend . . . 1984	137
D-18	Mean density (no./10 m^3) of larval fish captured near the surface at 0900 h at SSES on the Susquehanna River, 1984	138
D-19	Mean . . . near the bottom at 0900 h at SSES. . . 1984	139
D-20	Mean . . . near the surface at 2100 h at SSES . . . 1984	140
D-21	Mean . . . near the bottom at 2100 h at SSES . . . 1984	141
D-22	Mean . . . near the surface at 0900 h at Bell Bend . . . 1984	142
D-23	Mean . . . near the bottom at 0900 h at Bell Bend . . . 1984	143
D-24	Mean . . . near the surface at 2100 h at Bell Bend . . . 1984	144
D-25	Mean . . . near the bottom at 2100 h at Bell Bend . . . 1984	145
D-26	Results (F values) of six analysis of variance tests comparing larval fish densities among replicates, dates (1), sites (2), times (3), and depths (4) on the Susquehanna River, 1984	146

LIST OF FIGURES

Figure Page

D-1 Sampling sites for pumping larval fish, electrofishing (EL), and seining (SN) at SSES and Bell Bend on the Susquehanna River, 1984.. 147

D-2 The adjusted total number (sum of the number of fish/10 m^3 in each sample) of larval fish collected at SSES and Bell Bend on the Susquehanna River, 1978-84..... 148

D-3 Mean density of larval fish (no./10 m^3) captured at SSES and Bell Bend on the Susquehanna River, with daily mean river temperature and flow, 1978-84..... 149

ABSTRACT

Larval fish drift was sampled upriver from the Susquehanna SES intake structure (SSES) and downriver from the discharge diffuser (Bell Bend) from 3 May through 28 August 1984. A total of 1,981 larvae (96% prolarvae) of 16 species was collected. Maximum larval fish density (49.5 fish/10 m^3) occurred on 12 June; it was the highest density observed since 1978.

In decreasing order of abundance, common carp, tessellated darter, quillback, spottail shiner, spotfin shiner, and banded darter composed 96% of the total larvae. Most fish ($P<0.01$) were taken at night. Overall, the mean density of larval fish at SSES (5.8 fish/10 m^3) and Bell Bend (7.1 fish/10 m^3) was similar; there was no significant difference ($P>0.05$) between the number of larvae at the two sites.

No impact of the Susquehanna SES on density or composition of the larval fish drift was detected.

INTRODUCTION

The relative abundance and density of drifting larval fish near the Susquehanna SES have been monitored from 1974 through 1983 (Buynak and Mohr 1976-78, Gale and Mohr 1978, Mohr et al. 1979-82, Deutsch and Jacobsen 1983-84). Prior to 1978, larvae were collected at several sites with a variety of sampling gear. From 1978 to the present, sampling has been conducted by pumping at two sites (Fig. D-1), one upriver from the intake structure (SSES) and one downriver from the discharge diffuser (Bell Bend).

The Unit 1 reactor of the Susquehanna SES became operational on 1 September 1982. Data collected prior to that date were considered "preoperational" and data collected since were "operational." The objective of the operational studies was to monitor larval fish drift near the Susquehanna SES, and determine if the power plant had an impact on the drift at Bell Bend.

PROCEDURES

The SSES site was 220 m upriver from the Susquehanna SES intake structure, and the Bell Bend site was 930 m downriver from the discharge diffuser (Fig. D-1). Both sites were within 50 m of the west bank. The river at SSES was 0.8 m deeper than at Bell Bend. At SSES, river depth from May through August ranged from 3.6 to 8.2 m.

Samples were collected weekly in May and June, when peak abundance of larvae occurs, and biweekly in July and August, when there are relatively few larvae. No samples were collected in the last week of May because of high (>900 m^3/s) river flows. Sites were sampled simultaneously with high-capacity, gasoline-powered trash pumps on pontoon boats (methods described in Gale and Mohr 1978). Water was pumped through a 216-μ mesh net. Three replicate surface and bottom samples (5 min each) were taken at about 0900 and 2100 hours, starting at the surface.

The volume sampled in each replicate was determined by multiplying pumping duration by pumping rate (pumping rate was determined monthly by timing the filling of a 1,280-liter trough with the pump running at near

capacity). Tachometer readings were taken as pumping rate was calculated so that sample volume could be controlled to within about 1 m^3.

Samples were preserved in the field in 10% formalin with rose bengal added to stain the larvae. Fish were sorted from debris in white enamel pans in the laboratory. Larvae were identified using a dissecting microscope (10-70X) and the keys and descriptions in Buynak and Mohr (1980) and Lathrop (1982). Life stage terminology was according to Hubbs (1943). Prolarvae were fish with yolk and postlarvae were unscaled fish without yolk. Scaled fish and bullhead catfishes, 2.5 cm TL and larger, were considered to be juveniles and not reported. Specimens were stored in 10% formalin.

Larval fish data were analyzed using a four-way analysis of variance and a Hewlett-Packard 9830-A computer. Factors tested were dates, sites, times (day/night), depths (surface/bottom), and their first order interactions. Because replicate means were positively correlated with their variances, data were transformed (log X+1) prior to analysis.

RESULTS AND DISCUSSION

Density and Relative Abundance

A total of 1,981 larvae (96% prolarvae) of 16 species was collected from 3 May through 28 August (Tables D-1 through D-14). Seasonal fluctuations in larval fish density were similar at the two sampling sites. The annual mean larval fish density in 1984 (6.4 fish/10 m^3) was only slightly less than that found in 1983 (6.8 fish/10 m^3; Fig. D-2).

The annual mean density of larvae at SSES (5.8 fish/10 m^3) and Bell Bend (7.1 fish/10 m^3) was similar (Tables D-15 and D-16). About 92% of the total number of larvae at SSES was composed of common carp (31%), tessellated darter (31%), spottail shiner (13%), quillback (10%), and spotfin shiner (7%). At Bell Bend, nearly 93% of the total was made up of common carp (37%), tessellated darter (31%), quillback (13%), spottail shiner (7%), and spotfin shiner (5%). Since 1978, common carp, quillback, tessellated darter, and minnows (primarily spottail shiner and spotfin shiner) have composed from 85% to 93% of the total catch at both sites (Fig. D-2). The phenological occurrence of larval fishes in 1984 (Table D-17) was similar to that of previous years.

Larval fish drift (both stations combined) was unexpectedly low during the first five sampling periods (from 3 May to 5 June), and ranged from less than 0.1 to 4.3 fish/10 m^3 (mean = 1.2 fish/10 m^3). The paucity of larvae was probably due to lower than usual river temperatures and unusually high flows (Fig. D-3). Mean river temperature from 1 May to 5 June was only 13.3 C and spawning was probably delayed. From 1978 to 1983, larvae of species which compose most (Fig. D-2) of the drift (quillback, common carp, and tessellated darter) did not become abundant until river temperatures reached 15-20 C (usually in late May and early June). Scott and Crossman (1973) noted little spawning of common carp until water temperature was 17 C. Gale and Deutsch (1985) observed that tessellated darters began spawning at 12 C, but did not spawn frequently until temperatures reached about 15 C. The fact that cold water delays hatching would also contribute to a shortage of drifting larvae. River flows in early June (up to 3,200 m^3/s) were the highest observed in that period since 1978 (Fig. D-3). High flows not only destroy eggs and larvae by

abrasion and burial with river substrates, but also may disrupt spawning; the high flows would also decrease larval density by dilution (decreased number of fish per unit volume of water).

The high flows in early June probably had their greatest impact on quillback. Quillback have been primarily responsible for the sharp increase in total larval fish abundance from late May to early June 1978-83 (Fig. D-3), and have been the most numerous species in samples collected from 1978 to 1983 (Fig. D-2). From 1980 to 1983, peak density of quillback occurred between 18 May and 7 June (mean at both stations combined = 16.2 fish/10 m^3; range = 8.5 to 21.2 fish/10 m^3). In 1984, however, quillback density from 18 May to 12 June was very low, and ranged from less than 0.1 to only 5.6 fish/10 m^3. Annual mean density of quillback in 1984 (0.8 fish/10 m^3) was only about one third that found from 1980 to 1983 (1.6 to 3.2 fish/10 m^3; mean = 2.3 fish/ 10 m^3).

In contrast to quillback, common carp may have benefitted by high flows. When the river is high, low-lying shore areas with vegetation are flooded; such submerged vegetation is normally in short supply and the additional spawning habitat may contribute to strong common carp year classes. Scott and Crossman (1973) noted that common carp prefer to spawn in weedy or grassy, shallow water. Annual mean density of common carp in 1984 (2.2 fish/10 m^3) was nearly three-fold higher than found in 1980-83 (0.2 to 1.6 fish/10 m^3; mean = 0.8 fish/10 m^3). Peak density of the species occurred on 12 June (27.8 fish/10 m^3; Table D-17) and was much higher than peak densities found from 1980 to 1983 (1.8 to 18.6 fish/10 m^3; mean = 8.4 fish/10 m^3). For the first time since 1978, common carp was the most abundant species collected in larval

fish samples; it was three-fold more numerous than quillback (Fig. D-2). From 1980 to 1983, peak densities of common carp have occurred between 28 May and 15 June, from 7 to 15 days (mean = 9 days) after peak quillback densities. From 1-15 June, river flow markedly decreased from nearly 3,400 to less than 200 m^3/s, and river temperature rose sharply (Fig. D-3). This coincided with the abrupt appearance of common carp prolarvae (12 June) in high densities at both SSES (22.5 fish/10 m^3) and Bell Bend (33.1 fish/10 m^3).

Mean larval fish density fell from a peak of 49.5 fish/10 m^3 on 12 June (the highest density recorded since 1978) to 13.1 fish/10 m^3 on 19 June (Table D-17). For the remainder of the sampling season, mean densities were low and ranged from less than 0.1 to 8.2 fish/10 m^3.

Temporal and Spatial Distribution

Significantly more ($P<0.01$) larvae (all species combined) were collected at night (mean = 7.1 fish/10 m^3) than during the day (mean = 5.8 fish/10 m^3) (Tables D-18 through D-26). Similar results were found by Gale and Mohr (1978), and have been obtained in monitoring studies since 1978 (Mohr et al. 1979-82, Deutsch and Jacobsen 1983-84). As in 1979, 1980, and 1983 (Mohr et al. 1980-81, Deutsch and Jacobsen 1984), there was no significant difference ($P>0.05$) between the number of total larvae collected near the river surface (mean = 7.6 fish/10 m^3) and near the bottom (mean = 5.2 fish/10 m^3); however, significantly more ($P<0.01$) common carp, quillback, and spottail shiner were found near the surface (Table D-26). Maximum diel and depth differences in larval fish density may not have been detected in the 0900 and 2100 h samples. Diel studies by Gale and Mohr (1978) revealed that the greatest differences between surface and bottom catches occurred at 2400 h for most fishes.

An analysis of variance revealed no significant difference ($P>0.05$) between numbers of larvae at the two sampling sites (Table D-26). Spottail shiner was the only common species that was significantly ($P<0.01$) more abundant at one site (SSES) than the other.

No impact of the Susquehanna SES on density or composition of larval fish drift at Bell Bend was detected.

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Table D-1

Larval fishes collected in pump samples at SSES and Bell Bend on the Susquehanna River, 1978-84. An asterisk (*) denotes fishes taken in 1984. Names and order of listing conform to Robins et al. (1980).

Clupeidae - Herrings
Dorosoma cepedianum - gizzard shad

Cyprinidae - Carps and Minnows
**Cyprinus carpio* - common carp
Nocomis micropogon - river chub
**Notropis amoenus* - comely shiner
**N. hudsonius* - spottail shiner
**N. spilopterus* - spotfin shiner
Pimephales notatus - bluntnose minnow
Rhinichthys atratulus - blacknose dace

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

Ictaluridae - Bullhead Catfishes
Ictalurus catus - white catfish
I. natalis - yellow bullhead
**I. punctatus* - channel catfish
**Noturus insignis* - margined madtom

Centrarchidae - Sunfishes
**Ambloplites rupestris* - rock bass
Lepomis auritus - redbreast sunfish
L. gibbosus - pumpkinseed
**L. macrochirus* - bluegill
Lepomis spp. - sunfish spp.
Micropterus dolomieui - smallmouth bass
**Pomoxis* spp. - crappie spp.

Percidae - Perches
**Etheostoma olmstedi* - tessellated darter
**E. zonale* - banded darter
Perca flavescens - yellow perch
**Percina peltata* - shield darter
**Stizostedion vitreum vitreum* - walleye

Table D-2

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 3 May 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0932						2103-2137						0900-0934						2105-2145					
M^3/REPLICATE	8.9						8.9						10.2						10.2					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	001	002	003	004	005	006	013	014	015	016	017	018	007	008	009	010	011	012	019	020	021	022	023	024
SPECIES																								
WALLEYE PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

Table D-3

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 9 May 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0938						2100-2133						0900-0933						2100-2132					
M^3/REPLICATE	8.9						8.9						10.2						10.2					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	025	026	027	028	029	030	037	038	039	040	041	042	031	032	033	034	035	036	043	044	045	046	047	048
SPECIES																								
WHITE SUCKER PROLARVA	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	2	1	1
WALLEYE PROLARVA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
[illegible]	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	0	2	1	1

Table D-4

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 18 May 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0930-0963						2100-2132						0940-0019						2100-2135					
M^3/REPLICATE	9.6						9.6						10.2						10.2					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	049	050	051	052	053	054	061	062	063	064	065	066	055	056	057	058	059	060	067	068	069	070	071	072
SPECIES																								
QUILLBACK PROLARVA	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
WHITE SUCKER PROLARVA	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SHIELD DARTER PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
WALLEYE PROLARVA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	0	1	0	0	1	0	1	1	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0

Table D-5

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 21 May 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0933						2100-2133						0900-0934						2100-2141					
M^3/REPLICATE	10.0						10.0						10.2						10.2					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	073	074	075	076	077	078	085	086	087	088	089	090	079	080	081	082	083	084	091	092	093	094	095	096
SPECIES																								
QUILLBACK PROLARVA	2	2	0	0	2	0	1	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0
WHITE SUCKER PROLARVA	1	1	0	0	0	0	3	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER PROLARVA	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
TOTAL	3	3	0	0	2	0	5	2	7	0	1	0	0	0	1	0	0	0	0	2	0	0	1	0

Table D-6

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 5 June 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0938						2100-2133						0900-0935						2100-2134					
M^3/REPLICATE	10.3						10.3						10.0						10.0					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	097	098	099	100	101	102	109	110	111	112	113	114	103	104	105	106	107	108	115	116	117	118	119	120
SPECIES																								
SPOTTAIL SHINER PROLARVA	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
QUILLBACK PROLARVA	1	2	4	2	0	0	8	2	3	0	0	0	2	1	0	3	0	1	7	5	5	1	0	1
WHITE SUCKER POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORTHEAD REDHORSE PROLARVA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER PROLARVA	0	1	0	0	0	0	5	6	7	2	2	2	0	0	0	0	0	2	7	2	6	1	2	2
BANDED DARTER PROLARVA	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
TOTAL	1	3	4	2	1	0	14	8	11	3	4	2	3	2	0	3	0	3	15	7	11	2	2	3

Table D-7

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 12 June 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0933						2100-2132						0900-0933						2106-2143					
M^3/REPLICATE	9.4						10.3						10.0						10.0					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	121	122	123	124	125	126	133	134	135	136	137	138	127	128	129	130	131	132	139	140	141	142	143	144
SPECIES																								
COMMON CARP																								
PROLARVA	62	72	54	10	11	10	8	9	10	5	3	3	81	79	93	41	27	32	8	10	16	4	2	4
SPOTTAIL SHINER																								
PROLARVA	1	0	3	9	11	4	6	4	6	6	13	12	2	2	3	11	8	10	6	5	7	3	0	2
SPOTFIN SHINER																								
PROLARVA	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
QUILLBACK																								
PROLARVA	3	0	0	4	4	3	3	10	6	1	2	1	3	2	6	8	15	13	6	15	28	0	0	0
POSTLARVA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WHITE SUCKER																								
POSTLARVA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
SHORTHEAD REDHORSE																								
PROLARVA	1	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	1	4	0
POSTLARVA	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
SUCKER SPP.																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CRAPPIE SPP.																								
PROLARVA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER																								
PROLARVA	0	0	0	0	0	1	1	7	23	18	12	13	0	0	0	0	0	0	11	21	41	22	17	13
BANDED DARTER																								
PROLARVA	1	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	1	0	2	5	5	0	0	0
POSTLARVA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	1	0	2	4
SHIELD DARTER																								
PROLARVA	0	0	0	0	0	0	0	0	1	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	0	0	0	0	0
TOTAL	68	74	58	23	26	21	19	33	50	32	31	32	86	83	102	62	52	56	33	57	98	30	27	23

Table D-8

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 19 June 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0933						2100-2133						0900-0933						2100-2133					
M^3/REPLICATE	9.4						9.4						10.0						10.0					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	145	146	147	148	149	150	157	158	159	160	161	162	151	152	153	154	155	156	163	164	165	166	167	168
SPECIES																								
COMMON CARP																								
PROLARVA	1	0	0	0	0	0	1	3	1	1	0	1	0	0	1	0	0	0	0	3	2	0	0	1
COMELY SHINER																								
PROLARVA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER																								
PROLARVA	2	0	0	4	4	3	2	3	1	6	3	3	0	0	2	0	2	4	3	3	1	0	0	0
SPOTFIN SHINER																								
PROLARVA	2	1	1	1	2	2	3	0	2	0	0	1	0	0	1	1	1	2	2	2	1	1	0	1
QUILLBACK																								
PROLARVA	1	0	3	0	0	0	3	4	3	0	0	0	0	0	0	2	1	1	1	2	2	0	0	0
POSTLARVA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
WHITE SUCKER																								
POSTLARVA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
SHORTHEAD REDHORSE																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
BLUEGILL																								
POSTLARVA	0	1	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	0	3	5	14	18	19	10	3	0	0	1	1	1	1	4	7	15	21	26	19
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
BANDED DARTER																								
PROLARVA	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	2	2
TOTAL	6	2	4	5	7	9	15	24	26	28	14	8	0	0	6	4	5	9	11	17	21	28	30	25

Table D-9

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 26 June 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0932						2100-2134						0900-0934						2100-2134					
M^3/REPLICATE	10.1						10.0						10.0						10.0					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	169	170	171	172	173	174	181	182	183	184	185	186	175	176	177	178	179	180	187	188	189	190	191	192
SPECIES																								
COMMON CARP																								
PROLARVA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMELY SHINER																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER																								
PROLARVA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER																								
PROLARVA	1	1	0	2	3	2	1	0	1	1	1	1	0	0	1	3	1	0	1	1	3	0	0	1
QUILLBACK																								
PROLARVA	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2	1	3	0	0	0
POSTLARVA	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUCKER SPP.																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ROCK BASS																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER																								
PROLARVA	3	2	0	2	0	3	10	18	7	11	15	11	0	0	0	0	2	4	4	5	4	22	9	6
POSTLARVA	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0
BANDED DARTER																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2	2	2	0	1	0
POSTLARVA	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	6	1	4	6	6	11	18	9	12	22	15	0	0	1	5	4	5	9	9	12	22	10	7

Table D-10

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 3 July 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0932						2100-2137						0900-0935						2100-2134					
M^3/REPLICATE	10.3						10.3						10.0						10.0					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	193	194	195	196	197	198	205	206	207	208	209	210	199	200	201	202	203	204	211	212	213	214	215	216
SPECIES																								
COMMON CARP																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER																								
PROLARVA	1	0	0	1	1	0	1	0	1	0	0	0	0	1	2	0	0	0	0	1	1	0	0	0
QUILLBACK																								
PROLARVA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
SHORTHEAD REDHORSE																								
POSTLARVA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHANNEL CATFISH																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	3
MARGINED MADTOM																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
TESSELLATED DARTER																								
PROLARVA	0	0	0	0	0	0	2	5	4	3	0	1	0	0	0	1	0	0	5	1	2	3	0	1
POSTLARVA	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BANDED DARTER																								
PROLARVA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
POSTLARVA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTAL	1	1	0	1	2	1	3	5	7	3	0	2	0	2	3	1	0	2	6	2	4	3	1	5

Table D-11

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 17 July 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0933						2100-2134						0901-0936						2100-2132					
M^3/REPLICATE	9.8						9.8						9.8						9.8					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	217	218	219	220	221	222	229	230	231	232	233	234	223	224	225	226	227	228	235	236	237	238	239	240
SPECIES																								
SPOTFIN SHINER PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1
CHANNEL CATFISH POSTLARVA	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
TESSELLATED DARTER PROLARVA	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	4	4	7	2
BANDED DARTER POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	3	0	3	1	0	0	0	1	0	0	0	5	4	7	3

Table D-12

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 31 July 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0901-0938						2102-2136						0900-0932						2100-2135					
M^3/REPLICATE	8.9						9.2						10.5						9.8					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	241	242	243	244	245	246	253	254	255	256	257	258	247	248	249	250	251	252	259	260	261	262	263	264
SPECIES																								
SPOTFIN SHINER PROLARVA	0	0	0	1	0	1	4	4	0	1	0	3	0	0	1	0	0	1	5	1	5	1	0	0
CHANNEL CATFISH POSTLARVA	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	4
BLUEGILL PROLARVA	0	0	1	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	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1
BANDED DARTER POSTLARVA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
TOTAL	0	0	1	2	0	1	5	5	2	2	0	3	0	0	1	0	1	2	5	2	7	2	1	5

Table D-13

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 14 August 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0938						2100-2133						0900-0933						2100-2147					
M^3/REPLICATE	10.2						10.2						9.9						9.9					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	265	266	267	268	269	270	277	278	279	280	281	282	271	272	273	274	275	276	283	284	285	286	287	288
SPECIES																								
SPOTFIN SHINER PROLARVA	0	0	0	0	0	1	3	2	3	0	0	0	1	0	0	1	1	2	1	5	0	1	0	0
BANDED DARTER POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTAL	0	0	0	0	0	1	3	2	3	0	0	0	1	0	0	1	1	2	1	5	0	1	1	0

Table D-14

Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 28 August 1984.

SITE	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0932						2100-2133						0900-0933						2100-2140					
M^3/REPLICATE	10.2						10.2						9.9						9.9					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. WGD-84-	289	290	291	292	293	294	301	302	303	304	305	306	295	296	297	298	299	300	307	308	309	310	311	312
SPECIES																								
CHANNEL CATFISH POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Table D-15

Mean density (no./10 m³) of larval fish captured at SSES on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	22.49	0.71	0.08	0.00	0.00	0.00	0.00	0.00	1.79	31.2
COMELY SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.1
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.16	6.28	2.75	0.08	0.00	0.00	0.00	0.00	0.00	0.71	12.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.1
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.35	1.33	1.16	0.40	0.00	1.27	0.74	0.00	0.40	7.0
QUILLBACK															
PROLARVA	0.00	0.00	0.09	0.83	1.78	3.10	1.24	0.17	0.08	0.00	0.00	0.00	0.00	0.56	9.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.03	0.5
WHITE SUCKER															
PROLARVA	0.00	0.19	0.26	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	1.6
POSTLARVA	0.00	0.00	0.00	0.00	0.08	0.08	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.08	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.7
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.02	0.4
SUCKER SPP.															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.2
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.27	0.00	0.08	0.05	0.8
MARGINED MADTOM															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.01	0.1
ROCK BASS															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.1
BLUEGILL															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.01	0.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
CRAPPIE SPP.															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.33	2.02	6.08	6.38	6.83	1.21	0.09	0.18	0.00	0.00	1.79	30.9
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.08	0.00	0.00	0.00	0.00	0.03	0.4
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.16	0.42	0.27	0.08	0.08	0.00	0.00	0.00	0.00	0.08	1.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.08	0.09	0.33	0.08	0.17	0.09	0.00	0.00	0.06	1.1
SHIELD DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
WALLEYE															
PROLARVA	0.00	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.2
TOTAL	0.00	0.28	0.43	1.92	4.29	39.87	13.12	9.48	2.10	0.51	1.91	0.74	0.08	5.75	

Table D-16

Mean density (no./10 m') of larval fish captured at Bell Bend on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	33.08	0.58	0.00	0.17	0.00	0.00	0.00	0.00	2.60	36.7
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.17	4.92	1.25	0.08	0.00	0.00	0.00	0.00	0.00	0.49	7.0
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.08	1.00	0.92	0.42	0.26	1.18	1.01	0.00	0.37	5.3
QUILLBACK															
PROLARVA	0.00	0.00	0.08	0.25	2.17	8.00	0.75	0.50	0.08	0.00	0.00	0.00	0.00	0.91	12.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
WHITE SUCKER															
PROLARVA	0.00	0.49	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.6
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.17	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.5
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.2
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.60	0.00	0.00	0.08	1.1
MARGINED MADTOM															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.01	0.1
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.08	1.83	10.42	8.00	4.67	1.08	1.53	0.26	0.00	0.00	2.14	30.2
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.17	0.00	0.00	0.00	0.00	0.00	0.04	0.5
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.08	1.08	0.25	0.67	0.08	0.00	0.00	0.00	0.00	0.17	2.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.75	0.50	0.00	0.08	0.00	0.16	0.08	0.00	0.12	1.7
SHIELD DARTER															
PROLARVA	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
WALLEYE															
PROLARVA	0.08	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
TOTAL	0.08	0.65	0.25	0.33	4.25	59.08	13.00	7.00	2.42	1.79	2.19	1.09	0.00	7.09	

Table D-17

Mean density (no./10 m³) of larval fish captured at SSES and Bell Bend on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	27.79	0.65	0.04	0.08	0.00	0.00	0.00	0.00	2.20	34.2
COMELY SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.16	5.60	2.00	0.08	0.00	0.00	0.00	0.00	0.00	0.60	9.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.22	1.16	1.04	0.41	0.13	1.23	0.87	0.00	0.39	6.1
QUILLBACK															
PROLARVA	0.00	0.00	0.08	0.54	1.97	5.55	1.00	0.33	0.08	0.00	0.00	0.00	0.00	0.74	11.5
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.08	0.00	0.00	0.00	0.00	0.00	0.02	0.3
WHITE SUCKER															
PROLARVA	0.00	0.34	0.17	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	1.1
POSTLARVA	0.00	0.00	0.00	0.00	0.04	0.12	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.04	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.6
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.12	0.08	0.00	0.04	0.00	0.00	0.00	0.00	0.02	0.3
SUCKER SPP.															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.01	0.1
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.13	0.44	0.00	0.04	0.06	1.0
MARGINED MADTOM															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.01	0.1
ROCK BASS															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0
BLUEGILL															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1
CRAPPIE SPP.															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.21	1.93	8.25	7.19	5.75	1.15	0.81	0.22	0.00	0.00	1.96	30.6
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.21	0.04	0.00	0.00	0.00	0.00	0.03	0.5
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.12	0.75	0.26	0.38	0.08	0.00	0.00	0.00	0.00	0.12	1.9
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.42	0.29	0.17	0.08	0.09	0.12	0.04	0.00	0.09	1.5
SHIELD DARTER															
PROLARVA	0.00	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
WALLEYE															
PROLARVA	0.04	0.13	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
TOTAL	0.04	0.47	0.34	1.12	4.27	49.48	13.06	8.24	2.26	1.15	2.05	0.91	0.04	6.42	

Table D-18

Mean density (no./10 m³) of larval fish captured near the surface at 0900 h at SSES on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	66.67	0.35	0.33	0.00	0.00	0.00	0.00	0.00	5.18	79.1
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	1.42	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.16	2.5
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.35	1.42	0.66	0.32	0.00	0.00	0.00	0.00	0.21	3.2
QUILLBACK															
PROLARVA	0.00	0.00	0.00	1.33	2.27	1.06	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.47	7.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.4
WHITE SUCKER															
PROLARVA	0.00	0.00	0.35	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.2
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.02	0.4
BLUEGILL															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.03	0.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.4
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.32	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00	0.15	2.3
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.05	0.8
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.03	0.4
WALLEYE															
PROLARVA	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.4
TOTAL	0.00	0.00	0.69	2.00	2.59	70.92	4.26	3.63	0.65	0.00	0.37	0.00	0.00	6.55	

Table D-19

Mean density (no./10 m') of larval fish captured near the bottom at 0900 h at SSES on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	10.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	25.8
COMELY SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.8
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	8.51	3.90	0.33	0.00	0.00	0.00	0.00	0.00	0.98	29.9
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.71	1.77	2.31	0.65	0.00	0.75	0.33	0.00	0.50	15.3
QUILLBACK															
PROLARVA	0.00	0.00	0.35	0.67	0.65	3.90	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.45	13.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.05	1.5
WHITE SUCKER															
PROLARVA	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.9
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.8
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.03	0.9
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.35	1.06	1.65	0.00	0.00	0.00	0.00	0.00	0.24	7.2
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.02	0.8
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.35	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.7
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.02	0.8
TOTAL	0.00	0.37	0.35	0.67	0.97	24.82	7.45	5.28	1.29	0.00	1.12	0.33	0.00	3.28	

Table D-20

Mean density (no./10 m³) of larval fish captured near the surface at 2100 h at SSES on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	8.74	1.77	0.00	0.00	0.00	0.00	0.00	0.00	0.81	10.8
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.32	5.18	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.59	7.9
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.32	1.77	0.67	0.65	0.00	2.90	2.61	0.00	0.69	9.2
QUILLBACK															
PROLARVA	0.00	0.00	0.00	1.00	4.21	6.15	3.55	0.33	0.32	0.00	0.00	0.00	0.00	1.20	16.0
WHITE SUCKER															
PROLARVA	0.00	0.00	0.69	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	3.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.06	0.7
CRAPPIE SPP.															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	1.33	5.83	10.03	13.12	11.67	3.56	0.00	0.36	0.00	0.00	3.53	47.3
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.32	0.97	0.71	0.00	0.32	0.00	0.00	0.00	0.00	0.18	2.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.03	0.4
SHIELD DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.3
WALLEYE															
PROLARVA	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.4
TOTAL	0.00	0.37	0.69	4.67	10.68	33.01	23.05	12.67	4.85	0.00	4.35	2.61	0.00	7.46	

Table D-21

Mean density (no./10 m³) of larval fish captured near the bottom at 2100 h at SSES on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	3.56	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.33	5.8
COMELY SHINER															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.03	0.4
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.32	10.03	4.26	0.00	0.00	0.00	0.00	0.00	0.00	1.12	19.7
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.03	0.4
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.35	1.00	0.00	0.00	1.45	0.00	0.00	0.22	3.8
QUILLBACK															
PROLARVA	0.00	0.00	0.00	0.33	0.00	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	2.2
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.5
WHITE SUCKER															
PROLARVA	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.5
POSTLARVA	0.00	0.00	0.00	0.00	0.32	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.9
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.9
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.9
SUCKER SPP.															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.05	0.9
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.00	0.00	0.33	0.10	1.8
MARGINED MADTOM															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.02	0.4
ROCK BASS															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.03	0.4
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	1.94	13.92	11.35	12.33	1.29	0.34	0.36	0.00	0.00	3.20	56.0
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.03	0.4
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.05	0.9
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.32	0.35	1.00	0.00	0.68	0.00	0.00	0.00	0.18	3.2
TOTAL	0.00	0.37	0.00	0.33	2.91	30.74	17.73	16.33	1.62	2.04	1.81	0.00	0.33	5.71	

Table D-22

Mean density (no./10 m') of larval fish captured near the surface at 0900 h at Bell Bend on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	84.33	0.33	0.00	0.67	0.00	0.00	0.00	0.00	6.56	87.1
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.33	2.33	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.26	3.4
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	1.00	0.00	0.32	0.34	0.00	0.18	2.4
QUILLBACK															
PROLARVA	0.00	0.00	0.00	0.33	1.00	3.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	5.1
WHITE SUCKER															
PROLARVA	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.3
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.34	0.00	0.00	0.00	0.05	0.7
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.33	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.7
SHIELD DARTER															
PROLARVA	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.3
TOTAL	0.00	0.00	0.65	0.33	1.67	90.33	2.00	0.33	1.67	0.34	0.32	0.34	0.00	7.54	

Table D-23

Mean density (no./10 m³) of larval fish captured near the bottom at 0900 h at Bell Bend on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56	45.3
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	9.67	2.00	0.33	0.00	0.00	0.00	0.00	0.00	0.92	16.3
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.33	1.33	1.33	0.00	0.34	0.32	1.35	0.00	0.38	6.8
QUILLBACK															
PROLARVA	0.00	0.00	0.00	0.00	1.33	12.00	1.33	0.00	0.00	0.00	0.00	0.00	0.00	1.13	19.9
WHITE SUCKER															
PROLARVA	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.9
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.03	0.5
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.67	0.00	1.00	2.00	0.33	0.00	0.00	0.00	0.00	0.31	5.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.05	0.9
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.08	1.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.33	0.00	0.63	0.00	0.00	0.13	2.2
SHIELD DARTER															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.5
TOTAL	0.00	0.65	0.00	0.00	2.00	56.67	6.00	4.67	1.00	0.34	0.95	1.35	0.00	5.66	

Table D-24

Mean density (no./10 m³) of larval fish captured near the surface at 2100 h at Bell Bend on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	11.33	1.67	0.00	0.00	0.00	0.00	0.00	0.00	1.00	11.4
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.33	6.00	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.67	7.6
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	1.67	1.67	0.67	0.34	3.74	2.02	0.00	0.78	8.8
QUILLBACK															
PROLARVA	0.00	0.00	0.33	0.33	5.67	16.33	1.67	2.00	0.33	0.00	0.00	0.00	0.00	2.05	23.3
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.3
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.68	0.00	0.00	0.08	0.9
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.33	5.00	24.33	8.67	4.33	2.67	1.36	0.34	0.00	0.00	3.62	41.1
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	4.00	0.33	2.00	0.00	0.00	0.00	0.00	0.00	0.49	5.5
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.3
WALLEYE															
PROLARVA	0.33	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.9
TOTAL	0.33	0.65	0.33	0.65	11.00	62.67	16.33	10.00	4.00	1.70	4.76	2.02	0.00	8.80	

Table D-25

Mean density (no./10 m³) of larval fish captured near the bottom at 2100 h at Bell Bend on the Susquehanna River, 1984.

SPECIES	3 MAY	9 MAY	18 MAY	23 MAY	5 JUN	12 JUN	19 JUN	26 JUN	3 JUL	17 JUL	31 JUL	14 AUG	28 AUG	MEAN	% TOTAL
COMMON CARP															
PROLARVA	0.00	0.00	0.00	0.00	0.00	3.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.28	4.4
SPOTTAIL SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	2.0
SPOTFIN SHINER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.34	0.34	0.34	0.00	0.16	2.4
QUILLBACK															
PROLARVA	0.00	0.00	0.00	0.33	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.2
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.4
WHITE SUCKER															
PROLARVA	0.00	1.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.6
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.67	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.2
SHORTHEAD REDHORSE															
PROLARVA	0.00	0.00	0.00	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	2.0
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.8
CHANNEL CATFISH															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.70	0.00	0.00	0.21	3.3
MARGINED MADTOM															
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.03	0.4
TESSELLATED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	1.67	17.33	22.00	12.33	1.33	4.42	0.68	0.00	0.00	4.60	72.5
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.6
BANDED DARTER															
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.05	0.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	0.34	0.00	0.33	5.3
TOTAL	0.00	1.31	0.00	0.33	2.33	26.67	27.67	13.00	3.00	4.76	2.72	0.67	0.00	6.34	

Table D-26

Results (F values) of six analysis of variance tests comparing larval fish densities among replicates, dates (1), sites (2), times (3), and depths (4), on the Susquehanna River, 1984 (* = P<0.05, ** = P<0.01, and N.S. = not significant).

SPECIES	MAIN EFFECTS					INTERACTION EFFECTS						BARTLETT'S TEST[a]
	REPLICATES	1	2	3	4	1 X 2	1 X 3	2 X 3	1 X 4	2 X 4	3 X 4	
DF	(2,206)	(12,206)	(1,206)	(1,206)	(1,206)	(12,206)	(12,206)	(1,206)	(12,206)	(1,206)	(1,206)	
COMBINED	1.07	161.96**	0.00**	107.28**	2.24	3.13**	10.80**	1.13	6.35**	7.12	13.53**	N.S.
COMMON CARP	0.87	733.44**	2.34	47.06**	66.53**	3.72	81.24**	4.48*	30.67**	0.06	1.27	N.S.
SPOTTAIL SHINER	0.76	138.14**	6.87**	1.18	7.64**	3.51**	0.54	8.55**	3.79**	16.44**	22.14**	N.S.
SPOTFIN SHINER	2.53	20.32**	0.21	1.67	2.51	0.76	3.03**	0.48	1.54	0.47	32.23**	N.S.
QUILLBACK	0.12	67.96**	0.25	3.24	37.97**	2.39**	1.88*	0.35	6.70**	0.04	67.89**	N.S.
TESSELLATED DARTER	0.86	77.16**	0.83	381.27**	1.50	2.64**	43.55**	0.90	3.37**	5.23*	1.91	N.S.

[a]N.S. indicated that variances among data were adequately homogeneous for significance testing.

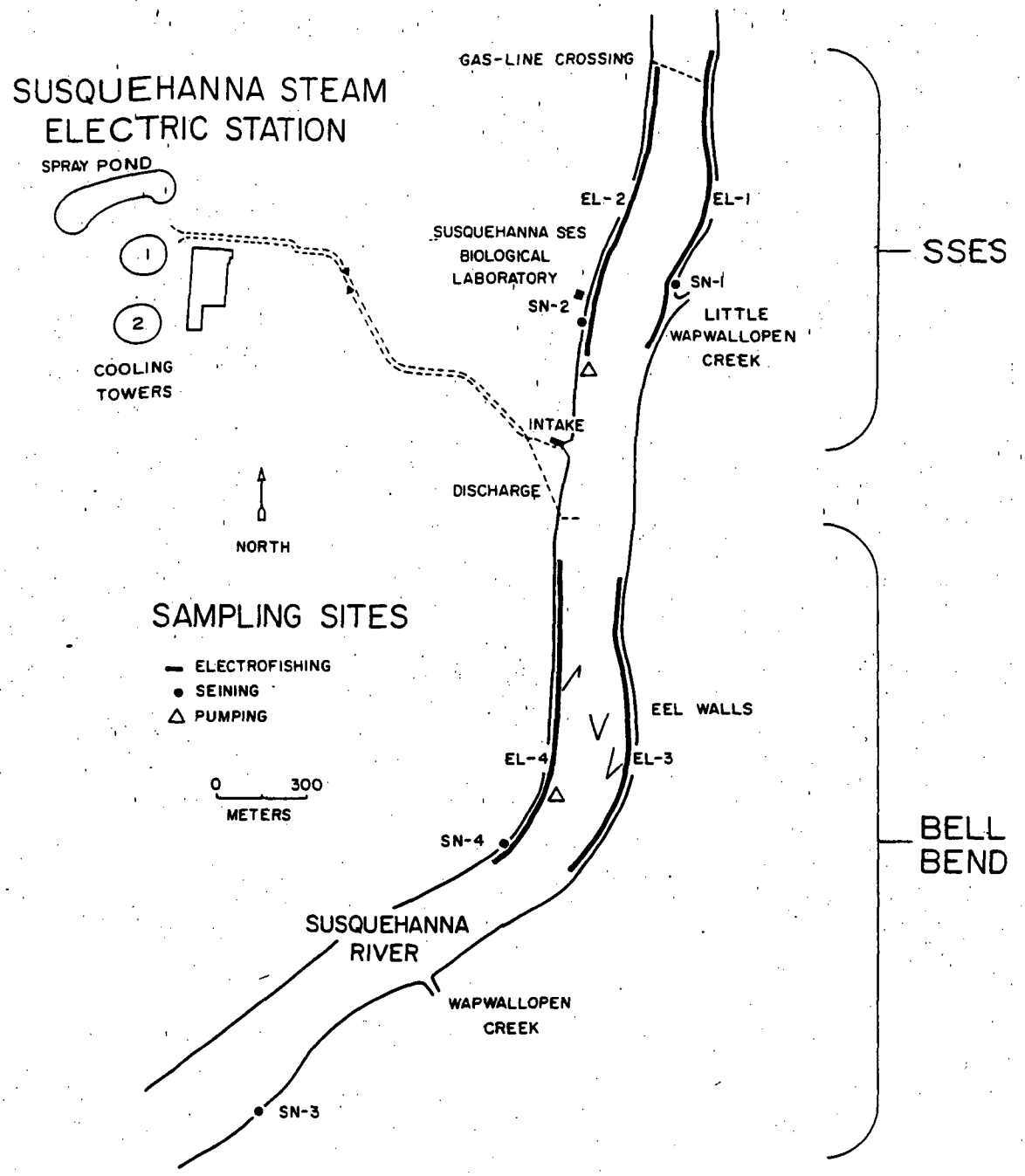

Fig. D-1

Sampling sites for pumping larval fish, electrofishing (EL), and seining (SN) at SSES and Bell Bend on the Susquehanna River, 1984.

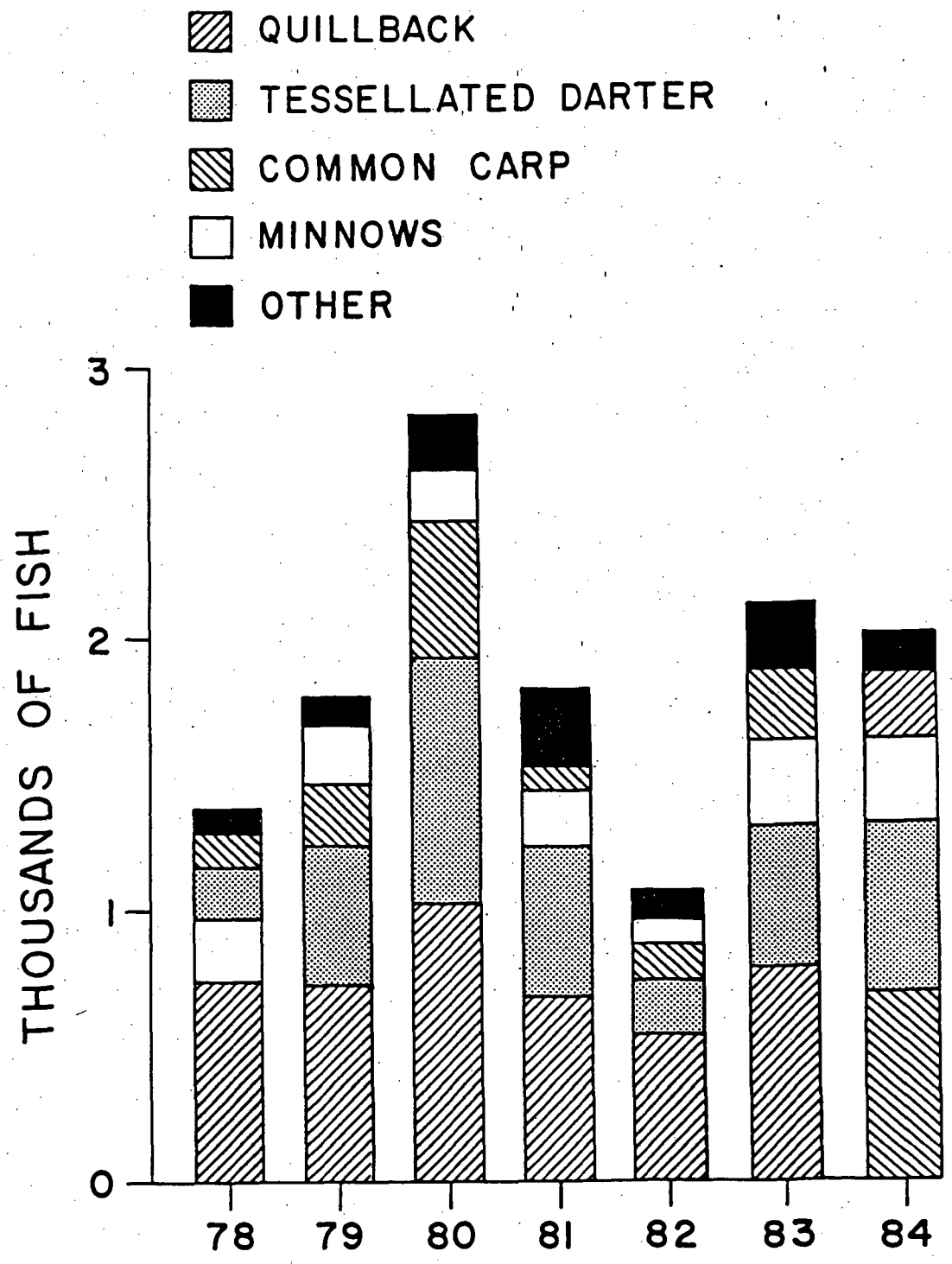

Fig. D-2

The adjusted total number (sum of the number of fish/10 m^3 in each sample) of larval fish collected at SSES and Bell Bend on the Susquehanna River, 1978-84.

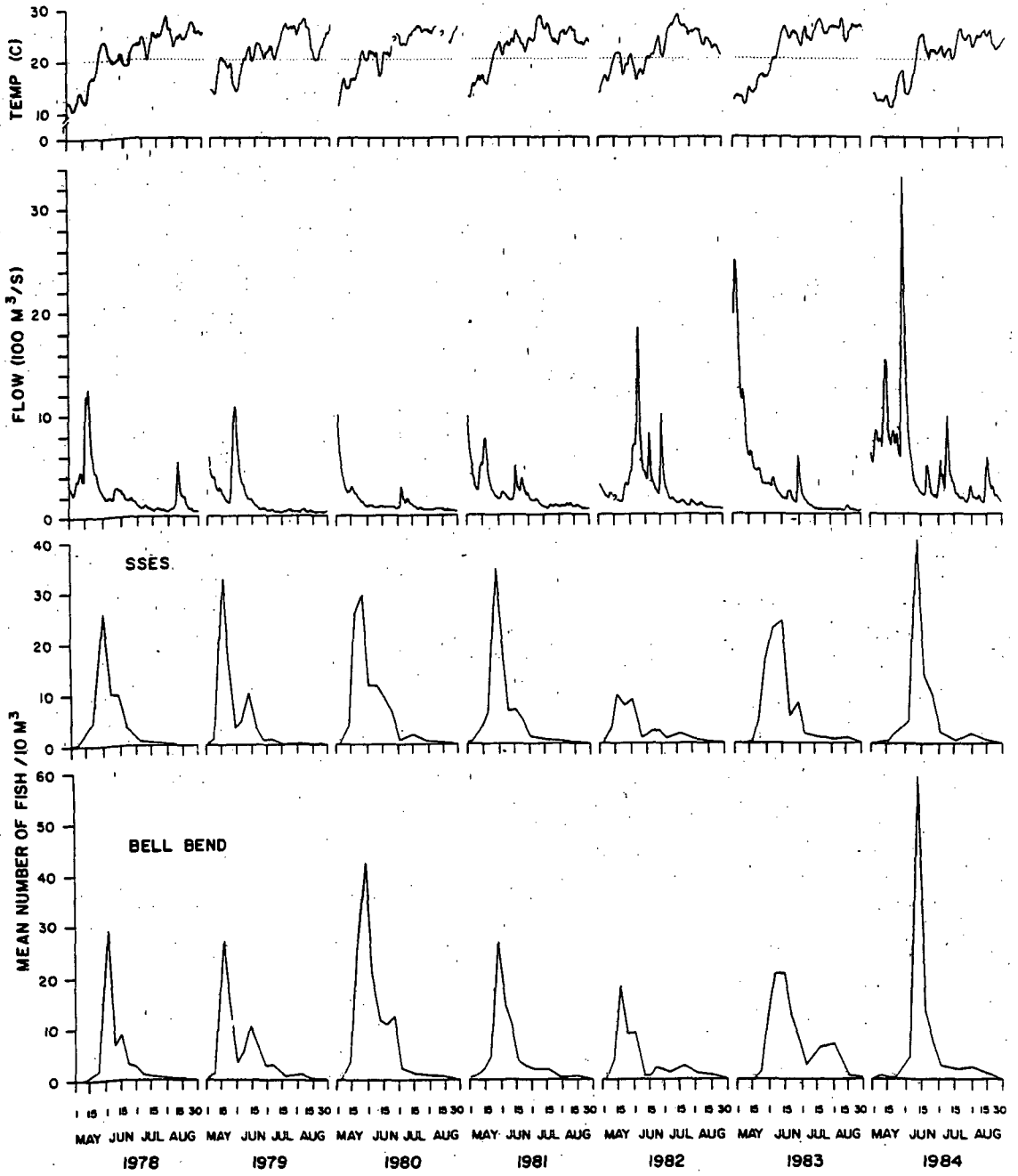

Fig. D-3

Mean density of larval fish (no./10 m^3) captured at SSES and Bell Bend on the Susquehanna River, with daily mean river temperature and flow, 1978-84.

FISHES

by

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TABLE OF CONTENTS

Page

ABSTRACT..... 152

INTRODUCTION..... 152

PROCEDURES
Electrofishing..... 153
Seining..... 154

RESULTS AND DISCUSSION
Electrofishing..... 155
Seining..... 157

REFERENCES CITED..... 158

LIST OF TABLES

Table

E-1 Descriptions of electrofishing (EL) and seining (SN) sites at SSES and Bell Bend on the Susquehanna River, 1984..... 161

E-2 Fishes that were observed or collected while electrofishing and seining at SSES and Bell Bend on the Susquehanna River, 1971-84... 162

E-3 Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 19 March 1984..... 163

E-4 Number . . . 30 April 1984..... 163

Table		Page
E-5	Number . . . 21 May 1984	164
E-6	Number . . . 20 June 1984	164
E-7	Number . . . 10 July 1984	165
E-8	Number . . . 27 August 1984	165
E-9	Number . . . 18 September 1984	166
E-10	Number . . . 17 October 1984	166
E-11	Number . . . 7 November 1984	167
E-12	Number . . . 5 December 1984	167
E-13	Mean number of fish observed per unit effort while electrofishing at SSES on the Susquehanna River, 1984	168
E-14	Mean . . . at Bell Bend . . . 1984	168
E-15	Number of fish captured by seining at SSES and Bell Bend on the Susquehanna River, 12 June 1984	169
E-16	Number . . . 17 July 1984	169
E-17	Number . . . 14 August 1984	170
E-18	Number . . . 25 September 1984	170
E-19	Number . . . 15 October 1984	171
E-20	Mean number of fish captured per unit effort in seining hauls at SSES on the Susquehanna River, 1984	171
E-21	Mean . . . at Bell Bend . . . 1984	171

LIST OF FIGURES

Fig.		
E-1	The annual mean number of fish observed per unit effort while electrofishing at SSES and Bell Bend on the Susquehanna River, 1978-84	172
E-2	The annual mean number of minnows and darters captured per unit effort by seining at SSES and Bell Bend on the Susquehanna River, 1978-84	173

ABSTRACT

Fish about 10 cm total length and larger were sampled monthly with an electrofisher at SSES and Bell Bend from March through December. Of the 2,748 specimens observed (24 species and one hybrid), quillback, white sucker, northern hog sucker, shorthead redhorse, and smallmouth bass composed 61%. The annual mean number of fish observed per unit effort at SSES (41) was significantly greater ($P<0.01$) than at Bell Bend (28), mostly due to greater number of northern hog sucker.

Fish (no size limit) were sampled monthly with a 7.6-m bag seine at SSES and Bell Bend from June through October. Spottail shiner, spotfin shiner, and bluntnose minnow composed 87% of the 1,214 specimens (19 species) captured. There was no significant difference ($P>0.01$) in the average number of fish captured per unit effort at SSES (81) and Bell Bend (40) in 1984.

No impact of the Susquehanna SES on the fish community at Bell Bend was detected.

INTRODUCTION

Seasonal fluctuations in species composition and relative abundance of fishes near the Susquehanna SES were monitored from 1971 to September 1982 to establish a baseline of preoperational conditions (Ichthyological Associates 1972; Ichthyological Associates, Inc. 1973-74; Buynak and Gurzynski 1976a-b, 1977a-b; Buynak et al. 1978a-b, 1979-82; Deutsch et al. 1983). Prior to 1976, fish were sampled from several stations, covering about 115 river km (Falls to Danville, Pennsylvania). From 1976 to the present, the study area was

confined to one station upriver from the intake structure (SSES) and one downriver from the discharge diffuser (Bell Bend) (Fig. D-1). The Susquehanna SES became operational on 1 September 1982. Operational studies began at that time (Deutsch et al. 1983, 1984); the objective was to determine if the power plant had an impact on the fish community at Bell Bend.

PROCEDURES

Electrofishing

The SSES and Bell Bend sampling stations were electrofished at two sites (east and west river bank). Each site was a 1000-m long (Table E-1; Fig. D-1). Sites were sampled within 50 m from the river bank, except during periods of low river level (less than 148.5 m above msl). During periods of low river level, sampling was conducted as close to the river bank as possible. In one stretch of the riffle at SSES, the river sometimes became so shallow in summer that we could not approach closer than 100 m from shore, along the east bank; consequently, the east and west bank runs overlapped in the channel, and the same area was sampled twice.

Fish were sampled monthly from March through December, when river levels at the Susquehanna SES Biological Laboratory were less than 150.3 m above msl. Turbidity and current velocity are too great at river levels higher than 150.3 m above msl for electrofishing to be effective .

The electrofisher was similar to that described by Novotny and Priegel (1974); it consisted of a 4-KV generator (direct current) and a variable voltage pulsator in a 6-m flat-bottomed boat powered by an outboard motor. Fish were sampled once during the day (beginning about 3 hours after sunrise)

and once at night (beginning about 1 hour after sunset) by moving slowly downriver with the electrofisher. Sampling sequences were randomly determined. Each 1,000-m run was considered one unit of effort, and took about 20 minutes to complete.

Stunned fish about 10 cm total length and larger were identified and counted by two observers at the bow of the boat. The few specimens which surfaced near the stern of the boat were identified and counted by the boat operator. One observer recorded data using a cassette tape recorder while the sampling run was in progress. Most of the fish that could not be identified to species in the water were netted, identified, and released; some escaped and were identified to the lowest taxon possible.

Seining

Fish (no size limits) were collected with a 7.6-m bag seine (6-mm mesh) at one site near each river bank of the SSES and Bell Bend sampling stations (Table E-1, Fig. D-1). Samples were taken monthly at each site from June through October, when river level at the laboratory was less than 149.4 m above msl. In April and May, the river level was too high for seining. Seining began about one hour after sunset, and required about 15 minutes at each site. Sampling sequences were randomly determined.

To sample, one seine brail was held on the river bank while the seine was taken into the river to a distance of about 6 m, if not limited sooner by depth. The brail on the river bank was held stationary while the seine was pulled upriver and then to shore. Two replicate hauls were made at the same location at each site. The catches from both hauls were combined and

considered one unit of effort. Fish were preserved in 10% formalin. In the laboratory, all specimens were identified, counted, then separated by species and stored in 40% isopropyl alcohol.

RESULTS AND DISCUSSION

Electrofishing

A total of 2,748 specimens of 24 species and one hybrid was observed while electrofishing at SSES and Bell Bend (Tables E-2 through E-12). Quillback, white sucker, northern hog sucker, shorthead redhorse, and smallmouth bass composed 66% of the total number observed per unit effort at SSES and 55% at Bell Bend (mean 61%) (Tables E-13 and E-14). Common carp and walleye were also common at both SSES and Bell Bend. A striped bass x white bass hybrid (*Morone saxatilis x M. crysops*) was collected at Bell Bend in September, the first time the hybrid has been collected in the study area. It was introduced to the Susquehanna River (Conowingo Pool) and other rivers and lakes in the state by the Pennsylvania Fish Commission (PFC) (News Release, PFC, 18 October 1984).

The mean number of fish observed per unit effort in 1984 (41 at SSES; 28 at Bell Bend; mean = 34; Tables E-13 and E-14) was 37% less than in 1983 (64 at SSES; 45 at Bell Bend; mean = 54). If only data from months when fish were sampled in both years (March, May, and July through November) are compared, the mean number of fish in 1984 (40) was 26% less than in 1983 (54). There was a reduction in the number of fish in nearly all major groups (Fig. E-1). Because fewer fish were observed at both stations, it does not seem that the reduction in numbers at Bell Bend was caused by the Susquehanna SES. In fact,

the actual number of fish at SSES and Bell Bend may have been similar to 1983. Construction upriver in New York State periodically caused extremely high river turbidity in 1984 (see "Physicochemical Analyses") and reduced electrofishing effectiveness by impairing the observer's ability to see fish (discussed by Reynolds 1983).

The average number of specimens observed per unit effort ranged from 8 in December to 76 in September at SSES, and from 10 in December to 55 in October at Bell Bend (Tables E-13 and E-14). The mean number of fish observed per unit effort at SSES (41) was significantly greater ($P<0.01$) than at Bell Bend (28); more fish were observed at SSES than at Bell Bend in every month sampled except December. Significantly more fish per unit effort were observed at SSES than at Bell Bend in 1983; from 1980 to 1982 differences in mean numbers observed at the two stations were not significant ($P>0.01$).

Habitat differences between SSES and Bell Bend seemed to affect the abundance of certain species. As in previous years, northern hog suckers were much more numerous at SSES (10 fish/unit effort) than at Bell Bend (3 fish/unit effort), probably due to the preferred riffle habitat and gravel substrate at SSES East. Scott and Crossman (1973) noted that northern hog suckers inhabit the riffles and adjacent pools of warm, clear, shallow streams with gravel to rubble substrates. Numbers of northern hog suckers, and other species that inhabit riffles, may have been overestimated at SSES in periods of low flow, when east and west bank electrofishing runs overlapped in the swift waters of the river channel.

The relative abundance of northern hog sucker at SSES has increased steadily over the last four years, from 3% in 1981 to 24% (the most abundant

species) in 1984 (Table E-13). The greater abundance of this species at SSES was the primary reason for the significantly greater numbers of total fish observed there in 1984. A similar, but less pronounced, increase in numbers of northern hog sucker has occurred at Bell Bend (from less than 1% in 1981 to 11% in 1984). The general increase in abundance of this species in the study area may reflect improvement in water quality over the last several years (Soya et al. 1984). In 1973 (Ichthyological Associates, Inc., 1974), northern hog suckers were common at the relatively clean-water station at Falls, Pennsylvania, but were seldom found at SSES.

Results of the 1984 electrofishing study revealed no impact of the Susquehanna SES on the fish community at Bell Bend.

Seining

A total of 1,214 specimens of 19 species was captured by seining at SSES and Bell Bend (Tables E-2 and E-15 through E-19). Of the 18 species at SSES and 12 species at Bell Bend, spottail shiner, spotfin shiner, and bluntnose minnow were most abundant. They composed 90% and 81% of the total catch at SSES and Bell Bend, respectively (Tables E-20 and E-21).

The number of fish captured per unit effort ranged from 8 in October to 214 in June at SSES, and from 20 in September to 58 in June at Bell Bend (Tables E-20 and E-21). There was no significant difference ($P>0.01$) in the annual mean number of fish collected at SSES (81) and Bell Bend (40). Many more fish were captured at SSES than at Bell Bend in June and July, but numbers were higher at Bell Bend than at SSES in August through October.

Overall, minnows and darters composed 90% of the total number of fish collected. Mean number of minnows and darters captured per unit effort in 1984 (75 at SSES; 35 at Bell Bend; mean = 55) was 61% less than that found in 1983 (191 and 93 at SSES and Bell Bend, respectively, mean = 142). There was a reduction in numbers of fish of all major species (Fig. E-2). The mean number of fish per unit effort at both stations in 1984, however, was within the range of annual means observed during the previous six years. From 1978 to 1984, the annual mean catch per effort of minnows and darters at SSES has fluctuated randomly (rank correlation = .14; $P>0.05$), from 54 fish per unit effort in 1979 to 191 in 1983. Mean catch per effort at Bell Bend has steadily decreased since 1981, and fell to a level in 1984 similar to those observed in 1978-80 (Fig. E-2). Because a decline in fish abundance also occurred at the control station (SSES) in 1984, there is no reason to believe that low numbers at Bell Bend were caused by the Susquehanna SES.

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Table E-1

Descriptions of electrofishing (EL) and seining (SN) sites at SSES and Bell Bend on the Susquehanna River, 1984.

Site	Location
	SSES
EL-1	East bank, 130 m upriver from gas-line crossing to 330 m upriver from a point opposite the center of the Susquehanna SES intake structure
EL-2	West bank from gas-line crossing to a point 250 m upriver from the center of the Susquehanna SES intake structure
SN-1	East bank, 560 m upriver from a point opposite the center of the Susquehanna SES intake structure (10 m upriver from the mouth of Little Wapwallopen Creek)
SN-2	West bank, 400 m upriver from the center of the Susquehanna SES intake structure (100 m downriver from the boat dock at the Susquehanna SES Biological Laboratory)
	BELL BEND
EL-3	East bank, 390 m downriver from a point opposite the Susquehanna SES intake structure to a point 500 m upriver from the mouth of Wapwallopen Creek
EL-4	West bank, 380 m downriver from the Susquehanna SES intake structure (170 m downriver from the discharge diffuser) to a point near the southeastern boundary of PP&L's Wetlands Nature Area
SN-3	East bank, 2.6 km downriver from a point opposite the Susquehanna SES intake structure, at the launching ramp of the Berwick Boat Club
SN-4	West bank, 1.3 km downriver from the Susquehanna SES intake structure, near the southeastern boundary of PP&L's Wetlands Nature Area

Table E-2

Fishes that were observed or collected while electrofishing and seining at SSES and Bell Bend on the Susquehanna River, 1971-84. An asterisk (*) denotes fishes taken in 1984. Names of fishes and the order of listing conform to Robins et al. (1980).

Anguillidae - Freshwater Eels
* *Anguilla rostrata* - American eel

Clupeidae - Herrings
Alosa sapidissima - American shad
Dorosoma cepedianum - gizzard shad

Salmonidae - Trouts
Coregonus artedii - cisco
Salmo gairdneri - rainbow trout
* *S. trutta* - brown trout

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

Cyprinidae - Carps and Minnows
Campostoma anomalum - central stoneroller
* *Cyprinus carpio* - common carp
Exoglossum maxillingua - cutlips minnow
Nocomis micropogon - river chub
* *Notemigonus crysoleucas* - golden shiner
* *Notropis amoenus* - comely shiner
N. cornutus - common shiner
* *N. hudsonius* - spottail shiner
N. procne - swallowtail shiner
N. rubellus - rosyface shiner
* *N. spilopterus* - spotfin shiner
* *Pimephales notatus* - bluntnose minnow
Rhinichthys atratulus - blacknose dace
R. cataractae - longnose dace
Semotilus atromaculatus - creek chub
* *S. corporalis* - fallfish

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

Ictaluridae - Bullhead Catfishes
* *Ictalurus catus* - white catfish
I. natalis - yellow bullhead
* *I. nebulosus* - brown bullhead
* *I. punctatus* - channel catfish
Noturus insignis - margined madtom

Cyprinodontidae - Killifishes
Fundulus diaphanus - banded killifish

Percichthyidae - Temperate Basses
* *Morone saxatilis x M. chrysops* - striped bass-white bass hybrid

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

Percidae - Perches
* *Etheostoma olmstedi* - tessellated darter
E. zonale - banded darter
* *Perca flavescens* - yellow perch
Percina peltata - shield darter
* *Stizostedion vitreum vitreum* - walleye

Cottidae - Sculpins
Cottus bairdi - mottled sculpin

Table E-3

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 19 March 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	JLM-84-003	JLM-84-005	JLM-84-004	JLM-84-006	JLM-84-002	JLM-84-007	JLM-84-001	JLM-84-008
TIME	1007-1023	1922-1937	1029-1042	1954-2006	0937-0952	2010-2024	0912-0929	2030-2048
SPECIES								
MUSKELLUNGE	0	2	0	0	0	0	0	0
PIKE SPP.	0	0	0	0	1	0	0	0
COMMON CARP	0	15	1	0	0	2	0	2
FALLFISH	1	1	0	0	0	2	1	3
QUILLBACK	0	0	0	0	0	3	0	0
WHITE SUCKER	21	45	11	13	12	30	9	25
NORTHERN HOG SUCKER	1	1	1	5	0	1	0	1
SHORTHEAD REDHORSE	2	1	4	1	0	0	0	2
SUCKER SPP.	0	0	0	0	2	0	0	0
LARGEMOUTH BASS	0	0	0	0	1	0	0	0
WALLEYE	0	22	0	4	0	0	0	0
FISH (UNIDENTIFIED)	3	0	2	1	0	6	0	1
TOTAL	28	87	19	24	16	44	10	34

Table E-4

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 30 April 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	JLM-84-011	JLM-84-014	JLM-84-012	JLM-84-013	JLM-84-010	JLM-84-015	JLM-84-009	JLM-84-016
TIME	1014-1030	2139-2155	1035-1047	2117-2133	0941-1001	2159-2215	0914-0933	2200-2218
SPECIES								
NORTHERN PIKE	0	0	0	0	0	0	0	1
PIKE SPP.	0	0	0	0	0	0	1	0
COMMON CARP	1	0	3	3	1	1	10	1
FALLFISH	0	4	0	2	0	0	0	2
QUILLBACK	3	7	37	10	0	0	7	3
WHITE SUCKER	0	12	1	10	0	0	1	13
NORTHERN HOG SUCKER	0	1	0	2	0	0	0	2
SHORTHEAD REDHORSE	7	10	5	18	0	0	0	7
BROWN BULLHEAD	0	0	0	0	1	0	0	0
ROCK BASS	0	1	0	7	0	2	1	9
SMALLMOUTH BASS	0	0	0	3	0	0	1	0
WALLEYE	0	3	0	1	0	0	0	7
FISH (UNIDENTIFIED)	3	3	5	6	0	2	5	5
TOTAL	14	41	51	62	2	5	26	50

Table E-5

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 21 May 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	JLM-84-019	JLM-84-022	JLM-84-020	JLM-84-021	JLM-84-018	JLM-84-023	JLM-84-017	JLM-84-(
TIME	1005-1023	2153-2213	1034-1049	2132-2146	0922-0941	2224-2245	0855-0914	2252-2:
SPECIES								
BROWN TROUT	0	0	1	0	0	0	0	0
MUSKELLUNGE	0	1	0	0	0	0	0	0
COMMON CARP	0	0	0	1	0	0	3	0
FALLFISH	0	4	0	0	0	0	2	1
QUILLBACK	5	7	0	0	0	0	5	0
WHITE SUCKER	0	5	0	0	0	0	1	0
SHORTHEAD REDHORSE	2	5	2	1	0	3	9	1
SUCKER SPP.	0	4	0	0	0	0	0	0
BROWN BULLHEAD	0	0	0	0	0	0	1	0
ROCK BASS	0	1	0	0	0	0	1	1
SMALLMOUTH BASS	0	2	0	1	1	0	2	1
WALLEYE	0	5	0	1	0	0	3	0
FISH (UNIDENTIFIED)	0	6	1	0	1	0	4	1
TOTAL	7	40	4	4	2	3	31	5

Table E-6

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 20 June 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	JLM-84-029	JLM-84-036	JLM-84-030	JLM-84-035	JLM-84-032	JLM-84-033	JLM-84-031	JLM-84-(
TIME	0900-0917	2330-2348	0922-0934	2311-2323	1018-1031	2149-2203	0937-0954	2211-2:
SPECIES								
AMERICAN EEL	0	0	0	1	0	0	0	0
NORTHERN PIKE	0	0	0	0	1	0	0	0
MUSKELLUNGE	0	0	0	0	1	1	1	0
CHAIN PICKEREL	0	0	1	0	0	0	0	0
COMMON CARP	19	13	3	0	3	3	6	1
QUILLBACK	1	0	3	0	0	1	0	1
WHITE SUCKER	2	0	1	2	1	2	2	3
NORTHERN HOG SUCKER	1	0	0	0	0	0	2	0
SHORTHEAD REDHORSE	4	5	12	10	2	1	0	3
WHITE CATFISH	1	0	0	0	0	0	0	0
CHANNEL CATFISH	0	2	0	0	0	0	2	1
CATFISH SPP.	0	1	0	0	0	0	0	0
ROCK BASS	1	2	2	0	0	1	1	1
PUMPKINSEED	1	0	0	0	0	0	0	0
BLUEGILL	0	0	0	0	0	1	0	0
SMALLMOUTH BASS	1	2	1	0	2	2	3	0
WALLEYE	0	6	1	2	0	3	0	1
FISH (UNIDENTIFIED)	5	8	3	3	4	6	3	5
TOTAL	36	39	27	18	14	21	20	16

Table E-7

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 10 July 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	JLM-84-039	JLM-84-042	JLM-84-040	JLM-84-041	JLM-84-038	JLM-84-043	JLM-84-037	JLM-84-044
TIME	1023-1040	2154-2208	1046-1058	2137-2147	0925-0938	2218-2226	0904-0918	2230-2245
SPECIES								
AMERICAN EEL	0	1	0	0	1	0	0	0
MUSKELLUNGE	1	1	0	0	0	0	0	0
COMMON CARP	4	2	2	0	3	3	4	0
QUILLBACK	0	1	0	0	0	2	0	2
WHITE SUCKER	5	2	4	0	0	4	5	1
NORTHERN HOG SUCKER	3	0	0	0	0	0	0	0
SHORTHEAD REDHORSE	1	3	4	6	2	2	3	5
CHANNEL CATFISH	0	0	0	0	0	0	0	1
ROCK BASS	1	0	1	0	2	1	1	0
BLUEGILL	1	0	0	0	0	0	0	0
SMALLMOUTH BASS	4	1	0	1	0	3	0	2
SUNFISH SPP.	0	0	0	0	0	0	0	1
YELLOW PERCH	0	0	1	0	0	0	0	0
WALLEYE	3	4	3	0	1	1	1	0
FISH (UNIDENTIFIED)	13	9	1	0	9	2	5	6
TOTAL	36	24	16	7	18	18	19	18

Table E-8

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 27 August 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	BPM-84-055	BPM-84-058	BPM-84-056	BPM-84-057	BPM-84-054	BPM-84-059	BPM-84-053	BPM-84-06(
TIME	1006-1024	2114-2129	1030-1045	2054-2109	0936-0953	2132-2149	0913-0929	2157-221!
SPECIES								
NORTHERN PIKE	0	0	0	0	0	1	0	0
CHAIN PICKEREL	0	0	0	0	1	0	0	0
COMMON CARP	1	0	0	0	0	2	0	0
FALLFISH	0	0	1	0	0	1	0	0
QUILLBACK	0	2	0	4	1	3	0	1
WHITE SUCKER	4	6	7	6	3	7	2	2
NORTHERN HOG SUCKER	25	13	47	19	3	7	0	0
SHORTHEAD REDHORSE	0	0	1	1	1	4	2	0
CHANNEL CATFISH	0	1	0	0	2	1	0	0
CATFISH SPP.	0	0	0	0	0	0	0	1
ROCK BASS	0	0	1	1	0	6	1	4
PUMPKINSEED	0	0	1	0	0	1	1	0
BLUEGILL	0	3	0	0	0	0	0	4
SMALLMOUTH BASS	6	6	7	12	2	22	5	6
LARGEMOUTH BASS	0	0	0	2	0	1	0	0
SUNFISH SPP.	0	1	1	9	1	3	1	1
BLACK CRAPPIE	1	1	0	0	0	0	0	0
CRAPPIE SPP.	2	0	0	0	0	1	0	0
YELLOW PERCH	1	0	0	1	0	0	0	0
WALLEYE	1	1	0	1	0	3	0	1
FISH (UNIDENTIFIED)	11	17	4	8	3	14	6	6
TOTAL	52	51	70	64	17	77	18	26

Table E-9

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 18 September 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	BPM-84-061	BPM-84-068	BPM-84-062	BPM-84-067	BPM-84-064	BPM-84-065	BPM-84-063	BPM-84-066
TIME	0911-0928	2141-2202	0933-0948	2120-2135	1018-1035	2015-2032	0954-1011	2039-2059
SPECIES								
CHAIN PICKEREL	2	0	0	0	0	0	0	0
COMMON CARP	1	1	1	1	0	2	1	1
FALLFISH	0	1	5	3	8	1	6	0
QUILLBACK	0	18	0	17	1	4	0	8
WHITE SUCKER	3	12	1	9	9	6	8	0
NORTHERN HOG SUCKER	27	29	13	37	29	2	7	6
SHORTHEAD REDHORSE	0	1	5	1	4	1	4	0
CHANNEL CATFISH	0	0	0	2	0	1	0	0
CATFISH SPP.	0	0	0	1	0	1	0	0
STRIPED BASS X WHITE BASS	0	0	0	0	0	0	0	1
ROCK BASS	0	10	0	5	0	8	0	11
REDBREAST SUNFISH	1	0	1	0	0	0	1	0
PUMPKINSEED	3	0	0	1	1	0	0	0
BLUEGILL	2	10	1	0	1	0	0	3
SMALLMOUTH BASS	6	9	4	0	7	7	11	3
LARGEMOUTH BASS	1	1	0	0	0	0	0	0
SUNFISH SPP.	0	3	0	0	1	1	0	0
WHITE CRAPPIE	0	1	0	0	0	2	0	0
BLACK CRAPPIE	0	1	0	0	0	0	0	0
CRAPPIE SPP.	0	1	0	0	0	1	0	0
YELLOW PERCH	0	0	0	0	0	0	0	1
WALLEYE	0	8	0	5	2	4	0	4
FISH (UNIDENTIFIED)	9	16	6	6	10	3	6	6
TOTAL	55	122	37	88	73	44	44	44

Table E-10

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 17 October 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	BPM-84-079	BPM-84-082	BPM-84-080	BPM-84-081	BPM-84-078	BPM-84-083	BPM-84-077	BPM-84-084
TIME	1007-1026	1959-2018	1032-1047	1934-1952	0937-0955	2028-2043	0911-0931	2054-2115
SPECIES								
AMERICAN EEL	0	0	0	0	0	1	0	0
COMMON CARP	0	1	1	1	0	0	0	0
FALLFISH	0	1	1	2	7	0	9	0
QUILLBACK	2	7	1	4	1	4	4	8
WHITE SUCKER	13	4	4	10	2	6	8	8
NORTHERN HOG SUCKER	13	15	0	48	5	18	19	4
SHORTHEAD REDHORSE	17	28	25	7	3	9	2	9
SUCKER SPP.	0	0	0	0	0	0	1	1
BROWN BULLHEAD	0	0	0	0	0	1	0	0
CHANNEL CATFISH	2	0	0	0	0	1	1	0
ROCK BASS	1	4	0	1	0	3	0	4
REDBREAST SUNFISH	0	1	0	0	0	0	0	0
PUMPKINSEED	2	0	0	0	1	0	0	0
BLUEGILL	4	1	1	0	1	0	2	0
SMALLMOUTH BASS	3	7	1	7	1	1	21	6
LARGEMOUTH BASS	0	0	0	0	0	0	2	0
SUNFISH SPP.	3	2	0	1	2	0	2	0
BLACK CRAPPIE	0	1	0	0	0	0	0	0
YELLOW PERCH	1	0	0	0	0	0	0	0
WALLEYE	2	4	0	1	0	1	1	1
FISH (UNIDENTIFIED)	4	9	6	9	7	20	8	4
TOTAL	67	85	40	91	30	65	80	45

Table E-11

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 7 November 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	BPM-84-087	BPM-84-090	BPM-84-088	BPM-84-089	BPM-84-086	BPM-84-091	BPM-84-085	BPM-84-092
TIME	1017-1036	1846-1913	1045-1106	1818-1838	0941-1001	1918-1943	0912-0932	1952-2016
SPECIES								
COMMON CARP	1	0	0	1	0	4	0	0
FALLFISH	0	0	0	1	0	1	0	0
QUILLBACK	0	3	0	2	0	2	0	3
WHITE SUCKER	0	9	3	9	7	9	4	3
NORTHERN HOG SUCKER	10	16	25	32	11	0	4	4
SHORTHEAD REDHORSE	1	4	0	7	0	5	3	6
SUCKER SPP.	0	2	2	0	3	3	1	2
CHANNEL CATFISH	1	1	0	0	0	0	0	0
ROCK BASS	0	2	0	6	0	2	1	12
REDBREAST SUNFISH	0	1	0	0	0	0	0	0
PUMPKINSEED	0	0	0	0	1	0	0	0
BLUEGILL	0	1	0	0	1	0	1	0
SMALLMOUTH BASS	2	0	4	1	3	1	5	3
LARGEMOUTH BASS	0	0	0	0	1	0	2	0
SUNFISH SPP.	0	4	0	0	2	3	1	3
WHITE CRAPPIE	0	1	0	0	0	0	0	0
BLACK CRAPPIE	0	5	0	0	0	3	0	0
YELLOW PERCH	0	0	0	0	0	1	0	0
WALLEYE	2	5	0	2	0	3	2	5
FISH (UNIDENTIFIED)	3	4	2	10	6	4	4	9
TOTAL	20	58	36	71	35	41	28	50

Table E-12

Number of fish observed while electrofishing at SSES and Bell Bend on the Susquehanna River, 5 December 1984.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	BPM-84-095	BPM-84-098	BPM-84-096	BPM-84-097	BPM-84-094	BPM-84-099	BPM-84-093	BPM-84-100
TIME	1117-1136	1832-1853	1141-1157	1809-1826	1017-1035	1857-1915	0952-1011	1921-1938
SPECIES								
COMMON CARP	1	0	1	0	0	1	0	0
WHITE SUCKER	2	2	7	2	0	5	0	7
NORTHERN HOG SUCKER	0	0	0	1	0	0	0	0
SHORTHEAD REDHORSE	2	1	0	0	2	5	1	1
SUCKER SPP.	0	1	0	0	0	1	0	0
SMALLMOUTH BASS	0	1	1	0	0	0	0	0
WALLEYE	0	3	1	0	0	4	4	0
FISH (UNIDENTIFIED)	2	1	0	1	2	3	1	1
TOTAL	7	9	10	4	4	19	6	9

Table E-13

Mean number of fish observed per unit effort while electrofishing at SSES on the Susquehanna River, 1984.

SPECIES	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOTAL
AMERICAN EEL	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.05	0.12
BROWN TROUT	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.06
MUSKELLUNGE	0.5	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.13	0.31
CHAIN PICKEREL	0.0	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.08	0.19
COMMON CARP	4.0	1.8	0.3	8.8	2.0	0.3	1.0	0.8	0.5	0.5	1.98	4.87
FALLFISH	0.5	1.5	1.0	0.0	0.0	0.3	2.3	1.0	0.3	0.0	0.68	1.67
QUILLBACK	0.0	14.3	3.0	1.0	0.3	1.5	8.8	3.5	1.3	0.0	3.35	8.27
WHITE SUCKER	22.5	5.8	1.3	1.3	2.8	5.8	6.3	7.8	5.3	3.3	6.18	15.24
NORTHERN HOG SUCKER	2.0	0.8	0.0	0.3	0.8	26.0	26.5	19.0	20.8	0.3	9.63	23.75
SHORTHEAD REDHORSE	2.0	10.0	2.5	7.8	3.5	0.5	1.8	19.3	3.0	0.8	5.10	12.58
SUCKER SPP.	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.23	0.56
WHITE CATFISH	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.06
CHANNEL CATFISH	0.0	0.0	0.0	0.5	0.0	0.3	0.5	0.5	0.5	0.0	0.23	0.56
CATFISH SPP.	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.05	0.12
ROCK BASS	0.0	2.0	0.3	1.3	0.5	0.5	3.8	1.5	2.0	0.0	1.18	2.90
REDBREAST SUNFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.3	0.0	0.10	0.25
PUMPKINSEED	0.0	0.0	0.0	0.3	0.0	0.3	1.0	0.5	0.0	0.0	0.20	0.49
BLUEGILL	0.0	0.0	0.0	0.0	0.3	0.8	3.3	1.5	0.3	0.0	0.60	1.48
SMALLMOUTH BASS	0.0	0.8	0.8	1.0	1.5	7.8	4.8	4.5	1.8	0.5	2.33	5.74
LARGEMOUTH BASS	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.10	0.25
SUNFISH SPP.	0.0	0.0	0.0	0.0	0.0	2.8	0.8	1.5	1.0	0.0	0.60	1.48
WHITE CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.05	0.12
BLACK CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.3	1.3	0.0	0.23	0.56
CRAPPIE SPP.	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.08	0.19
YELLOW PERCH	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.3	0.0	0.0	0.10	0.25
WALLEYE	6.5	1.0	1.5	2.3	2.5	0.8	3.3	1.8	2.3	1.0	2.28	5.61
FISH (UNIDENTIFIED)	1.5	4.3	1.8	4.8	5.8	10.0	9.3	7.0	4.8	1.0	5.00	12.34
TOTAL	39.5	42.0	13.8	30.0	20.8	59.3	75.5	70.8	46.3	7.5	40.53	

Table E-14

Mean number of fish observed per unit effort while electrofishing at Bell Bend on the Susquehanna River, 1984.

SPECIES	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOTAL
AMERICAN EEL	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.05	0.18
NORTHERN PIKE	0.0	0.3	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.08	0.27
MUSKELLUNGE	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.08	0.27
CHAIN PICKEREL	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.03	0.09
PIKE SPP.	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.18
COMMON CARP	1.0	3.3	0.8	3.3	2.5	0.5	1.0	0.0	1.0	0.3	1.35	4.79
FALLFISH	1.5	0.5	0.8	0.0	0.0	0.3	3.8	4.0	0.3	0.0	1.10	3.90
QUILLBACK	0.8	2.5	1.3	0.5	1.0	1.3	3.3	4.3	1.3	0.0	1.60	5.68
WHITE SUCKER	19.0	3.5	0.3	2.0	2.5	3.5	5.8	6.0	5.8	3.0	5.13	18.19
NORTHERN HOG SUCKER	0.5	0.5	0.0	0.5	0.0	2.5	11.0	11.5	4.8	0.0	3.13	11.09
SHORTHEAD REDHORSE	0.5	1.8	3.3	1.5	3.0	1.8	2.3	5.8	3.5	2.3	2.55	9.05
SUCKER SPP.	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.3	0.3	0.35	1.24
BROWN BULLHEAD	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.08	0.27
CHANNEL CATFISH	0.0	0.0	0.0	0.8	0.3	0.8	0.3	0.5	0.0	0.0	0.25	0.89
CATFISH SPP.	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.05	0.18
STRIPED BASS X WHITE BASS	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.03	0.09
ROCK BASS	0.0	3.0	0.5	0.8	1.0	2.8	4.8	1.8	3.8	0.0	1.83	6.48
REDBREAST SUNFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.03	0.09
PUMPKINSEED	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.3	0.3	0.0	0.13	0.44
BLUEGILL	0.0	0.0	0.0	0.3	0.0	1.0	1.0	0.8	0.5	0.0	0.35	1.24
SMALLMOUTH BASS	0.0	0.3	1.0	1.8	1.3	8.8	7.0	7.3	3.0	0.0	3.03	10.74
LARGEMOUTH BASS	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.5	0.8	0.0	0.18	0.62
SUNFISH SPP.	0.0	0.0	0.0	0.0	0.3	1.5	0.5	1.0	2.3	0.0	0.55	1.95
WHITE CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.05	0.18
BLACK CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.08	0.27
CRAPPIE SPP.	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.05	0.18
YELLOW PERCH	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.05	0.18
WALLEYE	0.0	1.8	0.8	1.0	0.8	1.0	2.5	0.8	2.5	2.0	1.30	4.61
FISH (UNIDENTIFIED)	1.8	3.0	1.5	4.5	5.5	7.3	6.3	9.8	5.8	1.8	4.70	16.68
TOTAL	26.0	20.8	10.3	17.8	18.3	34.5	51.3	55.0	38.5	9.5	28.18	

Table E-15

Number of fish captured by seining at SSES and Bell Bend on the Susquehanna River, 12 June 1984.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	JLM-84-027	JLM-84-028	JLM-84-025	JLM-84-026
TIME	2321-2334	2308-2319	2228-2240	2245-2257
SPECIES				
CHAIN PICKEREL	0	1	0	0
GOLDEN SHINER	0	0	1	0
SPOTTAIL SHINER	68	7	0	3
SPOTFIN SHINER	286	6	18	34
BLUNTNOSE MINNOW	3	24	25	9
FALLFISH	1	0	7	0
WHITE SUCKER	0	4	0	0
SHORTHEAD REDHORSE	0	7	0	0
ROCK BASS	0	13	12	4
GREEN SUNFISH	0	1	1	0
PUMPKINSEED	0	1	0	0
BLUEGILL	0	1	0	0
WHITE CRAPPIE	3	0	0	0
BLACK CRAPPIE	1	0	0	0
TESSELLATED DARTER	0	0	1	0
TOTAL	362	65	65	50

Table E-16

Number of fish captured by seining at SSES and Bell Bend on the Susquehanna River, 17 July 1984.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	BPM-84-045	BPM-84-046	BPM-84-048	BPM-84-047
TIME	2159-2220	2227-2236	2259-2311	2243-2253
SPECIES				
SPOTTAIL SHINER	36	1	3	2
SPOTFIN SHINER	167	28	50	23
BLUNTNOSE MINNOW	3	2	3	4
FALLFISH	0	0	1	0
WHITE SUCKER	3	1	3	0
ROCK BASS	3	2	7	6
GREEN SUNFISH	0	0	0	1
LARGEMOUTH BASS	1	1	0	0
TOTAL	213	35	67	36

Table E-17

Number of fish captured by seining at SSES and Bell Bend on the Susquehanna River, 14 August 1984.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	BPM-84-050	BPM-84-049	BPM-84-051	BPM-84-052
TIME	2232-2240	2207-2226	2252-2302	2309-2323
SPECIES				
COMELY SHINER	0	3	3	4
SPOTTAIL SHINER	1	8	4	0
SPOTFIN SHINER	56	4	61	12
BLUNTNOSE MINNOW	3	5	5	3
FALLFISH	0	0	4	0
WHITE SUCKER	2	0	0	0
ROCK BASS	1	3	2	0
GREEN SUNFISH	0	0	1	0
SMALLMOUTH BASS	1	2	0	0
LARGEMOUTH BASS	0	1	0	0
WHITE CRAPPIE	0	1	0	0
BLACK CRAPPIE	0	2	0	0
TESSELLATED DARTER	0	1	0	0
TOTAL	64	30	80	19

Table E-18

Number of fish captured by seining at SSES and Bell Bend on the Susquehanna River, 25 September 1984.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	BPM-84-072	BPM-84-071	BPM-84-069	BPM-84-070
TIME	2102-2113	2046-2056	2008-2021	2028-2037
SPECIES				
COMELY SHINER	3	0	2	1
SPOTTAIL SHINER	11	1	0	4
SPOTFIN SHINER	0	1	9	0
BLUNTNOSE MINNOW	2	1	3	13
ROCK BASS	1	2	1	2
BLUEGILL	2	0	1	0
SMALLMOUTH BASS	1	0	0	0
WHITE CRAPPIE	1	0	0	0
BLACK CRAPPIE	0	1	0	1
TESSELLATED DARTER	0	1	1	2
TOTAL	21	7	17	23

Table E-19

Number of fish captured by seining at SSES and Bell Bend on the Susquehanna River, 15 October 1984.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	BPM-84-076	BPM-84-075	BPM-84-073	BPM-84-074
TIME	2040-2054	2021-2035	1943-1954	2001-2012
SPECIES				
COMELY SHINER	3	0	0	0
SPOTTAIL SHINER	0	1	0	2
SPOTFIN SHINER	0	1	4	0
BLUNTNOSE MINNOW	1	1	20	9
WHITE SUCKER	0	0	0	1
ROCK BASS	0	1	0	2
REDBREAST SUNFISH	0	1	0	0
BLUEGILL	2	0	2	1
TESSELLATED DARTER	1	4	1	2
TOTAL	7	9	27	17

Table E-20

Mean number of fish captured per unit effort in seining hauls at SSES on the Susquehanna River, 1984.

SPECIES	JUN	JUL	AUG	SEP	OCT	MEAN	% TOTAL
CHAIN PICKEREL	0.5	0.0	0.0	0.0	0.0	0.10	0.12
COMELY SHINER	0.0	0.0	1.5	1.5	1.5	0.90	1.11
SPOTTAIL SHINER	37.5	18.5	4.5	6.0	0.5	13.40	16.48
SPOTFIN SHINER	146.0	97.5	30.0	0.5	0.5	54.90	67.53
BLUNTNOSE MINNOW	13.5	2.5	4.0	1.5	1.0	4.50	5.54
FALLFISH	0.5	0.0	0.0	0.0	0.0	0.10	0.12
WHITE SUCKER	2.0	2.0	1.0	0.0	0.0	1.00	1.23
SHORTHEAD REDHORSE	3.5	0.0	0.0	0.0	0.0	0.70	0.86
ROCK BASS	6.5	2.5	2.0	1.5	0.5	2.60	3.20
REDBREAST SUNFISH	0.0	0.0	0.0	0.0	0.5	0.10	0.12
GREEN SUNFISH	0.5	0.0	0.0	0.0	0.0	0.10	0.12
PUMPKINSEED	0.5	0.0	0.0	0.0	0.0	0.10	0.12
BLUEGILL	0.5	0.0	0.0	1.0	1.0	0.50	0.62
SMALLMOUTH BASS	0.0	0.0	1.5	0.5	0.0	0.40	0.49
LARGEMOUTH BASS	0.0	1.0	0.5	0.0	0.0	0.30	0.37
WHITE CRAPPIE	1.5	0.0	0.5	0.5	0.0	0.50	0.62
BLACK CRAPPIE	0.5	0.0	1.0	0.5	0.0	0.40	0.49
TESSELLATED DARTER	0.0	0.0	0.5	0.5	2.5	0.70	0.86
TOTAL	213.5	124.0	47.0	14.0	8.0	81.30	

Table E-21

Mean number of fish captured per unit effort in seining hauls at Bell Bend on the Susquehanna River, 1984.

SPECIES	JUN	JUL	AUG	SEP	OCT	MEAN	% TOTAL
GOLDEN SHINER	0.5	0.0	0.0	0.0	0.0	0.10	0.25
COMELY SHINER	0.0	0.0	3.5	1.5	0.0	1.00	2.49
SPOTTAIL SHINER	1.5	2.5	2.0	2.0	1.0	1.80	4.49
SPOTFIN SHINER	26.0	36.5	36.5	4.5	2.0	21.10	52.62
BLUNTNOSE MINNOW	17.0	3.5	4.0	8.0	14.5	9.40	23.44
FALLFISH	3.5	0.5	2.0	0.0	0.0	1.20	2.99
WHITE SUCKER	0.0	1.5	0.0	0.0	0.5	0.40	1.00
ROCK BASS	8.0	6.5	1.0	1.5	1.0	3.60	8.98
GREEN SUNFISH	0.5	0.5	0.5	0.0	0.0	0.30	0.75
BLUEGILL	0.0	0.0	0.0	0.5	1.5	0.40	1.00
BLACK CRAPPIE	0.0	0.0	0.0	0.5	0.0	0.10	0.25
TESSELLATED DARTER	0.5	0.0	0.0	1.5	1.5	0.70	1.75
	57.5	51.5	49.5	20.0	22.0	40.10	

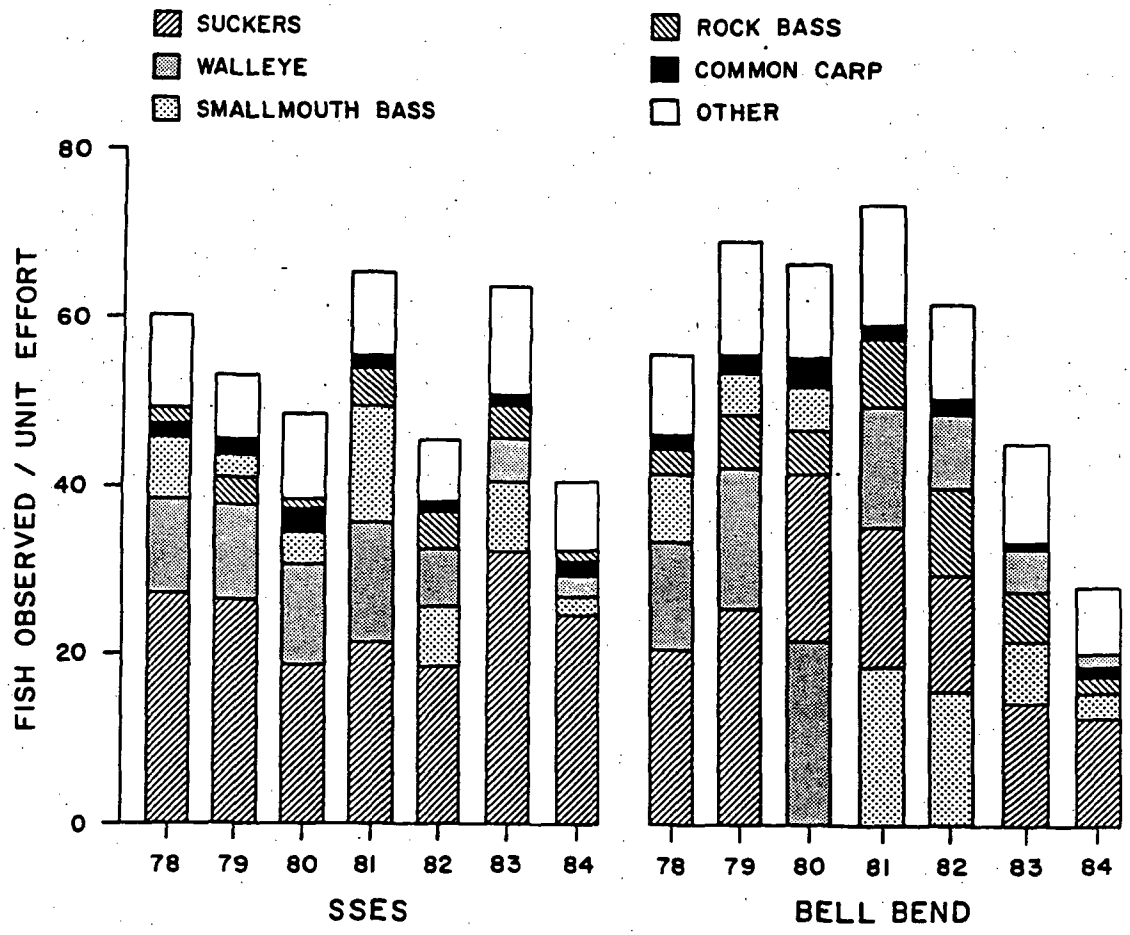

Fig. E-1

The annual mean number of fish observed per unit effort while electrofishing at SSES and Bell Bend on the Susquehanna River, 1978-84.

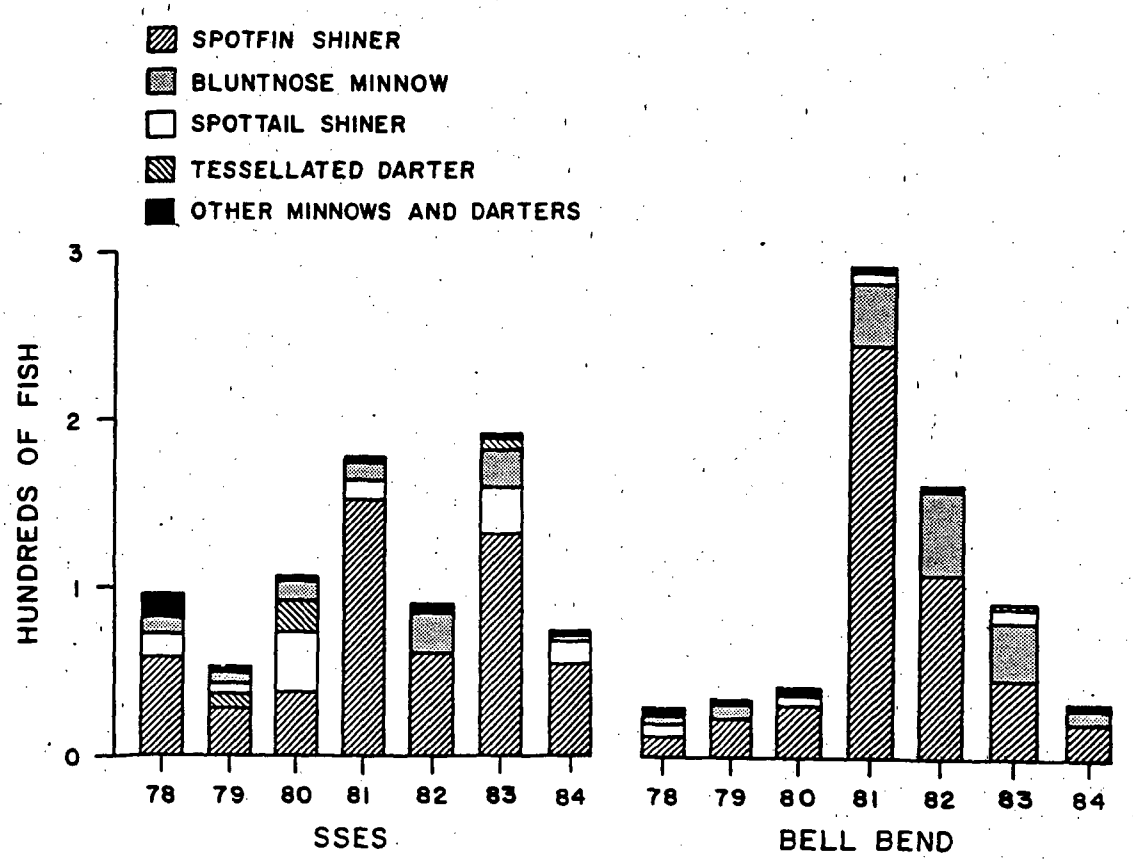

Fig. E-2

The annual mean number of minnows and darters captured per unit effort by seining at SSES and Bell Bend on the Susquehanna River, 1978-84.

ANGLER SURVEY

by

Walter J. Soya, Andrew J. Gurzynski, and Theodore V. Jacobsen

TABLE OF CONTENTS

Page

ABSTRACT..... 176

INTRODUCTION..... 176

PROCEDURES..... 177

RESULTS AND DISCUSSION..... 179

REFERENCES CITED..... 183

LIST OF TABLES

Table

F-1 Angler survey data collected on the Susquehanna River, January through December 1984..... 185

F-2 Summary of angler data collected on the Susquehanna River, 1984..... 190

F-3 Use of catch, residence, times interviewed, bait used, and preference of catch obtained during angler surveys on the Susquehanna River, 1984..... 191

F-4 Results (χ^2 values) of Friedman's two-way analysis of variance for comparison of angler survey data on the Susquehanna River, 1984..... 192

F-5 Summary of angler data from east and west banks and boats on the Susquehanna River, 1984..... 193

Table | Page
F-6 Summary of angler survey data in zones 1 through 6 on the Susquehanna River, 1984 194

F-7 Summary of anglers, hours fished, fish caught, and fish harvested on the Susquehanna River, 1981 through 1984 195

F-8 Summary of estimated number of anglers, hours fished, fish caught, and fish harvested on the Susquehanna River, 1981 through 1984 196

LIST OF FIGURES

Fig.
F-1 Location of zones 1 through 6 used on the angler survey on the Susquehanna River near the Susquehanna SES, 1984 197

ABSTRACT

A total of 490 anglers was interviewed during 48 surveys on a 5.5 km section of the Susquehanna River near the Susquehanna SES in 1984. These anglers fished for 1,410.0 hours, caught 583 fish of at least 18 species, and harvested 221 fish of at least 14 species. Channel catfish was the most frequently caught fish (25.4% of the total catch), followed by smallmouth bass (11.8%), walleye (11.5%), rock bass (9.6%), common carp (9.1%), white sucker (6.9%), bluegill (6.5%), and brown bullhead (6.2%). Of these, brown bullhead was most frequently harvested (83.3%). Variations in the number of anglers, hours fished, and fish caught over time (months and weekend/holiday or weekdays) and location (zones and east bank, west bank, or boat) were significant. Projected for 1984, an estimated 2,942 anglers fished 10,329 hours, caught 4,468 fish, and harvested 1,666 of these in the study area. Compared to previous surveys, river angling was suppressed by turbid river conditions from late June through mid-September as a result of highway construction in New York.

INTRODUCTION

Seasonal fluctuations in relative abundance of fishes have been monitored on the Susquehanna River near the Susquehanna SES since 1971 (see "Fishes"). Although this stretch is degraded by acid mine drainages and sewage (Gale et al. 1976), the water quality has improved in recent years (Soya et al. 1984b) and interest in river fishing has increased. In 1981, a creel survey was initiated to document angler usage near the Susquehanna SES (Buynak et al. 1982). A similar survey was conducted during 1982 and 1983 (Soya et al. 1983, 1984a). Results of the 1984 survey are presented in this report.

PROCEDURES

Angler surveys were conducted on the Susquehanna River from the southern tip of Gould Island to Hess Sand and Stone, Inc. (Fig. F-1). This 5.5-km study area was divided into six zones to better report angler distribution.

Survey dates included two randomly selected weekend days or holidays (weekend/holiday) and two weekdays in each month. On each date, day length (sunrise to sunset) was divided into three equal time periods and one survey was conducted within each period. The start time for each period was determined by dividing the first time period into equal intervals of no less than 45 minutes and no more than 60 minutes. There were from four to six intervals per time period depending upon day length. One of the intervals was randomly selected, and the first minute of that interval was the start time. The same interval was used to select start times in the other two periods. The only exception occurred on 10 May when the first survey was started at 0825 instead of 0746; the other two surveys were started on time. Surveys were conducted for at least one hour during each time period by a biologist.

The following information was obtained from anglers: 1) time fishing began; 2) species fished for; 3) number and species of fish caught, released, and harvested; 4) use of catch; 5) bait used; and 6) county or state of residence. The interviewer also recorded the time of the interview and the location of each angler (zone and east bank, west bank, or boat). At the conclusion of an interview, each angler was given a questionnaire (stamped postcard preaddressed to the Susquehanna SES Biological Laboratory) to obtain the time fishing ended and final catch and harvest data. Anglers were requested to return their cards even if they did not catch any fish. As an

incentive to return the questionnaire, anglers were informed that each completed questionnaire was eligible for three cash prizes in an annual drawing.

Data from both complete and incomplete fishing trips were used to estimate the number of anglers in each month. A fishing trip, defined as time spent fishing on the river, was considered complete when an angler or group of anglers was either interviewed at the end of fishing or when fishing continued after the interview and their completed questionnaire was returned. An incomplete trip was when an angler or group of anglers continued to fish after the interview, but did not return their questionnaire. Data from complete and incomplete fishing trips were grouped to obtain angler estimates (EA) for each month using the formula:

$$EA = (Mwe)\ (Twe) + (Mwd)\ (Twd)$$

where Mwe = mean number of anglers (complete and incomplete trips) interviewed per weekend day or holiday each month, Twe = total number of weekend days and holidays each month, Mwd = mean number of anglers (complete and incomplete trips) interviewed per weekday each month, and Twd = total number of weekdays each month. The annual estimate was then obtained by summing the monthly estimates.

Complete and incomplete fishing trips were also used to estimate the total number of hours fished (EH) using the formula:

$$EH = \sum_{i=1}^{12} \left[\frac{[H(C)_i]\ [EA(C)_i]}{A(C)_i} + \frac{2[H(I)_i]\ [EA(I)_i]}{A(I)_i} \right]$$

where $H(C)_i$ = total number of hours fished by complete trip anglers in month "i", $A(C)_i$ = total number of complete trip anglers in month "i", $H(I)_i$ = total number of hours fished by incomplete trip anglers in month "i", $A(I)_i$ = total number of incomplete trip anglers in month "i", while $EA(C)_i$ and $EA(I)_i$ represent estimated anglers for complete and incomplete trips, respectively, in month "i". Total fishing time for incomplete trips (time from start of fishing to time of interview) was doubled with the assumption that anglers were contacted during the midpoint of their fishing trip. We found, as did DiCostanzo (1956) and Groen and Schmulbach (1978), that doubling incomplete trip time produced data comparable to that of satisfactory estimates of complete fishing trips.

The monthly estimated number of fish caught and harvested was determined by multiplying mean monthly survey values by the estimated number of hours fished (EH). The annual estimate was the sum of monthly estimates. These estimates are conservative because interviews were only conducted from sunrise to sunset on each survey date, and, therefore, night anglers were not included. Survey data were analyzed using Friedman's two-way analysis of variance (Hollander and Wolfe 1973) to determine if the variation in numbers of anglers, hours fished, fish caught, and fish harvested over time (months, weekend/holiday or weekdays, and time period) and location (zones and east bank, west bank, or boat) was significant.

RESULTS AND DISCUSSION

There were 490 anglers interviewed (267 complete trips and 223 incomplete trips) during 48 surveys throughout 1984 (Table F-1). These anglers fished for 1,410.0 hours, caught 583 fish of at least 18 species, and harvested 221

fish of at least 14 species (Table F-2). Mean survey values in 1984 were 1.2 fish caught per angler, 0.5 fish harvested per angler, 2.9 hours fished per angler, 0.4 fish caught per hour, and 0.2 fish harvested per hour.

Eight species composed over 86% of the total catch and over 93% of the total harvest (Table F-2). Channel catfish was the most frequently caught fish (25.4%), followed by smallmouth bass (11.8%), walleye (11.5%), rock bass (9.6%), common carp (9.1%), white sucker (6.9%), bluegill (6.5%), and brown bullhead (6.2%). Of these, brown bullhead was most frequently harvested (83.3%), followed by white sucker (60.0%), walleye (53.7%), bluegill (47.4%), channel catfish (37.8%), rock bass (35.7%), smallmouth bass (21.7%), and common carp (15.1%). This was the first survey year in which walleye and smallmouth bass did not compose over one-half of the total catch. There were more white sucker, brown bullhead, channel catfish, rock bass, sunfish (*Lepomis* spp.), and yellow perch caught in 1984 than in the three previous surveys; fewer muskellunge, smallmouth bass, and walleye were caught in 1984 than in the previous surveys.

A majority of the anglers (63.3%) stated they would eat at least a portion of their catch (Table F-3) even though only 37.9% of the fish caught in 1984 were harvested. Anglers did not harvest more than 28% of the fish caught in any of the three previous surveys. Most anglers (50.2%) stated they had no preference of catch when asked what species they fished for (Table F-3). More anglers fished for gamefishes (muskellunge, smallmouth bass, and walleye) than for catfishes, common carp, or suckers. There was an increase of catfish anglers in 1984 when compared to the two previous surveys and a decrease in gamefish anglers. Over 87% of the anglers interviewed were from Luzerne and Columbia counties.

Significantly more anglers ($P<0.01$) were interviewed in the third time period (48.6%) than in the first (18.4%) or second (33.1%) period (Table F-1). More fish were caught (272) and harvested (118) in the third time period, but the catch rate was greatest in the first period (1.3 fish per angler). Anglers fished longer (3.7 h/angler) in the first time period than the second (3.1 h/angler) or third period (2.4 h/angler).

There were significant monthly differences ($P<0.05$) in the number of anglers and hours fished (Table F-4). No anglers were interviewed in January because river ice discouraged fishing. Over 62% of the total number of anglers, hours fished, and fish caught were recorded from May through September (Table F-2). During this time, most anglers (62.7%) had no preference of catch (Table F-3). More species were caught (at least 15) during these five months than in the remainder of the year.

Significantly greater numbers of anglers ($P<0.01$), hours fished ($P<0.01$), fish caught ($P<0.01$), and fish harvested ($P<0.05$) were found on weekend/holidays than weekdays (Table F-4). Of the total number of anglers, 77.1% were interviewed on weekend/holidays when they accounted for 81.6% of the total hours fished, 76.2% of the fish caught, and 67.4% of the fish harvested.

More anglers (74.7%) fished from the river banks than from boats (Table F-5). Comparison of angling data from the east bank, west bank, and boats revealed significant differences ($P<0.01$) in the number of anglers, hours fished, fish caught, and fish harvested (Table F-4). Over 94% of the river bank anglers were observed and interviewed on the east bank, probably because of easier access. Anglers along the east bank in zones 1, 5, and 6 have good access from PA Route 239 and Legislative Route 665 (Fig. F-1). Along the

entire west bank, access is limited by either private property or a 300-700 m walk to reach the river. Bank anglers on both sides of the river are also hindered by steep and sometimes slippery banks, over-hanging trees and brush, and poison ivy. Boat angling is limited by the lack of a public launch site.

Comparison of angling data in each of the six zones revealed significant differences ($P<0.01$) in the number of anglers, hours fished, fish caught, and fish harvested (Table F-4). Zones 5 and 6, both of which are readily accessible along the east bank, accounted for 81.8% of the anglers interviewed, 77.3% of the hours fished, 62.1% of the fish caught, and 58.4% of the fish harvested (Table F-6). Considerably less fishing occurred in zones 1 through 4, and there was no significant differences among them.

Fewer anglers were interviewed in 1984 than in the three previous surveys; however, they harvested more fish and, on the average, fished longer (Table F-7). The decrease in anglers interviewed can be attributed to generally poor angling conditions in most months from January through September. Ice prohibited angling in January and early February; high, turbid flows occurred in February, April, and May; and suspended sediment discolored the river from late June through mid-September. The suspended sediment was the result of major highway reconstruction on the Chemung River in New York State, a major tributary of the Susquehanna River (Stanley J. Lehman, Pennsylvania Department of Environmental Resources, personal communication).

The turbid conditions in June, July, August, and September 1984 had an effect on river angling relative to data collected during the same months of the previous surveys. Fewer anglers were interviewed in this four-month period (228) compared to 279 in 1981, 375 in 1982, and 306 in 1983.

In 1984, 21.1% of the anglers said they fished specifically for gamefishes whereas 32.5% and 32.4% did in 1982 and 1983, respectively. Smallmouth bass, the primary gamefish sought after during these months in previous surveys, accounted for only 19.2% of the total catch in 1984 compared to 51.6% in 1981, 48.4% in 1982, and 44.0% in 1983. Also, a higher percentage of anglers interviewed during this four-month period in 1984 fished specifically for catfishes (17.1%) compared to 7.7% in 1982 and 6.5% in 1983. This increased effort resulted in a greater catch of catfishes in 1984 (105) than in the same period in 1981 (70), 1982 (60), and 1983 (55).

Projected for 1984, an estimated 2,942 anglers fished 10,329 hours, caught 4,468 fish and harvested 1,666 of these in the study area (Table F-8). The estimated number of fish harvested in 1984 was greater than in the three previous surveys; however, the estimated number of anglers and hours fished in 1984 were lower than the other surveys. River conditions, unrelated to the operation of the Susquehanna SES, are attributed to the low numbers of anglers fishing in the study area in 1984. Anglers are usually discouraged by river ice, high flows, and high turbidity, all of which were prevalent at times in 1984. On the average, the catch and harvest per angler (1.2 and 0.5 fish, respectively) were greater than in previous surveys and the mean fishing trip length (2.9 h/angler) was longer (Table F-2).

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Table F-1

Angler survey data collected on the Susquehanna River, January through December 1984.

DATE	1 JAN			10 JAN			20 JAN			21 JAN		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0729	1034	1339	0817	1125	1434	0725	1039	1353	0900	1216	1530
RIVER LEVEL	149.16	149.16	149.16	148.73	148.73	148.73	148.82	148.85	148.82	148.82	148.85	148.82
WATER TEMPERATURE	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.1
AIR TEMPERATURE	-11.0	-7.0	-3.0	0.0	1.5	1.0	-22.5	-14.0	-11.0	-25.5	-15.0	-15.0
NO. PER TIME PERIOD												
ANGLERS	0	0	0	0	0	0	0	0	0	0	0	0

DATE	3 FEB			9 FEB			12 FEB			20 FEB		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0944	1307	1631	0941	1310	1638	0703	1034	1405	0652	1030	1407
RIVER LEVEL	148.67	148.67	148.67	149.00	148.94	148.97	148.85	148.88	148.88	151.90	151.84	151.78
WATER TEMPERATURE	0.2	0.6	0.5	0.1	0.9	0.6	1.3	1.7	1.7	3.4	3.5	3.6
AIR TEMPERATURE	2.0	8.0	5.0	1.0	5.0	5.0	3.0	5.0	11.0	6.0	6.5	7.0
NO. PER TIME PERIOD												
ANGLERS	0	0	0	0	0	2	0	11	22	3	7	8
FISH CAUGHT						4		16	27	0	7	11
FISH HARVESTED						4		3	15	0	0	10
HOURS FISHED						4.5		47.3	93.0	3.0	29.4	17.1
CATCH/ANGLER						2.0		1.5	1.2	0.0	1.0	1.4
HARVEST/ANGLER						2.0		0.3	0.7	0.0	0.0	1.3
HOURS/ANGLER						2.3		4.3	4.2	1.0	4.2	2.1
CATCH/HOUR						0.9		0.3	0.3	0.0	0.2	0.6
HARVEST/HOUR						0.9		0.1	0.2	0.0	0.0	0.6
SPECIES CAUGHT												
MUSKELLUNGE						0		0	1H	0	1R	0
COMMON CARP						0		3R	2H 5R	0	2R	2H
QUILLBACK						0		1R	0	0	0	0
WHITE SUCKER						0		0	7H 4R	0	0	2H 1R
SUCKER SPP.						0		0	0	0	4R	0
BROWN BULLHEAD						0		0	0	0	0	6H
CHANNEL CATFISH						0		0	3H 1R	0	0	0
WALLEYE						4H		3H 9R	2H 2R	0	0	0

DATE	6 MAR			16 MAR			17 MAR			24 MAR		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0729	1119	1509	0614	1013	1413	0838	1238	1638	0918	1324	1731
RIVER LEVEL	149.37	149.37	149.37	148.94	148.94	148.94	148.97	148.97	148.97	150.80	150.77	150.74
WATER TEMPERATURE	1.0	1.0	1.4	1.8	2.1	2.6	2.4	2.8	3.0	2.8	3.2	3.4
AIR TEMPERATURE	1.0	3.0	2.0	4.0	14.0	13.0	-1.0	2.0	4.0	5.0	10.0	9.0
NO. PER TIME PERIOD												
ANGLERS	0	4	5	0	0	4	0	3	2	0	11	2
FISH CAUGHT		5	2			0		0	15		18	1
FISH HARVESTED		0	2			0		0	15		12	0
HOURS FISHED		7.3	18.3			8.8		6.6	7.0		27.2	3.5
CATCH/ANGLER		1.3	0.4			0.0		0.0	7.5		1.6	0.5
HARVEST/ANGLER		0.0	0.4			0.0		0.0	7.5		1.1	0.0
HOURS/ANGLER		1.8	3.7			2.2		2.2	3.5		2.5	1.8
CATCH/HOUR		0.7	0.1			0.0		0.0	2.1		0.7	0.3
HARVEST/HOUR		0.0	0.1			0.0		0.0	2.1		0.4	0.0
SPECIES CAUGHT												
MUSKELLUNGE		0	2H			0		0	0		2R	0
COMMON CARP		0	0			0		0	0		0	1R
WHITE SUCKER		0	0			0		0	15H		0	0
BROWN BULLHEAD		0	0			0		0	0		7H	0
CHANNEL CATFISH		2R	0			0		0	0		5H 3R	0
WALLEYE		3R	0			0		0	0		1R	0

Table F-1 (cont.)

DATE	5 APR			15 APR			28 APR			30 APR		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0724	1142	1600	0619	1045	1511	0947	1325	1802	0603	1042	1521
RIVER LEVEL	151.38	151.69	152.14	150.35	150.41	150.41	150.38	150.32	150.28	150.01	149.98	149.9
WATER TEMPERATURE	5.5	5.5	5.3	8.0	8.0	8.2	10.3	10.6	10.9	12.9	12.9	13.
AIR TEMPERATURE	17.0	18.5	15.5	10.0	11.8	13.0	16.5	20.5	18.0	15.0	17.0	20.
NO. PER TIME PERIOD												
ANGLERS	0	0	0	0	2	2	5	3	4	0	1	
FISH CAUGHT					0	15	15	1	26		1	
FISH HARVESTED					0	1	2	0	11		1	
HOURS FISHED					3.5	6.0	10.5	6.4	6.7		0.2	
CATCH/ANGLER					0.0	7.5	3.0	0.1	6.5		1.0	
HARVEST/ANGLER					0.0	0.5	0.4	0.0	2.8		1.0	
HOURS/ANGLER					1.8	3.0	2.1	0.8	1.7		0.2	
CATCH/HOUR					0.0	2.5	1.4	0.2	3.9		6.0	
HARVEST/HOUR					0.0	0.2	0.2	0.0	1.7		6.0	
SPECIES CAUGHT												
COMMON CARP					0	5R	5R	0	0		1H	
RIVER CHUB					0	0	0	1R	0		0	
WHITE SUCKER					0	0	6R	0	0		0	
WHITE CATFISH					0	0	1H	0	0		0	
BROWN BULLHEAD					0	1H	0	0	0		0	
CHANNEL CATFISH					0	9R	1H 1R	0	11H 15R		0	
ROCK BASS					0	0	1R	0	0		0	

DATE	3 MAY			12 MAY			16 MAY			27 MAY		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0943	1425	1906	0548	1036	1524	0936	1427	1918	0933	1430	1926
RIVER LEVEL	149.64	149.64	149.64	150.04	149.98	149.92	151.23	151.17	151.11	149.89	149.83	149.8
WATER TEMPERATURE	13.2	13.1	12.9	12.6	12.5	12.8	10.6	10.7	10.9	17.4	17.9	18.
AIR TEMPERATURE	11.0	11.5	11.5	16.8	20.0	18.0	8.5	12.0	9.0	23.5	24.0	23.
NO. PER TIME PERIOD												
ANGLERS	0	2	0	2	4	9	1	2	3	15	21	2
FISH CAUGHT		0		2	0	1	2	0	2	19	20	
FISH HARVESTED		0		0	0	0	1	0	2	1	10	
HOURS FISHED		2.0		9.9	7.2	11.1	4.0	3.8	10.5	74.2	53.2	32.
CATCH/ANGLER		0.0		1.0	0.0	0.1	2.0	0.0	0.7	1.3	1.0	0.
HARVEST/ANGLER		0.0		0.0	0.0	0.0	1.0	0.0	0.7	0.1	0.5	0.
HOURS/ANGLER		1.0		5.0	1.8	1.2	4.0	1.9	3.5	4.9	2.5	1.
CATCH/HOUR		0.0		0.2	0.0	0.1	0.5	0.0	0.2	0.3	0.4	0.
HARVEST/HOUR		0.0		0.0	0.0	0.0	0.3	0.0	0.2	<0.1	0.2	0.
SPECIES CAUGHT												
COMMON CARP		0		0	0	1R	1R	0	0	1H 5R	1R	
WHITE SUCKER		0		0	0	0	0	0	0	0	4R	
SUCKER SPP.		0		0	0	0	0	0	0	1R	0	
BROWN BULLHEAD		0		0	0	0	0	0	0	0	1R	
CHANNEL CATFISH		0		0	0	0	1H	0	0	2R	0	
ROCK BASS		0		0	0	0	0	0	0	0	3H 2R	
BLUEGILL		0		0	0	0	0	0	0	0	4H 1R	
SMALLMOUTH BASS		0		0	0	0	0	0	2H	0	1H 1R	
SUNFISH SPP.		0		0	0	0	0	0	0	0	2H	
YELLOW PERCH		0		0	0	0	0	0	0	1R	0	
WALLEYE		0		2R	0	0	0	0	0	2R	0	
FISH (UNIDENTIFIED)		0		0	0	0	0	0	0	7R	0	

Table F-1 (cont.)

DATE	8 JUN			10 JUN			16 JUN			21 JUN		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0852	1354	1856	0711	1213	1715	0530	1033	1536	0851	1355	1859
RIVER LEVEL	149.43	149.43	149.34	149.13	149.13	149.13	148.91	148.91	148.88	149.64	149.59	149.49
WATER TEMPERATURE	19.9	20.6	21.0	22.2	23.2	23.7	21.4	21.8	22.7	21.5	22.2	22.0
AIR TEMPERATURE	27.5	34.0	27.0	22.5	35.0	35.0	7.0	23.0	26.0	21.0	27.0	24.0
NO. PER TIME PERIOD												
ANGLERS	0	0	15	9	11	4	4	10	7	3	0	9
FISH CAUGHT			30	5	23	2	15	10	4	1		2
FISH HARVESTED			25	4	3	0	0	3	3	1		0
HOURS FISHED			44.0	38.0	33.5	10.2	44.0	74.1	18.7	2.7		10.6
CATCH/ANGLER			2.0	0.6	2.1	0.5	3.8	1.0	0.6	0.3		0.2
HARVEST/ANGLER			1.7	0.4	0.3	0.0	0.0	0.8	0.4	0.3		0.0
HOURS/ANGLER			2.9	4.2	3.0	2.5	11.0	7.4	2.7	0.9		1.2
CATCH/HOUR			0.7	0.1	0.7	0.2	0.3	0.1	0.2	0.4		0.2
HARVEST/HOUR			0.6	0.1	0.1	0.0	0.0	0.1	0.2	0.4		0.0
SPECIES CAUGHT												
COMMON CARP			1H 1R	0	0	0	1R	1R	1R	0		0
FALLFISH			1H	0	0	0	0	0	0	0		0
SUCKER SPP.			0	0	0	0	4R	0	0	0		0
BROWN BULLHEAD			2H	0	0	0	1R	0	0	0		0
CHANNEL CATFISH			7H	0	3H	0	6R	1R	2H	0		0
ROCK BASS			10H 1R	4H	7R	0	0	0	0	0		1R
BLUEGILL			2H	0	0	0	0	0	0	0		0
SMALLMOUTH BASS			3R	0	13R	2R	1R	6H	0	1H		1R
YELLOW PERCH			0	1R	0	0	0	0	1H	0		0
WALLEYE			2H	0	0	0	2R	2H	0	0		0

DATE	6 JUL			8 JUL			18 JUL			22 JUL		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0858	1359	1900	0947	1448	1949	0942	1438	1933	0648	1142	1636
RIVER LEVEL	149.00	148.97	148.97	150.53	150.53	150.53	148.82	148.88	148.89	148.70	148.70	148.70
WATER TEMPERATURE	22.0	22.3	22.4	19.8	20.1	20.0	25.3	25.7	25.6	22.8	23.5	24.0
AIR TEMPERATURE	24.0	26.5	27.0	21.0	24.0	19.0	18.5	21.0	22.0	15.0	23.0	24.0
NO. PER TIME PERIOD												
ANGLERS	0	0	10	0	0	4	0	3	7	6	4	8
FISH CAUGHT			3			1		15	15	5	28	15
FISH HARVESTED			0			0		11	6	2	8	3
HOURS FISHED			9.7			8.0		12.0	27.8	31.8	19.0	24.0
CATCH/ANGLER			0.3			0.3		5.0	2.1	0.8	7.0	1.9
HARVEST/ANGLER			0.0			0.0		3.7	0.9	0.3	2.0	0.4
HOURS/ANGLER			1.0			2.0		4.0	4.0	5.3	4.8	3.0
CATCH/HOUR			0.3			0.1		1.3	0.5	0.2	1.5	0.6
HARVEST/HOUR			0.0			0.0		0.9	0.2	0.1	0.4	0.1
SPECIES CAUGHT												
CHAIN PICKEREL			0			0		0	0	0	1R	0
COMMON CARP			0			0		0	0	0	0	4R
SHINER SPP.			0			0		2R	0	0	0	0
MINNOW SPP.			0			0		0	0	0	6R	0
WHITE SUCKER			0			0		1R	0	0	0	0
BROWN BULLHEAD			0			0		7H	1H	0	0	1H
CHANNEL CATFISH			0			1R		0	2H 4R	2H	1R	0
ROCK BASS			1R			0		0	2H 2R	0	1R	0
REDBREAST SUNFISH			0			0		0	0	0	3R	0
PUMPKINSEED			0			0		2H	0	0	3R	0
BLUEGILL			1R			0		2H 1R	1R	0	8H 4R	0
SMALLMOUTH BASS			1R			0		0	1H 2R	3R	1R	1H 2R
SUNFISH SPP.			0			0		0	0	0	0	6R
YELLOW PERCH			0			0		0	0	0	0	1H

Table F-1 (cont.)

DATE	12 AUG			20 AUG			22 AUG			26 AUG		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0858	1338	1815	0806	1239	1713	0619	1051	1523	0900	1328	1757
RIVER LEVEL	148.55	148.52	148.52	149.04	149.00	148.97	149.10	149.04	149.00	148.76	148.73	148.73
WATER TEMPERATURE	24.3	25.0	25.0	22.0	22.8	22.9	21.4	21.9	22.7	21.9	23.1	23.0
AIR TEMPERATURE	21.5	25.0	22.0	12.5	17.0	18.5	7.5	23.0	25.0	10.5	23.5	23.0
NO. PER TIME PERIOD												
ANGLERS	3	5	12	6	0	2	0	3	1	7	4	19
FISH CAUGHT	2	4	36	31		0		4	1	8	3	13
FISH HARVESTED	0	0	8	8		0		4	0	5	0	4
HOURS FISHED	17.1	17.8	31.2	15.8		0.2		11.0	3.5	28.5	6.2	59.9
CATCH/ANGLER	0.7	0.8	3.0	5.2		0.0		1.3	1.0	1.1	0.8	0.7
HARVEST/ANGLER	0.0	0.0	0.7	1.3		0.0		1.3	0.0	0.7	0.0	0.2
HOURS/ANGLER	5.7	3.6	2.6	2.6		0.1		3.7	3.5	4.1	1.5	3.2
CATCH/HOUR	0.1	0.2	1.2	2.0		0.0		0.4	0.3	0.3	0.5	0.2
HARVEST/HOUR	0.0	0.0	0.3	0.5		0.0		0.4	0.0	0.2	0.0	0.1
SPECIES CAUGHT												
COMMON CARP	0	0	4R	0		0		0	0	0	0	1R
MINNOW SPP.	0	0	0	0		0		0	0	1H	0	0
BROWN BULLHEAD	0	0	2H 2R	0		0		0	0	0	0	1H 1R
CHANNEL CATFISH	0	0	3H 5R	8H 23R		0		4H	0	2R	0	2H 3R
ROCK BASS	2R	0	9R	0		0		0	0	1H	0	0
PUMPKINSEED	0	0	0	0		0		0	0	1R	0	0
BLUEGILL	0	3R	0	0		0		0	0	2H	1R	2R
SMALLMOUTH BASS	0	1R	4R	0		0		0	1R	0	0	2R
LARGEMOUTH BASS	0	0	1H 2R	0		0		0	0	0	0	0
SUNFISH SPP.	0	0	0	0		0		0	0	1H	0	0
YELLOW PERCH	0	0	0	0		0		0	0	0	1R	0
WALLEYE	0	0	2H 2R	0		0		0	0	0	0	1H
FISH (UNIDENTIFIED)	0	0	0	0		0		0	0	0	1R	0

DATE	5 SEP			8 SEP			16 SEP			18 SEP		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0816	1235	1654	1001	1417	1833	0912	1322	1732	0646	1054	1502
RIVER LEVEL	148.43	148.46	148.46	148.49	148.49	148.49	148.33	148.33	148.33	148.49	148.49	148.49
WATER TEMPERATURE	21.2	22.3	22.2	19.2	20.7	20.0	18.0	19.7	19.7	17.0	17.8	19.2
AIR TEMPERATURE	7.5	15.0	16.0	15.0	20.0	18.0	3.5	13.0	12.0	1.5	14.0	18.0
NO. PER TIME PERIOD												
ANGLERS	0	2	11	10	2	7	2	8	8	0	0	2
FISH CAUGHT		0	12	7	0	9	0	11	3			0
FISH HARVESTED		0	0	0	0	0	0	1	0			0
HOURS FISHED		7.2	18.5	31.7	2.8	17.4	8.0	27.4	26.8			1.7
CATCH/ANGLER		0.0	1.1	0.7	0.0	1.3	0.0	1.4	0.4			0.0
HARVEST/ANGLER		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0			0.0
HOURS/ANGLER		3.6	1.7	3.2	1.4	2.5	4.0	3.4	3.4			0.8
CATCH/HOUR		0.0	0.6	0.2	0.0	0.5	0.0	0.4	0.1			0.0
HARVEST/HOUR		0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0			0.0
SPECIES CAUGHT												
COMMON CARP		0	0	0	0	0	0	1R	0			0
BROWN BULLHEAD		0	0	0	0	1R	0	0	0			0
CHANNEL CATFISH		0	3R	0	0	4R	0	0	0			0
ROCK BASS		0	1R	1R	0	0	0	0	2R			0
BLUEGILL		0	2R	0	0	4R	0	0	0			0
SMALLMOUTH BASS		0	2R	3R	0	0	0	1H 9R	0			0
LARGEMOUTH BASS		0	0	2R	0	0	0	0	0			0
SUNFISH SPP.		0	4R	0	0	0	0	0	0			0
WALLEYE		0	0	1R	0	0	0	0	1R			0

Table F-1 (cont.)

DATE	13 OCT			21 OCT			22 OCT			24 OCT		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0906	1251	1636	0722	1100	1438	0723	1100	1437	0725	1100	1435
RIVER LEVEL	148.24	148.24	148.24	148.21	148.21	148.21	148.21	148.21	148.21	148.33	148.33	148.36
WATER TEMPERATURE	15.2	16.4	17.2	15.8	16.3	16.9	17.0	17.1	17.8	15.5	15.6	16.0
AIR TEMPERATURE	9.5	16.5	18.0	18.5	21.0	25.5	19.0	23.5	19.0	13.0	16.0	16.5
NO. PER TIME PERIOD												
ANGLERS	1	4	1	4	0	8	0	1	0	0	0	0
FISH CAUGHT	2	0	2	2		4		0				
FISH HARVESTED	0	0	2	2		3		0				
HOURS FISHED	3.5	12.5	3.1	9.3		12.3		2.0				
CATCH/ANGLER	2.0	0.0	2.0	0.5		0.5		0.0				
HARVEST/ANGLER	0.0	0.0	2.0	0.5		0.4		0.0				
HOURS/ANGLER	3.5	3.1	3.1	2.3		1.5		2.0				
CATCH/HOUR	0.6	0.0	0.6	0.2		0.3		0.0				
HARVEST/HOUR	0.0	0.0	0.6	0.2		0.2		0.0				
SPECIES CAUGHT												
COMMON CARP	1R	0	0	0		1H		0				
BROWN BULLHEAD	0	0	0	0		2H		0				
CHANNEL CATFISH	1R	0	0	2H		0		0				
ROCK BASS	0	0	0	0		1R		0				
SMALLMOUTH BASS	0	0	1H	0		0		0				
WALLEYE	0	0	1H	0		0		0				

DATE	3 NOV			8 NOV			11 NOV			29 NOV		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0730	1056	1423	0824	1147	1520	0916	1237	1558	0707	1017	1327
RIVER LEVEL	148.43	148.43	148.43	148.49	148.49	148.52	148.55	148.55	148.55	148.49	148.76	148.79
WATER TEMPERATURE	12.3	13.1	13.6	9.1	10.0	10.0	9.5	9.7	9.8	6.4	6.4	6.8
AIR TEMPERATURE	-3.0	5.0	9.0	-3.0	6.5	9.0	11.0	12.0	11.0	5.0	5.5	6.0
NO. PER TIME PERIOD												
ANGLERS	2	3	1	0	0	0	0	6	2	0	2	0
FISH CAUGHT	0	0	0					8	0		0	
FISH HARVESTED	0	0	0					3	0		0	
HOURS FISHED	1.0	2.4	2.0					24.7	4.0		1.0	
CATCH/ANGLER	0.0	0.0	0.0					1.3	0.0		0.0	
HARVEST/ANGLER	0.0	0.0	0.0					0.5	0.0		0.0	
HOURS/ANGLER	0.5	0.8	2.0					4.1	2.0		0.5	
CATCH/HOUR	0.0	0.0	0.0					0.3	0.0		0.0	
HARVEST/HOUR	0.0	0.0	0.0					0.1	0.0		0.0	
SPECIES CAUGHT												
MUSKELLUNGE	0	0	0					2R	0		0	
COMMON CARP	0	0	0					1R	0		0	
SMALLMOUTH BASS	0	0	0					1H 2R	0		0	
WALLEYE	0	0	0					2H	0		0	

DATE	2 DEC			4 DEC			29 DEC			31 DEC		
TIME PERIOD	1	2	3	1	2	3	1	2	3	1	2	3
START TIME	0931	1240	1548	0900	1108	1415	0816	1121	1426	0729	1034	1340
RIVER LEVEL	150.28	150.28	150.28	150.04	150.04	150.07	149.46	149.49	149.52	150.28	150.32	150.35
WATER TEMPERATURE	5.8	5.8	5.7	5.0	4.9	5.0	2.2	2.2	2.6	5.0	5.2	5.1
AIR TEMPERATURE	5.0	9.0	8.5	1.0	2.0	4.0	1.5	4.0	15.0	-6.0	-5.0	0.0
NO. PER TIME PERIOD												
ANGLERS	3	3	6	0	0	0	4	9	5	0	6	5
FISH CAUGHT	0	1	4				0	13	3		7	2
FISH HARVESTED	0	0	0				0	7	3		6	1
HOURS FISHED	1.3	3.8	8.0				1.2	19.4	10.7		24.8	8.0
CATCH/ANGLER	0.0	0.3	0.7				0.0	1.4	0.6		1.2	0.4
HARVEST/ANGLER	0.0	0.0	0.0				0.0	0.8	0.6		1.0	0.2
HOURS/ANGLER	0.4	1.3	1.3				0.3	2.2	2.1		4.1	1.6
CATCH/HOUR	0.0	0.3	0.5				0.0	0.7	0.3		0.3	0.3
HARVEST/HOUR	0.0	0.0	0.0				0.0	0.4	0.3		0.2	0.1
SPECIES CAUGHT												
MUSKELLUNGE	0	1R	0				0	0	0		0	0
QUILLBACK	0	0	0				0	0	0		0	1R
CHANNEL CATFISH	0	0	4R				0	0	0		1R	0
WALLEYE	0	0	0				0	7H 6R	3H		6H	1H

Table F-2

Summary of angler data collected on the Susquehanna River, 1984.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	% TOTAL
TOTAL NUMBER ANGLERS	0	53	31	22	80	72	42	62	52	19	16	41	490	
FISH CAUGHT		65	41	58	53	92	82	102	42	10	8	30	583	
FISH HARVESTED		32	29	15	14	44	30	29	1	7	3	17	221	
HOURS FISHED		194.3	78.7	33.2	208.4	275.7	132.2	191.1	141.5	42.6	35.1	77.2	1410.0	
CATCH/ANGLER		1.2	1.3	2.6	0.7	1.3	2.0	1.6	0.8	0.5	0.5	0.7	1.2	
HARVEST/ANGLER		0.6	0.9	0.7	0.2	0.6	0.7	0.5	<0.1	0.4	0.2	0.4	0.5	
HOURS/ANGLER		3.7	2.5	1.5	2.6	3.8	3.1	3.1	2.7	2.2	2.2	1.9	2.9	
CATCH/HOUR		0.3	0.5	1.7	0.3	0.3	0.6	0.5	0.3	0.2	0.2	0.4	0.4	
HARVEST/HOUR		0.2	0.4	0.5	0.1	0.2	0.2	0.2	<0.1	0.2	0.1	0.2	0.2	
SPECIES														
MUSKELLUNGE		1H 1R	2H 2R	0	0	0	0	0	0	0	2R	1R	3H	6R
CHAIN PICKEREL		0	0	0	0	0	1R	0	0	0	0	0		1R
COMMON CARP		4H 10R	1R	1H 10R	1H 8R	1H 4R	4R	5R	1R	1H 1R	1R	0	8H	45R
RIVER CHUB		0	0	1R	0	0	0	0	0	0	0	0		1R
SHINER SPP.		0	0	0	0	0	2R	0	0	0	0	0		2R
FALLFISH		0	0	0	0	1H	0	0	0	0	0	0	1H	
MINNOW SPP.		0	0	0	0	0	6R	1H	0	0	0	0	1H	6R
QUILLBACK		1R	0	0	0	0	0	0	0	0	0	1R		2R
WHITE SUCKER		9H 5R	15H	6R	4R	0	1R	0	0	0	0	0	24H	16R
SUCKER SPP.		4R	0	0	1R	4R	0	0	0	0	0	0		9R
WHITE CATFISH		0	0	1H	0	0	0	0	0	0	0	0	1H	
BROWN BULLHEAD		6H	7H	1H	1R	2H 1R	9H	3H 3R	1R	2H	0	0	30H	6R
CHANNEL CATFISH		3H 1R	5H 5R	12H 25R	1H 2R	12H 7R	4H 6R	17H 33R	7R	2H 1R	0	5R	56H	92R
ROCK BASS		0	0	1R	3H 6R	14H 9R	2H 4R	1H 11R	4R	1R	0	0	20H	36R
REDBREAST SUNFISH		0	0	0	0	0	3R	0	0	0	0	0		3R
PUMPKINSEED		0	0	0	0	0	2H 3R	1R	0	0	0	0	2H	4R
BLUEGILL		0	0	0	4H 1R	2H	10H 7R	2H 6R	6R	0	0	0	18H	20R
SMALLMOUTH BASS		0	0	0	3H 1R	7H 20R	2H 9R	8R	1H 14R	1H	1H 2R	0	15H	54R
LARGEMOUTH BASS		0	0	0	0	0	0	1H 2R	2R	0	0	0	1H	4R
SUNFISH SPP.		0	0	0	2H	0	6R	1H	4R	0	0	0	3H	10R
YELLOW PERCH		0	0	0	4R	1H 1R	1H	1R	0	0	0	0	2H	6R
WALLEYE		9H 11R	4R	0	4R	4H 2R	0	3H 2R	2R	1H	2H	17H 6R	36H	31R
FISH (UNIDENTIFIED)		0	0	0	7R	0	0	1R	0	0	0	0		8R

H = HARVESTED
R = RELEASED

Table F-3

Use of catch, residence, times interviewed, bait used, and preference of catch obtained during angler surveys on the Susquehanna River, 1984.

	NUMBER OF ANGLERS													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	% TOTAL
USE OF CATCH														
EAT	0	32	20	16	49	51	34	26	37	9	10	26	310	63.3
RELEASE	0	11	11	4	30	16	6	30	15	9	6	15	153	31.2
OTHER	0	10	0	2	1	5	2	6	0	1	0	0	27	5.5
RESIDENCE														
PA COUNTY														
BERKS	0	0	0	0	0	7	0	0	0	0	0	0	7	1.4
CARBON	0	0	0	0	0	0	7	0	0	0	0	0	7	1.4
CLEARFIELD	0	0	0	0	0	1	0	0	0	0	0	0	1	0.2
COLUMBIA	0	15	4	1	17	7	7	4	7	5	4	14	85	17.3
LACKAWANNA	0	0	0	0	0	0	0	0	1	0	0	0	1	0.2
LUZERNE	0	34	26	21	58	45	26	50	38	12	12	23	345	70.4
MONTOUR	0	0	0	0	1	0	0	0	0	0	0	0	1	0.2
NORTHUMBERLAND	0	0	0	0	3	0	0	2	0	0	0	0	5	1.0
SCHUYLKILL	0	4	1	0	0	12	2	6	4	2	0	1	32	6.5
SUSQUEHANNA	0	0	0	0	0	0	0	0	1	0	0	0	1	0.2
UNION	0	0	0	0	1	0	0	0	0	0	0	0	1	0.2
WAYNE	0	0	0	0	0	0	0	0	1	0	0	0	1	0.2
OUT OF STATE														
LOUISIANA	0	0	0	0	0	0	0	0	0	0	0	1	1	0.2
NEW YORK	0	0	0	0	0	0	0	0	0	0	0	1	1	0.2
OHIO	0	0	0	0	0	0	0	0	0	0	0	1	1	0.2
TIMES INTERVIEWED														
1	0	52	23	21	71	60	24	44	32	2	10	14	353	72.0
2	0	1	3	1	5	12	10	15	4	5	2	6	64	13.1
3	0	0	3	0	4	0	3	3	10	6	2	0	31	6.2
4-9	0	0	2	0	0	0	5	0	6	6	2	21	42	8.6
BAIT USED														
NATURAL	0	20	11	22	58	40	17	32	35	6	2	2	245	50.0
ARTIFICIAL	0	23	11	0	6	10	11	13	5	9	14	22	124	25.3
BOTH	0	10	9	0	16	22	14	17	12	4	0	17	121	24.7
PREFERENCE OF CATCH														
ANY FISH	0	11	12	13	54	45	33	28	33	9	3	5	246	50.2
GAMEFISHES[a]	0	42	8	0	9	12	7	21	8	7	10	36	160	32.7
CATFISHES	0	0	11	9	17	15	2	13	9	2	3	0	81	16.5
CARP/SUCKERS	0	0	0	0	0	0	0	0	2	1	0	0	3	0.6

[a]MUSKELLUNGE, SMALLMOUTH BASS, WALLEYE

Table F-4

Results (χ^2 values) of Friedman's two-way analysis of variance for comparison of angler survey data on the Susquehanna River, 1984 (* = P<0.05, ** = P<0.01).

FACTOR	MONTHS	WEEKEND DAYS OR WEEKDAYS	EAST BANK, WEST BANK, OR BOAT	ZONES (1-6)	ZONES (1-4)	TIME PERIODS
DF	11	1	2	5	3	2
NO. OF ANGLERS	22.7*	10.1**	17.5**	36.1**	3.3	11.2**
HOURS FISHED	24.5*	10.1**	17.5**	32.7**	6.2	2.7
FISH CAUGHT	17.6	10.1**	10.7**	21.2**	4.4	4.3
FISH HARVESTED	13.0	4.1*	12.2**	16.6**	2.7	3.9

Table F-5

Summary of angler data from east and west banks and boats on the Susquehanna River, 1984.

TOTAL NUMBER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
						EAST BANK							
ANGLERS	0	38	26	22	63	52	26	34	36	5	13	31	346
FISH CAUGHT		40	36	58	39	52	62	25	26	4	8	14	364
FISH KEPT		22	29	15	11	40	21	15	1	3	3	4	164
HOURS FISHED		137.2	70.2	33.2	159.1	183.7	78.7	95.7	97.2	8.8	32.1	48.1	943.9
CATCH/ANGLER		1.1	1.4	2.6	0.6	1.0	2.4	0.7	0.7	0.8	0.6	0.5	1.1
HARVEST/ANGLER		0.6	1.1	0.7	0.2	0.8	0.8	0.4	<0.1	0.6	0.2	0.1	0.5
HOURS/ANGLER		3.6	2.7	1.5	2.5	3.5	3.0	2.8	2.7	1.8	2.5	1.6	2.7
CATCH/HOUR		0.3	0.5	1.7	0.2	0.3	0.8	0.3	0.3	0.5	0.2	0.3	0.4
HARVEST/HOUR		0.2	0.4	0.5	0.1	0.2	0.3	0.2	<0.1	0.3	0.1	0.1	0.2
						WEST BANK							
ANGLERS	0	0	2	0	8	4	1	3	2	0	0	0	20
FISH CAUGHT			0		8	24	3	3	2				40
FISH KEPT			0		0	4	0	0	0				4
HOURS FISHED			4.0		22.7	10.0	13.5	6.8	4.5				61.4
CATCH/ANGLER			0.0		1.0	6.0	3.0	1.0	1.0				2.0
HARVEST/ANGLER			0.0		0.0	1.0	0.0	0.0	0.0				0.2
HOURS/ANGLER			2.0		2.8	2.5	13.5	2.3	2.3				3.1
CATCH/HOUR			0.0		0.4	2.4	0.2	0.4	0.4				0.7
HARVEST/HOUR			0.0		0.0	0.4	0.0	0.0	0.0				0.1
						BOAT							
ANGLERS	0	15	3	0	9	16	15	25	14	14	3	10	124
FISH CAUGHT		25	5		6	16	17	74	14	6	0	16	179
FISH KEPT		10	0		3	0	9	14	0	4	0	13	53
HOURS FISHED		57.2	4.5		26.7	82.0	40.1	88.6	39.8	33.8	3.0	29.1	404.7
CATCH/ANGLER		1.7	1.7		0.7	1.0	1.1	3.0	1.0	0.4	0.0	1.6	1.4
HARVEST/ANGLER		0.7	0.0		0.3	0.0	0.6	0.6	0.0	0.3	0.0	1.3	0.4
HOURS/ANGLER		3.8	1.5		3.0	5.1	2.7	3.5	2.8	2.4	1.0	2.9	3.3
CATCH/HOUR		0.4	1.1		0.2	0.2	0.4	0.8	0.4	0.2	0.0	0.6	0.4
HARVEST/HOUR		0.2	0.0		0.1	0.0	0.2	0.2	0.0	0.1	0.0	0.4	0.1

Table F-6

Summary of angler survey data in zones 1 through 6 on the Susquehanna River, 1984.

TOTAL NUMBER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
						ZONE 1							
ANGLERS	0	0	2	0	2	1	0	6	4	0	0	0	15
FISH CAUGHT			0		0	7		7	5				19
FISH KEPT			0		0	7		3	0				10
HOURS FISHED			4.8		1.3	4.6		27.5	10.8				49.1
CATCH/ANGLER			0.0		0.0	7.0		1.2	1.3				1.3
HARVEST/ANGLER			0.0		0.0	7.0		0.5	0.0				0.7
HOURS/ANGLER			2.4		0.7	4.6		4.6	2.7				3.3
CATCH/HOUR			0.0		0.0	1.5		0.3	0.5				0.4
HARVEST/HOUR			0.0		0.0	1.5		0.1	0.0				0.2
						ZONE 2							
ANGLERS	0	6	6	5	5	3	1	2	4	0	0	9	41
FISH CAUGHT		9	30	35	14	9	3	3	4			16	123
FISH KEPT		5	29	11	0	9	0	0	0			13	67
HOURS FISHED		16.2	29.0	9.3	39.5	16.5	13.5	6.0	14.5			28.8	173.3
CATCH/ANGLER		1.5	5.0	7.0	2.8	3.0	3.0	1.5	1.0			1.8	3.0
HARVEST/ANGLER		0.8	4.8	2.2	0.0	3.0	0.0	0.0	0.0			1.4	1.6
HOURS/ANGLER		2.7	4.8	1.9	7.9	5.5	13.5	3.0	3.6			3.2	4.2
CATCH/HOUR		0.6	1.0	3.8	0.4	0.5	0.2	0.5	0.3			0.6	0.7
HARVEST/HOUR		0.3	1.0	1.2	0.0	0.5	0.0	0.0	0.0			0.5	0.4
						ZONE 3							
ANGLERS	0	6	4	2	4	0	0	0	0	0	0	3	19
FISH CAUGHT		12	8	15	11							1	47
FISH KEPT		3	0	1	9							0	13
HOURS FISHED		24.0	8.3	6.0	10.2							4.8	53.2
CATCH/ANGLER		2.0	2.0	7.5	2.8							0.3	2.5
HARVEST/ANGLER		0.5	0.0	0.5	2.3							0.0	0.7
HOURS/ANGLER		4.0	2.1	3.0	2.5							1.6	2.8
CATCH/HOUR		0.5	1.0	2.5	1.1							0.2	0.9
HARVEST/HOUR		0.1	0.0	0.2	0.9							0.0	0.2
						ZONE 4							
ANGLERS	0	0	0	0	2	0	5	3	1	1	2	0	14
FISH CAUGHT					8		6	16	0	2	0		32
FISH KEPT					0		0	2	0	0	0		2
HOURS FISHED					9.0		13.3	11.0	4.0	3.5	4.0		44.8
CATCH/ANGLER					4.0		1.2	5.3	0.0	2.0	0.0		2.3
HARVEST/ANGLER					0.0		0.0	0.7	0.0	0.0	0.0		0.1
HOURS/ANGLER					4.5		2.7	3.7	4.0	3.5	2.0		3.2
CATCH/HOUR					0.9		0.5	1.5	0.0	0.6	0.0		0.7
HARVEST/HOUR					0.0		0.0	0.2	0.0	0.0	0.0		<0.1
						ZONE 5							
ANGLERS	0	22	14	11	43	46	23	36	29	10	8	13	255
FISH CAUGHT		25	0	2	11	46	16	30	25	4	7	6	172
FISH KEPT		11	0	1	5	22	9	5	1	3	2	2	61
HOURS FISHED		75.5	26.3	10.1	110.0	142.2	51.7	95.9	76.5	12.3	25.0	24.3	649.9
CATCH/ANGLER		1.1	0.0	0.2	0.3	1.0	0.7	0.8	0.9	0.4	0.9	0.5	0.7
HARVEST/ANGLER		0.5	0.0	0.1	0.1	0.5	0.4	0.1	<0.1	0.3	0.3	0.2	0.2
HOURS/ANGLER		3.4	1.9	0.9	2.6	3.1	2.2	2.7	2.6	1.2	3.1	1.9	2.5
CATCH/HOUR		0.3	0.0	0.2	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3
HARVEST/HOUR		0.1	0.0	0.1	<0.1	0.2	0.2	0.1	<0.1	0.2	0.1	0.1	0.1
						ZONE 6							
ANGLERS	0	19	5	4	24	22	13	15	14	8	6	16	146
FISH CAUGHT		19	3	6	9	30	57	46	8	4	1	7	190
FISH KEPT		13	0	2	0	6	21	19	0	4	1	2	68
HOURS FISHED		78.7	10.3	7.8	38.4	112.3	53.8	50.7	35.7	26.8	6.1	19.2	439.8
CATCH/ANGLER		1.0	0.6	1.5	0.4	1.4	4.4	3.1	0.6	0.5	0.2	0.4	1.3
HARVEST/ANGLER		0.7	0.0	0.5	0.0	0.3	1.6	1.3	0.0	0.5	0.2	0.1	0.5
HOURS/ANGLER		4.1	2.1	2.0	1.6	5.1	4.1	3.4	2.5	3.4	1.0	1.2	3.0
CATCH/HOUR		0.2	0.3	0.8	0.2	0.3	1.1	0.9	0.2	0.1	0.2	0.4	0.4
HARVEST/HOUR		0.2	0.0	0.3	0.0	0.1	0.4	0.4	0.0	0.1	0.2	0.1	0.2

Table F-7

Summary of anglers, hours fished, fish caught, and fish harvested on the Susquehanna River, 1981 through 1984.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANGLERS													
1981	2	58	72	62	42	69	104	32	74	31	35	3	584
1982	0	17	28	33	121	69	124	110	72	29	11	20	634
1983	30	76	58	48	59	84	68	71	83	10	2	0	589
1984	0	53	31	22	80	72	42	62	52	19	16	41	490
HOURS FISHED													
1981	5.5	91.8	99.8	75.3	73.5	156.4	260.7	66.7	208.0	94.2	73.5	6.8	1,210.1
1982	0	55.1	49.7	56.4	297.7	95.7	243.5	224.8	189.8	98.2	35.7	34.4	1,381.0
1983	66.8	237.6	141.7	123.0	152.4	219.3	178.2	171.6	219.1	20.4	2.3	0	1,532.3
1984	0	194.3	78.7	33.2	208.4	275.7	132.2	191.1	141.5	42.6	35.1	77.2	1,410.0
FISH CAUGHT													
1981	32	31	20	9	15	82	107	24	105	97	63	1	586
1982	0	55	44	21	81	47	144	41	41	48	41	13	576
1983	5	141	32	9	34	118	40	35	82	7	2	0	505
1984	0	65	41	58	53	92	82	102	42	10	8	30	583
FISH HARVESTED													
1981	1	15	9	0	4	21	23	0	20	53	15	0	161
1982	0	6	14	5	34	9	26	9	9	1	12	2	127
1983	1	10	11	6	13	53	9	7	9	4	0	0	123
1984	0	32	29	15	14	44	30	29	1	7	3	17	221

Table F-8

Summary of estimated number of anglers, hours fished, fish caught, and fish harvested on the Susquehanna River, 1981 through 1984.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANGLERS													
1981[a]	10	261	454	351	303	535	683	193	405	249	233	20	3,696
1982	0	97	157	239	814	542	895	723	402	187	75	117	4,248
1983	183	402	442	240	433	525	509	464	470	78	15	0	3,760
1984	0	250	224	115	412	486	320	338	346	92	84	275	2,942
HOURS FISHED													
1981[a]	28	687	1230	718	929	1624	2638	521	1408	869	610	45	11,308
1982	0	314	339	567	2868	1169	2811	2153	1372	734	243	253	12,823
1983	626	1308	1304	1031	1327	1857	1623	1324	1557	157	23	0	12,138
1984	0	961	736	308	1447	1896	1228	1335	1291	247	209	671	10,329
FISH CAUGHT													
1981[a]	163	232	246	86	190	851	1083	188	711	895	523	7	5,175
1982	0	313	300	211	780	574	1662	393	296	359	279	96	5,263
1983	47	776	294	75	296	999	364	270	583	54	20	0	3,778
1984	0	321	383	538	368	633	762	713	383	58	48	261	4,468
FISH HARVESTED													
1981[a]	5	112	111	0	51	218	233	0	135	489	124	0	1,478
1982	0	34	95	50	328	110	300	86	65	7	82	15	1,172
1983	9	55	101	50	113	449	82	54	64	31	0	0	1,008
1984	0	158	271	139	97	303	279	203	9	41	18	148	1,666

[a]Revised estimates using same formula as 1982, 1983, and 1984.

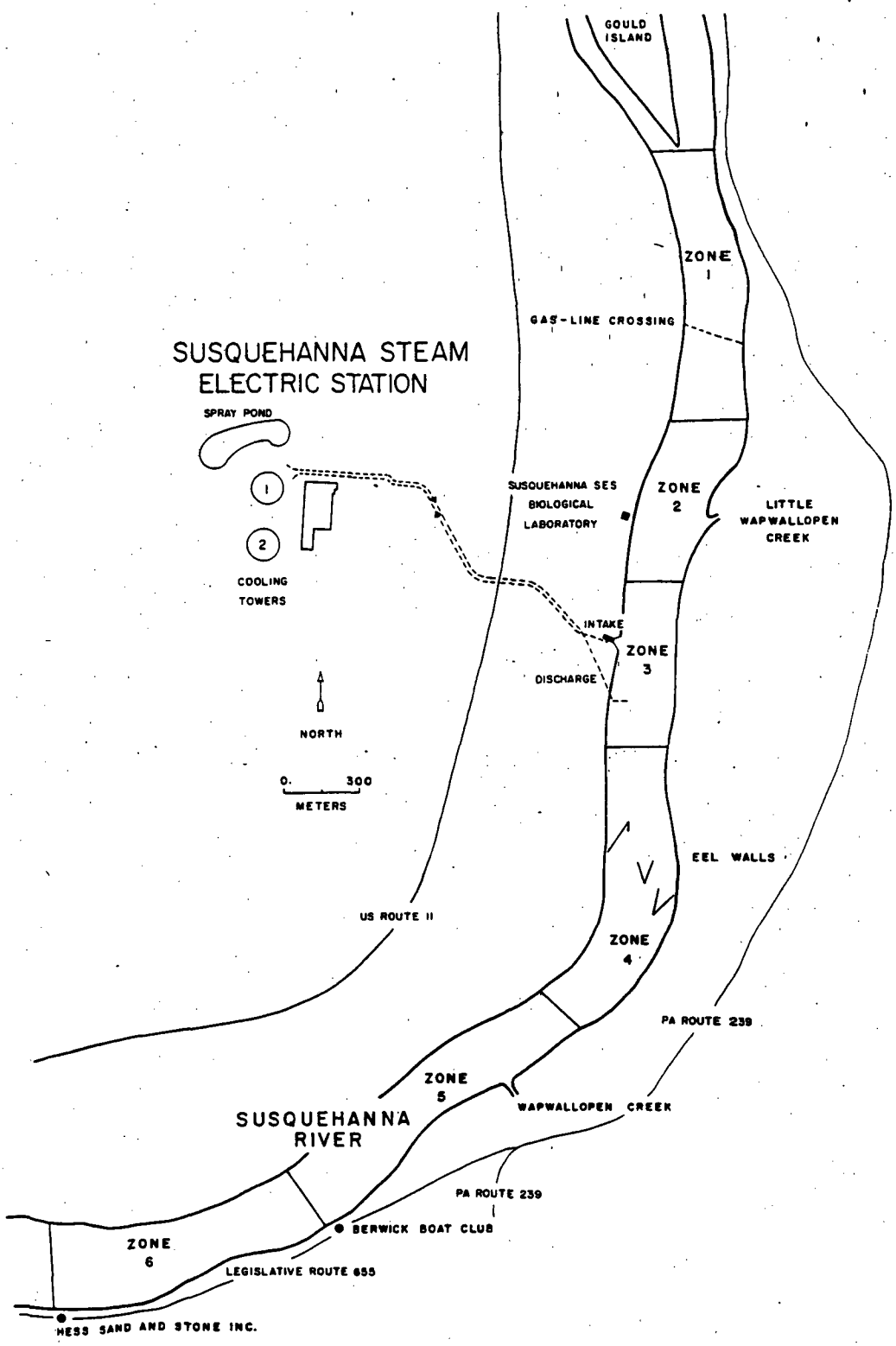

Fig. F-1

Location of zones 1 through 6 used on the angler survey on the Susquehanna River near the Susquehanna SES, 1984.

FLORA, VEGETATION, AND METEOROLOGY

by

James D. Montgomery

TABLE OF CONTENTS

Page

ABSTRACT..... 202

INTRODUCTION..... 203

PROCEDURES
Flora..... 203
Vegetation..... 204
Meteorology..... 210

RESULTS AND DISCUSSION
Flora..... 211
Vegetation..... 214
Meteorology..... 222

REFERENCES CITED..... 222

LIST OF TABLES

Table

G-1 Location of salt drift transects in the vicinity of the Susquehanna SES and at the Elimsport Substation, 1984..... 225

G-2 Species of woody plants observed in the vicinity of the Susquehanna SES, 1972-74 and 1977-84..... 226

G-3 Species of herbaceous plants observed in the vicinity of the Susquehanna SES, 1972-74 and 1977-84..... 228

G-4 Species of plants observed at Elimsport Substation and not found at Susquehanna SES, 1982-84..... 233

Table		Page
G-5	Months when plants were observed in flower or shedding spores on forest salt drift transects in the vicinity of the Susquehanna SES and Elimsport Substation, 1984	234
G-6	Months when plants were observed in flower or shedding spores on field salt drift transects in the vicinity of the Susquehanna SES, 1984	239
G-7	Parasitic plant diseases observed on salt drift transects in the vicinity of the Susquehanna SES and at Elimsport, 1984	242
G-8	Vegetation analysis for trees in the Council Cup Forest, 1984	245
G-9	Vegetation analysis for saplings. . . 1984	245
G-10	Vegetation analysis for tree seedlings . . . 1984	246
G-11	Vegetation analysis for shrubs, herbs, and ground cover . . . 1984	246
G-12	Comparison of trees (number of stems) in the Council Cup Forest, 1977-84	247
G-13	Comparison of saplings . . . 1977-84	247
G-14	Comparison of tree seedlings . . . 1977-84	248
G-15	Comparison of shrubs, herbs, and ground cover (% cover) . . . 1977-84	248
G-16	Vegetation analysis for trees in the TR419 Forest, 1984	249
G-17	Vegetation analysis for saplings . . . 1984	249
G-18	Vegetation analysis for tree seedlings . . . 1984	250
G-19	Vegetation analysis for shrubs, herbs, and ground cover . . . 1984	251
G-20	Comparison of trees (number of stems) in the TR419 Forest, 1977-84	252
G-21	Comparison of saplings . . . 1977-84	252
G-22	Comparison of tree seedlings . . . 1978-84	253
G-23	Comparison of shrubs, herbs, and ground cover (% cover) . . . 1978-84	253

Table		Page
G-24	Vegetation analysis for trees in the Quarry Hillside Forest, 1984	254
G-25	Vegetation analysis for saplings . . . 1984	254
G-26	Vegetation analysis for tree seedlings . . . 1984	255
G-27	Vegetation analysis for shrubs, herbs, and ground cover . . . 1984	256
G-28	Comparison of trees (number of stems) in the Quarry Hillside Forest, 1978-84	257
G-29	Comparison of saplings . . . 1978-84	257
G-30	Comparison of tree seedlings . . . 1978-84	258
G-31	Comparison of shrubs, herbs, and ground cover (% cover) . . . 1978-84	258
G-32	Vegetation analysis for trees in the Elimsport Substation Forest, 1984	259
G-33	Vegetation analysis for saplings . . . 1984	259
G-34	Vegetation analysis for tree seedlings . . . 1984	260
G-35	Vegetation analysis for shrubs, herbs, and ground cover . . . 1984	260
G-36	Comparison of trees (number of stems) in the Elimsport Substation Forest, 1982-84	261
G-37	Comparison of saplings . . . 1982-84	261
G-38	Comparison of tree seedlings . . . 1982-84	262
G-39	Comparison of shrubs, herbs, and ground cover (% cover) . . . 1982-84	262
G-40	Vegetation analysis for trees in the Gould Island Forest, 1984	263
G-41	Vegetation analysis for saplings . . . 1984	263
G-42	Vegetation analysis for tree seedlings . . . 1984	264
G-43	Vegetation analysis for shrubs, herbs, and ground cover . . . 1984	264

Table		Page
G-44	Comparison of trees (number of stems) in the Gould Island Forest, 1979-84	265
G-45	Comparison of saplings . . . 1979-84	265
G-46	Comparison of tree seedlings . . . 1979-84	266
G-47	Comparison of shrubs, herbs, and ground cover (% cover) . . . 1979-84	266
G-48	Estimated damage (% defoliation) by gypsy moth to trees in the Council Cup, TR419, and Quarry Hillside Forests near the Susquehanna SES and in the Elimsport Substation Forest, 1984	267
G-49	Vegetation analysis for tree seedlings, shrubs, and herbs in Switchyard Field, 1984	268
G-50	Comparison of tree seedlings, shrubs, and herbs (% cover) in Switchyard Field, 1978-84	269
G-51	Vegetation analysis for tree seedlings, shrubs, and herbs in Transmission Corridor Field, 1984	270
G-52	Comparison of tree seedlings, shrubs, and herbs (% cover) in Transmission Corridor Field, 1979-84	271
G-53	Daily minimum, maximum, and mean air temperature (C) at the Susquehanna SES Biological Laboratory, 1984	272
G-54	Barometric pressure (in Hg) and direction of change at 1200 and 2400 hours daily at the Susquehanna SES Biological Laboratory, 1984	275
G-55	Daily precipitation (cm), weather conditions, and fog (0700-0800 h) at the Susquehanna SES Biological Laboratory, 1984	278

LIST OF FIGURES

Fig.		
G-1	Location of vegetation and bird census plots and salt drift transects in the vicinity of the Susquehanna SES site, 1984	284
G-2	Tree, sapling, and seedling density for forest plots, 1977-84	285

ABSTRACT

From 1972 through 1974 and 1977 through 1984, 701 species of vascular plants have been observed in the vicinity of the Susquehanna SES. In 1984, 426 taxa were found in 10 salt drift transects. Thirty-two plant parasitic diseases were observed on 48 host species. Disease frequency ranged from rare to abundant. Disease effect ranged from discoloration to minor leaf necrosis for most diseases. Leaf spot anthracnose of *Cornus florida* continued to cause serious damage including host death.

Quantitative vegetation studies at the Susquehanna SES were conducted in three upland forests, a river-bottom hardwood forest, two abandoned fields, and at an upland forest that was a control site near Elimsport, Pennsylvania. Data from these plots were compared with preoperational studies of 1977-82. In the upland forest plots, there were 53 significant changes in 1984; 46 at Susquehanna SES plots and seven at Elimsport. Of those at Susquehanna SES, 30 were found in previous years. There were 16 significant changes in the river-bottom hardwood forest. Changes in the forest plots were results of natural forest dynamics, including disease and flooding. There were 40 significant changes in the two abandoned fields. Most of these were considered normal successional changes. None of the changes in the forest or field plots could be attributed to the operation of the Susquehanna SES.

Meteorological records for air temperature, barometric pressure, precipitation, fog, and cloud cover were made from January through December 1984. Mean temperature was lowest in January and March and highest in June; rainfall was lowest in September and highest in May. Fog occurred on 66 of 254 days (26%) of observation.

INTRODUCTION

Terrestrial ecological studies were conducted in the vicinity of the Susquehanna SES from 1972 through 1974 (Ichthyological Associates, Inc. 1973-74, Burton 1976) and from 1977 through 1983 (Montgomery 1978-84). The flora and vegetation studies conducted from 1977 through 1982 gathered baseline information for comparison with data collected after the Susquehanna SES began operation in September 1982. In 1984, systematic information was collected on the phenology of flowering plants and ferns and on the incidence of parasitic plant diseases (flora), and quantitative information was obtained on selected plant communities (vegetation). The purpose of the flora and vegetation studies in 1984 was to monitor changes, if any, during Susquehanna SES operation in comparison to preoperational studies of 1977-82.

PROCEDURES

Flora

Floristic studies were conducted from March through October 1984. As from 1977 through 1983 (Montgomery 1978-84), observations were made on both sides of the Susquehanna River in the vicinity of the Susquehanna SES (Fig. G-1). In addition to general observations, transects for systematic observations were established. Nine transects were selected for observing possible effects of moisture and salt drift from the Susquehanna SES cooling towers during operation, and are referred to as salt drift transects. These transects were located in several plant communities at varying distances and directions from the Susquehanna SES (Table G-1; Fig. G-1).

In 1982, an off-site control transect was established near the Elimsport Substation of PP&L. This area was selected primarily for vegetation studies; however, it was considered useful to have a salt drift transect at this site for comparison with the Susquehanna SES transects.

On each salt drift transect, the following data were recorded: all plant taxa in flower (shedding spores for ferns), all parasitic plant diseases observed according to host species, and frequency and relative effect of the disease on the host.

Each transect was surveyed once a month, usually in the latter half, from March through October. Identifications of vascular plants were made using Fernald (1950), Gleason and Cronquist (1963), Peterson and McKenny (1968); Wherry (1961) and Mickel (1979) for ferns; and Hitchcock (1950) for grasses. Nomenclature follows Gleason and Cronquist (1963), except for ferns and fern allies, for which Mickel (1979) is used. Parasitic plant diseases were identified using U.S. Department of Agriculture (1960), Hepting (1971), Westcott (1971), and Pennsylvania Department of Environmental Resources (1975). Scientific names are used because of the confusion of some common names of plants. Common and scientific names are given in Tables G-2 and G-3. Species not observed prior to 1984 were collected and added to the reference herbarium.

Vegetation

Quantitative vegetation studies at the Susquehanna SES were conducted in three upland forests: Council Cup Forest, Township Road 419 (TR419) Forest, and Quarry Hillside Forest; a river-bottom hardwood forest on Gould Island;

two abandoned fields: Switchyard Field and Transmission Corridor Field (Fig. G-1); and a control upland forest at Elimsport Substation.

The upland forest plots were sampled in July. Council Cup Forest is located east of the Council Cup Overlook, in Conyngham and Hollenback Townships, Luzerne County, 3 km southeast of the Susquehanna SES. The study plot was a nearly level to gently east-facing slope, at an elevation of approximately 335 m above mean sea level. 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 County. Elevation ranged from 200 to 250 m. Quarry Hillside Forest is located on a steep south-facing hillside east of an abandoned quarry above PA Route 239, in Conyngham Township, Luzerne County. Elevation ranged from 225 to 250 m. The Council Cup and TR419 Forests have been sampled annually since 1977; the Quarry Hillside Forest has been sampled annually since 1978. The Elimsport Substation Forest was established in 1982 as a control forest plot, so that changes that might occur during operation of the Susquehanna SES could be compared with a remote plot unlikely to be affected by operation of the Susquehanna SES (Montgomery 1983). The Elimsport Substation Forest is located 5.4 km NNE of Elimsport, in Washington Township, Lycoming County. It was 72 km N84^{o}W of the Susquehanna SES. The plot lies at the base of the south-facing slope of White Deer Ridge. It is crossed by several small streams that are wet in spring, but nearly dry in midsummer. There is a permanent stream at the base of the slope outside the plot. Elevation ranged from 210 to 220 m.

The river-bottom hardwood forest on Gould Island, sampled annually since July 1979, was sampled again in July 1984. The forest is located along the western edge of Gould Island adjacent to the Susquehanna River. Only the mature forest was sampled. The study plot was nearly level, with elevations of 152.8 to 154.6 m.

The forests were surveyed into transects parallel with the long dimension of the plot. Points were located along these transects at distances depending on the plot size: 50-m intervals in Council Cup Forest, 75-m intervals in TR419 Forest, 30-m intervals in Quarry Hillside Forest and Elimsport Forest, and 40-m intervals in Gould Island Forest. At each point, a 10x10-m quadrat was permanently 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 to 9.5-cm dbh, and seedlings less than 1.0-cm dbh. All trees and saplings in the 10x10-m quadrat were identified, counted, and the dbh measured to the nearest cm with a diameter tape. Two 1x1-m quadrats were established in diagonally opposite corners of the 10x10-m quadrat for sampling tree seedlings, shrubs, herbs, and ground cover (litter, moss, rock, and bare soil). Plants were identified and an estimate was made of the percent cover in the quadrat for each species, but stems were counted only for tree seedlings. Stems of shrubs and herbs were not counted because many species are colonial, and stem number was judged not to be useful. The following were calculated for trees, saplings, and tree seedlings (Cain and Castro 1959):

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

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

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

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

$$\text{Dominance (trees and saplings)} = \frac{\text{basal area of a species}}{\text{hectare}}$$

$$\text{where basal area} = \pi \left(\frac{\text{dbh}}{2}\right)^2$$

$$\text{Dominance (tree seedlings)} = \frac{\text{cover value of a species}}{\text{area sampled in m}^2}$$

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

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

The following were calculated from the quadrat data for shrubs, herbs, and ground cover:

Frequency and Relative Frequency = same as above

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

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

Importance Value = relative frequency + relative dominance

Comparisons of 1984 data with that collected from 1977 through 1983 were made using a repeated measures analysis of variance with a test for linear trends (Sokal and Rohlf 1969). Quadrat by quadrat tests were made using

number of stems per quadrat for each tree, sapling, and seedling species, and percent cover per quadrat for shrubs and herb species and ground cover. Log (X+1) transformations for stem numbers and arcsine transformations for percent cover values were made as recommended by Sokal and Rohlf (1969) and Goodall (1970).

Defoliation by gypsy moth (*Lymantria dispar*) has been observed in the upland forest plots in the late spring and early summer annually since 1981. While conducting the quadrat surveys in July, quantitative estimates of this damage were made in the forest plots by visually judging the percentage of defoliation for each tree and sapling in the 10x10-m quadrats. These estimates were made at the time of maximum defoliation, when gypsy moth larvae were beginning to pupate. Gypsy moth studies have been conducted annually since 1981.

Two abandoned fields, Switchyard Field and Transmission Corridor Field, were sampled in September and October 1984 (Fig. G-1). Both of these fields were sampled in 1979, and 1981 through 1983, and Switchyard Field also in 1978. Neither was done in 1980.

Switchyard Field is located adjacent to the PP&L Substation, east of PA Route 239, 2.8 km east of the Susquehanna SES in Conyngham Township, Luzerne County. Elevation was approximately 210 m. The field sloped gently northward and was relatively dry.

Transmission Corridor Field is located immediately east of the transmission lines in the transmission corridor south of the Susquehanna SES and north of U.S. Route 11. Elevation was approximately 195 m. The field was level and dry.

The line intercept method was used for sampling (Cain and Castro 1959, Smith 1966). A baseline was established near and parallel to one edge of each field and marked into 10-m intervals. Lines were run perpendicular to the baseline at these intervals. Beginning at the baseline, these lines were divided into 10-m transects with permanent numbered stakes. There were five transects per line in both Transmission Corridor Field and Switchyard Field. Fifty transects were sampled in Transmission Corridor Field, and 49 in Switchyard Field. The first 5 m of each transect was sampled by stretching a metric tape between the stakes marking the ends of the transect. The length of cover for each taxon along the tape was recorded to the nearest cm. Tree seedlings, shrubs, and herbs were sampled together, but the data for each were treated separately. Species area curves were drawn after sampling to check on the adequacy of the area sampled (Mueller-Dombois and Ellenberg 1974). The following were calculated for all taxa:

$$\text{Frequency} = \frac{\text{number of transects on which a species occurs}}{\text{total number of transects}}$$

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

$$\text{Percent Coverage} = \frac{\text{coverage of a species on all transects}}{\text{total length of transects}}$$

$$\text{Relative Dominance} = \frac{\text{percent coverage of a species}}{\text{total percent coverage of all species}} \times 100$$

Importance Value = relative frequency + relative dominance

Comparisons of 1984 data with that collected in previous years were made as with forest data. Percent cover values for species with importance value greater than 5.0 in any sampling year were tested for significant changes and trends. Species which had importance value of 5.0 or less were not tested since they occurred in too few transects and had cover values too low to make comparisons useful.

Meteorology

Meteorological records of air temperature, barometric pressure, precipitation, fog, and cloud cover were made as a supplement to flora, vegetation, and bird studies. Temperature and barometric pressure were continuously recorded at the Susquehanna SES Biological Laboratory using a Taylor Weather-Hawk Recording Thermometer and Barometer, respectively. Both instruments were calibrated monthly. Minimum and maximum temperatures, with times of occurrence, were tabulated daily, and daily barometric pressure readings were tabulated at 1200 and 2400 hours. Precipitation was collected in a U.S. Weather Bureau Rain Gauge at the Biological Laboratory. The amount was recorded daily except on weekends; precipitation that accumulated on weekends was measured on Monday morning. Fog observations were made at the Biological Laboratory and at Transmission Corridor Field just north of U.S. Route 11 (Fig. G-1) between 0700 and 0800 hours each day except on weekends. Fog was categorized as "light" (visibility one-fourth mile or more) or "dense" (visibility less than one-fourth mile) as done by the U.S. Weather Service. Photographs of the cooling towers were taken at each location to document the

presence or absence of fog using a 35-mm Minolta XG-M camera with a 28 to 80-mm macro-zoom lens. Slides were stored at the Biological Laboratory. Weather conditions, including cloud cover and type of precipitation if any, were recorded at the same time as fog observations. Since conditions differed little at the Biological Laboratory and Transmission Corridor Field, data were combined for reporting purposes. Fog was reported if it occurred at either site. Presence or absence of a plume from the cooling towers was determined from the photographs. In cases of dense fog where plume presence could not be determined, no report of plume was made.

RESULTS AND DISCUSSION

Flora

From 1972 through 1974 and 1977 through 1984, 701 species of vascular plants have been observed in the vicinity of the Susquehanna SES. This total includes 132 woody plants (Table G-2) and 569 herbaceous plants (Table G-3). Eight species were observed for the first time on the site in 1984. None of these plants is currently listed or under review as threatened or endangered by the U.S. Department of the Interior (1982, 1983). Except for *Festuca rubra*, found in 1980 and 1983 (Montgomery 1981, 1984), none of the species listed by Wiegman (1979) in Rare and Endangered Vascular Plant Species in Pennsylvania have been found on the site.

Although a complete survey of flora was not made at the Elimsport Substation in 1982-84, 11 species were found on the salt drift transect or in vegetation studies that did not occur at the Susquehanna SES site (Table G-4).

There were 426 plant taxa observed in flower or shedding spores on the salt drift transects, 395 on forest transects (Table G-5), and 202 on field transects (Table G-6). Of the forest transects, QSH (abbreviations are defined in Table G-1) had the greatest number of taxa (211), followed by TR419 (155), TR438 (148), CC (133), Elim (108), GIF (92), and RF (72). The highest number of taxa in flower or shedding spores on the transects occurred in August. On individual transects highest numbers occurred in August on RF, GIF, and QSH; in July on TR419 and TR438; in June on Elim; and in May on CC.

Comparison of 1984 forest transect phenology data with 1978 through 1983 data indicated that 167 taxa (42%) occurred on the same transects in 1984 as in 1983, including 86 taxa (22%) which occurred on the same transect for three or more consecutive years (at least 1982-84); 100 taxa (25%) occurred on one additional transect or one fewer transect in 1984 than 1983; and 61 taxa (15%) were more variable in occurrence. In addition, 67 taxa (17%) occurred in 1984, but not in 1983. There was more similarity (and less variability) from 1983 to 1984 than in most previous years, but 16 more taxa were observed in 1984. Some variability was caused by the short flowering period of spring forest plants. These plants may or may not be observed in flower on a given transect in each year. There was a general trend for plants to begin flowering later and remain in flower longer in 1984, probably associated with cool, wet weather in spring and early summer.

Of the abandoned field transects, TCF had the greatest number of taxa (123), followed by SwF (101) and NF (92) (Table G-6). The highest number of taxa in flower or shedding spores on the transects occurred in August on TCF and NF and in June on SwF. On individual transects, the highest number also occurred in August.

Comparison of 1984 field transect data with 1977 through 1983 data indicated that 96 taxa (48%) occurred on the same transect in 1984 as in 1983, including 70 taxa (35%) which occurred on the same transect for three or more years; 41 taxa (20%) occurred on one additional or one less transect in 1984 than in 1983; and 14 taxa (7%) were more variable in occurrence. In addition, 51 taxa (25%) occurred in 1984 but not in 1983.

Thirty-two parasitic diseases were observed on 48 host species (Table G-7). Two diseases were observed for the first time in 1984. As in 1977-83, leaf spots were the most frequent diseases encountered, accounting for 15 of the 32 diseases (47%) on 20 host species (42%). Powdery mildew occurred on 15 species (31%); rust diseases occurred on 15 species (31%). The largest number of diseases (22) occurred on QSH.

Disease frequency ranged from rare to abundant (Table G-7) for all kinds of diseases and no pattern was evident. Disease effect ranged from discoloration only for powdery mildews, to minor leaf necrosis for most other diseases. Leaf spot anthracnose (dieback) of *Cornus florida* caused serious effects, including host death. Dr. Barry Towers, Bureau of Forestry, Pennsylvania Department of Agriculture (personal communication, December 1984), indicated that this disease continued to be widespread in Pennsylvania, causing serious losses of trees in many areas. This disease was observed at Elimsport as well as at the Susquehanna SES transects.

Numbers of diseases and hosts, and disease frequency were within ranges from previous years. No effects were observed that could be attributed to operation of the Susquehanna SES, and no effects of salt drift were observed.

Vegetation

Betula lenta was the most important (highest importance value) tree in the Council Cup Forest (Table G-8). Associates included four oaks (*Quercus velutina, Q. prinus, Q. borealis*, and *Q. alba*). Total density was 615 trees/ha. *Acer rubrum* was the most important sapling (Table G-9), with *B. lenta* and two oaks (*Quercus borealis, Q. prinus*) as associates. Total density was 1,555 saplings/ha. *Acer rubrum* was the most important seedling (Table G-10), with *Prunus serotina, Sassafras albidum,* and *Quercus alba* as associates. Total density was 30,750 seedlings/ha. *Vaccinium vacillans* was the most important shrub (Table G-11). *Lycopodium flabelliforme* was the most important herb, with *Aralia nudicaulis* and *Dennstaedtia punctilobula* as the most important associates; 18 taxa were encountered. Litter was the predominant ground cover.

The only significant change found in trees in the Council Cup Forest was for *Quercus velutina* (Table G-12); this change was first noted in 1978 (Montgomery 1979). Tree density has remained between 590 and 620 trees/ha since 1977 (Fig. G-2). Significant decreases in saplings from 1977 through 1984 were found for *Betula lenta, Quercus borealis, Q. prinus, Q. velutina, Betula populifolia, Prunus serotina,* and *Carya glabra* (Table G-13); and change with no trend for *Carya tomentosa* and *Fraxinus americana*. All of these changes were also found in previous years and most were associated with a steady decrease in total sapling density from 1977 through 1984 (Fig. G-2). *Acer rubrum* increased significantly, *Prunus serotina* decreased significantly, and *Quercus velutina* changed significantly with no trend in number of seedlings from 1978 through 1984 (Table G-14). The change in *Prunus serotina*

was first significant in 1984; the others were observed previously. Seedling density decreased slightly in 1984 (Fig. G-2). There were two significant increases and one significant decrease in shrub cover, and three increases in herb cover (Table G-15). Most of these changes were found in earlier years, and may be related to canopy decrease caused by gypsy moth defoliation in 1981 (Montgomery 1982). Rock decreased and moss changed significantly with no trend from 1977 through 1984.

In the TR419 Forest, *Quercus velutina* was the most important tree, with *Pinus virginiana* and *Cornus florida* as associates (Table G-16). Total density was 533 trees/ha. *Cornus florida* was the most important sapling, with *Quercus velutina*, *Acer rubrum*, and *Carya tomentosa* as associates (Table G-17). Total density was 1,017 saplings/ha. *Acer rubrum* was the most important seedling, with *Fraxinus americana*, *Sassafras albidum*, and *Prunus serotina* as associates (Table G-18). Total density was 63,125 seedlings/ha. *Rubus allegheniensis* was the most important shrub, with *Lindera benzoin*, *Parthenocissus quinquefolia*, and *Vaccinium stamineum* as associates (Table G-19). *Carex swanii* was the most important herb, with *Dennstaedtia punctilobula* the most important associate; 49 taxa were encountered. Litter was the most important ground cover.

Quercus velutina increased significantly and *Pinus virginiana* decreased significantly in the TR419 Forest (Table G-20). These changes were first significant in 1984. Tree density decreased slightly from 1983 to 1984 (Fig. G-2). *Cornus florida* and *Betula populifolia* decreased significantly among saplings (Table G-21). These changes also were not significant before 1984. Sapling density has remained nearly constant at just above 1,000 saplings/ha since 1977 (Fig. G-2). *Acer rubrum* and *Quercus velutina* increased

significantly, *Fraxinus americana* decreased significantly, and *Sassafras albidum* changed with no trend among seedlings from 1978 through 1984 (Table G-22). Seedling density decreased from 1983 to 1984 continuing a trend observed in 1983 (Fig. G-2). *Vitis aestivalis* decreased significantly among shrubs (Table G-23). Among herbs, *Carex swanii* and *Uvularia perfoliata* increased from 1978 through 1984.

In the Quarry Hillside Forest, *Quercus borealis* was the most important tree with *Quercus velutina*, *Fraxinus americana*, and *Acer rubrum* as the most important associates (Table G-24). Total density was 647 trees/ha. *Cornus florida* was the most important sapling, with *Quercus borealis*, *Acer rubrum*, and *Fraxinus americana* as associates (Table G-25). Total density was 1,000 saplings/ha. *Fraxinus americana* was the most important seedling with *Acer rubrum*, *Sassafras albidum*, and *Ulmus americana* as important associates (Table G-26). Total density was 73,666 seedlings/ha. *Lindera benzoin* was the most important shrub, with *Parthenocissus quinquefolia* as the most important associate (Table G-27). *Aster divaricatus* was the most important herb, with *Dryopteris marginalis*, *Deschampsia flexuosa*, and *Eupatorium rugosum* as associates; 37 taxa were encountered. Litter was the most important ground cover.

Quercus borealis increased significantly and *Q. velutina* decreased significantly from 1978 through 1984 in Quarry Hillside Forest (Table G-28). These changes were more likely caused by problems in identification than by changes in trees, since the total of the two *Quercus* species has remained nearly constant between 31 and 34 stems (Table G-28). Tree density decreased from 1983 to 1984, but has changed little since 1978 (Fig. G-2). *Cornus*

florida and *Quercus velutina* decreased significantly among saplings from 1978 through 1984 (Table G-29). The change in *Cornus florida* was significant for the first time in 1983, although the number of stems has declined steadily since 1978. Sapling density has decreased in each year from 1978 through 1984 (Fig. G-2). Among seedlings, *Acer rubrum* increased significantly, and *Prunus serotina*, and *Quercus prinus* decreased significantly, and *Fraxinus americana* changed without trend from 1978 through 1984 (Table G-30); these changes were noted previously (Montgomery 1981-84). Seedling density increased from 1983 to 1984 (Fig. G-2). There were no significant changes among shrubs (Table G-31). *Dryopteris marginalis* and *Eupatorium rugosum* increased significantly, *Carex* sp. decreased significantly, and *Veronica serpyllifolia* changed without trend from 1978 through 1984. Significant changes in ground cover were observed previously (Montgomery 1980).

In the Elimsport Substation Forest, *Acer rubrum* was the most important tree, with *Betula lenta*, *Liriodendron tulipifera*, and *Nyssa sylvatica* as associates (Table G-32). Total density was 565 trees/ha. *Betula lenta* was the most important sapling, with *Acer rubrum*, *Sassafras albidum*, and *Liriodendron tulipifera* as the most important associates (Table G-33). Total density was 5,355 saplings/ha. *Acer rubrum* was the most important seedling, with *Sassafras albidum*, *Nyssa sylvatica*, and *Prunus scrotina* as associates (Table G-34). Seedling density was 49,000/ha. *Smilax rotundifolia* was the most important shrub, with *Hamamelis virginiana*, *Lindera benzoin*, and *Vaccinium vacillans* as the most important associates (Table G-35). *Dennstaedtia punctilobula* was the most important herb; *Thelypteris noveboracensis* and *Osmunda cinnamomea* were the most important associates. Litter was the predominant ground cover.

Acer rubrum, *Liriodendron tulipifera*, and *Betula lenta* increased significantly among trees from 1982 through 1984 in the Elimsport Forest (Table G-36). Tree density also increased from 1982 through 1984 (Fig. G-2). *Betula lenta*, *Acer rubrum*, and *Sassafras albidum* decreased significantly among saplings from 1982 through 1984 (Table G-37). Sapling density has decreased in each year (Fig. G-2). Both death of saplings due to crowding and recruitment into tree size class were causes of this decrease. There were no significant changes among seedlings (Table G-38), herbs, or ground cover (Table G-39). *Vaccinium vacillans* decreased significantly from 1982 through 1984.

Acer saccharinum was the most important tree in the Gould Island Forest, with *Celtis occidentalis*, *Ulmus americana*, and *Tilia americana* as important associates (Table G-40). Total density was 289 trees/ha. *Fraxinus pennsylvanica* was the most important sapling, with *Ulmus americana* and *Fraxinus americana* as associates (Table G-41). Total density was 147 saplings/ha. *Ulmus americana* was the most important tree seedling, with *Fraxinus americana* and *Carya cordiformis* as associates (Table G-42). Total density was 8,947 seedlings/ha. *Parthenocissus quinquefolia* was the most important shrub, with *Rhus radicans* and *Lindera benzoin* as the most important associates (Table G-43). *Matteuccia struthiopteris* was the most important herb. *Viola papilionacea*, *Polygonum virginianum*, and *Alliaria officinalis* were the most important associates; 29 herb taxa were encountered. Bare soil was the most important ground cover.

There were no significant changes among trees in the Gould Island Forest from 1979 through 1984 (Table G-44). Tree density remained approximately the

same (300/ha) as in previous years (Fig. G-2). Among saplings, *Fraxinus pennsylvanica* increased significantly from 1979 through 1984 (Table G-45). This change was discussed in 1981 (Montgomery 1982). Sapling density has remained low and nearly constant from 1979 through 1984 (Fig. G-2). *Ulmus americana* seedlings increased and *Celtis occidentalis* and *Acer saccharinum* decreased significantly from 1979 through 1984 (Table G-46). The change in *Ulmus americana* was noted previously; the changes in *Celtis occidentalis* and *Acer saccharium* were new in 1984. Seedling density decreased slightly from 1983 to 1984 (Fig. G-2). *Rhus radicans* increased significantly among shrubs (Table G-47); this change was not significant before. Among herbs, *Matteuccia struthiopteris, Eupatorium rugosum, Elymus riparius, E. virginicus,* and *Polygonum punctatum* increased; *Polygonum cilinode* and *Impatiens biflora* decreased; and *Alliaria officinalis* and *Pilea pumila* changed without trend from 1979 through 1984 (Table G-47). Of these nine changes, four had been significant before and five were first significant in 1984. Changes in ground cover (Table G-47) were first noted and discussed in 1980 (Montgomery 1981).

There were 53 significant changes in the upland forest plots in 1984, 46 at Susquehanna SES plots and 7 at Elimsport. Of those at the Susquehanna SES, 10 were new in 1984, and 30 were found previously. Six changes found significant in 1983 were no longer significant, indicating that these changes are within normal variation over longer periods of time (all of these were in seedlings (2), shrubs (2), or herbs (2), where annual variation is common). Most of these changes occurred before the Susquehanna SES began operation in 1982, and can be attributed to natural forest dynamics. Decrease in oaks (*Quercus* spp.) in several plots was caused by severe gypsy moth defoliation

and subsequent tree death in 1982, and decreases in *Cornus florida* in TR419 and Quarry Hillside Forests was the result of leaf spot anthracnose. None of these changes could be attributed to the operation of the Susquehanna SES.

There were seven significant changes in the Elimsport Substation Forest, three more than found in 1983. Two of these new changes occurred among saplings, where density is decreasing during succession.

There were 16 significant changes in the Gould Island Forest, five more than found in 1983. All of the changes first significant in 1984 occurred among seedlings or herbs, and are probably associated with flooding of the forest. Partial or total flooding of the forest floor occurred four times during the winter and spring of 1983-84: 15 December 1983; 16 February, 7 April, and 30 May 1984 (Soya et al. 1984; Table A-3 in this report) (Gould Island Forest plots begin to flood when the river level reaches 152 m above msl and are all flooded at 154.5 m above msl).

Defoliation by gypsy moth was found on six species at Susquehanna SES upland plots, and on three species at Elimsport Substation Forest (Table G-48). Defoliation occurred primarily on *Quercus* spp., and ranged from 1.7% on one species in the TR419 Forest to 5.0% on one of three species in the Quarry Hillside Forest. Defoliation was less than 1% for all species in each plot, similar to 1983, and in contrast to 1982 when defoliation reached 31% in Council Cup Forest (Montgomery 1982, Table F-39).

In Switchyard Field, *Cornus florida* was the most important tree seedling (Table G-49). *Cornus racemosa* was the most important shrub, *Solidago rugosa* and grass were the most important herbs, with *S. canadensis* and *Potentilla*

simplex the most important associates; 67 taxa were encountered, of which 48 were herbs. Twenty-one significant changes were found among taxa tested in Switchyard Field (Table G-50). Eleven were increases, six were decreases, and four showed no trend. All except one of these changes were found in 1983 (Montgomery 1984); the increase in *Viburnum dentatum* was significant for the first time in 1984. All changes in trees and shrubs had positive trends and are clearly successional as young trees and shrubs increase in cover. Significant decreases in annual and biennial herbs, including *Rumex acetosella*, *Daucus carota*, and *Veronica officinalis* are probably successional also. Other changes in this field indicate no clear pattern, although the increase in perennial grasses may be successional.

In Transmission Corridor Field, *Acer rubrum* was the most important tree seedling (Table G-51). *Rubus flagellaris* was the most important shrub. Grass was the most important herb taxon, with *Fragaria virginiana*, *Solidago juncea*, and *S. rugosa* the most important associates; 53 taxa were encountered of which 36 were herbs. Nineteen significant changes were found in Transmission Corridor Field (Table G-52); 10 were increases, 7 were decreases, and 2 showed no trend. All except two of these changes were found in 1983 (Montgomery 1984); changes in moss and *Hieracium pratense* were first significant in 1984. The increases in *Acer rubrum*, *Cornus racemosa* and decreases in woody vines and *Rubus* spp. are probably successional in nature, but the pattern of succession is less clear in Transmission Corridor Field.

There were 40 significant changes in the two fields. Many of these, including increases in tree and shrub cover and decreases in annuals and short-lived perennials, are normal successional changes. Thirty-seven of the

40 changes were found in 1984 or earlier and none could be attributed to the operation of the Susquehanna SES.

Meteorology

Meteorological data are presented in Tables G-53 through G-55. January was the coldest month, and June was the warmest month (Table G-53). The lowest temperature was recorded on 22 January (-28.0 C), and the highest on 13 June (37.0 C). Barometric pressure is reported in Table G-54. Rainfall was greatest in May and least in September (Table G-55). April, May, July, and August were relatively wet, and January and September were relatively dry. In 254 days of observation, there were 66 days (26%) with fog, 35 (14%) with light fog and 31 (12%) with dense fog (Table G-55). August had the most days with fog (13), followed by October (12). There was no evidence of a relationship between plume from the Susquehanna SES cooling towers and fog, since fog was usually either widespread in the valley or local but not related to plume presence or direction.

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Table G-1

Location of salt drift transects in the vicinity of the Susquehanna SES and at the Elimsport Substation, 1984.

Transect (Abbreviation)	Direction from Susquehanna SES	Distance (km) from Susquehanna SES	Habitat Type	Transect Length (km)	Location of Transect
River Forest (RF)	E-NE	1.5-2.0	River bottom hardwood forest	1.2	Adjacent to the Susquehanna River, north from Susquehanna SES Biological Laboratory to southern tip of Gould Island
Gould Island Forest (GIF)	NE	2.2-2.7	River bottom hardwood forest	1.0	Marked trail along western shore of Gould Island
TR 419 (TR419)	N	0.5-1.2	Upland hardwood-pine forest	1.5	Along Township Road 419, from U.S. 11 to T.R. 438
TR 438 (TR438)	W-SW	0.4-1.9	Upland forest, open field, marsh	2.3	Along Township Road 438, from T.R. 419 to the entrance of abandoned race track
Quarry-Spring House Trail (QSH)	ENE	2.2-3.2	Upland hardwood-pine forest	2.3	Trail from PA. 239 (quarry trail) to the transmission line along ridge top to the transmission line down the slope of Little Wapwallopen Valley to a trail past an abandoned spring house, ending on PA. 239
Council Cup (CC)	ESE	2.8-3.3	Upland hardwood-pine forest	1.4	Council Cup Nature Trail and Overlook
North Field (NF)	NE	1.8-2.0	Abandoned field	0.4	Field north of Susquehanna SES Biological Laboratory
Switchyard Field (SwF)	E	2.7-3.0	Abandoned field	0.3	Field north of the switching station east of PA. 239
Transmission Corridor Field (TCF)	S	1.3-2.3	Abandoned field	1.0	Field in the transmission corridor of Susquehanna SES
Elimsport Substation (Elim)	WNW	72	Upland forest and transmission line	0.8	Adjacent to and east of Elimsport Substation, 5.4 km NNE of Elimsport, Lycoming County

Table G-2

Species of woody plants observed in the vicinity of the Susquehanna SES, 1972-74 and 1977-84. Taxa are arranged alphabetically within phyla. An asterisk (*) indicates taxa observed for the first time in 1984.

PINOPHYTA

Cupressaceae
- *Juniperus virginiana* - red cedar
- *Thuja occidentalis* - arbor vitae

Pinaceae
- *Picea glauca* - white spruce
- *P. rubens* - red spruce
- *Pinus rigida* - pitch pine
- *P. strobus* - white pine
- *P. sylvestris* - scotch pine
- *P. virginiana* - Virginia pine
- *Tsuga canadensis* - eastern hemlock

MAGNOLIOPHYTA-DICOTYLEDONEAE

Aceraceae
- *Acer negundo* - box-elder
- *A. nigrum* - black maple
- *A. pensylvanicum* - striped maple
- *A. platanoides* - Norway maple
- *A. rubrum* - red maple
- *A. saccharinum* - silver maple
- *A. saccharum* - sugar maple
- *A. spicatum* - mountain maple

Anacardiaceae
- *Rhus copallina* - winged sumac
- *R. glabra* - smooth sumac
- *R. radicans* - poison ivy
- *R. typhina* - staghorn sumac
- *R. vernix* - poison sumac

Aquifoliaceae
- *Ilex verticellata* - winterberry

Berberidaceae
- *Berberis thunbergii* - Japanese barberry

Betulaceae
- *Alnus rugosa* - speckled alder
- *Betula lenta* - sweet birch
- *B. lutea* - yellow birch
- *B. nigra* - river birch
- *B. papyrifera* - paper birch
- *B. populifolia* - gray birch
- *Carpinus caroliniana* - American hornbeam
- *Corylus americana* - hazel-nut
- *Ostrya virginiana* - hop-hornbeam

Bignoniaceae
- * *Campsis radicans* - trumpet-creeper
- *Catalpa bignonioides* - catalpa

Caprifoliaceae
- *Diervilla lonicera* - bush-honeysuckle
- *Lonicera tatarica* - tartarian honeysuckle
- *Sambucus canadensis* - common elder
- *S. pubens* - red-berried elder
- *Viburnum acerifolium* - maple-leaf viburnum
- *V. dentatum* - arrowwood

Celastraceae
- *Celastrus scandens* - bittersweet

Cornaceae
- *Cornus alternifolia* - alternate-leaf dogwood
- *C. amomum* - silky dogwood
- *C. florida* - flowering dogwood
- *C. racemosa* - gray dogwood
- *C. rugosa* - round-leaf dogwood
- *Nyssa sylvatica* - black gum

Elaeagnaceae
- *Elaeagnus commutata* - silverberry

Ericaceae
- *Gaylussacia baccata* - black huckleberry
- *Kalmia angustifolia* - sheep laurel
- *K. latifolia* - mountain laurel
- *Rhododendron maximum* - rhododendron
- *R. nudiflorum* - pinxter-flower
- *R. roseum* - mountain azalea
- *Vaccinium corymbosum* - high-bush blueberry
- *V. stamineum* - deerberry
- *V. vacillans* - low-bush blueberry

Fagaceae
- *Castanea dentata* - American chestnut
- *Fagus grandifolia* - American beech
- *Quercus alba* - white oak
- *Q. bicolor* - swamp white oak
- *Q. borealis* - red oak
- *Q. ilicifolia* - scrub oak
- *Q. palustris* - pin oak
- *Q. prinus* - chestnut oak
- *Q. velutina* - black oak

Hamamelidaceae
- *Hamamelis virginiana* - witch hazel

Juglandaceae
- *Carya cordiformis* - bitternut hickory
- *C. glabra* - pignut hickory
- *C. ovata* - shagbark hickory
- *C. tomentosa* - mockernut hickory
- *Juglans cinerea* - butternut
- *J. nigra* - black walnut

Lauraceae
- *Lindera benzoin* - spicebush
- *Sassafras albidum* - sassafras

Leguminosae
- *Gleditsia triacanthos* - honey locust
- *Robinia pseudoacacia* - black locust
- *Wisteria floribunda* - wisteria

Magnoliaceae
- *Liriodendron tulipifera* - tulip-tree

Moraceae
- *Morus rubra* - red mulberry

Myricaceae
- *Myrica asplenifolia* - sweet fern

Oleaceae
- *Forsythia* sp. - forsythia
- *Fraxinus americana* - white ash
- *F. pennsylvanica* - red ash
- *Ligustrum vulgare* - common privet
- *Syringa vulgaris* - lilac

Platanaceae
- *Platanus occidentalis* - sycamore

Rhamnaceae
- *Ceanothus americanus* - New Jersey tea

Rosaceae
- *Amelanchier arborea* - shad-bush
- *A. stolonifera* - shad-bush
- *Aronia melanocarpa* - chokeberry
- *Crataegus pruinosa* - hawthorne
- *Crataegus* sp. - hawthorne
- *Physocarpus opulifolius* - ninebark
- *Prunus avium* - sweet cherry
- *P. pensylvanica* - pin cherry
- *P. serotina* - black cherry
- *P. virginiana* - choke cherry

Table G-2 (cont.)

Rosaceae (cont.)
Pyrus communis - pear
P. malus - apple
Pyrus sp. - crabapple
* *Rosa canina* - dog-rose
R. multiflora - multiflora rose
R. palustris - swamp rose
R. virginiana - wild rose
Rubus allegheniensis - blackberry
R. flagellaris - dewberry
R. hispidus - dewberry
R. occidentalis - black raspberry
Spiraea latifolia - meadow-sweet
S. tomentosa - steeplebush

Rubiaceae
Cephalanthus occidentalis - buttonbush

Rutaceae
Zanthoxylum americanum - prickly ash

Salicaceae
Populus grandidentata - big-toothed aspen
P. tremuloides - quaking aspen
Salix humilis - prairie willow
S. nigra - black willow
S. sericea - silky willow
Salix sp. - willow

Saxifragaceae
Hydrangea arborescens - hydrangea
Ribes americanum - wild black currant

Staphyleaceae
Staphylea trifolia - bladder-nut

Tiliaceae
Tilia americana - basswood

Ulmaceae
Celtis occidentalis - hackberry
Ulmus americana - American elm
U. rubra - slippery elm

Vitaceae
Parthenocissus quinquefolia - Virginia creeper
Vitis aestivalis - summer grape
V. labrusca - fox grape
V. riparia - riverbank grape

MAGNOLIOPHYTA-MONOCOTYLEDONEAE
Liliaceae
Smilax rotundifolia - greenbrier

Table G-3

Species of herbaceous plants observed in the vicinity of the Susquehanna SES, 1972-74 and 1977-84. Taxa are arranged alphabetically within phyla. An asterisk (*) indicates taxa observed for the first time in 1984.

EQUISETOPHYTA

Equisetaceae

Equisetum arvense - field horsetail
E. sylvaticum - woodland horsetail

LYCOPODIOPHYTA

Isoetaceae

Isoetes engelmannii - Englemann's quillwort

Lycopodiaceae

Lycopodium clavatum - staghorn clubmoss
L. flabelliforme - ground pine
L. inundatum - bog clubmoss
L. lucidulum - shining clubmoss
L. obscurum - tree clubmoss
L. tristachyum - ground cedar
Lycopodium X habereri - hybrid clubmoss

Selaginellaceae

Selaginella apoda - meadow spike-moss

POLYPODIOPHYTA

Ophioglossaceae

Botrychium dissectum - grape fern
B. lanceolatum - lanceolate
B. matricariifolium - daisy-leaf grape fern
B. virginianum - rattlesnake fern

Osmundaceae

Osmunda cinnamomea - cinnamon fern
O. claytoniana - interrupted fern

Polypodiaceae

Adiantum pedatum - maidenhair fern
Asplenium platyneuron - ebony spleenwort
Athyrium filix-femina - lady fern
A. thelypterioides - silvery spleenwort
Cystopteris fragilis - fragile fern
C. protrusa - lowland fragile fern
Dennstaedtia punctilobula - hay-scented fern
Dryopteris cristata - crested wood fern
D. intermedia - evergreen wood fern
D. marginalis - marginal wood fern
D. spinulosa - spinulose wood fern
Dryopteris X boottii - Boott's wood fern
Dryopteris X triploidea - hybrid wood fern
Dryopteris X uligonosa - hybrid wood fern
Gymnocarpium dryopteris - oak fern
Matteuccia struthiopteris - ostrich fern
Onoclea sensibilis - sensitive fern
Polypodium virginianum - common polypody
Polystichum acrostichoides - Christmas fern
Pteridium aquilinum - bracken
Thelypteris noveboracensis - New York fern
T. palustris - marsh fern
Woodsia ilvensis - rusty woodsia
W. obtusa - blunt-lobed woodsia

MAGNOLIOPHYTA-DICOTYLEDONEAE

Acanthaceae

Justicia americana - water-willow

Aizoaceae

Mollugo verticillata - carpet-weed

Apocynaceae

Apocynum androsaemifolium - dogbane
A. cannabinum - Indian hemp
Vinca minor - periwinkle

Araliaceae

Aralia nudicaulis - wild sarsaparilla
Panax trifolium - dwarf ginseng

Asclepiadaceae

Asclepias amplexicaulis - blunt-leaved milkweed
A. incarnata - swamp milkweed
A. quadrifolia - four-leaved milkweed
A. syriaca - common milkweed
A. tuberosa - butterfly-weed
**A. viridiflora* - green milkweed

Asteraceae

Achillea millefolium - yarrow
Ambrosia artemisiifolia - ragweed
A. trifida - giant ragweed
Anaphalis margaritacea - pearly everlasting
Antennaria neglecta - pussytoes
A. plantaginifolia - pussytoes
Anthemis cotula - mayweed
Arctium minus - burdock
Aster acuminatus - whorled wood aster
A. cordifolius - heart-leaved aster
A. divaricatus - white wood aster
A. dumosus - aster
A. laevis - smooth aster
A. lateriflorus - calico aster
A. novae-angliae - New England aster
A. patens - late purple aster
A. paternus - aster
A. pilosus - aster
A. prenanthoides - aster
A. puniceus - purple-stemmed aster
A. simplex - aster
A. umbellatus - flat-topped white aster
A. undulatus - aster
Bidens cernua - beggar-ticks
B. frondosa - beggar-ticks
B. tripartita - beggar-ticks
Cacalia suaveolens - Indian-plantain
Centaurea maculosa - spotted knapweed
Chrysanthemum leucanthemum - ox-eye daisy
Cichorium intybus - chicory
Cirsium arvense - Canada thistle
C. pumilum - pasture thistle
C. vulgare - bull thistle
Conyza canadensis - horseweed
Erechtites hieracifolia - fireweed
Erigeron annus - daisy fleabane
E. philadelphicus - dairy fleabane
Eupatorium fistulosum - Joe-Pye-weed
E. maculatum - spotted Joe-Pye-weed
E. perfoliatum - boneset
E. rugosum - white snakeroot
Galinsoga ciliata - galinsoga
Gnaphalium obtusifolium - cudweed
G. uliginosum - cudweed
Helenium autumnale - sneezeweed
Helianthus decapetalus - thin-leaf sunflower
H. divaricatus - woodland sunflower
H. tuberosus - Jerusalem artichoke
Heliopsis helianthoides - ox-eye
Hieracium aurantiacum - king-devil
H. paniculatum - hawkweed
H. pilosella - mouse-ear hawkweed
H. pratense - hawkweed
**H. scabrum* - hawkweed
H. venosum - rattlesnake-weed
Krigia virginica - dwarf dandelion
Lactuca canadensis - wild lettuce
Matricaria matricarioides - pineapple-weed
Prenanthes alba - tall white lettuce
Rudbeckia hirta - black-eyed susan
R. laciniata - coneflower
Senecio aureus - golden ragwort
S. obovatus - roundleaf ragwort
Solidago arguta - sharp-leaved goldenrod
S. bicolor - silverrod
S. caesia - blue-stemmed goldenrod
S. canadensis - Canada goldenrod
S. flexicaulis - zigzag goldenrod
S. gigantea - late goldenrod
S. graminifolia - flat-topped goldenrod
S. juncea - early goldenrod
S. nemoralis - little gray goldenrod
S. rugosa - rough goldenrod
Taraxacum officinale - dandelion
Tragopogon dubius - goat's beard
Tussilago farfara - coltsfoot
Vernonia noveboracensis - ironweed
Xanthium strumarium - cocklebur

Table G-3 (cont.)

Balsaminaceae
Impatiens biflora - jewelweed
I. pallida - pale jewelweed

Berberidaceae
Caulophyllum thalictroides - blue cohosh
Podophyllum peltatum - may apple

Boraginaceae
Hackelia virginiana - beggar's lice
Mertensia virginica - Virginia bluebells
Myosotis laxa - forget-me-not
M. scorpioides - forget-me-not
M. verna - forget-me-not

Callitrichaceae
Callitriche heterophylla - water starwort

Campanulaceae
Campanula aparinoides - marsh bellflower
Triodanis perfoliata - Venus' looking-glass

Cannabinaceae
Cannabis sativa - marijuana

Caprifoliacea
Lonicera japonica - Japanese honeysuckle

Caryophyllaceae
**Agrostemma githago* - corn-cockle
Arenaria serpyllifolia - sandwort
Cerastium arvense - field chickweed
C. vulgatum - mouse-ear chickweed
Dianthus armeria - deptford pink
Lychnis alba - white campion
Paronychia canadensis - whitlow-wort
Saponaria officinalis - bouncing bet
Silene stellata - starry campion
Stellaria aquatica - chickweed
S. graminea - common stitchwort
S. longifolia - chickweed
S. media - common chickweed

Ceratophyllaceae
Ceratophyllum demersum - hornwort

Chenopodiaceae
Chenopodium album - lamb's quarters
C. ambrosioides - Mexican tea

Cistaceae
Helianthemum canadense - frostweed

Convolvulaceae
Convolvulus sepium - hedge bindweed
Cuscuta gronovii - dodder

Crassulaceae
Penthorum sedoides - ditch stonecrop
Sedum telephium - orpine

Cruciferae
Alliaria officinalis - garlic mustard
Arabidopsis thalliana - mouse-ear cress
Arabis canadensis - rock cress
A. glabra - rock cress
A. laevigata - rock cress
A. lyrata - rock cress
A. shortii - rock cress

Cruciferae (cont.)
Barbarea vulgaris - wintercress
Brassica campestris - field mustard
B. kaber - charlock
B. nigra - black mustard
Capsella bursa-pastoris - shepherd's purse
Cardamine bulbosa - bitter cress
C. parviflora - bitter cress
C. pensylvanica - bitter cress
C. pratensis - cuckoo-flower
Dentaria diphylla - pepperwort
D. laciniata - cut-leaf toothwort
Erysimum cheiranthoides - wormseed mustard
Hesperis matronalis - dame's rocket
Lepidium campestre - field cress
L. virginicum - pepper-grass
Nasturtium officinale - water-cress
Rorippa islandica - marsh cress
R. sylvestris - yellow cress
Sisymbrium altissimum - tumble mustard
S. officinale - water-cress
Thlaspi arvense - field pennycress

Cucurbitaceae
Echinocystis lobata - wild cucumber
Sicyos angulatus - bur-cucumber

Ericaceae
Chimaphila maculata - spotted wintergreen
Epigaea repens - trailing arbutus
Gaultheria procumbens - wintergreen
Monotropa uniflora - Indian pipe
Pyrola elliptica - shinleaf

Euphorbiaceae
Acalypha rhomboidea - three-seeded mercury
Euphorbia maculata - spurge
E. presiii - spurge

Fumariaceae
Corydalis flavula - corydalis
** C. sempervirens* - corydalis
Dicentra cucullaria - Dutchman's breeches

Gentianaceae
Gentiana andrewsii - bottle gentian
G. crinita - fringed gentian

Geraniaceae
Geranium carolinianum - Carolina cranesbill
G. maculatum - wild geranium

Hydrophyllaceae
Hydrophyllum virginianum - waterleaf

Hypericaceae
Hypericum gentianoides - St. John's wort
H. mutilum - St. John's wort
H. perforatum - common St. John's wort
H. punctatum - spotted St. John's wort
H. pyramidatum - great St. John's wort
Triadenum virginicum - marsh St. John's wort

Labiatae
Collinsonia canadensis - horse-balm
Cunila origanoides - dittany
Galeopsis tetrahit - hemp-nettle
Glecoma hederacea - gill-over-the-ground
Hedeoma pulegioides - American pennyroyal
Lamium amplexicaule - dead nettle
Leonurus cardiaca - motherwort
Lycopus americanus - water horehound
L. virginicus - water horehound

Table G-3 (cont.)

Labiatae (cont.)
Monarda clinopodia - wild bergamot
M. fistulosa - wild bergamot
Nepeta cataria - catnip
Prunella vulgaris - self-heal
Pycnanthemum incanum - mountain-mint
P. virginianum - mountain-mint
Satureja vulgaris - wild basil
Scutellaria galericulata - skullcap
S. lateriflora - skullcap
Stachys hispida - rough hedge-nettle
Teucrium canadense - woodsage
Trichostema dichotomum - blue curls

Leguminosae
Amphicarpa bracteata - hog peanut
Apios americana - groundnut
Baptisia tinctoria - wild indigo
Cassia nictitans - wild sensitive plant
Coronilla varia - crown vetch
Desmodium canescens - tick-trefoil
D. dillenii - tick-trefoil
D. glutinosum - tick-trefoil
D. lineatum - tick-trefoil
D. nudiflorum - tick-trefoil
D. paniculatum - tick-trefoil
Lathyrus latifolius - everlasting pea
Lespedeza hirta - bush-clover
L. intermedia - bush-clover
L. violacea - bush-clover
L. virginica - bush-clover
Lotus corniculatus - bird's-foot trefoil
Medicago lupulina - black medick
Melilotus alba - white sweet clover
M. officinalis - yellow sweet clover
Trifolium agrarium - hop-clover
T. arvense - rabbit-foot clover
T. hybridum - alsike clover
T. pratense - red clover
T. repens - white clover
Vicia cracca - cow vetch

Lentibulariaceae
Utricularia vulgaris - bladderwort

Limnanthaceae
Floerkia proserpinacoides - false mermaid

Linaceae
Linum virginianum - wild flax

Lobeliaceae
Lobelia cardinalis - cardinal-flower
L. inflata - Indian-tobacco
L. siphilitica - great lobelia
L. spicata - lobelia

Lythraceae
Lythrum salicaria - purple loosestrife

Malvaceae
Abutilon theophrasti - velvet-leaf
Malva neglecta - cheeses

Onograceae
Circaea quadrisulcata - enchanter's nightshade
Epilobium coloratum - willow-herb
Gaura biennis - biennial gaura
Ludwigia alternifolia - seed-box
L. palustris - seed-box
Oenothera biennis - evening-primrose
O. perennis - sundrops

Orobanchaceae
Orobanche uniflora - cancer-root

Oxalidaceae
Oxalis dillenii - yellow wood sorrel
O. stricta - yellow wood sorrel
O. violacea - violet wood sorrel

Papaveraceae
Chelidonium majus - celandine
Sanguinaria canadensis - bloodroot

Phytolaccaceae
Phytolacca americana - pokeweed

Plantaginaceae
Plantago aristata - buckhorn
P. lanceolata - English plantain
P. major - common plantain

Polemoniaceae
Phlox paniculata - phlox
P. subulata - moss-pink
Polemonium reptans - Jacob's ladder

Polygalaceae
Polygala paucifolia - fringed polygala
P. sanguinea - cross-leaved milkwort
P. verticillata - whorled milkwort

Polygonaceae
Polygonum arifolium - halberd-leaved tearthu
P. aviculare - knotweed
P. caespitosum - long-bristled smartweed
P. cilinode - bindweed
P. convolvulus - black bindweed
P. cuspidatum - Mexican bamboo
P. hydropiperoides - mild water pepper
P. natans - water smartweed
P. pensylvanicum - smartweed
P. persicaria - smartweed
P. punctatum - smartweed
P. sagittatum - arrow-leaved tearthumb
P. scandens - false buckwheat
P. virginanum - Virginia knotweed
Rumex acetosella - sheep sorrel
R. crispus - curly dock
R. obtusifolius - bitter dock
R. patientia - patience dock

Portulacaceae
Claytonia virginica - spring beauty

Primulaceae
Lysimachia ciliata - fringed loosestrife
L. quadrifolia - whorled loosestrife
L. terrestris - yellow loosestrife
L. vulgaris - garden loosestrife
Trientalis borealis - starflower

Ranunculaceae
Anemone canadensis - Canada anemone
A. quinquefolia - wood anemone
A. virginiana - thimbleweed
Anemonella thalictroides - rue anemone
Aquilegia canadensis - columbine
Cimicifuga racemosa - bugbane
Clematis virginiana - virgin's bower
Coptis trifolia - goldthread
Hepatica americana - hepatica
Ranunculus abortivus - kidneyleaf buttercup
R. acris - common buttercup

Table G-3 (cont.)

Ranunculaceae (cont.)
Ranunculus bulbosus - buttercup
R. pensylvanicus - buttercup
R. recurvatus - buttercup
R. repens - creeping buttercup
R. septentrionalis - buttercup
Thalictrum dioicum - early meadow rue
T. polygamum - tall meadow rue

Rosaceae
Agrimonia grypsosepala - agrimony
Fragaria virginiana - wild strawberry
Geum canadense - avens
G. laciniatum - avens
Gillenia trifoliata - bowman's root
Potentilla canadensis - dwarf cinquefoil
P. norvegica - rough cinquefoil
P. recta - rough-fruited cinquefoil
P. simplex - cinquefoil

Rubiaceae
Galium aparine - cleavers
G. asprellum - bedstraw
G. boreale - bedstraw
G. circaezans - bedstraw
G. mollugo - cleavers
G. palustre - bedstraw
G. trifidum - bedstraw
G. triflorum - bedstraw
Houstonia caerulea - bluets
Mitchella repens - partridge-berry

Santalaceae
Commandra umbellata - bastard toad-flax

Saxigragaceae
Chrysosplenum americanum - golden saxifrage
Mitella diphylla - miterwort
Saxifraga virginiensis - early saxifrage

Scrophylariaceae
Aureolaria virginica - downy false foxglove
Chelone glabra - turtle-head
Gerardia tenuifolia - slender gerardia
Linaria vulgaris - butter-and-eggs
Lindernia dubia - false pumpernel
Melamphrym lineare - cow-wheat
Mimulus ringens - monkey-flower
Pedicularis canadensis - lousewort
Penstemon digitalis - beard-tongue
P. hirsutis - hairy beard-tongue
Scrophylaria lanceolata - figwort
Verbascum blattaria - moth mullein
V. thapsus - common mullein
Veronica americana - American brooklime
V. arvensis - speedwell
V. officinalis - common speedwell
V. peregrina - speedwell
V. serpyllifolia - speedwell
Veronicastrum virginicum - culver's root

Solanaceae
Physalis hetcrophylla - ground cherry
Solanum carolinense - horse-nettle
S. dulcamara - nightshade
S. nigrum - black nightshade

Umbelliferae
Cicuta bulbifera - water hemlock
C. maculata - water hemlock
Cryptotaenia canadensis - honewort
Daucus carota - Queen Anne's lace
Osmorhiza claytoni - sweet cicely
O. longistylis - sweet cicely

Umbelliferae (cont.)
Pastinaca sativa - wild parsnip
Sanicula marilandica - black snakeroot
Zizea aptera - golden alexawders
Z. aurea - golden alexanders

Urticaceae
Boehmeria cylindrica - false nettle
Parietaria pensylvanica - pellitory
Pilea pumila - clearweed
Urtica dioica - stinging nettle

Valerianaceae
Valerianella locusta - corn-salad

Verbenaceae
Verbena hastata - blue vervain
V. urticifolia - white vervain

Violaceae
Viola blanda - sweet white violet
V. conspersa - American dog-violet
V. cucullata - blue marsh violet
V. eriocarpa - smooth yellow violet
V. fimbriatula - northern downy violet
V. palmata - wood-violet
V. papilionacea - common blue violet
V. pubescens - downy yellow violet
V. sororia - woolly blue violet
V. striata - pale violet

MAGNOLIOPHYTA-MONOCOTYLEDONEAE

Alismaceae
Alisma subcordatum - water-plantain
Sagittaria latifolia - arrow-head

Amaryllidaceae
Hypoxis hirsuta - stargrass

Araceae
Acorus calamus - sweet flag
Arisaema dracontium - green dragon
A. triphyllum - jack-in-the-pulpit
Symplocarpus foetidus - skunk cabbage

Commelinaceae
Commelina communis - day-flower

Cyperaceae
Bulbostylis capillaris - sedge
Carex annectens - sedge
C. bromoides - sedge
C. comosa - sedge
C. crinita - sedge
C. debilis - sedge
C. intumescens - sedge
C. lacustris - sedge
C. laevivaginata - sedge
C. laxiflora - sedge
C. lurida - sedge
C. muhlenbergii - sedge
C. pensylvanica - sedge
C. rosea - sedge
C. scoparia - sedge
C. stipata - sedge
C. stricta - sedge
C. swannii - sedge
C. tribuloides - sedge
C. vulpinoidea - sedge
Carex sp. (unidentified) - sedge
Cyperus esculentus - yellow nut-grass
C. filiculmis - galingale
C. odoratus - galingale
C. strigosus - galingale
Dulichium arundinaceum - three-way sedge

Table G-3 (cont.)

Cyperaceae (cont.)
- *Eleocharis acicularis* - spike-rush
- *E. intermedia* - spike-rush
- *E. obtusa* - spike-rush
- *E. tenuis* - spike-rush
- *Scirpus americanus* - three-sqaure
- *S. atrovirens* - bulrush
- *S. cyperinus* - woolgrass
- *S. validus* - great bulrush

Dioscoreaceae
- *Dioscorea villosa* - wild yam

Gramineae
- *Agropyron repens* - quack grass
- *Agrostis hyemalis* - bentgrass
- *A. perennans* - autumn bent
- *A. stolonifera* - bentgrass
- *Alopecurus aequalis* - foxtail
- *Andropogon gerardi* - big bluestem
- *A. scoparius* - little bluestem
- *A. virginicus* - broom sedge
- *Anthoxanthum odoratum* - sweet vernal grass
- *Aristida dichotoma* - three-awn
- * *Arrhenantherum elatius* - oat-grass
- *Bromus inermis* - smooth brome
- *B. japonicus* - Japanese chess
- *B. latiglumis* - bromegrass
- *B. mollis* - soft chess
- *B. tectorum* - downy chess
- *Cinna arundinacea* - stout woodreed
- *Dactylis glomerata* - orchard grass
- *Danthonia spicata* - poverty oatgrass
- *Deschampsia flexuosa* - hairgrass
- *Digitaria ischaemum* - crabgrass
- *D. sanguinalis* - crabgrass
- *Echinochloa muricata* - barnyard grass
- *Elymus canadensis* - wild rye
- *E. riparius* - wild rye
- *E. villosus* - wild rye
- *E. virginicus* - wild rye
- *Eragrostis capillaris* - lovegrass
- *E. cilianensis* - lovegrass
- *E. frankii* - lovegrass
- *E. hypnoides* - lovegrass
- *E. pilosa* - lovegrass
- *E. spectabilis* - purple lovegrass
- *Festuca elatior* - meadow fescue
- *F. obtusa* - nodding fescue
- *F. rubra* - red fescue
- *Glyceria canadensis* - rattlesnake mannagrass
- *G. striata* - fowl mannagrass
- *Holcus lanatus* - velvet grass
- *Hysterix patula* - bottlebrush
- *Leersia oryzoides* - rice cutgrass
- *L. virginica* - white grass
- *Lolium perenne* - perennial ryegrass
- *Muhlenbergia frondosa* - wirestem muhly
- *M. schreberi* - nimblewill
- *M. sobolifera* - muhly
- *Panicum boscii* - panic-grass
- *P. capillare* - witch grass
- *P. clandestinum* - panic-grass
- *P. commutatum* - panic-grass
- *P. depauperatum* - panic-grass
- *P. dichotomiflorum* - panic-grass
- *P. dichotomum* - panic-grass
- *P. lanuginosum* - panic-grass
- *P. nitidum* - panic-grass
- *P. virgatum* - switchgrass
- *Paspalum pubescens* - paspalum
- *Phalaris arundinacea* - reed canary grass
- *Phleum pratense* - timothy
- *Poa annua* - speargrass
- *P. compressa* - Canada bluegrass
- *P. palustris* - fowl bluegrass
- *P. pratensis* - Kentucky bluegrass
- *P. trivialis* - bluegrass
- *Setaria faberii* - nodding foxtail
- *S. glauca* - foxtail grass
- *S. italica* - foxtail millet

Gramineae (cont.)
- *Sorghastrum nutans* - Indian grass
- *Sphenopholis intermedia* - wedgegrass
- *Sporobolus vaginiflorus* - dropseed
- *Triodia flava* - purpletop

Hydrocharitaceae
- *Anacharis canadensis* - water-weed

Iridaceae
- *Iris versicolor* - blue flag
- *Sisyrinchium angustifolium* - blue-eyed grass

Juncaceae
- *Juncus acuminatus* - rush
- *J. effusus* - rush
- *J. tenuis* - path rush
- *Luzula campestris* - wood rush

Lemnaceae
- *Lemna minor* - duckweed
- *Wolffia punctata* - water meal

Liliaceae
- *Allium canadense* - wild garlic
- *A. vineale* - field garlic
- *Asparagus officinalis* - asparagus
- *Erythronium albidum* - white trout-lily
- *E. americanum* - trout-lily
- *Hemerocallus fulva* - day-lily
- *Lilium canadense* - Canada lily
- *L. superbum* - turk's-cap
- *Maianthemum canadense* - wild lily-of-the-valley
- *Medeola virginiana* - Indian cucumber
- *Ornithogalum umbellatum* - star of Bethlehem
- *Polygonatum biflorum* - Soloman's seal
- *P. pubsecens* - Soloman's seal
- *Smilacina racemosa* - false Soloman's seal
- *Trillum cernuum* - nodding trillium
- *T. erectum* - purple trillium
- *Uvularia perfoliata* - perfoliate bellwort
- *U. sessilifolia* - sessile-leaved bellwort
- *Veratrum veride* - false hellebore

Najadaceae
- *Potamogeton crispis* - pondweed
- * *P. foliosus* - pondweed
- *P. spirillus* - pondweed

Orchidaceae
- *Cypripedium acaule* - pink lady's slipper
- *Epipactis helleborine* - helleborine
- *Goodyera pubescens* - rattlesnake plantain
- *Habenaria lacera* - ragged finged orchid
- *H. orbiculata* - round-leaved orchid
- *Spiranthes cernua* - ladies' tresses
- *S. gracilis* - ladies' tresses

Sparganiaceae
- *Sparganium eurycarpum* - bur-reed

Typhaceae
- *Typha angustifolia* - narrow-leaf cat-tail
- *T. latifolia* - cat-tail

Table G-4

Species of plants observed at Elimsport Substation and not found at Susquehanna SES, 1982-84. Arrangement as in Table G-3.

POLYPODIOPHYTA
- Osmundaceae
  - *Osmunda regalis* - royal fern

MAGNOLIOPHYTA-DICOTYLEDONEAE
- Ericaceae
  - *Lyonia ligustrina* - male berry
- Gentianaceae
  - *Bartonia paniculata* - bartonia
- Leguminosae
  - *Desmodium marilandicum* - tick-trefoil
- Melastomataceae
  - *Rhexia virginica* - meadow-beauty
- Violaceae
  - *Viola sagittata* - arrow-leaved violet

MAGNOLIOPHYTA-MONOCOTYLEDONEAE
- Cyperaceae
  - *Rhynchospora capitellata* - beak-rush
- Gramineae
  - *Calamagrostis cinnoides* - reed grass
  - *Festuca ovina* - sheep fescue
- Juncaceae
  - *Juncus marginatus* - rush
- Orchidaceae
  - *Habenaria clavellata* - green woodland orchid

Table G-5

Months when plants were observed in flower or shedding spores on forest salt drift transects in the vicinity of the Susquehanna SES and Elimsport Substation, 1984. Names, abbreviations, and locations of transects are given in Table G-1.

SPECIES	RF	GIF	TR419	TR439	OSH	CC	ELIM
ACALYPHA RHOMBOIDEA	0	0	AUG	0	0	0	0
ACER NIGRUM	0	MAY	0	0	0	0	0
A. RUBRUM	0	0	APR	APR	APR	APR	APR
A. SACCHARINUM	MAR	MAR	0	0	MAR	0	0
ACHILLEA MILLEFOLIUM	0	0	JUN-SEP	JUL,AUG	JUL-SEP	JUL-SEP	JUN-AUG
AGRIMONIA GRYPSOSEPALA	0	0	0	0	JUL,AUG	JUL,AUG	0
AGROPYRON REPENS	0	0	JUN	JUN	JUL	0	0
AGROSTIS PERENNANS	0	0	AUG	AUG	AUG	AUG,SEP	AUG
A. STOLONIFERA	JUN	JUN	JUN,JUL	JUL	JUL	JUN	JUN,JUL
ALLIARIA OFFICINALIS	MAY-JUL	MAY-JUL	0	0	MAY	0	0
ALNUS RUGOSA	0	0	0	APR	0	0	0
AMBROSIA ARTEMISIIFOLIA	0	0	AUG,SEP	AUG,SEP	AUG,SEP	AUG,SEP	AUG,SEP
A. TRIFIDA	AUG	AUG	0	0	0	0	0
AMELANCHIER ARBOREA	0	0	MAY	MAY	MAY	0	0
A. STOLONIFERA	0	0	0	0	0	MAY	0
AMPHICARPA BRACTEATA	0	0	0	0	AUG	AUG	0
ANDROPOGON SCOPARIUS	0	0	0	0	AUG	0	0
A. VIRGINICUS	0	0	0	0	AUG	AUG	0
ANEMONE QUINQUEFOLIA	0	0	0	MAY	0	0	0
ANEMONELLA THALICTROIDES	0	0	0	0	APR,MAY	0	0
ANTENNARIA NEGLECTA	0	0	MAY	MAY	MAY	MAY	MAY
A. PLANTAGINIFOLIA	0	0	MAY	0	MAY	0	0
ANTHEMIS COTULA	0	0	JUN	0	0	0	JUN
ANTHOXANTHUM ODORATUM	0	0	MAY	MAY	MAY,JUN	MAY,JUN	0
APIOS AMERICANA	0	0	0	AUG	0	0	0
APOCYNUM ANDROSAEMIFOLIUM	0	0	0	0	JUL	0	0
A. CANNABINUM	0	0	JUL	0	JUN,JUL	0	JUL
AQUILEGIA CANADENSIS	0	0	0	0	0	MAY	0
ARABIDOPSIS THALLIANA	0	0	APR,MAY	APR,MAY	APR,MAY	0	0
ARABIS LAEVIGATA	0	0	MAY,JUN	0	JUN	JUN	0
A. LYRATA	0	0	0	0	0	MAY	0
ARALIA NUDICAULIS	0	0	0	0	MAY	MAY	0
ARCTIUM MINUS	0	0	AUG	0	0	0	0
ARENARIA SERPYLLIFOLIA	0	0	0	MAY	0	0	0
ARISAEMA DRACONTIUM	JUN	0	0	0	0	0	0
A. TRIPHYLLUM	MAY	MAY	MAY	0	MAY	0	0
ARISTIDA DICHOTOMUM	0	0	0	0	AUG	0	0
ARRHENANTHERUM ELATIUS	0	0	0	JUN	0	0	0
ASCLEPIAS INCARNATA	0	JUL	0	0	0	0	0
A. SYRIACA	0	0	0	JUL	0	0	0
ASPLENIUM PLATYNEURON	0	0	JUN,JUL	0	JUN,JUL	JUN-AUG	0
ASTER CORDIFOLIUS	OCT	SEP	SEP,OCT	OCT	SEP,OCT	0	0
A. DIVARICATUS	AUG-OCT	AUG,SEP	SEP	0	AUG-OCT	AUG,SEP	0
A. DUMOSUS	0	0	0	0	0	0	SEP,OCT
A. LAEVIS	0	0	0	0	0	SEP,OCT	0
A. LATERIFLORUS	0	0	SEP,OCT	SEP,OCT	SEP,OCT	SEP	SEP
A. NOVAE-ANGLIAE	0	0	0	0	SEP	0	0
A. PATENS	0	0	0	0	AUG,SEP	0	0
A. PATERNUS	0	0	0	0	JUL	0	0
A. PILOSUS	0	0	SEP,OCT	SEP,OCT	AUG-OCT	SEP,OCT	SEP,OCT
A. PUNICEUS	0	0	0	SEP,OCT	0	0	0
A. SIMPLEX	0	0	OCT	SEP,OCT	SEP	0	0
A. UMBELLATUS	0	AUG	0	0	0	0	0
A. UNDULATUS	0	0	0	0	0	SEP,OCT	0
ATHYRIUM FILIX-FEMINA	0	JUL,AUG	JUL,AUG	JUL,AUG	JUL,AUG	AUG	0
A. THELYPTERIOIDES	0	JUL,AUG	0	0	0	0	0
AUREOLARIA VIRGINICA	0	0	0	0	0	JUL	0
BAPTISIA TINCTORIA	0	0	0	0	JUL	0	JUL
BARBAREA VULGARIS	MAY	MAY	MAY	MAY	JUN	MAY	MAY
BARTONIA VIRGINICA	0	0	0	0	0	0	JUL,AUG
BETULA LENTA	0	MAY	MAY	0	MAY	MAY	MAY
BETULA POPULIFOLIA	0	0	0	0	MAY	MAY	0
BIDENS CERNUA	AUG	AUG,SEP	SEP	0	0	0	0
B. FRONDOSA	AUG,SEP	0	OCT	AUG	0	0	0
BOEHMERIA CYLINDRICA	AUG	JUL	0	0	0	0	0
BOTRYCHIUM DISSECTUM	0	0	0	0	SEP,OCT	0	0
B. VIRGINIANUM	0	0	0	0	JUN	0	0
BRASSICA KABER	0	0	JUN,JUL,SEP,OCT	JUN,JUL,SEP	0	0	0
B. NIGRA	JUN,AUG	0	0	0	0	0	0
BROMUS INERMIS	JUN	0	JUN	JUN	JUN	0	JUN
B. JAPONICUS	0	0	JUN	JUN	JUN	0	0
B. LATIGLUMIS	AUG	AUG	0	0	0	0	0
CACALIA SUAVEOLENS	0	AUG,SEP	0	0	0	0	0
CALAMAGROSTIS CINNOIDES	0	0	0	0	0	0	AUG
CAMPANULA APARINOIDES	0	0	0	0	0	JUN	0

Table G-5 (cont.)

SPECIES	RF	GIF	TR419	TR438	QSH	CC	ELIM
CAPSELLA BURSA-PASTORIS	0	0	MAY	0	0	0	0
CARDAMINE PARVIFLORA	0	0	0	0	0	APR,MAY,AUG	0
C. PENSYLVANICA	0	0	MAY	0	MAY	JUN	0
CAREX PENSYLVANICA	0	0	MAY	0	MAY	MAY	0
CAREX SP.	MAY	MAY	MAY	0	MAY	MAY	0
CARYA TOMENTOSA	0	0	0	0	0	MAY	MAY
CASSIA NICTITANS	0	0	0	JUL,AUG	0	0	0
CAULOPHYLLUM THALICTROIDES	0	MAY	0	0	0	0	0
CEANOTHUS AMERICANUS	0	0	JUN	0	JUN	JUN	0
CELTIS OCCIDENTALIS	MAY	MAY	MAY	0	MAY	0	0
CENTAUREA MACULOSA	0	0	0	JUL,AUG	0	0	JUL-OCT
CERASTIUM ARVENSE	0	0	0	0	0	MAY	0
C. VULGATUM	0	0	JUN	JUL	MAY,JUN	MAY,JUN	MAY
CHELIDONIUM MAJUS	0	0	MAY-JUL	0	0	0	0
CHENOPODIUM AMBROSIOIDES	0	0	0	0	0	AUG	0
CHRYSANTHEMUM LEUCANTHEMUM	0	0	JUN-AUG	JUN-AUG,OCT	JUN-OCT	0	JUN,JUL
CICHORIUM INTYBUS	JUL	0	0	JUL	0	0	SEP,OCT
CICUTA MACULATA	0	0	0	JUL	0	0	0
CIMICIFUGA RACEMOSA	0	0	JUL	0	0	JUL	0
CINNA ARUNDINACEA	0	JUN-AUG	0	0	0	0	0
CIRCAEA QUADRISULCATA	JUL	JUL	JUL	0	JUL	JUL	0
CIRSIUM VULGARE	0	0	JUL,AUG	0	0	0	0
CLAYTONIA VIRGINICA	MAY	MAY	0	0	0	0	0
COLLINSONIA CANADENSIS	0	0	0	AUG	0	0	0
COMMANDRA UMBELLATA	0	0	0	0	MAY	0	0
COMMELINA COMMUNIS	AUG	AUG	JUL-SEP	JUL,AUG	JUN-OCT	0	0
CONVOLVULUS SEPIUM	0	0	JUL-SEP	0	0	0	0
CONYZA CANADENSIS	0	0	AUG,SEP	AUG,SEP	AUG	AUG	0
CORNUS AMOMUM	0	0	0	JUN	0	0	0
C. FLORIDA	0	0	MAY	MAY	MAY	MAY	MAY
C. RACEMOSA	0	JUN	0	JUN	0	0	0
CORONILLA VARIA	0	0	JUN-OCT	JUN-OCT	0	0	JUN,JUL,SEP
CORYDALIS SEMPERVIRENS	0	0	0	0	JUN	0	0
CORYLUS AMERICANA	0	0	MAR	MAR,APR	0	0	0
CRATAEGUS SP.	0	0	0	0	MAY	MAY	0
CRYPTOTAENIA CANADENSIS	JUN	JUN	0	0	0	0	0
CUNILA ORIGANOIDES	0	0	0	0	AUG	0	0
CYPERUS STRIGOSUS	0	0	0	AUG	0	0	AUG
CYPREPEDIUM ACAULE	0	0	0	0	MAY	MAY	MAY
CYSTOPTERIS FRAGILIS	0	0	0	0	JUN,JUL	0	0
C. PROTRUSA	0	JUN	0	0	0	0	0
DACTYLIS GLOMERATA	0	0	JUN	JUN	JUN	0	JUN
DANTHONIA SPICATA	0	0	0	0	JUN	MAY,JUN	JUN
DAUCUS CAROTA	0	0	JUL-OCT	JUL-OCT	JUL-OCT	JUL-OCT	JUL-OCT
DENNSTAEDTIA PUNCTILOBULA	0	0	JUL,AUG	JUL,AUG	JUL,AUG	JUL,AUG	JUL,AUG
DENTARIA LACINIATA	MAY	MAY	0	0	0	0	0
DESCHAMPSIA FLEXUOSA	0	0	0	0	JUN	JUN	0
DESMODIUM DILLENII	0	0	AUG,SEP	AUG	AUG	AUG	0
D. LINEATUM	0	0	0	0	AUG	0	0
D. NUDIFLORUM	0	0	AUG	0	AUG	JUL,AUG	0
D. PANICULATUM	0	0	AUG	AUG	AUG,SEP	JUL	0
DIANTHUS ARMERIA	0	0	0	JUN,JUL	JUN-OCT	0	JUN,AUG
DICENTRA CUCULLARIA	MAY	MAY	0	0	0	0	0
DIGITARIA SANGUINALIS	0	0	0	AUG	AUG	0	AUG
DRYOPTERIS INTERMEDIA	0	0	JUN,JUL	0	JUN,JUL	0	0
D. MARGINALIS	0	0	JUL	JUL	JUL,AUG	JUN-AUG	0
D. SPINULOSA	0	0	JUN	0	JUN	0	0
ECHINOCYSTIS LOBATA	AUG	0	0	0	0	0	0
ELEOCHARIS OBTUSA	0	0	0	0	0	0	JUN,JUL
E. TENUIS	0	0	0	0	0	0	MAY
ELYMUS RIPARIUS	JUN,JUL	JUN,JUL	0	0	0	0	0
E. VIRGINICUS	0	JUN,JUL	0	0	0	0	0
EPIGAEA REPENS	0	0	0	0	MAY	APR,MAY	0
EPILOBIUM COLORATUM	0	0	AUG	0	0	0	0
EQUISETUM ARVENSE	0	0	0	MAY	MAY	0	0
ERAGROSTIS CAPILLARIS	0	0	JUL,AUG	0	0	0	0
E. CILIANENSIS	0	0	JUL	0	0	0	0
E. FRANKII	0	AUG	0	0	0	0	0
E. HYPNOIDES	0	AUG	0	0	0	0	0
E. SPECTABILIS	0	0	0	0	AUG	0	0
ERECHTITES HIERACIFOLIA	0	0	SEP,OCT	AUG-OCT	AUG,SEP	SEP	AUG,SEP
ERIGERON ANNUUS	JUN	JUN,JUL	JUN-SEP	JUN-SEP	JUN-SEP	JUN-AUG	JUN-AUG
ERYSIMUM CHIERANTHOIDES	0	0	JUN	0	0	0	0
ERYTHRONIUM ALBIDUM	MAY	MAY	0	0	0	0	0
E. AMERICANUM	MAY	MAY	0	0	0	0	0
EUPATORIUM FISTULOSUM	0	0	0	AUG,SEP	0	0	AUG
E. MACULATUM	0	0	0	SEP	0	0	0
E. PERFOLIATUM	0	0	0	AUG,SEP	SEP	0	AUG,SEP
E. RUGOSUM	AUG-OCT	AUG-OCT	AUG-OCT	SEP	AUG,SEP	AUG-OCT	0
EUPHORBIA PRESLII	0	0	AUG	AUG	JUL,AUG	0	0

Table G-5 (cont.)

SPECIES	RF	GIF	TR419	TR438	QSH	CC	ELIM
FESTUCA ELATIOR	0	0	0	0	JUN	0	0
F. OBTUSA	JUN	JUN	0	0	0	0	0
FLOERKIA PROSERPINACOIDES	MAY	MAY	0	0	0	0	0
FRAGARIA VIRGINIANA	0	0	MAY	MAY	MAY	MAY	MAY
FRAXINUS AMERICANA	0	0	0	0	MAY	0	0
GALINSOGA CILIATA	JUL	0	JUL-OCT	SEP	AUG-OCT	0	0
GALIUM APARINE	0	MAY,JUL,AUG	MAY,JUL	0	MAY	MAY	0
GAYLUSSACIA BACCATA	0	0	0	0	MAY	MAY	MAY
GERANIUM MACULATUM	0	0	0	0	MAY	MAY	0
GERARDIA TENUIFOLIA	0	0	0	0	AUG,SEP	0	0
GEUM CANADENSE	JUL,AUG	JUL	JUN,JUL	0	JUL	JUN,JUL	0
GLECHOMA HEDERACEA	0	MAY	0	0	APR	0	0
GNAPHALIUM OBTUSIFOLIUM	0	0	0	SEP	SEP	SEP	SEP,OCT
GOODYERA PUBESCENS	0	0	0	0	0	AUG	JUL
HABENARIA ORBICULATA	0	0	0	0	0	0	JUN
HACKELIA VIRGINIANA	0	0	JUL	0	0	0	0
HEDEOMA PULEGIOIDES	0	0	0	0	AUG	0	0
HELIANTHUS DIVARICATUS	0	0	0	0	JUL,AUG	JUL,AUG	0
H. TUBEROSUS	0	AUG,SEP	0	0	0	0	0
HEMEROCALLUS FULVA	0	0	JUN,JUL	JUL	JUL	0	0
HEPATICA AMERICANA	0	0	0	0	APR	APR	0
HESPERIS MATRONALIS	JUN	JUN	0	0	0	0	0
HIERACIUM PANICULATUM	0	0	AUG	0	JUL,AUG	0	0
H. PRATENSE	0	0	JUN	JUN,JUL	JUN	JUN	JUN-AUG
H. SCABRUM	0	0	0	AUG	AUG,SEP	0	AUG
H. VENOSUM	0	0	JUN	0	JUN	0	0
HOLCUS LANATUS	0	0	0	JUN	0	JUN	0
HOUSTONIA CAERULEA	0	0	0	MAY	APR-JUN	MAY	0
HYPERICUM PERFORATUM	0	0	JUN-AUG	JUL	JUN,JUL	JUN-AUG	JUN,JUL
H. PUNCTATUM	0	0	JUL	JUL	JUL	JUL	JUL
HYPOXIS HIRSUTA	0	0	0	0	0	0	MAY,JUN
HYSTRIX PATULA	0	0	0	0	0	JUL	0
IMPATIENS BIFLORA	JUL-SEP	JUL,AUG	JUL-SEP	AUG,SEP	0	0	0
I.PALLIDA	JUL-SEP	AUG	JUL,SEP,OCT	0	AUG	0	0
JUGLANS NIGRA	0	0	0	0	MAY	0	0
JUNCUS ACUMINATUS	0	0	0	0	0	0	JUN,JUL
J. EFFUSUS	0	0	0	JUN	0	0	JUN
J. TENUIS	0	0	JUN	0	JUN	JUN	JUN
KALMIA LATIFOLIA	0	0	0	0	0	JUN	0
KRIGIA VIRGINICA	0	0	0	0	MAY,JUN	JUN	0
LACTUCA CANADENSIS	0	0	JUL,AUG	JUL,AUG	JUL,SEP	JUL,AUG	JUL
LEERSIA VIRGINICA	SEP	AUG	AUG,SEP	0	0	0	0
LEONURUS CARDIACA	0	0	JUN-AUG	0	0	0	0
LEPIDIUM CAMPESTRE	0	0	MAY	MAY	MAY	0	MAY
LESPEDIZA HIRTA	0	0	0	0	AUG	0	0
L. INTERMEDIA	0	0	0	0	0	AUG	0
L. VIRGINICA	0	0	0	0	AUG	0	0
LIGUSTRUM VULGARE	0	JUN	0	0	JUN	0	0
LILIUM SUPERBUM	JUL	0	0	0	0	0	0
LINARIA VULGARIS	0	0	JUL	SEP	JUN-SEP	SEP	0
LINDERA BENZOIN	0	MAY	APR,MAY	APR,MAY	APR,MAY	0	0
LIRIODENDRON TULIPIFERA	0	JUN	0	0	0	0	0
LOBELIA INFLATA	0	0	AUG	AUG	JUL,AUG	AUG	JUL,AUG
LOLIUM PERENNE	0	0	0	0	JUN	0	JUN
LOTUS CORNICULATUS	0	0	JUN-AUG	JUN-AUG	0	0	JUN-AUG
LUDWIGIA ALTERNIFOLIA	0	0	0	0	0	0	JUL,AUG
LUZULA CAMPESTRIS	0	0	0	0	MAY	MAY	0
LYCHNIS ALBA	0	0	0	JUN,JUL,SEP,OCT	JUN	JUL	0
LYCOPODIUM FLABELLIFORME	0	0	0	OCT	0	OCT	0
L. INUNDATUM	0	0	0	0	0	0	SEP,OCT
L. OBSCURUM	0	0	0	0	0	OCT	0
LYCOPIS VIRGINICUS	0	AUG	0	0	0	0	0
LYONIA LIGUSTRINA	0	0	0	0	0	0	JUN
LYSIMACHIA CILIATA	JUL	JUL	0	0	0	0	0
L. QUADRIFOLIA	0	0	0	0	0	JUN	JUN,JUL
L. VULGARIS	0	JUL	0	0	0	0	0
MAIANTHEMUM CANADENSE	0	0	0	0	0	MAY	0
MATRICARIA MATRICARIOIDES	0	0	JUL	0	0	0	0
MEDICAGO LUPULINA	0	0	JUN,JUL	JUN,JUL	0	0	0
MELAMPYRUM LINEARE	0	0	0	0	0	JUL,AUG	0
MELILOTUS ALBA	0	0	0	JUL	JUL-SEP	0	0
M. OFFICINALIS	0	0	0	JUN,JUL	0	0	0
MERTENSIA VIRGINICA	MAY	MAY	0	0	0	0	0
MITCHELLA REPENS	0	0	0	0	JUN	JUN	JUN
MONOTROPA UNIFLORA	0	0	0	0	JUL	JUL,AUG	JUL
MUHLENBERGIA FRONDOSA	0	AUG	0	0	0	0	0
MYRICA ASPLENIFOLIA	0	0	0	0	MAY	0	0
NYSSA SYLVATICA	0	0	0	0	MAY	0	0
OENOTHERA BIENNIS	0	0	AUG,SEP	AUG,SEP	AUG,OCT	0	AUG-OCT
ONOCLEA SENSIBILIS	0	0	0	MAR	0	0	0

Table G-5 (cont.)

SPECIES	RF	GIF	TR419	TR438	QSH	CC	ELIM
OSMUNDA CINNAMOMEA	0	0	0	0	0	0	MAY
O. CLAYTONIANA	0	0	0	MAY	0	0	MAY
OSTRYA VIRGINIANA	0	0	0	0	0	MAY	0
OXALIS VIOLACEA	0	0	0	0	MAY,JUN	0	0
OXALIS SP.	JUL	JUL,AUG	JUN-SEP	JUN-AUG	MAY-AUG	MAY,JUL,AUG	MAY-JUL
PANICUM CAPILLARE	0	AUG	AUG,SEP	SEP	AUG	0	0
P. CLANDESTINUM	0	JUN	0	0	JUN	0	JUL
P. COMMUTATUM	0	0	0	0	0	JUN	0
PANICUM SP.	0	0	JUL	JUN	JUN-AUG	0	JUN,JUL
PARONYCHIA CANADENSIS	0	0	0	0	AUG	0	0
PENSTEMON DIGITALIS	0	0	0	0	0	0	JUN
P. HIRSUTUS	0	0	JUN	0	JUN	0	0
PHALARIS ARUNDINACEA	JUN	JUN	JUN	JUN	0	0	0
PHLEUM PRATENSE	0	0	JUN	JUN	JUN	0	JUN
PHLOX SUBULATA	0	0	0	0	0	MAY	0
PHYSOCARPUS OPULIFOLIUS	0	JUN	0	0	0	0	0
PHYTOLACCA AMERICANA	0	0	JUL,AUG	JUL	JUL	0	0
PILEA PUMILA	AUG	AUG	AUG	0	JUL,AUG	0	0
PLANTAGO LANCEOLATA	0	0	JUN,JUL	MAY-JUL	0	0	JUN
P. MAJOR	0	0	0	JUL-	0	0	0
POA ANNUA	0	0	MAY	0	MAY	MAY	0
P. COMPRESSA	0	0	MAY,JUN	MAY,JUN	MAY,JUN	MAY,JUN	MAY,JUN
P. PRATENSIS	0	0	JUN	0	0	0	0
PODOPHYLLUM PELTATUM	0	MAY	0	0	MAY	0	0
POLEMONIUM REPTANS	0	MAY	0	0	0	0	0
POLYGALA PAUCIFOLIA	0	0	0	0	0	MAY	0
P. SANGUINEA	0	0	0	0	SEP	0	0
P. VERTICELLATA	0	0	0	0	AUG	0	0
POLYGONATUM BIFLORUM	0	0	0	0	0	MAY	0
POLYGONUM ARIFOLIUM	0	0	0	0	0	0	AUG
P. AVICULARE	0	0	JUL,AUG	0	0	0	0
P. CILINODE	JUL	JUN	0	0	0	0	0
P. CUSPIDATUM	AUG,SEP	AUG	0	0	0	0	0
P. PENSYLVANICUM	AUG,SEP	AUG,SEP	AUG,SEP	AUG,SEP	JUL,AUG	0	AUG
P. PERSICARIA	SEP	AUG	JUN-AUG	AUG	JUN-SEP	0	JUL
P. PUNCTATUM	AUG,SEP	AUG,SEP	0	0	AUG	0	0
P. SAGITTATUM	0	0	0	SEP	0	0	0
P. SCANDENS	0	AUG	0	0	AUG	AUG	0
P. VIRGINIANUM	AUG	AUG	AUG	0	JUL,AUG	AUG	0
POLYPODIUM VIRGINIANUM	0	0	0	0	0	JUN-AUG	0
POLYSTICHUM ACROSTICHOIDES	0	0	JUN,JUL	JUN,JUL	JUN,JUL	0	0
POPULUS GRANDIDENTATA	0	0	APR	0	APR	0	0
P. TREMULOIDES	0	0	APR	APR	0	0	0
POTENTILLA NORVEGICA	0	0	JUL	JUL,AUG	JUL	0	0
P. RECTA	0	0	JUN	JUN	JUN	0	0
P. SIMPLEX	0	0	0	MAY,JUN	MAY,JUN	MAY	MAY,JUN
PRUNELLA VULGARIS	0	0	JUL-OCT	JUL-OCT	JUL-OCT	JUL	AUG-OCT
PRUNUS AVIUM	0	0	0	0	MAY	0	0
P. PENSYLVANICA	0	0	0	0	MAY	MAY	0
PYCNANTHEMUM INCANUM	0	0	0	0	JUL,AUG	JUL,AUG	0
PYROLA ELLIPTICA	0	0	0	0	0	JUN	0
PYRUS COMMUNIS	0	0	0	0	MAY	0	0
P. MALUS	0	0	MAY	0	MAY	0	0
QUERCUS ALBA	0	0	MAY	0	0	0	MAY
Q. BICOLOR	0	0	0	MAY	0	0	0
Q. BOREALIS	MAY	MAY	MAY	0	MAY	0	MAY
Q. PRINUS	0	0	0	MAY	0	0	MAY
Q. VELUTINA	0	0	MAY	0	MAY	MAY	0
RANUNCULUS ABORTIVUS	MAY	0	MAY	MAY	MAY	MAY	0
R. ACRIS	0	0	0	JUL	JUN,JUL	0	0
R, REPENS	0	0	0	JUN	0	0	0
RHEXIA VIRGINICA	0	0	0	0	0	0	JUL,AUG
RHODODENDRON NUDIFLORUM	0	0	0	0	0	MAY	MAY
R. ROSEUM	0	0	0	0	0	MAY	0
RHUS GLABRA	0	0	0	JUL	JUL	0	0
R. RADICANS	0	JUN	0	0	0	0	0
R. TYPHINA	0	0	0	JUN	0	0	JUN
RHYNCHOSPORA CAPITELLATA	0	0	0	0	0	0	JUL
RIBES ROTUNDIFOLIUM	0	0	0	0	0	MAY	0
ROSA MULTIFLORA	0	0	JUN	JUN	0	0	0
R. VIRGINIANA	0	0	0	0	JUN	JUN	0
RUBUS ALLEGHENIENSIS	0	JUN	0	JUN	0	0	JUN
R. FLAGELLARIS	0	0	JUN	JUN	MAY,JUN	0	JUN
R. HISPIDUS	0	0	0	0	0	0	JUN
R. OCCIDENTALIS	0	0	0	0	0	MAY	0
RUDBECKIA HIRTA	0	0	JUL,AUG	JUL-OCT	JUL	0	JUL,AUG
RUMEX ACETOSELLA	0	0	JUN	MAY-JUL	MAY-JUL	0	MAY-JUL
R. CRISPUS	0	JUN	JUN	JUN	JUN	0	0
R. OBTUSIFOLIUS	JUN	JUN	0	0	0	0	0
SALIX SERICEA	0	0	0	MAY	0	0	0
SAMBUCUS CANADENSIS	0	0	0	JUN	0	0	JUN

Table G-5 (cont.)

SPECIES	RF	GIF	TR419	TR438	QSH	CC	ELIM
SANGUINARIA CANADENSIS	0	0	0	0	APR	0	0
SAPONARIA OFFICINALIS	0	0	0	JUL-OCT	JUL	0	0
SASSAFRAS ALBIDUM	0	0	MAY	MAY	MAY	0	MAY
SATUREJA VULGARIS	0	0	JUL	0	AUG	JUN-AUG	0
SAXIFRAGA VIRGINIENSIS	0	0	MAY	0	APR,MAY	MAY	0
SCIRPUS ATROVIRENS	0	0	0	0	JUN	0	0
SCROPHULARIA LANCEOLATA	JUN	0	JUL	JUL	MAY-JUL	JUN,JUL	0
SELAGINELLA APODA	JUL	0	0	0	0	0	0
SENECIO OBOVATUS	0	0	0	0	0	MAY	0
SETARIA FABERII	0	0	0	0	0	0	AUG
S. GLAUCA	0	0	JUL	0	AUG	0	0
SICYOS ANGULATUS	AUG,SEP	AUG	0	0	0	0	0
SILENE STELLATA	0	0	0	0	JUL	0	0
SISYRINCHIUM ANGUSTIFOLIUM	0	0	0	0	JUN	0	0
SMILACENA RACEMOSA	0	0	0	0	MAY	MAY	0
SOLANUM CAROLINENSE	0	AUG	0	JUL-SEP	JUL	0	0
S. DULCAMARA	0	0	JUN,JUL	0	0	0	0
S. NIGRUM	0	AUG	0	0	0	0	0
SOLIDAGO ARGUTA	0	0	0	0	0	JUL-SEP	0
S. BICOLOR	0	0	0	0	AUG-OCT	SEP,OCT	0
S. CAESIA	0	0	SEP, OCT	0	SEP,OCT	SEP,OCT	0
S. CANADENSIS	SEP	AUG,SEP	AUG-OCT	AUG-OCT	AUG,SEP	0	SEP
S. FLEXICAULIS	SEP,OCT	SEP,OCT	0	0	0	0	0
S. GIGANTEA	AUG,SEP	AUG,SEP	AUG,SEP	AUG,SEP	AUG	0	0
S. GRAMINIFOLIA	0	0	AUG,SEP	AUG,SEP	AUG,SEP	0	AUG-OCT
S. JUNCEA	JUL	0	JUL,AUG	JUL-SEP	JUL-SEP	0	AUG-OCT
S. NEMORALIS	0	0	0	SEP,OCT	AUG-OCT	0	SEP,OCT
S. RUGOSA	0	SEP	SEP,OCT	SEP,OCT	AUG-OCT	SEP	SEP,OCT
SPIRAEA LATIFOLIA	0	0	0	JUL-SEP	0	0	0
SPIRANTHES CERNUA	0	0	0	SEP,OCT	SEP	0	SEP,OCT
S. GRACILIS	0	0	0	SEP	0	0	0
STAPHYLEA TRIFOLIA	MAY	0	0	0	0	0	0
STELLARIA AQUATICA	JUN,JUL	JUN,AUG	0	0	0	0	0
S. LONGIFOLIA	0	0	0	JUN	MAY,JUN	0	0
S. MEDIA	0	0	APR,MAY	0	APR,MAY	MAY	0
SYMPLOCARPUS FOETIDUS	0	0	0	MAR,APR	0	0	0
TARAXACUM OFFICINALE	MAY	0	MAY-JUL	MAY,JUL	APR,MAY	MAY,JUN	MAY
TEUCRIUM CANADENSE	JUL,AUG	JUL,AUG	JUL	0	JUL	0	0
THALICTRUM POLYGAMUM	0	JUL	0	0	0	0	0
THELYPTERIS NOVEBORACENSIS	0	0	0	JUL	JUL,AUG	0	JUL,AUG
THLASPI ARVENSE	0	0	MAY	0	0	0	0
TILIA AMERICANA	JUL	0	0	0	0	0	0
TRAGOPOGON DUBIUS	0	0	0	0	JUL	JUN	0
TRICHOSTEMA DICHOTOMUM	0	0	0	0	AUG	0	0
TRIFOLIUM AGRARIUM	0	0	JUN,JUL	JUN,JUL	JUN,JUL	JUN	0
T. ARVENSE	0	0	0	JUL-SEP	0	0	0
T. HYBRIDUM	0	0	0	0	JUN-AUG	0	JUN,JUL
T. PRATENSE	0	0	JUL	JUL-OCT	0	0	AUG-OCT
T. REPENS	0	0	JUN,JUL	JUN,JUL	JUN,JUL	JUN,JUL	0
TRILLIUM ERECTUM	MAY	0	0	0	0	0	0
TRIODANIS PERFOLIATA	0	0	JUN	0	JUN	JUN	0
TRIODIA FLAVA	0	0	AUG	AUG	AUG	0	0
TUSSILAGO FARFARA	0	0	0	APR	0	0	0
ULMUS AMERICANA	APR	APR	0	0	APR	0	0
URTICA DIOICA	JUL,AUG	JUL	0	0	0	0	0
VACCINIUM CORYMBOSUM	0	0	0	MAY	0	0	MAY
V. STAMINEUM	0	0	0	0	MAY	MAY	0
V. VACILLANS	0	0	MAY	0	MAY	MAY	MAY
VERBASCUM THAPSIS	0	0	JUL,AUG	0	JUL	JUL	0
VERBENA URTICIFOLIA	JUL,AUG	JUL,AUG	JUL,AUG	AUG	JUL,AUG	AUG	0
VERNONIA NOVABORACENSIS	0	0	0	AUG,SEP	0	0	0
VERONICA ARVENSIS	0	0	JUN	MAY	MAY	MAY	0
V. OFFICINALIS	0	0	JUN	0	JUN	0	0
V. PEREGRINA	0	0	MAY	0	0	0	0
V. SERPYLLIFOLIA	0	0	MAY	0	MAY	MAY	0
VIBURNUM DENTATUM	0	0	0	JUN	0	0	0
VICIA CRACCA	0	0	0	JUN	0	0	0
VINCA MINOR	0	0	APR,MAY	0	0	0	0
VIOLA BLANDA	0	0	0	0	0	MAY	MAY,JUN
V. CUCULLATA	0	0	0	0	MAY	0	0
V. FIMBRIATULA	0	0	0	0	APR,MAY	0	MAY
V. PALMATA	0	0	0	0	0	MAY	0
V. PAPILIONACEA	MAY	MAY	MAY	MAY	MAY	MAY	MAY
V. PUBESCENS	MAY	MAY	0	0	0	0	0
V. SAGITTATA	0	0	0	0	0	0	MAY
V. SORORIA	MAY	0	MAY	0	0	0	0
VITIS AESTIVALIS	0	0	JUN	JUN	JUN	JUN	0
WOODSIA OBTUSA	0	0	0	0	JUN,JUL	0	0
ZIZEA AUREA	0	MAY	0	0	0	0	0

Table G-6

Months when plants were observed in flower or shedding spores on field salt drift transects in the vicinity of the Susquehanna SES, 1984. Names, abbreviations, and locations of transects are given in Table G-1.

SPECIES	NF	SWF	TCF
ACER RUBRUM	0	APR	APR
ACHILLEA MILLEFOLIUM	JUL	JUL-SEP	JUN-OCT
AGROPYRON REPENS	JUL	0	JUN
AGROSTIS PERENNANS	AUG	AUG	AUG
A. STOLONIFERA	JUN, JUL	JUL	JUN, JUL
ALLIARIA OFFICINALIS	MAY	0	0
ALNUS RUGOSA	MAR, APR	MAR, APR	0
AMBROSIA ARTEMISIIFOLIA	AUG	AUG	AUG, SEP
ANAPHALIS MARGARITACEA	0	AUG	0
ANDROPOGON GERARDI	AUG	0	0
A. SCOPARIUS	0	0	AUG
A. VIRGINICUS	0	0	AUG
ANEMONE VIRGINIANA	0	0	JUL
ANTENNARIA NEGLECTA	0	MAY	MAY
A. PLANTAGINIFOLIA	0	0	MAY
ANTHEMIS COTULA	0	JUN	0
ANTHOXANTHUM ODORATUM	0	MAY, JUN	MAY, JUN
APIOS AMERICANA	AUG	0	0
APOCYNUM CANNABINUM	JUL	JUN, JUL	JUN, JUL
ARABIDOPSIS THALLIANA	0	0	MAY
ASCLEPIAS TUBEROSA	0	0	JUL
A. VIRIDIFLORA	0	0	JUL
ASPLENIUM PLATYNEURON	0	0	JUN-AUG
ASTER LATERIFLORUS	SEP, OCT	SEP	0
A. NOVAE-ANGLIAE	0	SEP, OCT	SEP
A. PILOSUS	SEP, OCT	SEP, OCT	AUG-OCT
A. SIMPLEX	SEP, OCT	SEP	SEP
A. UMBELLATUS	0	AUG, SEP	0
ATHYRIUM FILIX-FEMINA	0	0	JUL
BARBAREA VULGARIS	MAY	MAY	MAY
BETULA POPULIFOLIA	0	MAY	MAY
BOTRYCHIUM DISSECTUM	0	SEP	SEP, OCT
BRASSICA NIGRA	OCT	0	0
BROMUS INERMIS	0	0	JUN
B. LATIGLUMIS	AUG	0	0
CARDAMINE PRATENSIS	MAY	0	0
CAREX SP.	MAY	MAY	0
CERASTIUM VULGATUM	0	MAY, JUN	MAY
CHRYSANTHEMUM LEUCANTHEMUM	JUL	JUN-AUG	JUN-AUG
CICUTA MACULATA	JUL	JUL	0
CIRSIUM PUMILUM	0	0	JUL-SEP
C. VULGARE	0	0	AUG
COMMELINA COMMUNIS	AUG	0	0
CONVOLVULUS SEPIUM	JUL-SEP	JUL	JUL-SEP
CONYZA CANADENSIS	AUG	0	AUG
CORNUS AMOMUM	0	JUN	JUN
C. FLORIDA	0	MAY	MAY
C. RACEMOSA	0	JUN	JUN
CORONILLA VARIA	0	0	JUN-SEP
CYPREPEDIUM ACAULE	0	0	MAY
DACTYLIS GLOMERATA	0	JUN	0
DANTHONIA SPICATA	0	JUN	JUN
DAUCUS CAROTA	JUL-SEP	JUL-OCT	JUL-OCT
DENNSTAEDTIA PUNCTILOBULA	0	0	JUL
DESMODIUM DILLENII	JUL, AUG	AUG	JUL, AUG
D. PANICULATUM	0	0	AUG
DIANTHUS ARMERIA	0	JUN, JUL	JUN-AUG
DIGITARIA SANGUINALIS	0	AUG	AUG
ECHINOCHLOA MURICATA	0	AUG	0
ECHINOCYSTIS LOBATA	AUG	0	0
ELAEAGNUS COMMUTATA	0	MAY	0
ELEOCHARIS OBTUSA	0	0	JUN, JUL
ERAGROSTIS CAPILLARIS	0	0	AUG
E. CILIANENSIS	0	0	AUG
E. SPECTABILIS	0	0	AUG
ERECHTITES HIERACIFOLIA	AUG	0	AUG, SEP
ERIGERON ANNUUS	JUN, JUL	JUN-SEP	JUN-AUG
EUPATORIUM FISTULOSUM	SEP	0	0
E. MACULATUM	AUG	0	0
E. PERFOLIATUM	SEP	AUG	0
E. RUGOSUM	SEP	0	0

Table G-6 (cont.)

SPECIES	NF	SWF	TCF
FLOERKIA PROSERPINACOIDES	MAY	0	0
FRAGARIA VIRGINIANA	0	MAY	MAY
FRAXINUS AMERICANA	0	0	MAY
GALINSOGA CILIATA	SEP	0	0
GALIUM APARINE	JUN	0	0
G. PALUSTRE	JUL, AUG	0	0
GAURA BIENNIS	SEP	0	0
GENTIANA ANDREWSII	0	SEP, OCT	0
GERARDIA TENUIFOLIA	0	AUG	0
GEUM CANADENSE	JUN	JUN	0
GNAPHALIUM OBTUSIFOLIUM	0	0	SEP
HELENIUM AUTUMNALE	SEP	0	0
HELIANTHUS DECAPETALUS	JUL, SEP	0	0
H. TUBEROSUS	AUG	0	0
HESPERIS MATRONALIS	JUN	0	0
HIERACIUM PRATENSE	0	JUN	MAY-JUL
H. SCABRUM	0	0	AUG
HOLCUS LANATUS	0	JUN	0
HOUSTONIA CAERULEA	0	APR, MAY	0
HYPERICUM PERFORATUM	0	JUN-AUG	JUN-AUG
H. PUNCTATUM	0	JUN	JUL
H. PYRAMIDATUM	JUL	0	0
IMPATIENS BIFLORA	AUG, SEP	0	0
I. PALLIDA	JUL-SEP	0	0
JUNCUS EFFUSUS	JUN	0	0
J. TENUIS	JUN	JUN	JUN
KRIGIA VIRGINICA	0	0	MAY
LACTUCA CANADENSIS	AUG	0	0
LEERSIA VIRGINICA	AUG	0	0
LEPIDIUM CAMPESTRE	0	MAY	MAY
L. VIRGINICUM	0	MAY	MAY
LINARIA VULGARIS	0	0	JUL-SEP
LOBELIA INFLATA	AUG	AUG	JUL
L. SIPHILITICA	SEP	0	0
L. SPICATA	0	JUN	0
LONICERA TATARICA	0	0	MAY
LUZULA CAMPESTRIS	0	MAY	0
LYCHNIS ALBA	JUN, AUG	0	0
LYCOPODIUM FLABELLIFORME	0	0	SEP, OCT
L. OBSCURUM	0	0	SEP, OCT
L. TRISTACHYUM	0	0	AUG
LYCOPUS AMERICANUS	JUL	0	0
L. VIRGINICUS	AUG	0	0
LYSIMACHIA CILIATA	JUL, AUG	0	0
L. QUADRIFOLIA	0	JUN	0
L. VULGARIS	JUL	0	0
LYTHRUM SALICARIA	JUL	0	0
MEDICAGO LUPULINA	0	0	AUG
MELILOTUS ALBA	0	JUL	JUL, AUG
M. OFFICINALIS	0	JUN	JUN, JUL
MONARDA FISTULOSA	AUG, SEP	0	0
MUHLENBERGIA FRONDOSA	SEP	0	0
OENOTHERA BIENNIS	AUG	0	JUL-SEP
O. PERENNIS	0	Jun	0
ONOCLEA SENSIBILIS	0	MAR	0
OSMUNDA CLAYTONIANA	0	MAY	0
OXALIS SP.	JUN, SEP	MAY, JUL, AUG	MAY-AUG
PANICUM CAPILLARE	0	AUG	AUG
P. CLANDESTINUM	JUN	0	0
P. VIRGATUM	JUL, AUG	0	JUL, AUG
PANICUM SP.	0	JUN	JUN
PHALARIS ARUNDINACEA	JUN	0	0
PHLEUM PRATENSE	0	JUN	JUN
PHYSOCARPUS OPULIFOLIUS	JUN	0	0
PHYTOLACCA AMERICANA	0	0	JUL
PLANTAGO ARISTATA	0	0	JUN, JUL
P. LANCEOLATA	0	MAY, JUN	MAY, JUN
POA COMPRESSA	0	MAY, JUN	MAY, JUN
POLYGALA VERTICELLATA	0	0	JUL, AUG
POLYGONUM PENSYLVANICUM	AUG	AUG	0
P. SAGITTATUM	0	AUG	0
P. SCANDENS	SEP	0	0
POLYSTICHUM ACROSTICHOIDES	0	0	JUL
POPULUS TREMULOIDES	0	APR	MAR, APR
POTENTILLA NORVEGICA	JUL	0	JUL, AUG
P. RECTA	0	JUN	JUN
P. SIMPLEX	0	MAY, JUN	MAY

Table G-6 (cont.)

SPECIES	NF	SWF	TCF
PRUNELLA VULGARIS	AUG	JUN-AUG	JUL-SEP
PRUNUS SEROTINA	0	MAY	MAY
PYCNANTHEMUM VIRGINIANUM	0	JUL	0
RANUNCULUS ACRIS	0	MAY, JUN	0
RHUS GLABRA	0	0	JUL
R. TYPHINA	0	0	JUN
RORIPPA SYLVESTRIS	JUN	0	0
ROSA VIRGINIANA	0	0	JUN
RUBUS ALLEGHENIENSIS	JUN	0	0
R. FLAGELLARIS	JUN	MAY, JUN	MAY, JUN
R. OCCIDENTALIS	0	MAY	0
RUDBECKIA HIRTA	JUL, AUG	JUN, JUL	JUN-AUG, OCT
RUMEX ACETOSELLA	JUN	MAY, JUN	MAY-JUL
R. OBTUSIFOLIUS	JUN	0	0
SALIX HUMILIS	0	APR	APR
SAMBUCUS CANADENSIS	0	JUN	0
SASSAFRAS ALBIDUM	0	0	MAY
SATUREJA VULGARIS	0	0	AUG
SCIRPUS ATROVIRENS	0	JUN	0
SCROPHULARIA LANCEOLATA	AUG	0	0
SENECIO AUREUS	0	MAY	0
SETARIA FABERII	0	AUG	AUG
S. GLAUCA	0	0	AUG
SICYOS ANGULATUS	AUG	0	0
SISYRINCHIUM ANGUSTIFOLIUM	0	JUN	MAY
SOLANUM CAROLINENSE	JUL	0	JUL, AUG
SOLIDAGO CANADENSIS	AUG-OCT	AUG-OCT	AUG-OCT
S. GIGANTEA	AUG	AUG	0
S. GRAMINIFOLIA	AUG, SEP	AUG, SEP	AUG, SEP
S. JUNCEA	JUL, AUG	JUL, AUG	JUL-SEP
S. NEMORALIS	0	AUG-OCT	AUG-OCT
S. RUGOSA	SEP, OCT	SEP	SEP
SPIRAEA LATIFOLIA	JUL-SEP	JUL	JUL, AUG
S. TOMENTOSA	JUL	0	0
SPIRANTHES GRACILIS	0	0	AUG
STELLARIA AQUATICA	JUN-OCT	0	0
S. LONGIFOLIA	0	MAY, JUN	MAY
TARAXACUM OFFICINALE	MAY	APR-JUN	APR, MAY, JUL
TEUCRIUM CANADENSE	JUL	JUL	0
TRICHOSTEMA DICHOTOMUM	0	0	AUG
TRIFOLIUM AGRARIUM	0	JUN, JUL	JUN, JUL
T. ARVENSE	0	0	JUL, AUG
T. HYBRIDUM	JUN, JUL	JUN-AUG	MAY-AUG
T. PRATENSE	0	JUN-SEP	JUN-OCT
T. REPENS	JUN	JUN	JUN, JUL
TRIODIA FLAVA	0	AUG	AUG
VACCINIUM CORYMBOSUM	0	0	MAY
V. VACILLANS	0	0	MAY
VERBASCUM THAPSIS	0	0	JUN, JUL
VERONICA ARVENSIS	0	MAY	MAY
V. PEREGRINA	MAY	0	MAY
V. SERPYLLIFOLIA	0	MAY	0
VIOLA FIMBRIATULA	0	0	MAY
V. PAPILIONACEA	MAY	MAY	MAY

Table G-7

Parasitic plant diseases observed on salt drift transects in the vicinity of the Susquehanna SES, and at Elimsport, 1984. Names, abbreviations, and locations of transects are given in Table G-1. An asterisk (*) indicates diseases observed for the first time in 1984.

HOST SPECIES	DISEASE	TRANSECT	DISEASE EFFECT[a]	DISEASE FREQUENCY
ACER PENSYLVANICUM	RHYTISMA PUNCTATUM* TAR SPOT	CC, ELIM	1	4
A. RUBRUM	PHYLLOSTICTA MINIMA LEAF SPOT	TR419,TR438,QSH,CC, SWF,TCF, ELI	1	4-5
A. RUBRUM	RHYTISMA ACERINUM TAR SPOT	TCF	1	4
A. SACCHARINUM	PHYLLOSTICTA MINIMA LEAF SPOT	RF,GIF,NF	1	4
A. SACCHARINUM	RHYTISMA ACERINUM TAR SPOT	RF, NF	1	3-4
ACHILLEA MILLEFOLIUM	ERYSIPHE CICHORACEARUM POWDERY MILDEW	CC	0	2
ARISAEMA TRIPHYLLUM	UROMYCES ARI-TRIPHYLLI RUST	GIF	1	2
ASTER CORDIFOLIUS	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	TR419, QSH	1	3
A. DIVARICATUS	(UNIDENTIFIED) LEAF SPOT	QSH	1	3
A. LATERIFLORUS	ERYSIPHE CICHORACEARUM POWDERY MILDEW	TR419, QSH	0	2
A. PUNICEUS	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	TR438	1	3
A. PUNICEUS	ERYSIPHE CICHORACEARUM POWDERY MILDEW	TR438	0	5
A. SIMPLEX	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	QSH	1	4
A. SIMPLEX	ERYSIPHE CICHORACEARUM POWDERY MILDEW	RF	0	1
BETULA LENTA	GLOEOSPORIUM BETULARUM LEAF SPOT	QSH, CC	1	1-3
CASTACEA DENTATA	ENDOTHIA PARASITICA CHESTNUT BLIGHT	CC	5	3
CATALPA BIGNONIOIDES	PHYLLOSTICTA CATALPAE LEAF SPOT	GIF	1	4
CORNUS AMOMUM	SEPTORIA CORNICOLA LEAF SPOT	TR438,SWF,TCF	1	3-5
C. FLORIDA	DISCULA CORNI SPOT ANTHRACNOSE	TR419,QSH,CC, SWF,ELIM	1-5	3-5
C. RACEOMSA	SEPTORIA CORNICOLA LEAF SPOT	TR438, TCF	1	3
CRATAEGUS SP.	GYMNOSPORANGIUM GLOBOSUM CEDAR-HAWTHORN RUST	TCF	1	3
EUPATORIUM RUGOSUM	ERYSIPHE CICHORACEARUM POWDERY MILDEW	TR419,QSH,CC	0	2-3

Table G-7 (cont.)

HOST SPECIES	DISEASE	TRANSECT	DISEASE EFFECT	DISEASE FREQUENCY
S. GIGANTEA	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	RF, GIF	1	3-4
S. GIGANTEA	ERYSIPHE CICHORACEARUM POWDERY MILDEW	GIF	0	3
S. GRAMINIFOLIA	PLACOSPHAERA HAYDENI TAR SPOT	RF,TR419,TR438,QSH, NF,SWF,TCF,ELIM	1	2-5
S. JUNCEA	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	TCF	1	3
S. RUGOSA	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	GIF,TR419,TR438,QSH, NF,SWF,TCF,ELIM	1	2-5
S. RUGOSA	ERYSIPHE CICHORACEARUM POWDERY MILDEW	TR419,QSH,NF,ELIM	0	2-4
TILIA AMERICANA	GNOMONIA TILIAE ANTHRACNOSE	RF	1	3
TRIFOLIUM HYBRIDUM	ERYSIPHE POLYGONI POWDERY MILDEW	TCF	0	1
T. PRATENSE	E. POLYGONI POWDERY MILDREW	TR438	0	3
VERBENA URTICIFOLIA	E. CICHORACEARUM POWDERY MILDEW	GIF, TR419, QSH	0	3-5
VIOLA BLANDA	SEPTORIA VERBENAE? LEAF SPOT	ELIM	1	4
VITIS AESTIVALIS	PHYLLOSTICTA VITICOLA LEAF SPOT	TR419, QSH	1	2-5

[a]Disease Effect Code
0 = No effect.
1 = Local necrosis in small areas only.
2 = More important necrosis in larger area.
3 = Important necrosis and minor defoliation or twig death.
4 = Important necrosis and more important defoliation or twig death.
5 = Major necrosis and defoliation or host death.

[b]Disease Frequency Code
1 = Rare -- one or two plants only (estimated at less than 5% of population affected).
2 = Uncommon -- a few plants, either scattered or clumped (estimated at less than 10% of population affected).
3 = Scattered -- several plants at different localities (estimated at 10-25% of population affected).
4 = Common -- many plants affected (estimated at 25-50% of population).
5 = Abundant -- more than half affected (estimated at 50-100% of population).

Table G-7 (cont.)

HOST SPECIES	DISEASE	TRANSECT	DISEASE EFFECT	DISEASE FREQUENCY
FRAXINUS AMERICANA	GLOEOSPORIUM ARIDUM ANTHRACNOSE	RF,GIF,TR419,TR438, QSH,CC,NF,SWF,ELIM	1	3-4
FRAGARIA VIRGINIANA	CYLINDROSPORIUM SP. LEAF SPOT	TR438, SWF, TCF	1	3-4
IMPATIENS SP.	PUCCINA RECONDITA RUST	RF, GIF	1	2
KALMIA LATIFOLIA	PHYLLOSTICTA SP. LEAF SPOT	CC	1	5
LIRIODENDRON TULIPIFERA	MYCOSPHAERELLA LIRIODENDRI LEAF SPOT	ELIM	1	4
MONARDA FISTULOSA	ERYSIPHE CICHORACEARUM POWDERY MILDEW	NF	0	2
PANICUM LANUGINOSUM	BALANSIA STRANGULANS BLACK RING	QSH	1	2
PARTHENOCISSUS QUINQUEFOLIA	GUIGNARDII BIDWILLII LEAF SPOT	RF,TR419,TR438, QSH,CC,TCF	1	2-4
PODOPHYLLUM PELTATUM	PUCCINIA PODOPHYLLI RUST	GIF, QSH	1	2-4
PRUNUS SEROTINA	COCCOMYCES LUTESCENS LEAF SPOT	TR438, SWF, TCF	1	2-3
P. VIRGINIANA	C. LUTESCENS LEAF SPOT	CC	1	5
QUERCUS BOREALIS	MICROSPHAERA ALNI POWDERY MILDEW	TR419, CC	0	1
Q. PALUSTRIS	ACTINOPELTE DRYINA LEAF SPOT	TR438	1	4
Q. PALUSTRIS	MICROSPHAERA ALNI POWDERY MILDEW	TR438	0	3
RHUS RADICANS	CERCOSPORA SP.? * LEAF SPOT	RF, QSH	1	3
RUBUS ALLEGHENIENSIS	GLOEOSPORIUM RUFOMACULANS LEAF SPOT	NF	1	4
R. ALLEGHENIENSIS	GYMNOCONIA PECKIANA RUST	GIF	2	2
R. FLAGELLARIS	GLOEOSPORIUM RUFOMACULANS LEAF SPOT	QSH, TCF	1	2-3
R. FLAGELLARIS	GYMNOCONIA PECKIANA RUST	TCF	1	2
SASSAFRAS ALBIDUM	ACTINOPELTE DRYINA LEAF SPOT	TR419,TR438,CC, TCF,ELIM	1	2-4
SOLIDAGO CAESIA	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	TR419,QSH,CC	1	3
S. CAESIA	ERYSIPHE CICHORACEARUM POWDERY MILDEW	CC	0	4
S. CANADENSIS	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	RF,TR419,TR438,QSH, NF,SWF,TCF,ELIM	1	2-4
S. CANADENSIS	ERYSIPHE CICHORACEARUM POWDERY MILDEW	RF,TR419,TR438,QSH, NF,SWF,TCF,ELIM	0	2-4
S. FLEXICAULIS	COLEOSPORIUM ASTERUM PINE-NEEDLE RUST	RF, GIF	1	3

Table G-8

Vegetation analysis for trees in the Council Cup Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
BETULA LENTA	SWEET BIRCH	0.70	24.6	225	36.6	60108	35.2	96.3
QUERCUS VELUTINA	BLACK OAK	0.40	14.0	80	13.0	22223	13.0	40.1
QUERCUS PRINUS	CHESTNUT OAK	0.30	10.5	65	10.6	13363	7.8	28.9
QUERCUS BOREALIS	RED OAK	0.30	10.5	60	9.8	11204	6.6	26.8
QUERCUS ALBA	WHITE OAK	0.15	5.3	20	3.3	24214	14.2	22.7
ACER RUBRUM	RED MAPLE	0.30	10.5	50	8.1	6181	3.6	22.3
PINUS VIRGINIANA	VIRGINIA PINE	0.15	5.3	40	6.5	15237	8.9	20.7
PINUS STROBUS	WHITE PINE	0.20	7.0	30	4.9	10560	6.2	18.1
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.05	1.8	10	1.6	2081	1.2	4.6
TSUGA CANADENSIS	EASTERN HEMLOCK	0.05	1.8	10	1.6	1547	0.9	4.3
PYRUS MALUS	APPLE	0.05	1.8	5	0.8	1418	0.8	3.4
CARYA GLABRA	PIGNUT HICKORY	0.05	1.8	5	0.8	1135	0.7	3.2
SASSAFRAS ALBIDUM	SASSAFRAS	0.05	1.8	5	0.8	664	0.4	3.0
PRUNUS PENSYLVANICA	PIN CHERRY	0.05	1.8	5	0.8	475	0.3	2.8
BETULA POPULIFOLIA	GRAY BIRCH	0.05	1.8	5	0.8	393	0.2	2.8
TOTAL		-	100.0	615	100.0	170795	100.0	300.0

Table G-9

Vegetation analysis for saplings in the Council Cup Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANC VALUE
ACER RUBRUM	RED MAPLE	0.80	17.2	525	33.8	7087	24.0	75.0
BETULA LENTA	SWEET BIRCH	0.70	15.1	340	21.9	7975	27.0	63.9
QUERCUS BOREALIS	RED OAK	0.60	12.9	135	8.7	3161	10.7	32.3
QUERCUS PRINUS	CHESTNUT OAK	0.40	8.6	135	8.7	2478	8.4	25.7
PINUS STROBUS	WHITE PINE	0.45	9.7	100	6.4	1528	5.2	21.3
QUERCUS VELUTINA	BLACK OAK	0.35	7.5	50	3.2	1626	5.5	16.3
QUERCUS ALBA	WHITE OAK	0.20	4.3	40	2.6	797	2.7	9.6
CARYA GLABRA	PIGNUT HICKORY	0.20	4.3	25	1.6	648	2.2	8.1
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.20	4.3	20	1.3	668	2.3	7.8
BETULA POPULIFOLIA	GRAY BIRCH	0.10	2.2	30	1.9	1111	3.8	7.8
CORNUS FLORIDA	FLOWERING DOGWOOD	0.10	2.2	30	1.9	369	1.3	5.3
TSUGA CANADENSIS	EASTERN HEMLOCK	0.05	1.1	25	1.6	585	2.0	4.7
SASSAFRAS ALBIDUM	SASSAFRAS	0.05	1.1	15	1.0	734	2.5	4.5
AMELANCHIER ARBOREA	SHAD-BUSH	0.10	2.2	20	1.3	137	0.5	3.9
CASTANEA DENTATA	AMERICAN CHESTNUT	0.10	2.2	20	1.3	59	0.2	3.6
PRUNUS SEROTINA	BLACK CHERRY	0.05	1.1	25	1.6	169	0.6	3.3
FRAXINUS AMERICANA	WHITE ASH	0.10	2.2	10	0.6	51	0.2	3.0
PRUNUS PENSYLVANICA	PIN CHERRY	0.05	1.1	5	0.3	318	1.1	2.5
ACER PENSYLVANICUM	STRIPED MAPLE	0.05	1.1	5	0.3	16	0.1	1.5
TOTAL		-	100.0	1555	100.0	29516	100.0	300.0

Table G-10

Vegetation analysis for tree seedlings in the Council Cup Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ACER RUBRUM	RED MAPLE	0.58	33.3	14000	45.5	2.00	22.5	101.4
PRUNUS SEROTINA	BLACK CHERRY	0.18	10.1	4000	13.0	1.03	11.5	34.7
SASSAFRAS ALBIDUM	SASSAFRAS	0.13	7.2	2500	8.1	1.35	15.2	30.6
QUERCUS ALBA	WHITE OAK	0.05	2.9	2250	7.3	1.58	17.7	28.0
QUERCUS BOREALIS	RED OAK	0.20	11.6	1250	4.1	0.63	7.0	22.7
QUERCUS VELUTINA	BLACK OAK	0.18	10.1	1500	4.9	0.60	6.8	21.8
QUERCUS PRINUS	CHESTNUT OAK	0.13	7.2	1250	4.1	0.38	4.2	15.5
BETULA LENTA	SWEET BIRCH	0.08	4.3	1000	3.3	0.25	2.8	10.4
CASTANEA DENTATA	AMERICAN CHESTNUT	0.03	1.4	250	0.8	0.38	4.2	6.5
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.03	1.4	250	0.8	0.30	3.4	5.6
ACER PENSYLVANICUM	STRIPED MAPLE	0.05	2.9	500	1.6	0.05	0.6	5.1
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.03	1.4	750	2.4	0.03	0.3	4.2
AMELANCHIER ARBOREA	SHAD-BUSH	0.03	1.4	500	1.6	0.08	0.8	3.9
CARYA GLABRA	PIGNUT HICKORY	0.03	1.4	250	0.8	0.13	1.4	3.7
FRAXINUS AMERICANA	WHITE ASH	0.03	1.4	250	0.8	0.10	1.1	3.4
CRATAEGUS SP.	HAWTHORNE	0.03	1.4	250	0.8	0.03	0.3	2.5
TOTAL		-	100.0	30750	100.0	8.88	100.0	300.0

Table G-11

Vegetation analysis for shrubs, herbs, and ground cover in the Council Cup Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.50	36.4	5.13	20.5	56.8
KALMIA LATIFOLIA	MOUNTAIN LAUREL	0.20	14.5	6.33	25.3	39.8
VACCINIUM STAMINEUM	DEERBERRY	0.18	12.7	6.10	24.4	37.1
RHODODENDRON NUDIFLORUM	PINXTER-FLOWER	0.15	10.9	2.90	11.6	22.5
RHUS RADICANS	POISON IVY	0.13	9.1	1.78	7.1	16.2
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.05	3.6	1.05	4.2	7.8
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.08	5.5	0.35	1.4	6.9
GAYLUSSACIA BACCATA	BLACK HUCKLEBERRY	0.05	3.6	0.53	2.1	5.7
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.03	1.8	0.45	1.8	3.6
KALMIA ANGUSTIFOLIA	SHEEP LAUREL	0.03	1.8	0.43	1.7	3.5
HERBS						
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.30	21.1	4.58	25.7	46.7
ARALIA NUDICAULIS	WILD SARSAPARILLA	0.25	17.5	4.43	24.8	42.4
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	0.13	8.8	3.90	21.9	30.7
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.13	8.8	2.45	13.7	22.5
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.15	10.5	0.65	3.6	14.2
DESCHAMPSIA FLEXUOSA	HAIRGRASS	0.05	3.5	0.70	3.9	7.4
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.08	5.3	0.15	0.8	6.1
POLYGALA PAUCIFOLIA	FRINGED POLYGALA	0.05	3.5	0.23	1.3	4.8
PYROLA ELLIPTICA	SHINLEAF	0.05	3.5	0.15	0.8	4.4
CHIMAPHILIA MACULATA	SPOTTED WINTERGREEN	0.05	3.5	0.05	0.3	3.8
MITCHELLA REPENS	PARTRIDGE-BERRY	0.03	1.8	0.30	1.7	3.4
PRENANTHES ALBA	TALL WHITE LETTUCE	0.03	1.8	0.05	0.3	2.0
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.03	1.8	0.05	0.3	2.0
MEDEOLA VIRGINIANA	INDIAN CUCUMBER	0.03	1.8	0.05	0.3	2.0
GALIUM CIRCAEZANS	BEDSTRAW	0.03	1.8	0.03	0.1	1.9
GAULTHERIA PROCUMBENS	WINTERGREEN	0.03	1.8	0.03	0.1	1.9
SMILACINA RACEMOSA	FALSE SOLOMAN'S SEAL	0.03	1.8	0.03	0.1	1.9
CAREX SWANNII	SEDGE	0.03	1.8	0.03	0.1	1.9
GROUND COVER						
LITTER	-	1.00	70.2	98.40	98.6	168.8
MOSS	-	0.25	17.5	0.68	0.7	18.2
ROCK	-	0.18	12.3	0.70	0.7	13.0

Table G-12

Comparison of trees (number of stems) in the Council Cup Forest, 1977-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	1979	1980	1981	1982	1983	1984	F	TREND
BETULA LENTA	SWEET BIRCH	45	41	40	45	40	43	44	45	0.51	
QUERCUS VELUTINA	BLACK OAK	11	21	19	17	18	19	16	16	2.21*	
QUERCUS PRINUS	CHESTNUT OAK	13	13	13	13	9	13	13	13	1.02	
QUERCUS BOREALIS	RED OAK	9	6	5	5	9	5	8	12	1.02	
ACER RUBRUM	RED MAPLE	8	7	8	7	10	11	9	10	1.71	
PINUS VIRGINIANA	VIRGINIA PINE	8	11	10	9	10	9	8	8	1.40	
PINUS STROBUS	WHITE PINE	10	10	9	9	8	8	9	6	1.37	
QUERCUS ALBA	WHITE OAK	3	5	5	5	5	5	5	4	1.69	
TSUGA CANADENSIS	EASTERN HEMLOCK	1	1	1	1	2	2	2	2	1.00	
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	3	3	2	3	2	2	2	2	0.74	
PRUNUS PENSYLVANICA	PIN CHERRY	0	0	0	1	1	1	1	1	1.00	
BETULA POPULIFOLIA	GRAY BIRCH	0	1	1	1	0	1	1	1	0.39	
PYRUS MALUS	APPLE	1	1	1	1	1	1	1	1	0.00	
SASSAFRAS ALBIDUM	SASSAFRAS	1	1	1	1	1	1	1	1	0.00	
CARYA GLABRA	PIGNUT HICKORY	1	1	1	1	1	1	1	1	0.00	
CORNUS FLORIDA	FLOWERING DOGWOOD	3	2	3	3	2	2	2	0	1.31	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-13

Comparison of saplings (number of stems) in the Council Cup Forest, 1977-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	1979	1980	1981	1982	1983	1984	F	TREND
ACER RUBRUM	RED MAPLE	133	114	98	100	97	99	93	105	1.37	
BETULA LENTA	SWEET BIRCH	131	131	118	104	82	79	73	68	5.86**	-
QUERCUS BOREALIS	RED OAK	57	38	47	33	36	36	29	27	2.47*	-
QUERCUS PRINUS	CHESTNUT OAK	55	45	47	37	32	25	33	27	3.21**	-
PINUS STROBUS	WHITE PINE	24	22	22	24	21	23	20	20	0.52	
QUERCUS VELUTINA	BLACK OAK	36	38	35	25	28	19	16	10	4.44**	-
QUERCUS ALBA	WHITE OAK	20	11	15	16	4	13	8	8	2.05	
CORNUS FLORIDA	FLOWERING DOGWOOD	10	10	9	8	8	9	8	6	1.20	
BETULA POPULIFOLIA	GRAY BIRCH	27	16	16	18	11	7	6	6	5.62**	-
CARYA GLABRA	PIGNUT HICKORY	15	6	7	6	5	5	3	5	4.30**	-
TSUGA CANADENSIS	EASTERN HEMLOCK	4	4	4	6	6	5	5	5	0.99	
PRUNUS SEROTINA	BLACK CHERRY	9	7	2	4	3	1	5	5	2.18*	-
AMELANCHIER ARBOREA	SHAD-BUSH	3	4	3	3	3	3	3	4	0.87	
CASTANEA DENTATA	AMERICAN CHESTNUT	2	4	3	2	1	2	6	4	0.93	
CARYA TOMENTOSA	MOCKERNUT HICKORY	0	12	6	6	7	6	7	4	4.01**	
SASSAFRAS ALBIDUM	SASSAFRAS	6	4	6	6	2	5	5	3	1.22	
FRAXINUS AMERICANA	WHITE ASH	3	0	0	3	4	4	4	2	2.23*	
ACER PENSYLVANICUM	STRIPED MAPLE	0	0	0	0	0	0	1	1	1.00	
PRUNUS PENSYLVANICA	PIN CHERRY	3	2	2	1	1	1	1	1	1.00	
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0	1	1	1	1	0	0	0	1.00	
PINUS VIRGINIANA	VIRGINIA PINE	3	0	1	0	0	0	0	0	1.70	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-14

Comparison of tree seedlings (number of stems) in the Council Cup Forest, 1977-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1978	1979	1980	1981	1982	1983	1984	F	TREND
ACER RUBRUM	RED MAPLE	37	50	52	52	83	82	56	4.58**	+
PRUNUS SEROTINA	BLACK CHERRY	24	25	32	25	28	20	16	2.19*	-
SASSAFRAS ALBIDUM	SASSAFRAS	4	2	4	4	12	11	10	1.98	
QUERCUS ALBA	WHITE OAK	0	1	2	1	1	1	9	1.87	
QUERCUS VELUTINA	BLACK OAK	8	7	1	6	6	3	6	2.34*	
QUERCUS BOREALIS	RED OAK	6	4	7	5	9	4	5	1.22	
QUERCUS PRINUS	CHESTNUT OAK	8	5	9	8	6	11	5	1.09	
BETULA LENTA	SWEET BIRCH	5	6	5	2	3	3	4	1.65	
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0	0	0	0	0	0	3	1.00	
ACER PENSYLVANICUM	STRIPED MAPLE	0	0	0	0	1	0	2	1.48	
AMELANCHIER ARBOREA	SHAD-BUSH	0	0	6	5	4	3	2	1.00	
CARYA GLABRA	PIGNUT HICKORY	1	1	1	1	0	2	1	1.18	
FRAXINUS AMERICANA	WHITE ASH	2	2	2	3	3	2	1	1.00	
CARYA TOMENTOSA	MOCKERNUT HICKORY	0	1	1	0	0	1	1	1.00	
CASTANEA DENTATA	AMERICAN CHESTNUT	3	3	3	1	1	1	1	1.96	
CRATAEGUS SP.	HAWTHORNE	1	0	0	1	1	1	1	1.00	
PRUNUS AVIUM	SWEET CHERRY	0	0	0	1	1	1	0	1.00	
PINUS VIRGINIANA	VIRGINIA PINE	0	0	1	0	0	0	0	1.00	
PINUS STROBUS	WHITE PINE	1	0	1	1	0	0	0	1.00	
POPULUS TREMULOIDES	QUAKING ASPEN	3	9	1	1	0	0	0	1.89	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-15

Comparison of shrubs, herbs, and ground cover (% cover) in the Council Cup Forest, 1977-84.

SPECIES	COMMON NAME	% COVER 1978	1979	1980	1981	1982	1983	1984	F	TREND
SHRUBS										
KALMIA LATIFOLIA	MOUNTAIN LAUREL	4.28	3.30	4.93	4.23	5.75	5.93	6.33	2.43*	+
VACCINIUM STAMINEUM	DEERBERRY	0.00	0.00	0.00	1.28	4.75	7.60	6.10	3.95**	+
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	10.28	9.93	9.83	6.38	6.90	4.98	5.13	2.18*	-
RHODODENDRON NUDIFLORUM	PINXTER-FLOWER	2.00	2.40	2.65	1.90	3.08	2.98	2.90	1.54	
RHUS RADICANS	POISON IVY	1.08	1.10	1.20	1.15	1.55	1.58	1.78	0.78	
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.45	0.25	0.58	0.33	1.68	1.40	1.05	1.35	
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.18	0.10	0.15	0.18	0.20	0.25	0.35	1.49	
HERBS										
LYCOPODIUM FLABELLIFORME	GROUND PINE	6.75	6.08	6.38	4.13	4.85	4.75	4.58	1.97	
ARALIA NUDICAULIS	WILD SARSAPARILLA	3.90	3.65	2.40	3.00	4.15	3.88	4.43	1.42	
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	2.48	3.18	2.15	2.30	5.03	4.85	3.90	3.35**	+
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.50	1.05	1.43	2.13	2.63	2.98	2.45	3.38**	+
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.53	0.33	0.38	0.43	1.23	0.95	0.65	3.27**	+
POLYGALA PAUCIFOLIA	FRINGED POLYGALA	0.55	0.43	0.35	0.35	0.33	0.45	0.23	0.73	
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.00	0.05	0.15	0.45	1.18	1.23	0.15	1.95	
CHIMAPHILIA MACULATA	SPOTTED WINTERGREEN	0.00	0.03	0.03	0.05	0.08	0.08	0.05	1.94	
GROUND COVER										
LITTER	-	97.35	97.75	97.48	98.23	97.60	98.30	98.40	1.09	
ROCK	-	1.18	1.18	1.38	0.88	1.28	0.90	0.70	2.90*	-
MOSS	-	0.63	0.53	0.58	0.65	0.85	0.48	0.68	2.38*	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-16

Vegetation analysis for trees in the TR419 Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
QUERCUS VELUTINA	BLACK OAK	0.54	17.8	133	25.0	84855	37.4	80.2
PINUS VIRGINIANA	VIRGINIA PINE	0.33	11.0	67	12.5	38805	17.1	40.6
CORNUS FLORIDA	FLOWERING DOGWOOD	0.54	17.8	79	14.8	10959	4.8	37.5
QUERCUS PRINUS	CHESTNUT OAK	0.29	9.6	46	8.6	13437	5.9	24.1
ACER RUBRUM	RED MAPLE	0.25	8.2	42	7.8	13885	6.1	22.2
PRUNUS SEROTINA	BLACK CHERRY	0.21	6.8	38	7.0	14268	6.3	20.2
PINUS STROBUS	WHITE PINE	0.13	4.1	42	7.8	13587	6.0	17.9
FRAXINUS AMERICANA	WHITE ASH	0.17	5.5	21	3.9	7955	3.5	12.9
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.21	6.8	21	3.9	4683	2.1	12.8
QUERCUS ALBA	WHITE OAK	0.08	2.7	8	1.6	10138	4.5	8.8
PRUNUS AVIUM	SWEET CHERRY	0.08	2.7	8	1.6	4297	1.9	6.2
TSUGA CANADENSIS	EASTERN HEMLOCK	0.04	1.4	8	1.6	4451	2.0	4.9
LIRIODENDRON TULIPIFERA	TULIP-TREE	0.04	1.4	4	0.8	3145	1.4	3.5
CARYA GLABRA	PIGNUT HICKORY	0.04	1.4	8	1.6	723	0.3	3.3
SASSAFRAS ALBIDUM	SASSAFRAS	0.04	1.4	4	0.8	946	0.4	2.6
PYRUS MALUS	APPLE	0.04	1.4	4	0.8	641	0.3	2.4
TOTAL		-	100.0	533	100.0	226768	100.0	300.0

Table G-17

Vegetation analysis for saplings in the TR419 Forest, 1984

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
CORNUS FLORIDA	FLOWERING DOGWOOD	0.75	20.7	342	33.6	11570	52.2	106.5
QUERCUS VELUTINA	BLACK OAK	0.38	10.3	204	20.1	3092	13.9	44.4
ACER RUBRUM	RED MAPLE	0.58	16.1	133	13.1	1564	7.1	36.3
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.42	11.5	100	9.8	2392	10.8	32.1
CRATAEGUS SP.	HAWTHORNE	0.25	6.9	38	3.7	403	1.8	12.4
CARYA GLABRA	PIGNUT HICKORY	0.13	3.4	38	3.7	743	3.3	10.5
QUERCUS BOREALIS	RED OAK	0.17	4.6	21	2.0	278	1.3	7.9
QUERCUS PRINUS	CHESTNUT OAK	0.13	3.4	33	3.3	137	0.6	7.3
BETULA POPULIFOLIA	GRAY BIRCH	0.13	3.4	13	1.2	295	1.3	6.0
PRUNUS SEROTINA	BLACK CHERRY	0.13	3.4	13	1.2	281	1.3	5.9
SASSAFRAS ALBIDUM	SASSAFRAS	0.13	3.4	13	1.2	59	0.3	4.9
FRAXINUS AMERICANA	WHITE ASH	0.13	3.4	13	1.2	46	0.2	4.9
QUERCUS ALBA	WHITE OAK	0.08	2.3	13	1.2	298	1.3	4.9
BETULA LENTA	SWEET BIRCH	0.08	2.3	17	1.6	52	0.2	4.2
AMELANCHIER ARBOREA	SHAD-BUSH	0.04	1.1	13	1.2	324	1.5	3.8
PINUS STROBUS	WHITE PINE	0.04	1.1	8	0.8	383	1.7	3.7
PINUS VIRGINIANA	VIRGINIA PINE	0.04	1.1	4	0.4	209	0.9	2.5
FAGUS GRANDIFOLIA	AMERICAN BEECH	0.04	1.1	4	0.4	52	0.2	1.8
TOTAL		-	100.0	1017	100.0	22179	100.0	300.0

Table G-18

Vegetation analysis for tree seedlings in the TR419 Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ACER RUBRUM	RED MAPLE	0.65	20.4	11250	17.8	2.29	20.1	58.4
FRAXINUS AMERICANA	WHITE ASH	0.48	15.1	11042	17.5	2.17	19.0	51.7
SASSAFRAS ALBIDUM	SASSAFRAS	0.38	11.8	10000	15.8	1.92	16.9	44.5
PRUNUS SEROTINA	BLACK CHERRY	0.46	14.5	10625	16.8	1.35	11.9	43.2
CORNUS FLORIDA	FLOWERING DOGWOOD	0.42	13.2	8750	13.9	0.63	5.5	32.5
QUERCUS VELUTINA	BLACK OAK	0.17	5.3	1875	3.0	0.71	6.2	14.5
PRUNUS AVIUM	SWEET CHERRY	0.17	5.3	3542	5.6	0.40	3.5	14.4
QUERCUS PRINUS	CHESTNUT OAK	0.08	2.6	625	1.0	0.88	7.7	11.3
CRATAEGUS SP.	HAWTHORNE	0.10	3.3	1458	2.3	0.35	3.1	8.7
CELTIS OCCIDENTALIS	HACKBERRY	0.08	2.6	1458	2.3	0.21	1.8	6.8
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.08	2.6	625	1.0	0.13	1.1	4.7
BETULA LENTA	SWEET BIRCH	0.02	0.7	1042	1.7	0.13	1.1	3.4
POPULUS TREMULOIDES	QUAKING ASPEN	0.02	0.7	208	0.3	0.13	1.1	2.1
AMELANCHIER ARBOREA	SHAD-BUSH	0.02	0.7	208	0.3	0.04	0.4	1.4
QUERCUS BOREALIS	RED OAK	0.02	0.7	208	0.3	0.04	0.4	1.4
PINUS VIRGINIANA	VIRGINIA PINE	0.02	0.7	208	0.3	0.02	0.2	1.2
TOTAL		-	100.0	63125	100.0	11.37	100.0	300.0

Table G-19

Vegetation analysis for shrubs, herbs, and ground cover in the TR419 Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.35	23.6	3.98	24.7	48.3
LINDERA BENZOIN	SPICEBUSH	0.17	11.1	4.10	25.5	36.6
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.33	22.2	1.96	12.2	34.4
VACCINIUM STAMINEUM	DEERBERRY	0.08	5.6	2.42	15.0	20.6
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.17	11.1	0.96	6.0	17.1
RHUS RADICANS	POISON IVY	0.13	8.3	1.25	7.8	16.1
VITIS AESTIVALIS	SUMMER GRAPE	0.15	9.7	0.31	1.9	11.7
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.06	4.2	0.96	6.0	10.1
RUBUS FLAGELLARIS	DEWBERRY	0.02	1.4	0.06	0.4	1.8
VITIS RIPARIA	RIVERBANK GRAPE	0.02	1.4	0.06	0.4	1.8
HAMAMELIS VIRGINIANA	WITCH HAZEL	0.02	1.4	0.04	0.3	1.6
HERBS						
CAREX SWANNII	SEDGE	0.44	17.6	2.13	11.8	29.4
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	0.13	5.0	3.42	19.0	24.0
ALLIARIA OFFICINALIS	GARLIC MUSTARD	0.02	0.8	1.67	9.2	10.1
PILEA PUMILA	CLEARWEED	0.04	1.7	1.46	8.1	9.8
UVULARIA PERFOLIATA	PERFOLIATE BELLWORT	0.10	4.2	0.73	4.0	8.2
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.06	2.5	1.00	5.5	8.1
SOLIDAGO CAESIA	BLUE-STEMMED GOLDENROD	0.13	5.0	0.54	3.0	8.0
GEUM CANADENSE	AVENS	0.10	4.2	0.42	2.3	6.5
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.10	4.2	0.38	2.1	6.3
PANICUM SPP.	PANIC-GRASS	0.10	4.2	0.35	2.0	6.2
VIOLA PUBESCENS	DOWNY YELLOW VIOLET	0.02	0.8	0.73	4.0	4.9
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.06	2.5	0.42	2.3	4.8
ASTER DIVARICATUS	WHITE WOOD ASTER	0.06	2.5	0.31	1.7	4.3
POLYSTICHUM ACROSTICHOIDES	CHRISTMAS FERN	0.04	1.7	0.44	2.4	4.1
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.06	2.5	0.27	1.5	4.0
DRYOPTERIS SPINULOSA	SPINULOSE WOOD FERN	0.04	1.7	0.42	2.3	4.0
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.04	1.7	0.33	1.8	3.5
POLYGONUM PERSICARIA	SMARTWEED	0.06	2.5	0.17	0.9	3.4
DESMODIUM NUDIFLORUM	TICK-TREFOIL	0.06	2.5	0.13	0.7	3.2
HACKELIA VIRGINIANA	BEGGAR'S LICE	0.02	0.8	0.42	2.3	3.2
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.04	1.7	0.19	1.0	2.7
GALIUM APARINE	CLEAVERS	0.04	1.7	0.15	0.8	2.5
SMILACINA RACEMOSA	FALSE SOLOMAN'S SEAL	0.04	1.7	0.15	0.8	2.5
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.04	1.7	0.13	0.7	2.4
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.04	1.7	0.10	0.6	2.3
ATHYRIUM FILIX-FEMINA	LADY FERN	0.02	0.8	0.25	1.4	2.2
PANICUM CLANDESTINUM	PANIC-GRASS	0.04	1.7	0.06	0.3	2.0
GALIUM CIRCAEZANS	BEDSTRAW	0.04	1.7	0.06	0.3	2.0
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.04	1.7	0.06	0.3	2.0
POA COMPRESSA	CANADA BLUEGRASS	0.02	0.8	0.15	0.8	1.6
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.02	0.8	0.13	0.7	1.5
IMPATIENS BIFLORA	JEWELWEED	0.02	0.8	0.13	0.7	1.5
ARISAEMA TRIPHYLLUM	JACK-IN-THE-PULPIT	0.02	0.8	0.08	0.5	1.3
POLYGONATUM BIFLORUM	SOLOMAN'S SEAL	0.02	0.8	0.08	0.5	1.3
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.02	0.8	0.08	0.5	1.3
VERBASCUM THAPSUS	COMMON MULLEIN	0.02	0.8	0.08	0.5	1.3
CUNILA ORIGANOIDES	DITTANY	0.02	0.8	0.06	0.3	1.2
CAREX SP.	SEDGE	0.02	0.8	0.04	0.2	1.1
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.02	0.8	0.04	0.2	1.1
FRAGARIA VIRGINIANA	WILD STRAWBERRY	0.02	0.8	0.04	0.2	1.1
CAREX PENSYLVANICA	SEDGE	0.02	0.8	0.04	0.2	1.1
CAREX ROSEA	SEDGE	0.02	0.8	0.04	0.2	1.1
DANTHONIA SPICATA	POVERTY OATGRASS	0.02	0.8	0.04	0.2	1.1
CHIMAPHILIA MACULATA	SPOTTED WINTERGREEN	0.02	0.8	0.02	0.1	1.0
POA PRATENSIS	KENTUCKY BLUEGRASS	0.02	0.8	0.02	0.1	1.0
OXALIS STRICTA	YELLOW WOOD SORREL	0.02	0.8	0.02	0.1	1.0
BOTRYCHIUM VIRGINIANUM	RATTLESNAKE FERN	0.02	0.8	0.02	0.1	1.0
ANTENNARIA NEGLECTA	PUSSYTOES	0.02	0.8	0.02	0.1	1.0
TARAXACUM OFFICINALE	DANDELION	0.02	0.8	0.02	0.1	1.0
GROUND COVER						
LITTER	-	1.00	52.2	94.06	95.4	147.6
MOSS	-	0.44	22.8	2.52	2.6	25.4
ROCK	-	0.29	15.2	0.90	0.9	16.1
BARE SOIL	-	0.19	9.8	1.10	1.1	10.9

Table G-20

Comparison of trees (number of stems) in the TR419 Forest, 1977-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	1979	1980	1981	1982	1983	1984	F	TREND
QUERCUS VELUTINA	BLACK OAK	27	31	29	27	26	31	32	32	2.19*	+
CORNUS FLORIDA	FLOWERING DOGWOOD	18	23	19	20	23	21	20	19	0.81	
PINUS VIRGINIANA	VIRGINIA PINE	28	25	24	22	22	22	20	16	2.80**	-
QUERCUS PRINUS	CHESTNUT OAK	10	9	8	11	9	11	10	11	0.48	
PINUS STROBUS	WHITE PINE	13	15	13	11	12	11	10	10	1.73	
ACER RUBRUM	RED MAPLE	12	12	11	9	8	10	9	10	1.79	
PRUNUS SEROTINA	BLACK CHERRY	8	9	8	9	10	10	8	9	0.46	
FRAXINUS AMERICANA	WHITE ASH	3	4	4	4	4	5	5	5	1.31	
CARYA TOMENTOSA	MOCKERNUT HICKORY	6	6	6	5	5	5	5	5	0.50	
TSUGA CANADENSIS	EASTERN HEMLOCK	2	2	2	2	2	2	3	2	1.00	
QUERCUS ALBA	WHITE OAK	2	2	2	2	2	2	2	2	0.00	
PRUNUS AVIUM	SWEET CHERRY	2	2	2	2	2	2	2	2	0.00	
CARYA GLABRA	PIGNUT HICKORY	1	1	1	1	1	2	2	2	1.00	
SASSAFRAS ALBIDUM	SASSAFRAS	1	1	1	1	1	1	1	1	0.00	
PYRUS MALUS	APPLE	3	2	2	2	1	2	1	1	1.31	
LIRIODENDRON TULIPIFERA	TULIP-TREE	1	1	1	1	1	1	1	1	0.00	
QUERCUS BOREALIS	RED OAK	0	0	0	0	1	1	0	0	1.00	
CRATAEGUS SP.	HAWTHORNE	0	1	0	1	0	0	0	0	1.00	
BETULA POPULIFOLIA	GRAY BIRCH	2	2	2	3	1	2	0	0	1.22	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-21

Comparison of saplings (number of stems) in the TR419 Forest, 1977-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	1979	1980	1981	1982	1983	1984	F	TREND
CORNUS FLORIDA	FLOWERING DOGWOOD	136	128	137	127	132	112	118	82	4.07**	-
QUERCUS VELUTINA	BLACK OAK	50	47	48	42	51	41	42	49	0.38	
ACER RUBRUM	RED MAPLE	16	25	25	18	25	22	23	32	1.62	
CARYA TOMENTOSA	MOCKERNUT HICKORY	19	20	22	23	25	23	20	24	1.29	
CRATAEGUS SP.	HAWTHORNE	6	10	8	8	8	7	9	9	1.42	
CARYA GLABRA	PIGNUT HICKORY	9	9	9	7	8	7	10	9	0.72	
QUERCUS PRINUS	CHESTNUT OAK	6	5	8	6	4	4	6	8	1.40	
QUERCUS BOREALIS	RED OAK	2	2	4	3	3	3	4	5	1.65	
BETULA LENTA	SWEET BIRCH	0	0	0	0	0	2	2	4	1.48	
BETULA POPULIFOLIA	GRAY BIRCH	11	16	9	9	7	9	2	3	2.35*	-
SASSAFRAS ALBIDUM	SASSAFRAS	1	0	5	4	4	5	3	3	1.26	
FRAXINUS AMERICANA	WHITE ASH	1	5	3	2	0	3	3	3	1.23	
QUERCUS ALBA	WHITE OAK	5	5	2	4	0	2	1	3	1.70	
PRUNUS SEROTINA	BLACK CHERRY	8	5	3	8	5	3	6	3	1.32	
AMELANCHIER ARBOREA	SHAD-BUSH	4	5	4	4	3	3	5	3	0.66	
PINUS STROBUS	WHITE PINE	1	2	2	1	1	2	2	2	1.00	
PINUS VIRGINIANA	VIRGINIA PINE	7	4	3	1	1	1	1	1	1.66	
FAGUS GRANDIFOLIA	AMERICAN BEECH	2	2	1	1	1	0	1	1	1.10	
ULMUS AMERICANA	AMERICAN ELM	0	0	0	1	0	0	0	0	1.00	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-22

Comparison of tree seedlings (number of stems) in the TR419 Forest, 1978-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1978	1979	1980	1981	1982	1983	1984	F	TREND
ACER RUBRUM	RED MAPLE	45	48	32	41	82	91	54	5.35**	+
FRAXINUS AMERICANA	WHITE ASH	157	122	136	89	71	60	53	2.72*	-
PRUNUS SEROTINA	BLACK CHERRY	66	73	57	57	57	41	51	1.29	
SASSAFRAS ALBIDUM	SASSAFRAS	29	43	40	45	68	42	48	3.69**	
CORNUS FLORIDA	FLOWERING DOGWOOD	78	60	103	65	69	54	42	1.24	
PRUNUS AVIUM	SWEET CHERRY	15	35	25	9	22	17	17	0.48	
QUERCUS VELUTINA	BLACK OAK	6	6	8	9	12	14	9	2.48*	+
CELTIS OCCIDENTALIS	HACKBERRY	0	2	0	4	2	2	7	1.97	
CRATAEGUS SP.	HAWTHORNE	2	1	2	4	2	3	7	1.54	
BETULA LENTA	SWEET BIRCH	11	11	7	5	3	4	5	1.00	
QUERCUS PRINUS	CHESTNUT OAK	4	3	4	6	4	4	3	0.98	
CARYA TOMENTOSA	MOCKERNUT HICKORY	1	1	1	0	0	1	3	1.27	
POPULUS TREMULOIDES	QUAKING ASPEN	0	2	0	0	0	1	1	0.74	
QUERCUS BOREALIS	RED OAK	0	0	1	1	2	2	1	0.93	
PINUS VIRGINIANA	VIRGINIA PINE	1	1	0	0	1	2	1	0.60	
AMELANCHIER ARBOREA	SHAD-BUSH	6	2	1	1	2	1	1	1.47	
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0	0	0	2	0	1	0	1.67	
PYRUS MALUS	APPLE	0	1	1	1	0	0	0	1.00	
CARYA GLABRA	PIGNUT HICKORY	0	0	1	1	1	0	0	0.74	
BETULA POPULIFOLIA	GRAY BIRCH	4	2	1	0	3	1	0	0.93	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-23

Comparison of shrubs, herbs, and ground cover (% cover) in the TR419 Forest, 1978-84.

SPECIES	COMMON NAME	% COVER 1978	1979	1980	1981	1982	1983	1984	F	TREND
SHRUBS										
LINDERA BENZOIN	SPICEBUSH	1.17	2.65	3.19	3.04	3.02	3.83	4.10	1.33	
RUBUS ALLEGHENIENSIS	BLACKBERRY	3.06	4.13	5.63	5.60	5.73	6.54	3.98	1.93	
VACCINIUM STAMINEUM	DEERBERRY	1.90	1.96	2.19	1.77	2.21	2.46	2.42	0.72	
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	2.27	2.65	2.10	2.67	2.00	1.96	1.96	1.54	
RHUS RADICANS	POISON IVY	0.94	1.42	0.92	0.75	1.00	1.17	1.25	0.57	
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.58	0.71	0.75	0.50	0.75	0.81	0.96	1.28	
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	2.83	2.31	2.06	1.56	0.88	0.98	0.96	1.10	
VITIS AESTIVALIS	SUMMER GRAPE	0.71	0.96	0.40	0.48	0.52	0.31	0.31	2.38*	-
HERBS										
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	3.60	3.67	5.27	3.38	3.52	3.65	3.42	0.57	
CAREX SWANNII	SEDGE	0.92	1.73	1.79	1.35	3.08	3.06	2.13	3.64**	+
PILEA PUMILA	CLEARWEED	1.25	1.04	1.38	0.00	0.50	1.08	1.46	1.39	
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.44	1.08	1.40	1.02	0.81	0.88	1.00	0.70	
UVULARIA PERFOLIATA	PERFOLIATE BELLWORT	0.13	0.17	0.44	0.17	0.35	0.46	0.73	2.31*	+
SOLIDAGO CAESIA	BLUE-STEMMED GOLDENROD	0.33	0.35	0.46	0.35	0.58	0.50	0.54	0.32	
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.27	0.46	0.25	0.31	0.56	0.56	0.42	0.90	
GEUM CANADENSE	AVENS	0.44	0.60	0.42	0.46	0.73	0.52	0.42	1.33	
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.63	0.44	0.29	0.17	0.46	0.60	0.38	0.43	
PANICUM SPP.	PANIC-GRASS	0.33	0.27	0.27	0.19	0.29	0.54	0.35	0.79	
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.25	0.60	0.40	0.21	0.29	0.31	0.33	0.65	
ASTER DIVARICATUS	WHITE WOOD ASTER	0.40	0.44	0.29	0.19	0.38	0.31	0.31	1.11	
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.13	0.15	0.10	0.08	0.17	0.25	0.27	1.08	
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.56	0.42	0.29	0.02	0.13	0.23	0.19	1.13	
POLYGONUM PERSICARIA	SMARTWEED	0.15	0.04	0.15	0.23	0.15	0.10	0.17	1.01	
GALIUM APARINE	CLEAVERS	0.40	0.71	0.25	0.08	0.06	0.25	0.15	1.17	
DESMODIUM NUDIFLORUM	TICK-TREFOIL	0.08	0.25	0.19	0.13	0.17	0.13	0.13	1.55	
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.02	0.27	0.44	0.54	0.29	0.10	0.06	0.95	
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.35	0.38	0.17	0.21	0.02	0.21	0.04	1.76	
CAREX PENSYLVANICA	SEDGE	0.02	0.19	0.19	0.33	0.21	0.02	0.04	0.91	
GROUND COVER										
LITTER	-	91.96	93.96	93.31	94.38	91.83	93.67	94.06	1.85	
MOSS	-	2.65	1.90	1.65	2.13	2.54	2.42	2.52	1.58	
BARE SOIL	-	2.21	1.25	2.08	1.48	2.60	2.04	1.10	1.43	
ROCK	-	1.40	1.29	1.21	0.83	1.35	1.10	0.90	1.22	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-24

Vegetation analysis for trees in the Quarry Hillside Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
QUERCUS BOREALIS	RED OAK	0.53	16.0	140	21.6	38740	18.7	56.4
QUERCUS VELUTINA	BLACK OAK	0.40	12.0	73	11.3	39610	19.2	42.5
FRAXINUS AMERICANA	WHITE ASH	0.40	12.0	107	16.5	25446	12.3	40.8
ACER RUBRUM	RED MAPLE	0.40	12.0	93	14.4	17802	8.6	35.0
QUERCUS PRINUS	CHESTNUT OAK	0.47	14.0	67	10.3	18954	9.2	33.5
TILIA AMERICANA	BASSWOOD	0.13	4.0	33	5.2	20792	10.1	19.2
ULMUS AMERICANA	AMERICAN ELM	0.13	4.0	27	4.1	13394	6.5	14.6
PINUS VIRGINIANA	VIRGINIA PINE	0.13	4.0	27	4.1	11299	5.5	13.6
CARYA GLABRA	PIGNUT HICKORY	0.13	4.0	13	2.1	3435	1.7	7.7
SASSAFRAS ALBIDUM	SASSAFRAS	0.13	4.0	13	2.1	2644	1.3	7.3
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.07	2.0	7	1.0	4712	2.3	5.3
BETULA LENTA	SWEET BIRCH	0.07	2.0	13	2.1	2063	1.0	5.1
PRUNUS SEROTINA	BLACK CHERRY	0.07	2.0	7	1.0	3272	1.6	4.6
CELTIS OCCIDENTALIS	HACKBERRY	0.07	2.0	7	1.0	2094	1.0	4.0
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.07	2.0	7	1.0	1178	0.6	3.6
CORNUS FLORIDA	FLOWERING DOGWOOD	0.07	2.0	7	1.0	754	0.4	3.4
JUGLANS NIGRA	BLACK WALNUT	0.07	2.0	7	1.0	634	0.3	3.3
TOTAL		-	100.0	647	100.0	206819	100.0	300.0

Table G-25

Vegetation analysis for saplings in the Quarry Hillside Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
CORNUS FLORIDA	FLOWERING DOGWOOD	0.67	17.2	260	26.0	5487	20.6	63.8
QUERCUS BOREALIS	RED OAK	0.53	13.8	193	19.3	6157	23.1	56.2
ACER RUBRUM	RED MAPLE	0.40	10.3	147	14.7	3587	13.5	38.5
FRAXINUS AMERICANA	WHITE ASH	0.47	12.1	120	12.0	3759	14.1	38.2
QUERCUS PRINUS	CHESTNUT OAK	0.40	10.3	80	8.0	3304	12.4	30.7
TILIA AMERICANA	BASSWOOD	0.13	3.4	33	3.3	654	2.5	9.2
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.13	3.4	27	2.7	723	2.7	8.8
SASSAFRAS ALBIDUM	SASSAFRAS	0.13	3.4	20	2.0	764	2.9	8.3
CARYA GLABRA	PIGNUT HICKORY	0.20	5.2	20	2.0	110	0.4	7.6
ULMUS AMERICANA	AMERICAN ELM	0.13	3.4	13	1.3	445	1.7	6.5
QUERCUS VELUTINA	BLACK OAK	0.13	3.4	13	1.3	445	1.7	6.5
PINUS VIRGINIANA	VIRGINIA PINE	0.13	3.4	13	1.3	319	1.2	6.0
AMELANCHIER ARBOREA	SHAD-BUSH	0.13	3.4	20	2.0	126	0.5	5.9
PRUNUS AVIUM	SWEET CHERRY	0.07	1.7	13	1.3	382	1.4	4.5
CELTIS OCCIDENTALIS	HACKBERRY	0.07	1.7	13	1.3	105	0.4	3.5
JUGLANS NIGRA	BLACK WALNUT	0.07	1.7	7	0.7	257	1.0	3.4
PRUNUS VIRGINIANA	CHOKE CHERRY	0.07	1.7	7	0.7	21	0.1	2.5
TOTAL		-	100.0	1000	100.0	26645	100.0	300.0

Table G-26

Vegetation analysis for tree seedlings in the Quarry Hillside Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
FRAXINUS AMERICANA	WHITE ASH	0.60	24.0	37000	50.2	1.83	24.0	98.2
ACER RUBRUM	RED MAPLE	0.50	20.0	14000	19.0	0.67	8.7	47.7
SASSAFRAS ALBIDUM	SASSAFRAS	0.37	14.7	5000	6.8	0.43	5.7	27.1
ULMUS AMERICANA	AMERICAN ELM	0.10	4.0	2667	3.6	0.93	12.2	19.8
PRUNUS SEROTINA	BLACK CHERRY	0.17	6.7	3000	4.1	0.43	5.7	16.4
AMELANCHIER ARBOREA	SHAD-BUSH	0.13	5.3	1667	2.3	0.67	8.7	16.3
QUERCUS VELUTINA	BLACK OAK	0.07	2.7	0	0.0	0.97	12.7	15.3
QUERCUS BOREALIS	RED OAK	0.13	5.3	1333	1.8	0.53	7.0	14.1
CORNUS FLORIDA	FLOWERING DOGWOOD	0.07	2.7	4333	5.9	0.30	3.9	12.5
QUERCUS PRINUS	CHESTNUT OAK	0.07	2.7	667	0.9	0.13	1.7	5.3
PRUNUS AVIUM	SWEET CHERRY	0.07	2.7	1000	1.4	0.07	0.9	4.9
TILIA AMERICANA	BASSWOOD	0.03	1.3	1333	1.8	0.13	1.7	4.9
CELTIS OCCIDENTALIS	HACKBERRY	0.07	2.7	667	0.9	0.07	0.9	4.4
PINUS VIRGINIANA	VIRGINIA PINE	0.03	1.3	333	0.5	0.13	1.7	3.5
CARYA GLABRA	PIGNUT HICKORY	0.03	1.3	0	0.0	0.17	2.2	3.5
PINUS STROBUS	WHITE PINE	0.03	1.3	333	0.5	0.10	1.3	3.1
PRUNUS VIRGINIANA	CHOKE CHERRY	0.03	1.3	333	0.5	0.07	0.9	2.7
TOTAL		-	100.0	73666	100.0	7.63	100.0	300.0

Table G-27

Vegetation analysis for shrubs, herbs, and ground cover in the Quarry Hillside Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
LINDERA BENZOIN	SPICEBUSH	0.10	10.0	6.43	44.6	54.6
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.30	30.0	2.07	14.3	44.3
HAMAMELIS VIRGINIANA	WITCH HAZEL	0.13	13.3	2.63	18.2	31.6
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.13	13.3	1.97	13.6	27.0
VITIS AESTIVALIS	SUMMER GRAPE	0.13	13.3	0.73	5.1	18.4
RHUS RADICANS	POISON IVY	0.13	13.3	0.13	0.9	14.3
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.03	3.3	0.30	2.1	5.4
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.03	3.3	0.17	1.2	4.5
HERBS						
ASTER DIVARICATUS	WHITE WOOD ASTER	0.40	11.5	9.90	32.8	44.3
DRYOPTERIS MARGINALIS	MARGINAL WOOD FERN	0.30	8.7	4.20	13.9	22.6
DESCHAMPSIA FLEXUOSA	HAIRGRASS	0.20	5.8	4.53	15.0	20.8
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.30	8.7	1.20	4.0	12.6
SOLIDAGO CAESIA	BLUE-STEMMED GOLDENROD	0.20	5.8	0.77	2.5	8.3
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.13	3.8	0.97	3.2	7.0
POLYSTICHUM ACROSTICHOIDES	CHRISTMAS FERN	0.07	1.9	1.20	4.0	5.9
ARALIA NUDICAULIS	WILD SARSAPARILLA	0.07	1.9	1.20	4.0	5.9
POA COMPRESSA	CANADA BLUEGRASS	0.07	1.9	1.20	4.0	5.9
DANTHONIA SPICATA	POVERTY OATGRASS	0.13	3.8	0.53	1.8	5.6
CAREX SWANNII	SEDGE	0.13	3.8	0.43	1.4	5.3
CAREX ROSEA	SEDGE	0.10	2.9	0.60	2.0	4.9
PARIETARIA PENSYLVANICA	PELLITORY	0.10	2.9	0.23	0.8	3.7
CAREX LAXIFLORA	SEDGE	0.10	2.9	0.23	0.8	3.7
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.10	2.9	0.20	0.7	3.5
CAREX PENSYLVANICA	SEDGE	0.07	1.9	0.37	1.2	3.1
GEUM CANADENSE	AVENS	0.07	1.9	0.33	1.1	3.0
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.07	1.9	0.33	1.1	3.0
POTENTILLA SIMPLEX	CINQUEFOIL	0.07	1.9	0.27	0.9	2.8
WOODSIA OBTUSA	BLUNT-LOBED WOODSIA	0.07	1.9	0.17	0.6	2.5
SMILACINA RACEMOSA	FALSE SOLOMAN'S SEAL	0.07	1.9	0.13	0.4	2.4
PANICUM SPP.	PANIC-GRASS	0.07	1.9	0.13	0.4	2.4
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.07	1.9	0.13	0.4	2.4
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.07	1.9	0.07	0.2	2.1
OXALIS STRICTA	YELLOW WOOD SORREL	0.07	1.9	0.07	0.2	2.1
GERANIUM MACULATUM	WILD GERANIUM	0.03	1.0	0.13	0.4	1.4
SOLIDAGO BICOLOR	SILVERROD	0.03	1.0	0.10	0.3	1.3
BARBAREA VULGARIS	WINTERCRESS	0.03	1.0	0.10	0.3	1.3
GALIUM APARINE	CLEAVERS	0.03	1.0	0.07	0.2	1.2
GRASS(UNIDENTIFIED)	-	0.03	1.0	0.07	0.2	1.2
CAREX SP.	SEDGE	0.03	1.0	0.07	0.2	1.2
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.03	1.0	0.07	0.2	1.2
POLYGONATUM BIFLORUM	SOLOMAN'S SEAL	0.03	1.0	0.07	0.2	1.2
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.03	1.0	0.03	0.1	1.1
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.03	1.0	0.03	0.1	1.1
ARABIS LAEVIGATA	ROCK CRESS	0.03	1.0	0.03	0.1	1.1
BOTRYCHIUM MATRICARIAEFOLIUM	DAISY-LEAF GRAPE FERN	0.03	1.0	0.03	0.1	1.1
GROUND COVER						
LITTER	-	1.00	34.5	80.43	80.8	115.3
ROCK	-	0.90	31.0	12.23	12.3	43.3
MOSS	-	0.67	23.0	2.90	2.9	25.9
BARE SOIL	-	0.33	11.5	3.93	4.0	15.4

Table G-28

Comparison of trees (number of stems) in the Quarry Hillside Forest, 1978-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1978	1979	1980	1981	1982	1983	1984	F	TREND
QUERCUS BOREALIS	RED OAK	8	7	8	12	17	20	21	5.32**	+
FRAXINUS AMERICANA	WHITE ASH	15	12	13	12	14	16	16	1.10	
ACER RUBRUM	RED MAPLE	11	10	11	13	12	13	14	1.49	
QUERCUS VELUTINA	BLACK OAK	25	24	24	20	17	12	11	5.17**	-
QUERCUS PRINUS	CHESTNUT OAK	12	12	11	12	12	14	10	0.98	
TILIA AMERICANA	BASSWOOD	5	5	6	6	5	5	5	0.53	
ULMUS AMERICANA	AMERICAN ELM	3	4	4	4	4	4	4	1.00	
PINUS VIRGINIANA	VIRGINIA PINE	5	5	5	4	4	4	4	1.00	
CARYA GLABRA	PIGNUT HICKORY	0	1	1	0	2	2	2	1.61	
SASSAFRAS ALBIDUM	SASSAFRAS	1	2	2	2	2	2	2	1.00	
BETULA LENTA	SWEET BIRCH	2	2	2	2	2	2	2	0.00	
JUGLANS NIGRA	BLACK WALNUT	0	1	1	1	1	1	1	1.00	
PRUNUS SEROTINA	BLACK CHERRY	1	1	1	1	1	1	1	0.00	
CELTIS OCCIDENTALIS	HACKBERRY	1	1	1	1	1	1	1	0.00	
CARYA TOMENTOSA	MOCKERNUT HICKORY	1	1	1	1	1	1	1	0.00	
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	2	1	2	2	1	1	1	1.00	
CORNUS FLORIDA	FLOWERING DOGWOOD	4	3	4	3	3	3	1	1.36	
PRUNUS AVIUM	SWEET CHERRY	1	0	0	0	0	0	0	1.00	
CARYA OVATA	SHAGBARK HICKORY	1	1	1	1	0	0	0	1.00	

* -SIGNIFICANT AT $P \leq 0.05$
**-SIGNIFICANT AT $P \leq 0.01$

Table G-29

Comparison of saplings (number of stems) in the Quarry Hillside Forest, 1978-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1978	1979	1980	1981	1982	1983	1984	F	TREND
CORNUS FLORIDA	FLOWERING DOGWOOD	106	105	101	89	77	62	39	4.90**	-
QUERCUS BOREALIS	RED OAK	27	29	29	33	31	29	29	0.92	
ACER RUBRUM	RED MAPLE	30	29	27	23	24	24	22	0.77	
FRAXINUS AMERICANA	WHITE ASH	27	25	20	25	24	23	18	1.37	
QUERCUS PRINUS	CHESTNUT OAK	15	16	17	13	11	13	12	1.61	
TILIA AMERICANA	BASSWOOD	3	3	5	4	3	3	5	1.29	
CARYA TOMENTOSA	MOCKERNUT HICKORY	8	6	6	5	7	7	4	1.47	
AMELANCHIER ARBOREA	SHAD-BUSH	2	4	3	3	4	3	3	0.69	
SASSAFRAS ALBIDUM	SASSAFRAS	3	3	3	3	3	3	3	0.00	
CARYA GLABRA	PIGNUT HICKORY	0	1	1	2	1	0	3	1.75	
CELTIS OCCIDENTALIS	HACKBERRY	3	0	1	2	2	2	2	1.22	
PRUNUS AVIUM	SWEET CHERRY	0	3	2	1	1	1	2	0.75	
ULMUS AMERICANA	AMERICAN ELM	4	4	2	3	2	2	2	1.82	
QUERCUS VELUTINA	BLACK OAK	12	10	8	3	2	3	2	4.47**	-
PINUS VIRGINIANA	VIRGINIA PINE	4	2	2	2	2	2	2	0.74	
JUGLANS NIGRA	BLACK WALNUT	0	1	1	0	1	1	1	1.00	
PRUNUS VIRGINIANA	CHOKE CHERRY	2	4	1	4	2	2	1	0.81	
PRUNUS SEROTINA	BLACK CHERRY	2	1	1	0	0	0	0	1.20	
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	1	1	1	0	0	0	0	1.00	
CARYA OVATA	SHAGBARK HICKORY	1	0	0	0	0	0	0	1.00	

* -SIGNIFICANT AT $P \leq 0.05$
**-SIGNIFICANT AT $P \leq 0.01$

Table G-30

Comparison of tree seedlings (number of stems) in the Quarry Hillside Forest, 1978-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1978	1979	1980	1981	1982	1983	1984	F	TREND
FRAXINUS AMERICANA	WHITE ASH	111	61	86	32	28	28	111	8.17**	
ACER RUBRUM	RED MAPLE	24	41	46	64	80	66	42	4.58**	+
SASSAFRAS ALBIDUM	SASSAFRAS	14	7	4	5	10	12	15	1.38	
CORNUS FLORIDA	FLOWERING DOGWOOD	30	8	21	23	10	8	13	1.02	
PRUNUS SEROTINA	BLACK CHERRY	11	15	11	7	7	6	9	2.50*	-
ULMUS AMERICANA	AMERICAN ELM	7	6	9	9	9	11	8	0.74	
AMELANCHIER ARBOREA	SHAD-BUSH	3	6	4	5	6	6	5	1.01	
QUERCUS BOREALIS	RED OAK	8	3	3	3	3	5	4	1.61	
TILIA AMERICANA	BASSWOOD	4	2	10	11	6	6	4	0.44	
PRUNUS AVIUM	SWEET CHERRY	0	0	0	5	0	1	3	1.92	
QUERCUS PRINUS	CHESTNUT OAK	3	4	2	1	0	0	2	2.33*	-
CELTIS OCCIDENTALIS	HACKBERRY	1	0	0	0	0	0	2	1.70	
PINUS STROBUS	WHITE PINE	1	1	1	1	1	1	1	0.00	
PRUNUS VIRGINIANA	CHOKE CHERRY	6	1	0	0	0	0	1	2.16	
PINUS VIRGINIANA	VIRGINIA PINE	1	1	1	1	1	1	1	0.00	
PYRUS MALUS	APPLE	0	0	0	0	0	2	0	1.00	
CRATAEGUS SP.	HAWTHORNE	1	0	0	0	0	0	0	1.00	
QUERCUS VELUTINA	BLACK OAK	0	0	0	0	1	0	0	1.00	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-31

Comparison of shrubs, herbs, and ground cover (% cover) in the Quarry Hillside Forest, 1978-84.

SPECIES	COMMON NAME	% COVER 1978	1979	1980	1981	1982	1983	1984	F	T
SHRUBS										
LINDERA BENZOIN	SPICEBUSH	2.43	2.97	4.53	5.07	5.57	6.60	6.43	1.21	
HAMAMELIS VIRGINIANA	WITCH HAZEL	2.03	3.33	0.03	1.73	1.73	2.10	2.63	0.40	
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	6.27	5.80	4.53	5.60	5.30	3.30	2.07	1.50	
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	1.67	1.53	1.60	1.10	1.90	2.03	1.97	0.89	
VITIS AESTIVALIS	SUMMER GRAPE	0.27	0.43	0.47	0.30	0.43	0.50	0.73	0.47	
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.17	0.23	0.20	0.27	0.60	0.53	0.30	1.30	
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.07	0.00	0.20	0.10	0.13	0.13	0.17	0.89	
RHUS RADICANS	POISON IVY	0.03	0.10	0.13	0.13	0.13	0.07	0.13	0.84	
HERBS										
ASTER DIVARICATUS	WHITE WOOD ASTER	7.50	8.80	9.80	7.30	10.13	9.80	9.90	1.20	
DESCHAMPSIA FLEXUOSA	HAIRGRASS	4.33	4.57	6.30	2.83	7.20	5.10	4.53	2.14	
DRYOPTERIS MARGINALIS	MARGINAL WOOD FERN	3.63	3.00	3.47	3.27	3.73	4.70	4.20	2.52*	
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.77	0.80	2.10	2.17	3.00	2.03	1.20	2.29*	
POA COMPRESSA	CANADA BLUEGRASS	0.33	0.53	0.83	0.13	0.67	1.50	1.20	0.83	
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.63	0.47	0.43	0.43	0.67	0.97	0.97	1.41	
SOLIDAGO CAESIA	BLUE-STEMMED GOLDENROD	0.90	0.83	0.90	0.93	1.30	1.00	0.77	1.29	
CAREX ROSEA	SEDGE	0.60	1.40	1.30	0.10	0.00	0.30	0.60	2.16	
DANTHONIA SPICATA	POVERTY OATGRASS	0.20	0.27	0.00	1.03	1.23	0.80	0.53	1.66	
CAREX SWANNII	SEDGE	1.80	1.17	0.73	0.33	0.63	0.43	0.43	0.82	
CAREX PENSYLVANICA	SEDGE	0.47	0.47	0.30	0.23	0.30	0.37	0.37	0.10	
PARIETARIA PENSYLVANICA	PELLITORY	0.00	0.23	0.40	0.23	0.23	0.00	0.23	1.64	
CAREX LAXIFLORA	SEDGE	0.00	0.07	0.07	0.07	0.10	0.23	0.23	0.64	
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.20	0.23	0.07	0.17	0.13	0.27	0.20	1.26	
PANICUM SPP.	PANIC-GRASS	0.10	0.20	0.07	0.10	0.30	0.30	0.13	0.57	
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.13	0.20	0.10	0.17	0.13	0.20	0.13	0.47	
CAREX SP.	SEDGE	0.73	0.67	0.83	0.77	0.37	0.17	0.07	3.01*	
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.27	0.30	0.53	0.13	0.20	0.17	0.07	1.17	
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.00	0.00	0.00	0.23	0.00	0.00	0.03	2.86*	
GROUND COVER										
LITTER	-	75.97	80.17	76.23	82.80	81.17	81.93	80.43	1.52	
ROCK	-	19.33	14.10	16.87	13.00	13.30	12.70	12.23	3.30**	
BARE SOIL	-	5.20	3.90	4.50	1.67	2.53	3.13	3.93	1.31	
MOSS	-	1.33	1.23	1.50	2.13	2.40	1.50	2.90	2.46*	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-32

Vegetation analysis for trees in the Elimsport Substation Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ACER RUBRUM	RED MAPLE	0.75	23.1	165	29.2	34231	25.0	77.2
BETULA LENTA	SWEET BIRCH	0.75	23.1	100	17.7	19870	14.5	55.3
LIRIODENDRON TULIPIFERA	TULIP-TREE	0.45	13.8	115	20.4	14957	10.9	45.1
NYSSA SYLVATICA	BLACK GUM	0.45	13.8	55	9.7	19654	14.3	37.9
QUERCUS PRINUS	CHESTNUT OAK	0.30	9.2	50	8.8	19666	14.3	32.4
QUERCUS BOREALIS	RED OAK	0.20	6.2	30	5.3	15358	11.2	22.7
PINUS STROBUS	WHITE PINE	0.10	3.1	10	1.8	7811	5.7	10.5
ACER PENSYLVANICUM	STRIPED MAPLE	0.05	1.5	15	2.7	1343	1.0	5.2
CARYA GLABRA	PIGNUT HICKORY	0.05	1.5	10	1.8	1139	0.8	4.1
QUERCUS VELUTINA	BLACK OAK	0.05	1.5	5	0.9	1418	1.0	3.5
TSUGA CANADENSIS	EASTERN HEMLOCK	0.05	1.5	5	0.9	1272	0.9	3.4
SASSAFRAS ALBIDUM	SASSAFRAS	0.05	1.5	5	0.9	475	0.3	2.8
TOTAL		-	100.0	565	100.0	137192	100.0	300.0

Table G-33

Vegetation analysis for saplings in the Elimsport Substation Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
BETULA LENTA	SWEET BIRCH	1.00	15.2	3385	63.2	42405	46.7	125.1
ACER RUBRUM	RED MAPLE	1.00	15.2	645	12.0	18089	19.9	47.1
SASSAFRAS ALBIDUM	SASSAFRAS	0.85	12.9	495	9.2	12298	13.5	35.7
LIRIODENDRON TULIPIFERA	TULIP-TREE	0.70	10.6	220	4.1	6793	7.5	22.2
QUERCUS PRINUS	CHESTNUT OAK	0.65	9.8	145	2.7	4115	4.5	17.1
NYSSA SYLVATICA	BLACK GUM	0.40	6.1	125	2.3	2871	3.2	11.6
QUERCUS BOREALIS	RED OAK	0.40	6.1	125	2.3	1716	1.9	10.3
CORNUS FLORIDA	FLOWERING DOGWOOD	0.30	4.5	60	1.1	577	0.6	6.3
QUERCUS VELUTINA	BLACK OAK	0.25	3.8	30	0.6	601	0.7	5.0
QUERCUS ALBA	WHITE OAK	0.25	3.8	30	0.6	137	0.2	4.5
PINUS STROBUS	WHITE PINE	0.15	2.3	20	0.4	106	0.1	2.8
BETULA PAPYRIFERA	PAPER BIRCH	0.10	1.5	10	0.2	444	0.5	2.2
FAGUS GRANDIFOLIA	AMERICAN BEECH	0.10	1.5	15	0.3	67	0.1	1.9
ACER PENSYLVANICUM	STRIPED MAPLE	0.10	1.5	10	0.2	114	0.1	1.8
PRUNUS PENSYLVANICA	PIN CHERRY	0.05	0.8	5	0.1	318	0.4	1.2
FRAXINUS AMERICANA	WHITE ASH	0.05	0.8	10	0.2	20	0.0	1.0
PRUNUS SEROTINA	BLACK CHERRY	0.05	0.8	5	0.1	35	0.0	0.9
AMELANCHIER ARBOREA	SHAD-BUSH	0.05	0.8	5	0.1	16	0.0	0.9
TSUGA CANADENSIS	EASTERN HEMLOCK	0.05	0.8	5	0.1	16	0.0	0.9
CARYA GLABRA	PIGNUT HICKORY	0.05	0.8	5	0.1	16	0.0	0.9
CASTANEA DENTATA	AMERICAN CHESTNUT	0.05	0.8	5	0.1	16	0.0	0.9
TOTAL		-	100.0	5355	100.0	90768	100.0	300.0

Table G-34

Vegetation analysis for tree seedlings in the Elimsport Substation Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ACER RUBRUM	RED MAPLE	0.68	32.5	22750	46.4	1.03	20.8	99.8
SASSAFRAS ALBIDUM	SASSAFRAS	0.40	19.3	12250	25.0	1.63	33.0	77.3
NYSSA SYLVATICA	BLACK GUM	0.28	13.3	5000	10.2	0.70	14.2	37.7
PRUNUS SEROTINA	BLACK CHERRY	0.20	9.6	2750	5.6	0.23	4.6	19.8
BETULA LENTA	SWEET BIRCH	0.13	6.0	1250	2.6	0.35	7.1	15.7
FRAXINUS AMERICANA	WHITE ASH	0.05	2.4	500	1.0	0.30	6.1	9.5
LIRIODENDRON TULIPIFERA	TULIP-TREE	0.10	4.8	1250	2.6	0.10	2.0	9.4
CORNUS FLORIDA	FLOWERING DOGWOOD	0.05	2.4	750	1.5	0.13	2.5	6.5
PINUS STROBUS	WHITE PINE	0.05	2.4	250	0.5	0.18	3.6	6.5
ACER PENSYLVANICUM	STRIPED MAPLE	0.05	2.4	1250	2.6	0.05	1.0	6.0
QUERCUS ALBA	WHITE OAK	0.03	1.2	250	0.5	0.13	2.5	4.3
QUERCUS BOREALIS	RED OAK	0.03	1.2	250	0.5	0.05	1.0	2.7
QUERCUS VELUTINA	BLACK OAK	0.03	1.2	250	0.5	0.05	1.0	2.7
CARYA GLABRA	PIGNUT HICKORY	0.03	1.2	250	0.5	0.03	0.5	2.2
TOTAL		-	100.0	49000	100.0	4.93	100.0	300.0

Table G-35

Vegetation analysis for shrubs, herbs, and ground cover in the Elimsport Substation Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
SMILAX ROTUNDIFOLIA	GREENBRIER	0.48	38.8	6.00	41.2	79.9
HAMAMELIS VIRGINIANA	WITCH HAZEL	0.15	12.2	3.70	25.4	37.6
LINDERA BENZOIN	SPICEBUSH	0.10	8.2	1.73	11.8	20.0
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.15	12.2	0.83	5.7	17.9
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.15	12.2	0.25	1.7	14.0
VACCINIUM CORYMBOSUM	HIGH-BUSH BLUEBERRY	0.03	2.0	1.25	8.6	10.6
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.08	6.1	0.20	1.4	7.5
VITIS AESTIVALIS	SUMMER GRAPE	0.08	6.1	0.13	0.9	7.0
RUBUS HISPIDUS	DEWBERRY	0.03	2.0	0.50	3.4	5.5
HERBS						
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	0.53	44.7	5.30	56.1	100.8
THELYPTERIS NOVEBORACENSIS	NEW YORK FERN	0.10	8.5	1.60	16.9	25.4
OSMUNDA CINNAMOMEA	CINNAMON FERN	0.08	6.4	1.05	11.1	17.5
ARALIA NUDICAULIS	WILD SARSAPARILLA	0.05	4.3	0.28	2.9	7.2
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.05	4.3	0.13	1.3	5.6
MITCHELLA REPENS	PARTRIDGE-BERRY	0.03	2.1	0.20	2.1	4.2
ATHYRIUM FILIX-FEMINA	LADY FERN	0.03	2.1	0.20	2.1	4.2
OSMUNDA CLAYTONIANA	INTERRUPTED FERN	0.03	2.1	0.13	1.3	3.5
GLYCERIA STRIATA	FOWL MANNAGRASS	0.03	2.1	0.13	1.3	3.5
POLYGONATUM BIFLORUM	SOLOMAN'S SEAL	0.03	2.1	0.10	1.1	3.2
LUDWIGIA ALTERNIFOLIA	SEED-BOX	0.03	2.1	0.08	0.8	2.9
PANICUM SPP.	PANIC-GRASS	0.03	2.1	0.05	0.5	2.7
SMILACINA RACEMOSA	FALSE SOLOMAN'S SEAL	0.03	2.1	0.05	0.5	2.7
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.03	2.1	0.03	0.3	2.4
PRENANTHES ALBA	TALL WHITE LETTUCE	0.03	2.1	0.03	0.3	2.4
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.03	2.1	0.03	0.3	2.4
CAREX SP.	SEDGE	0.03	2.1	0.03	0.3	2.4
MEDEOLA VIRGINIANA	INDIAN CUCUMBER	0.03	2.1	0.03	0.3	2.4
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.03	2.1	0.03	0.3	2.4
MONOTROPA UNIFLORA	INDIAN PIPE	0.03	2.1	0.03	0.3	2.4
GROUND COVER						
LITTER	-	1.00	39.2	87.85	88.2	127.4
ROCK	-	0.80	31.4	7.78	7.8	39.2
MOSS	-	0.75	29.4	4.03	4.0	33.5

Table G-36

Comparison of trees (number of stems) in the Elimsport Substation Forest, 1982-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1982	1983	1984	F	TREND
ACER RUBRUM	RED MAPLE	24	32	33	4.57*	+
LIRIODENDRON TULIPIFERA	TULIP-TREE	12	18	23	5.19*	+
BETULA LENTA	SWEET BIRCH	9	17	20	7.04**	+
NYSSA SYLVATICA	BLACK GUM	9	11	11	1.54	
QUERCUS PRINUS	CHESTNUT OAK	7	8	10	1.81	
QUERCUS BOREALIS	RED OAK	6	6	6	0.28	
ACER PENSYLVANICUM	STRIPED MAPLE	3	3	3	0.00	
CARYA GLABRA	PIGNUT HICKORY	1	2	2	1.00	
PINUS STROBUS	WHITE PINE	2	2	2	0.00	
QUERCUS VELUTINA	BLACK OAK	1	1	1	0.00	
SASSAFRAS ALBIDUM	SASSAFRAS	1	2	1	0.49	
TSUGA CANADENSIS	EASTERN HEMLOCK	1	1	1	0.00	
CORNUS FLORIDA	FLOWERING DOGWOOD	1	0	0	1.00	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-37

Comparison of saplings (number of stems) in the Elimsport Substation Forest, 1982-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1982	1983	1984	F	TREND
BETULA LENTA	SWEET BIRCH	853	791	677	12.95**	-
ACER RUBRUM	RED MAPLE	176	163	129	11.50**	-
SASSAFRAS ALBIDUM	SASSAFRAS	152	131	99	11.11**	-
LIRIODENDRON TULIPIFERA	TULIP-TREE	60	51	44	2.39	
QUERCUS PRINUS	CHESTNUT OAK	46	37	29	2.96	
NYSSA SYLVATICA	BLACK GUM	21	27	25	1.87	
QUERCUS BOREALIS	RED OAK	30	26	25	0.81	
CORNUS FLORIDA	FLOWERING DOGWOOD	14	20	12	1.21	
QUERCUS VELUTINA	BLACK OAK	4	11	6	1.00	
QUERCUS ALBA	WHITE OAK	9	6	6	1.58	
PINUS STROBUS	WHITE PINE	5	3	4	1.54	
FAGUS GRANDIFOLIA	AMERICAN BEECH	4	3	3	0.63	
FRAXINUS AMERICANA	WHITE ASH	1	2	2	1.00	
ACER PENSYLVANICUM	STRIPED MAPLE	3	3	2	1.00	
BETULA PAPYRIFERA	PAPER BIRCH	2	1	2	1.00	
TSUGA CANADENSIS	EASTERN HEMLOCK	1	1	1	0.00	
PRUNUS SEROTINA	BLACK CHERRY	3	1	1	2.11	
CARYA GLABRA	PIGNUT HICKORY	1	1	1	0.00	
PRUNUS PENSYLVANICA	PIN CHERRY	1	1	1	0.00	
AMELANCHIER ARBOREA	SHAD-BUSH	1	3	1	0.85	
CASTANEA DENTATA	AMERICAN CHESTNUT	1	1	1	0.00	

* -SIGNIFICANT AT P <=0.05
**-SIGNIFICANT AT P <=0.01

Table G-38

Comparison of tree seedlings (number of stems) in the Elimsport Substation Forest, 1982-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1982	1983	1984	F	TREND
ACER RUBRUM	RED MAPLE	100	117	91	2.15	
SASSAFRAS ALBIDUM	SASSAFRAS	52	47	49	0.18	
NYSSA SYLVATICA	BLACK GUM	10	13	20	1.95	
PRUNUS SEROTINA	BLACK CHERRY	10	11	11	0.01	
LIRIODENDRON TULIPIFERA	TULIP-TREE	0	2	5	2.59	
ACER PENSYLVANICUM	STRIPED MAPLE	4	4	5	1.00	
BETULA LENTA	SWEET BIRCH	5	7	5	0.02	
CORNUS FLORIDA	FLOWERING DOGWOOD	0	2	3	1.24	
FRAXINUS AMERICANA	WHITE ASH	1	2	2	0.16	
PINUS STROBUS	WHITE PINE	1	1	1	0.00	
QUERCUS ALBA	WHITE OAK	1	1	1	0.00	
QUERCUS BOREALIS	RED OAK	2	2	1	1.00	
CARYA GLABRA	PIGNUT HICKORY	1	0	1	1.00	
QUERCUS VELUTINA	BLACK OAK	1	1	1	0.00	
CRATAEGUS SP.	HAWTHORNE	1	2	0	1.54	
QUERCUS PRINUS	CHESTNUT OAK	4	2	0	1.54	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-39

Comparison of shrubs, herbs, and ground cover (% cover) in the Elimsport Substation Forest, 1982-84.

SPECIES	COMMON NAME	% COVER 1982	1983	1984	F	TREND
SHRUBS						
SMILAX ROTUNDIFOLIA	GREENBRIER	5.40	5.03	6.00	0.54	
HAMAMELIS VIRGINIANA	WITCH HAZEL	3.50	3.05	3.70	1.30	
LINDERA BENZOIN	SPICEBUSH	1.25	1.90	1.73	0.09	
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	1.18	0.93	0.83	3.30*	-
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.40	0.25	0.25	0.17	
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.13	0.15	0.20	0.89	
VITIS AESTIVALIS	SUMMER GRAPE	0.10	0.05	0.13	0.41	
HERBS						
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	5.03	4.78	5.30	0.43	
THELYPTERIS NOVEBORACENSIS	NEW YORK FERN	1.10	1.65	1.60	0.89	
OSMUNDA CINNAMOMEA	CINNAMON FERN	0.48	1.00	1.05	1.72	
ARALIA NUDICAULIS	WILD SARSAPARILLA	0.18	0.23	0.28	0.64	
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.03	0.13	0.13	0.78	
POLYGONATUM BIFLORUM	SOLOMAN'S SEAL	0.15	0.13	0.10	1.23	
CAREX SP.	SEDGE	0.20	0.18	0.03	1.98	
GROUND COVER						
LITTER	-	87.30	89.03	87.85	0.46	
ROCK	-	8.40	8.48	7.78	0.29	
MOSS	-	2.18	2.18	4.03	2.44	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-40

Vegetation analysis for trees in the Gould Island Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ACER SACCHARINUM	SILVER MAPLE	0.47	28.1	95	32.7	204327	57.2	118.0
CELTIS OCCIDENTALIS	HACKBERRY	0.37	21.9	58	20.0	78033	21.8	63.7
ULMUS AMERICANA	AMERICAN ELM	0.26	15.6	37	12.7	14220	4.0	32.3
TILIA AMERICANA	BASSWOOD	0.05	3.1	37	12.7	19618	5.5	21.3
BETULA LENTA	SWEET BIRCH	0.11	6.3	16	5.5	4121	1.2	12.9
FRAXINUS AMERICANA	WHITE ASH	0.11	6.3	11	3.6	9495	2.7	12.5
CARYA CORDIFORMIS	BITTERNUT HICKORY	0.05	3.1	11	3.6	10657	3.0	9.7
LIRIODENDRON TULIPIFERA	TULIP-TREE	0.05	3.1	5	1.8	11611	3.2	8.2
JUGLANS CINEREA	BUTTERNUT	0.05	3.1	5	1.8	3476	1.0	5.9
PRUNUS SEROTINA	BLACK CHERRY	0.05	3.1	5	1.8	810	0.2	5.2
CATALPA BIGNONIOIDES	CATALPA	0.05	3.1	5	1.8	595	0.2	5.1
FRAXINUS PENNSYLVANICA	RED ASH	0.05	3.1	5	1.8	500	0.1	5.1
TOTAL		-	100.0	289	100.0	357461	100.0	300.0

Table G-41

Vegetation analysis for saplings in the Gould Island Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
FRAXINUS PENNSYLVANICA	RED ASH	0.16	21.4	63	42.9	2174	48.4	112.7
ULMUS AMERICANA	AMERICAN ELM	0.26	35.7	42	28.6	1682	37.5	101.8
FRAXINUS AMERICANA	WHITE ASH	0.16	21.4	26	17.9	128	2.9	42.1
CARYA CORDIFORMIS	BITTERNUT HICKORY	0.05	7.1	5	3.6	265	5.9	16.6
TILIA AMERICANA	BASSWOOD	0.05	7.1	5	3.6	203	4.5	15.2
CATALPA BIGNONIOIDES	CATALPA	0.05	7.1	5	3.6	37	0.8	11.5
TOTAL		-	100.0	147	100.0	4489	100.0	300.0

Table G-42

Vegetation analysis for tree seedlings in the Gould Island Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ULMUS AMERICANA	AMERICAN ELM	0.26	47.6	5000	55.9	0.97	44.0	147.5
FRAXINUS AMERICANA	WHITE ASH	0.11	19.0	1842	20.6	0.55	25.0	64.6
CARYA CORDIFORMIS	BITTERNUT HICKORY	0.11	19.0	1053	11.8	0.58	26.2	57.0
ACER NIGRUM	BLACK MAPLE	0.05	9.5	789	8.8	0.05	2.4	20.7
CELTIS OCCIDENTALIS	HACKBERRY	0.03	4.8	263	2.9	0.05	2.4	10.1
TOTAL		-	100.0	8947	100.0	2.21	100.0	300.0

Table G-43

Vegetation analysis for shrubs, herbs, and ground cover in the Gould Island Forest, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.66	47.2	12.16	57.8	105.0
RHUS RADICANS	POISON IVY	0.32	22.6	3.84	18.3	40.9
LINDERA BENZOIN	SPICEBUSH	0.16	11.3	3.29	15.6	27.0
LIGUSTRUM VULGARE	COMMON PRIVET	0.08	5.7	0.61	2.9	8.5
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.08	5.7	0.45	2.1	7.8
RUBUS FLAGELLARIS	DEWBERRY	0.05	3.8	0.45	2.1	5.9
ROSA VIRGINIANA	WILD ROSE	0.03	1.9	0.13	0.6	2.5
STAPHYLEA TRIFOLIA	BLADDER-NUT	0.03	1.9	0.11	0.5	2.4
HERBS						
MATTEUCCIA STRUTHIOPTERIS	OSTRICH FERN	0.63	10.3	57.71	51.4	61.7
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.84	13.8	12.66	11.3	25.1
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.53	8.6	9.05	8.1	16.7
ALLIARIA OFFICINALIS	GARLIC MUSTARD	0.58	9.5	3.42	3.0	12.5
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.37	6.0	5.00	4.5	10.5
POLYGONUM CILINODE	BINDWEED	0.39	6.5	4.45	4.0	10.4
GEUM CANADENSE	AVENS	0.32	5.2	3.26	2.9	8.1
LEERSIA VIRGINICA	WHITE GRASS	0.29	4.7	3.05	2.7	7.5
ELYMUS RIPARIUS	WILD RYE	0.32	5.2	2.00	1.8	7.0
IMPATIENS BIFLORA	JEWELWEED	0.24	3.9	2.37	2.1	6.0
TEUCRIUM CANADENSE	WOOD-SAGE	0.24	3.9	1.32	1.2	5.1
ARISAEMA TRIPHYLLUM	JACK-IN-THE-PULPIT	0.16	2.6	0.95	0.8	3.4
PILEA PUMILA	CLEARWEED	0.18	3.0	0.32	0.3	3.3
POLYGONUM PUNCTATUM	SMARTWEED	0.16	2.6	0.42	0.4	3.0
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.13	2.2	0.47	0.4	2.6
POLYGONUM CUSPIDATUM	MEXICAN BAMBOO	0.08	1.3	1.37	1.2	2.5
ELYMUS VIRGINICUS	WILD RYE	0.08	1.3	1.03	0.9	2.2
BOEHMERIA CYLINDRICA	FALSE NETTLE	0.08	1.3	0.63	0.6	1.9
URTICA DIOICA	STINGING NETTLE	0.08	1.3	0.32	0.3	1.6
PODOPHYLLUM PELTATUM	MAY APPLE	0.05	0.9	0.79	0.7	1.6
OXALIS STRICTA	YELLOW WOOD SORREL	0.08	1.3	0.18	0.2	1.5
GLECOMA HEDERACEA	GILL-OVER-THE-GROUND	0.05	0.9	0.24	0.2	1.1
BIDENS FRONDOSA	BEGGAR-TICKS	0.05	0.9	0.16	0.1	1.0
LYSIMACHIA CILIATA	FRINGED LOOSESTRIFE	0.05	0.9	0.16	0.1	1.0
SOLIDAGO FLEXICAULIS	ZIGZAG GOLDENROD	0.03	0.4	0.45	0.4	0.8
CAREX SP.	SEDGE	0.03	0.4	0.24	0.2	0.6
FESTUCA OBTUSA	NODDING FESCUE	0.03	0.4	0.16	0.1	0.6
HESPERIS MATRONALIS	DAME'S ROCKET	0.03	0.4	0.11	0.1	0.5
ZIZEA AUREA	GOLDEN ALEXANDERS	0.03	0.4	0.05	0.0	0.5
GROUND COVER						
BARE SOIL	-	1.00	42.7	77.34	78.1	120.8
LITTER	-	1.00	42.7	20.53	20.7	63.4
MOSS	-	0.34	14.6	1.21	1.2	15.8

Table G-44

Comparison of trees (number of stems) in the Gould Island Forest, 1979-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1979	1980	1981	1982	1983	1984	F	TREND
ACER SACCHARINUM	SILVER MAPLE	17	18	18	17	18	18	0.80	
CELTIS OCCIDENTALIS	HACKBERRY	11	11	10	12	11	11	1.00	
TILIA AMERICANA	BASSWOOD	7	7	7	7	7	7	0.00	
ULMUS AMERICANA	AMERICAN ELM	8	8	5	6	7	7	0.35	
BETULA LENTA	SWEET BIRCH	3	3	3	3	3	3	0.00	
FRAXINUS AMERICANA	WHITE ASH	7	4	2	2	2	2	1.24	
CARYA CORDIFORMIS	BITTERNUT HICKORY	0	2	2	2	2	2	1.00	
FRAXINUS PENNSYLVANICA	RED ASH	0	0	2	1	2	1	1.00	
CATALPA BIGNONIOIDES	CATALPA	0	1	0	1	1	1	1.00	
PRUNUS SEROTINA	BLACK CHERRY	1	1	1	1	1	1	0.00	
JUGLANS CINEREA	BUTTERNUT	1	1	1	1	1	1	0.00	
LIRIODENDRON TULIPIFERA	TULIP-TREE	1	1	1	2	1	1	1.00	
ROBINIA PSEUDOACACIA	BLACK LOCUST	1	1	0	0	0	0	1.00	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-45

Comparison of saplings (number of stems) in the Gould Island Forest, 1979-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1979	1980	1981	1982	1983	1984	F	TREND
FRAXINUS PENNSYLVANICA	RED ASH	0	0	13	10	18	12	3.50**	+
ULMUS AMERICANA	AMERICAN ELM	10	8	9	9	8	8	1.27	
FRAXINUS AMERICANA	WHITE ASH	17	18	6	14	5	5	1.35	
CATALPA BIGNONIOIDES	CATALPA	3	1	1	1	1	1	1.00	
TILIA AMERICANA	BASSWOOD	0	1	0	1	1	1	1.00	
CARYA CORDIFORMIS	BITTERNUT HICKORY	1	1	1	1	1	1	0.00	
LIRIODENDRON TULIPIFERA	TULIP-TREE	0	0	1	1	0	0	1.00	
PRUNUS SEROTINA	BLACK CHERRY	1	1	0	0	0	0	1.00	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-46

Comparison of tree seedlings (number of stems) in the Gould Island Forest, 1979-84.

SPECIES	COMMON NAME	NUMBER OF STEMS 1979	1980	1981	1982	1983	1984	F	TREND
ULMUS AMERICANA	AMERICAN ELM	7	12	16	19	22	19	2.93*	+
FRAXINUS AMERICANA	WHITE ASH	6	5	7	4	3	7	1.31	
CARYA CORDIFORMIS	BITTERNUT HICKORY	3	0	2	2	3	4	1.83	
ACER NIGRUM	BLACK MAPLE	1	2	0	7	3	3	1.00	
CELTIS OCCIDENTALIS	HACKBERRY	7	6	11	10	2	1	3.42**	-
PRUNUS SEROTINA	BLACK CHERRY	0	0	0	1	0	0	1.00	
QUERCUS BOREALIS	RED OAK	0	0	1	0	1	0	0.79	
BETULA NIGRA	RIVER BIRCH	0	3	0	0	0	0	2.00	
ACER SACCHARINUM	SILVER MAPLE	67	1	1	1	2	0	2.36*	-

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-47

Comparison of shrubs, herbs, and ground cover (% cover) in the Gould Island Forest, 1979-84.

SPECIES	COMMON NAME	% COVER 1979	1980	1981	1982	1983	1984	F	TREND
SHRUBS									
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	9.66	13.21	13.08	11.08	10.47	12.16	1.21	
RHUS RADICANS	POISON IVY	1.39	1.84	1.89	1.84	2.53	3.84	6.57**	+
LINDERA BENZOIN	SPICEBUSH	0.71	0.58	0.68	1.32	2.05	3.29	1.81	
LIGUSTRUM VULGARE	COMMON PRIVET	0.53	0.63	0.47	0.47	0.74	0.61	1.49	
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.32	1.29	0.50	0.92	0.66	0.45	0.55	
HERBS									
MATTEUCCIA STRUTHIOPTERIS	OSTRICH FERN	45.21	46.79	46.05	47.97	52.79	57.71	3.21*	+
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	13.79	14.34	12.08	9.13	12.74	12.66	1.38	
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	9.11	7.45	6.82	5.45	8.21	9.05	1.13	
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	1.76	3.00	4.58	9.47	12.03	5.00	18.78**	+
POLYGONUM CILINODE	BINDWEED	10.05	8.11	13.03	8.50	9.29	4.45	4.72**	-
ALLIARIA OFFICINALIS	GARLIC MUSTARD	4.18	14.00	6.13	1.47	11.63	3.42	11.65**	
GEUM CANADENSE	AVENS	4.45	3.24	3.24	4.18	3.24	3.26	1.25	
LEERSIA VIRGINICA	WHITE GRASS	1.50	1.95	1.76	2.74	3.92	3.05	2.08	
IMPATIENS BIFLORA	JEWELWEED	5.42	6.16	3.16	0.97	2.89	2.37	5.82**	-
ELYMUS RIPARIUS	WILD RYE	0.42	0.79	0.42	0.68	1.39	2.00	2.96*	+
POLYGONUM CUSPIDATUM	MEXICAN BAMBOO	0.42	1.11	1.29	1.79	2.84	1.37	1.54	
TEUCRIUM CANADENSE	WOOD-SAGE	2.34	1.74	2.47	2.61	1.21	1.32	1.94	
ELYMUS VIRGINICUS	WILD RYE	0.00	0.00	0.00	0.00	0.58	1.03	2.59*	+
ARISAEMA TRIPHYLLUM	JACK-IN-THE-PULPIT	2.03	1.84	1.00	0.42	0.84	0.95	0.79	
BOEHMERIA CYLINDRICA	FALSE NETTLE	1.11	1.34	1.71	1.24	0.92	0.63	0.29	
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.24	0.66	1.74	1.03	0.87	0.47	2.07	
POLYGONUM PUNCTATUM	SMARTWEED	0.00	0.00	0.00	0.00	0.05	0.42	6.45**	+
URTICA DIOICA	STINGING NETTLE	0.68	0.11	0.18	0.32	0.00	0.32	1.79	
PILEA PUMILA	CLEARWEED	0.08	0.87	0.26	0.37	0.18	0.32	4.18**	
CAREX SP.	SEDGE	0.34	0.16	0.05	0.11	0.16	0.24	0.87	
GROUND COVER									
BARE SOIL	-	76.74	23.18	20.34	24.76	42.66	77.34	70.19**	+
LITTER	-	21.21	74.21	77.13	71.21	53.26	20.53	71.72**	-
MOSS	-	0.29	1.37	1.89	2.58	2.76	1.21	4.45**	

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-48

Estimated damage (% defoliation) by gypsy moth to trees in the Council Cup, TR419, and Quarry Hillside Forests near the Susquehanna SES, and in the Elimsport Substation Forest, 1984.

SPECIES	COUNCIL CUP		TR419		QUARRY HILLSIDE		TOTAL SSES		ELIMSPORT	
	NO.	% DEF.	NO.	% DEF.	NO.	% DEF.	NO.	% DEF.[a]	NO.	% DEF.
QUERCUS PRINUS	40	4.0	18	1.7	22	5.0	80	3.8	39	6.9
TILIA AMERICANA	0	0	0	0	10	2.0	10	2.0	0	0
QUERCUS ALBA	12	1.7	5	0	0	0	17	1.2	6	0
Q. BOREALIS	39	1.5	5	0	50	0	94	0.6	31	1.3
Q. VELUTINA	26	1.2	71	0	13	0	110	0.3	7	0
FRAXINUS AMERICANA	2	0	7	0	34	0.3	43	0.2	2	0
ACER RUBRUM	114	0	31	0	34	0	179	0	162	0
AMELANCHIER ARBOREA	4	0	3	0	3	0	10	0	1	0
BETULA LENTA	113	0	2	0	2	0	117	0	697	0
B. POPULIFOLIA	7	0	2	0	0	0	9	0	0	0
CARYA GLABRA	6	0	11	0	5	0	22	0	3	0
C. TOMENTOSA	4	0	28	0	4	0	36	0	0	0
CASTANEA DENTATA	4	0	0	0	0	0	4	0	1	0
CELTIS OCCIDENTALIS	0	0	0	0	3	0	3	0	0	0
CORNUS FLORIDA	3	0	72	0	40	0	115	0	12	0
CRATAEGUS SP.	0	0	8	0	0	0	8	0	0	0
PINUS STROBUS	26	0	12	0	0	0	38	0	6	0
P. VIRGINIANA	8	0	14	0	5	0	27	0	0	0
POPULUS GRANDIDENTATA	2	0	0	0	1	0	3	0	0	0
PRUNUS AVIUM	0	0	2	0	2	0	4	0	0	0
P. SEROTINA	5	0	10	0	1	0	16	0	1	0
SASSAFRAS ALBIDUM	4	0	2	0	5	0	11	0	100	0
TSUGA CANADENSIS	7	0	2	0	0	0	9	0	2	0
ULMUS AMERICANA	0	0	0	0	6	0	6	0	0	0
NYSSA SYLVATICA	0	0	0	0	0	0	0	0	36	0.3
ACER PENSYLVANICUM	1	0	0	0	0	0	1	0	5	0
FAGUS GRANDIFOLIA	0	0	1	0	0	0	1	0	3	0
LIRIODENDRON TULIPIFERA	0	0	1	0	0	0	1	0	66	0
OTHER SPP.[b]	3	0	1	0	3	0	7	0	3	0
TOTAL	430	0.6[a]	308	0.1[a]	243	0.6[a]	981	0.4[a]	1,183	0.3[a]

[a]Weighted mean.

[b]Species with less than three individuals per plot.

Table G-49

Vegetation analysis for tree seedlings, shrubs, and herbs in Switchyard Field, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
TREE SEEDLINGS						
CORNUS FLORIDA	FLOWERING DOGWOOD	0.61	46.9	20.29	70.1	117.0
BETULA POPULIFOLIA	GRAY BIRCH	0.12	9.4	5.25	18.1	27.5
FRAXINUS AMERICANA	WHITE ASH	0.27	20.3	1.22	4.2	24.5
ACER RUBRUM	RED MAPLE	0.14	10.9	1.52	5.3	16.2
PRUNUS SEROTINA	BLACK CHERRY	0.08	6.3	0.20	0.7	6.9
SASSAFRAS ALBIDUM	SASSAFRAS	0.06	4.7	0.16	0.5	5.2
FRAXINUS PENNSYLVANICA	RED ASH	0.02	1.6	0.31	1.1	2.6
SHRUBS						
CORNUS RACEMOSA	GRAY DOGWOOD	0.88	40.6	18.60	62.2	102.7
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.31	14.2	3.14	10.5	24.6
RHUS RADICANS	POISON IVY	0.29	13.2	2.29	7.7	20.9
CORNUS AMOMUM	SILKY DOGWOOD	0.16	7.5	2.52	8.4	16.0
RUBUS FLAGELLARIS	DEWBERRY	0.16	7.5	1.14	3.8	11.4
VIBURNUM DENTATUM	ARROWWOOD	0.16	7.5	1.04	3.5	11.0
VITIS AESTIVALIS	SUMMER GRAPE	0.08	3.8	0.15	0.5	4.3
ILEX VERTICELLATA	WINTERBERRY	0.04	1.9	0.38	1.3	3.1
ROSA MULTIFLORA	MULTIFLORA ROSE	0.02	0.9	0.33	1.1	2.1
VITIS RIPARIA	RIVERBANK GRAPE	0.02	0.9	0.15	0.5	1.4
SALIX HUMILIS	PRAIRIE WILLOW	0.02	0.9	0.13	0.4	1.4
RUBUS HISPIDUS	DEWBERRY	0.02	0.9	0.04	0.1	1.1
HERBS						
GRASS (UNIDENTIFIED)	-	1.00	9.4	49.26	32.0	41.4
SOLIDAGO RUGOSA	ROUGH GOLDENROD	1.00	9.4	39.67	25.8	35.2
SOLIDAGO CANADENSIS	CANADA GOLDENROD	0.98	9.2	23.22	15.1	24.3
POTENTILLA SIMPLEX	CINQUEFOIL	0.86	8.1	9.30	6.0	14.1
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	0.73	6.9	5.59	3.6	10.6
FRAGARIA VIRGINIANA	WILD STRAWBERRY	0.47	4.4	6.55	4.3	8.7
RUMEX ACETOSELLA	SHEEP SORREL	0.63	6.0	1.79	1.2	7.1
HIERACIUM PRATENSE	HAWKWEED	0.49	4.6	1.80	1.2	5.8
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.37	3.5	2.90	1.9	5.4
TRIFOLIUM SP.	CLOVER	0.49	4.6	0.70	0.5	5.1
ONOCLEA SENSIBILIS	SENSITIVE FERN	0.22	2.1	4.39	2.8	5.0
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.39	3.7	0.64	0.4	4.1
ASTER PILOSUS	HEATH ASTER	0.27	2.5	0.64	0.4	2.9
SOLIDAGO GIGANTEA	LATE GOLDENROD	0.18	1.7	1.62	1.1	2.8
OXALIS STRICTA	YELLOW WOOD SORREL	0.27	2.5	0.35	0.2	2.7
DAUCUS CAROTA	QUEEN ANNE'S LACE	0.27	2.5	0.33	0.2	2.7
CAREX SP.	SEDGE	0.20	1.9	0.71	0.5	2.4
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.22	2.1	0.21	0.1	2.3
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.20	1.9	0.22	0.1	2.1
ASTER LATERIFLORUS	CALICO ASTER	0.14	1.3	0.54	0.3	1.7
APOCYNUM CANNABINUM	INDIAN HEMP	0.12	1.2	0.44	0.3	1.4
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.10	1.0	0.61	0.4	1.4
TARAXACUM OFFICINALE	DANDELION	0.10	1.0	0.13	0.1	1.1
GALIUM APARINE	CLEAVERS	0.08	0.8	0.22	0.1	0.9
HYPERICUM PUNCTATUM	SPOTTED ST. JOHN'S WORT	0.08	0.8	0.11	0.1	0.8
LYSIMACHIA CILIATA	FRINGED LOOSESTRIFE	0.08	0.8	0.06	0.0	0.8
ACHILLEA MILLEFOLIUM	YARROW	0.06	0.6	0.33	0.2	0.8
DESMODIUM DILLENII	TICK-TREFOIL	0.04	0.4	0.48	0.3	0.7
SOLIDAGO NEMORALIS	LITTLE GREY GOLDENROD	0.06	0.6	0.12	0.1	0.7
ASTER UMBELLATUS	FLAT-TOPPED WHITE ASTER	0.04	0.4	0.19	0.1	0.5
CHRYSANTHEMUM LEUCANTHEMUM	OX-EYE DAISY	0.04	0.4	0.07	0.0	0.4
TRIFOLIUM PRATENSE	RED CLOVER	0.04	0.4	0.06	0.0	0.4
TEUCRIUM CANADENSE	WOOD-SAGE	0.04	0.4	0.04	0.0	0.4
TRIODIA FLAVA	PURPLETOP	0.02	0.2	0.32	0.2	0.4
ANEMONE VIRGINIANA	THIMBLEWEED	0.02	0.2	0.08	0.1	0.2
ASCLEPIAS TUBEROSA	BUTTERFLY-WEED	0.02	0.2	0.07	0.0	0.2
ASTER NOVAE-ANGLIAE	NEW ENGLAND ASTER	0.02	0.2	0.05	0.0	0.2
RUDBECKIA HIRTA	BLACK-EYED SUSAN	0.02	0.2	0.04	0.0	0.2
GOODYERA PUBESCENS	RATTLESNAKE PLANTAIN	0.02	0.2	0.03	0.0	0.2
JUNCUS TENUIS	PATH RUSH	0.02	0.2	0.02	0.0	0.2
PRUNELLA VULARIS	SELF-HEAL	0.02	0.2	0.02	0.0	0.2
THELYPTERIS NOVEBORACENSIS	NEW YORK FERN	0.02	0.2	0.02	0.0	0.2
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.02	0.2	0.02	0.0	0.2
AMBROSIA ARTEMISIIFOLIA	RAGWEED	0.02	0.2	0.01	0.0	0.2
HYPERICUM PERFORATUM	COMMON ST. JOHN'S WORT	0.02	0.2	0.01	0.0	0.2
CONVOLVULUS SEPIUM	HEDGE BINDWEED	0.02	0.2	0.01	0.0	0.2
POLYGONUM SCANDENS	FALSE BUCKWHEAT	0.02	0.2	0.01	0.0	0.2
PLANTAGO LANCEOLATA	ENGLISH PLANTAIN	0.02	0.2	0.00	0.0	0.2

Table G-50

Comparison of tree seedlings, shrubs, and herbs (% cover) in Switchyard Field, 1978-84.

SPECIES	COMMON NAME	% COVER 1978	1979	1981	1982	1983	1984	F	TREND
TREE SEEDLINGS									
CORNUS FLORIDA	FLOWERING DOGWOOD	1.96	4.40	6.93	13.04	15.64	20.29	141.85**	+
BETULA POPULIFOLIA	GRAY BIRCH	1.15	1.79	3.92	4.55	5.30	5.25	22.21**	+
ACER RUBRUM	RED MAPLE	0.31	0.22	1.05	1.18	1.04	1.52	9.54*	+
FRAXINUS AMERICANA	WHITE ASH	0.69	0.51	1.04	1.05	0.90	1.22	1.51	
PRUNUS SEROTINA	BLACK CHERRY	0.06	0.07	0.08	0.20	0.19	0.20	1.10	
SASSAFRAS ALBIDUM	SASSAFRAS	0.09	0.10	0.09	0.30	0.14	0.16	0.72	
SHRUBS									
CORNUS RACEMOSA	GRAY DOGWOOD	4.29	5.06	8.51	14.33	15.11	18.60	187.81**	+
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.56	0.62	1.04	2.38	2.09	3.14	34.01**	+
CORNUS AMOMUM	SILKY DOGWOOD	0.60	0.74	1.40	2.33	1.63	2.52	21.34**	+
RHUS RADICANS	POISON IVY	0.73	0.68	1.41	1.43	0.71	2.29	13.35**	+
RUBUS FLAGELLARIS	DEWBERRY	0.89	0.76	1.33	0.89	0.31	1.14	1.71	
VIBURNUM DENTATUM	ARROWWOOD	0.00	0.11	0.31	0.51	0.73	1.04	19.02**	+
ILEX VERTICELLATA	WINTERBERRY	0.17	0.21	0.35	0.53	0.48	0.38	1.35	
HERBS									
GRASS(UNIDENTIFIED)	-	13.15	20.94	26.90	33.37	36.56	49.26	123.41**	+
SOLIDAGO RUGOSA	ROUGH GOLDENROD	39.65	31.52	34.75	39.61	36.62	39.67	4.63**	+
SOLIDAGO CANADENSIS	CANADA GOLDENROD	24.12	24.58	30.24	28.09	23.44	23.22	2.72*	
POTENTILLA SIMPLEX	CINQUEFOIL	10.58	14.03	14.25	14.66	6.86	9.30	6.23**	
FRAGARIA VIRGINIANA	WILD STRAWBERRY	3.46	5.50	4.18	3.80	5.10	6.55	29.39**	+
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	4.29	4.77	5.25	5.34	4.34	5.59	1.48	
SOLIDAGO JUNCEA	EARLY GOLDENROD	2.82	2.66	3.22	3.72	2.83	2.90	1.53	
HIERACIUM PRATENSE	HAWKWEED	1.56	2.63	1.11	1.60	1.25	1.80	3.72**	
RUMEX ACETOSELLA	SHEEP SORREL	5.09	9.68	9.71	6.17	2.63	1.79	67.54**	-
CAREX SP.	SEDGE	1.90	2.10	0.88	1.31	0.92	0.71	28.05**	-
TRIFOLIUM SP.	CLOVER	0.20	0.76	0.74	0.07	0.27	0.70	10.71**	
ASTER PILOSUS	HEATH ASTER	1.26	1.89	2.19	1.33	0.59	0.64	13.82**	-
DAUCUS CAROTA	QUEEN ANNE'S LACE	1.45	1.15	0.53	0.46	0.31	0.33	48.28**	-
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.90	1.95	0.94	0.83	0.32	0.22	29.21**	-
POA PRATENSIS	KENTUCKY BLUEGRASS	6.27	5.54	0.00	0.54	0.00	0.00	13.90**	-

* -SIGNIFICANT AT P<=0.05
**-SIGNIFICANT AT P<=0.01

Table G-51

Vegetation analysis for tree seedlings, shrubs, and herbs in Transmission Corridor Field, 1984.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
TREE SEEDLINGS						
ACER RUBRUM	RED MAPLE	0.08	23.5	2.89	44.7	68.2
PRUNUS SEROTINA	BLACK CHERRY	0.14	41.2	1.07	16.6	57.8
QUERCUS PALUSTRIS	PIN OAK	0.06	17.6	1.12	17.3	35.0
POPULUS TREMULOIDES	QUAKING ASPEN	0.02	5.9	0.87	13.4	19.3
BETULA POPULIFOLIA	GRAY BIRCH	0.02	5.9	0.42	6.5	12.4
CRATAEGUS SP.	HAWTHORNE	0.02	5.9	0.10	1.5	7.4
SHRUBS						
RUBUS FLAGELLARIS	DEWBERRY	0.98	57.0	20.13	60.0	117.0
CORNUS RACEMOSA	GRAY DOGWOOD	0.16	9.3	7.54	22.5	31.8
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.24	14.0	0.73	2.2	16.1
VITIS AESTIVALIS	SUMMER GRAPE	0.10	5.8	1.78	5.3	11.1
CELASTRUS SCANDENS	BITTERSWEET	0.06	3.5	0.83	2.5	6.0
RHUS GLABRA	SMOOTH SUMAC	0.04	2.3	0.60	1.8	4.1
LONICERA TARTARICA	TARTARIAN HONEYSUCKLE	0.04	2.3	0.44	1.3	3.6
CORNUS AMOMUM	SILKY DOGWOOD	0.02	1.2	0.75	2.2	3.4
RHUS RADICANS	POISON IVY	0.04	2.3	0.15	0.4	2.8
SALIX HUMILIS	PRAIRIE WILLOW	0.02	1.2	0.50	1.5	2.6
SAMBUCUS CANADENSIS	COMMON ELDER	0.02	1.2	0.10	0.3	1.4
HERBS						
GRASS (UNIDENTIFIED)	-	1.00	10.3	41.26	36.9	47.2
FRAGARIA VIRGINIANA	WILD STRAWBERRY	0.96	9.9	18.00	16.1	26.0
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.96	9.9	8.55	7.6	17.5
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.48	4.9	9.17	8.2	13.1
MOSS	-	0.38	3.9	7.78	7.0	10.9
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.78	8.0	2.72	2.4	10.5
ASTER PILOSUS	HEATH ASTER	0.58	6.0	4.92	4.4	10.4
SOLIDAGO NEMORALIS	LITTLE GREY GOLDENROD	0.54	5.6	2.78	2.5	8.0
HIERACIUM PRATENSE	HAWKWEED	0.56	5.8	2.21	2.0	7.7
RUMEX ACETOSELLA	SHEEP SORREL	0.58	6.0	0.78	0.7	6.7
SOLIDAGO CANADENSIS	CANADA GOLDENROD	0.22	2.3	3.79	3.4	5.7
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.38	3.9	1.51	1.4	5.3
POTENTILLA SIMPLEX	CINQUEFOIL	0.32	3.3	1.75	1.6	4.9
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	0.22	2.3	2.82	2.5	4.8
ACHILLEA MILLEFOLIUM	YARROW	0.22	2.3	0.61	0.5	2.8
LINARIA VULGARIS	BUTTER-AND-EGGS	0.24	2.5	0.20	0.2	2.7
HYPERICUM PUNCTATUM	SPOTTED ST. JOHN'S WORT	0.20	2.1	0.27	0.2	2.3
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.14	1.4	0.78	0.7	2.1
CAREX SP.	SEDGE	0.14	1.4	0.40	0.4	1.8
DESMODIUM DILLENII	TICK-TREFOIL	0.10	1.0	0.49	0.4	1.5
DAUCUS CAROTA	QUEEN ANNE'S LACE	0.12	1.2	0.08	0.1	1.3
RUDBECKIA HIRTA	BLACK-EYED SUSAN	0.10	1.0	0.19	0.2	1.2
TRIFOLIUM SP.	CLOVER	0.10	1.0	0.08	0.1	1.1
ONOCLEA SENSIBILIS	SENSITIVE FERN	0.06	0.6	0.20	0.2	0.8
APOCYNUM CANNABINUM	INDIAN HEMP	0.04	0.4	0.10	0.1	0.5
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.04	0.4	0.09	0.1	0.5
CIRSIUM PUMILUM	PASTURE THISTLE	0.04	0.4	0.04	0.0	0.5
PLANTAGO LANCEOLATA	ENGLISH PLANTAIN	0.04	0.4	0.04	0.0	0.4
ANTENNARIA NEGLECTA	PUSSYTOES	0.04	0.4	0.04	0.0	0.4
OENOTHERA BIENNIS	EVENING-PRIMROSE	0.02	0.2	0.05	0.0	0.2
CIRSIUM VULGARE	BULL THISTLE	0.02	0.2	0.03	0.0	0.2
CHRYSANTHEMUM LEUCANTHEMUM	OX-EYE DAISY	0.02	0.2	0.02	0.0	0.2
PRUNELLA VULARIS	SELF-HEAL	0.02	0.2	0.02	0.0	0.2
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.02	0.2	0.01	0.0	0.2
TARAXACUM OFFICINALE	DANDELION	0.02	0.2	0.01	0.0	0.2
LACTUCA CANADENSIS	WILD LETTUCE	0.02	0.2	0.01	0.0	0.2

Table G-52

Comparison of tree seedlings, shrubs, and herbs (% cover) in Transmission Corridor Field, 1979-84.

SPECIES	COMMON NAME	% COVER 1979	1981	1982	1983	1984	F	TREND
TREE SEEDLINGS								
ACER RUBRUM	RED MAPLE	1.09	1.78	2.27	2.86	2.89	9.60*	+
QUERCUS PALUSTRIS	PIN OAK	0.02	0.36	0.13	0.92	1.12	1.78	
PRUNUS SEROTINA	BLACK CHERRY	1.21	0.70	0.41	0.73	1.07	1.42	
POPULUS TREMULOIDES	QUAKING ASPEN	0.00	0.02	0.30	0.67	0.87	1.00	
BETULA POPULIFOLIA	GRAY BIRCH	0.00	0.33	0.26	0.34	0.42	1.11	
CRATAEGUS SP.	HAWTHORNE	0.06	0.13	0.09	0.07	0.10	1.00	
AMELANCHIER ARBOREA	SHAD-BUSH	0.00	0.00	0.00	0.06	0.00	1.00	
ULMUS AMERICANA	AMERICAN ELM	0.00	0.00	0.01	0.00	0.00	1.00	
SASSAFRAS ALBIDUM	SASSAFRAS	0.00	0.00	0.06	0.08	0.00	1.00	
PRUNUS VIRGINIANA	CHOKE CHERRY	0.01	0.00	0.00	0.00	0.00	1.00	
PRUNUS PENSYLVANICA	PIN CHERRY	0.03	0.00	0.00	0.00	0.00	1.00	
SHRUBS								
RUBUS FLAGELLARIS	DEWBERRY	29.80	23.19	30.23	24.47	20.13	6.38**	-
CORNUS RACEMOSA	GRAY DOGWOOD	2.39	2.75	4.23	5.72	7.54	25.49**	+
VITIS AESTIVALIS	SUMMER GRAPE	1.17	2.72	1.99	1.56	1.78	1.12	
CELASTRUS SCANDENS	BITTERSWEET	0.09	0.25	0.78	0.74	0.83	7.97*	+
RUBUS ALLEGHENIENSIS	BLACKBERRY	4.50	3.51	2.04	1.94	0.73	48.78**	-
SALIX HUMILIS	PRAIRIE WILLOW	1.84	0.48	0.05	0.37	0.50	1.00	
RHUS RADICANS	POISON IVY	2.54	0.45	1.32	0.70	0.15	19.87*	-
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.30	0.00	0.00	0.00	0.00	9.38**	-
HERBS								
GRASS(UNIDENTIFIED)	-	20.77	21.06	31.58	32.40	41.26	96.57**	+
FRAGARIA VIRGINIANA	WILD STRAWBERRY	16.93	8.44	10.09	12.56	18.00	7.05**	+
SOLIDAGO RUGOSA	ROUGH GOLDENROD	4.76	4.63	7.16	8.21	9.17	29.24**	+
SOLIDAGO JUNCEA	EARLY GOLDENROD	10.72	9.16	9.42	8.18	8.55	1.06	
MOSS	-	6.76	5.60	6.50	7.38	7.78	9.57*	+
ASTER PILOSUS	HEATH ASTER	1.70	3.30	6.39	6.02	4.92	33.06**	+
SOLIDAGO CANADENSIS	CANADA GOLDENROD	3.00	4.13	3.43	3.49	3.79	1.60	
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	2.94	2.90	2.58	2.71	2.82	0.42	
SOLIDAGO NEMORALIS	LITTLE GREY GOLDENROD	2.80	8.73	10.28	4.93	2.78	22.94**	
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.91	1.15	2.09	2.48	2.72	62.56**	+
HIERACIUM PRATENSE	HAWKWEED	3.91	2.90	3.35	3.60	2.21	6.38**	-
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.88	0.63	1.12	1.86	1.51	11.16**	+
RUMEX ACETOSELLA	SHEEP SORREL	6.80	4.61	4.74	2.60	0.78	105.60**	-
HYPERICUM PUNCTATUM	SPOTTED ST. JOHN'S WORT	0.57	0.18	1.61	1.13	0.27	9.25**	
LINARIA VULGARIS	BUTTER-AND-EGGS	3.32	1.57	0.80	0.50	0.20	79.92**	-

* -SIGNIFICANT AT $P \leq 0.05$

**-SIGNIFICANT AT $P \leq 0.01$

Table G-53

Daily minimum, maximum, and mean air temperature (C) at the Susquehanna SES Biological Laboratory, 1984.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN					
1	-14.5	0200	-2.0	1500	-8.2
2	-8.0	0100	0.0	1500	-4.0
3	-2.5	0100	2.0	2400	-0.2
4	0.0	0300	4.0	1300	2.0
5	1.0	0600	5.5	1300	3.2
6	2.0	2000	5.0	1100	3.5
7	-9.0	2400	2.5	0100	-3.2
8	-12.0	0800	-3.5	1500	-7.8
9	-12.0	0800	-1.0	1400	-6.5
10	-6.0	2300	1.5	1100	-2.2
11	-12.5	2400	-5.0	1200	-8.8
12	-19.0	0600	-7.5	1500	-13.2
13	-14.0	0100	-2.0	2000	-8.0
14	-4.5	0400	1.0	1200	-1.8
15	-17.5	2400	-4.5	0100	-11.0
16	-21.0	0500	-6.5	1400	-13.8
17	-9.0	0100	1.0	1500	-4.0
18	-12.5	0400	-5.5	2200	-9.0
19	-16.5	2400	-5.0	0200	-10.8
20	-22.5	0700	-10.0	1500	-16.2
21	-25.5	0700	-14.5	1500	-20.0
22	-28.0	0600	-9.0	1400	-18.5
23	-19.5	0700	-2.5	1500	-11.0
24	-8.0	0100	3.0	1200	-2.5
25	-5.0	2400	5.0	1200	0.0
26	-6.5	0500	5.5	1200	-0.5
27	-7.0	0800	8.0	1400	0.5
28	-7.5	0700	-2.0	1500	-4.8
29	-7.0	0100	0.0	1300	-3.5
30	-5.5	0600	2.0	1100	-1.8
31	-12.5	2400	-1.0	0100	-6.8
MEAN					-6.1
SE					1.11

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
FEB					
1	-19.0	0700	-7.0	1300	-13.0
2	-20.0	0400	2.0	1600	-9.0
3	-7.0	0500	8.5	1400	0.8
4	-1.5	2400	2.5	1500	0.5
5	-2.5	0400	3.5	1400	0.5
6	-7.0	2400	0.0	1200	-3.5
7	-7.0	2400	-0.5	1400	-3.8
8	-8.5	0400	0.0	1300	-4.2
9	-6.5	0200	6.0	1300	-0.2
10	-5.5	0700	9.0	1400	1.8
11	0.5	0800	6.5	1500	3.0
12	1.5	2400	12.0	1600	6.8
13	0.0	0500	13.0	1500	6.5
14	9.0	0100	15.5	1500	12.2
15	6.5	0800	12.0	0100	9.2
16	3.5	0600	12.0	1500	7.8
17	2.5	0100	7.5	1100	5.0
18	2.5	2400	11.5	1500	7.0
19	2.5	0100	8.5	2100	5.5
20	2.0	2400	7.5	0100	4.8
21	-1.0	0500	6.5	1300	2.8
22	-4.0	0700	9.0	1600	2.5
23	-3.0	0700	12.5	1500	4.8
24	4.5	0800	18.0	1600	11.2
25	-1.0	2400	7.5	1200	3.2
26	-5.0	0600	3.5	1500	-0.8
27	-7.5	0600	0.0	1500	-3.8
28	-1.5	0100	4.5	1600	1.5
29	-8.0	2400	0.0	0100	-4.0
MEAN					1.9
SE					1.06

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR					
1	-9.5	0500	-3.0	1100	-6.2
2	-10.0	0500	0.5	1100	-4.8
3	-7.0	0700	0.0	1500	-3.5
4	-13.0	0700	1.5	1700	-5.8
5	-2.5	0100	0.0	1200	-1.2
6	-3.5	2300	3.5	1400	0.0
7	-11.0	2400	0.5	1200	-5.2
8	-13.5	0600	-5.0	1500	-9.2
9	-15.0	2400	-6.5	1300	-10.8
10	-20.0	0700	-1.5	1500	-10.8
11	-11.5	2300	3.5	1200	-4.0
12	-15.0	0700	-1.0	1300	-8.0
13	-4.5	0500	2.5	1600	-1.0
14	-2.5	2400	4.5	1400	1.0
15	-7.0	0600	12.0	1500	2.5
16	2.5	0100	15.0	1100	8.8
17	-1.5	0800	4.0	1500	1.2
18	-1.0	0400	9.0	1600	4.0
19	1.5	2300	10.5	1300	6.0
20	2.5	0100	17.5	1400	10.0
21	0.0	2300	10.0	1500	5.0
22	-0.5	0600	8.0	1300	3.8
23	0.5	2400	5.0	1100	2.8
24	-3.0	0700	11.0	1500	4.0
25	0.5	0100	11.5	1600	6.0
26	-1.5	2400	10.5	1400	4.5
27	-3.5	0500	15.0	1600	5.8
28	3.0	2200	7.5	0100	5.2
29	2.0	0600	5.0	1400	3.5
30	2.5	2400	7.5	1400	5.0
31	0.5	2400	12.0	1100	6.2
MEAN					0.5
SE					1.05

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
APR					
1	-2.0	0600	13.5	1400	5.8
2	-2.0	0600	16.0	1300	7.0
3	1.0	0600	16.5	1600	8.2
4	5.5	0400	13.0	2400	9.2
5	12.0	2400	20.0	1300	16.0
6	8.0	2400	12.0	0100	10.0
7	6.0	2200	10.0	1400	8.0
8	4.0	2400	16.0	1600	10.0
9	0.5	0600	17.5	1500	9.0
10	0.5	0500	16.0	1600	8.2
11	1.5	0600	19.5	1700	10.5
12	3.5	0600	24.5	1500	14.0
13	8.0	0400	16.5	1300	12.2
14	9.0	0700	12.0	1600	10.5
15	10.0	0500	13.0	1700	11.5
16	10.0	0200	14.0	1800	12.0
17	7.5	0600	20.0	1200	13.8
18	4.0	0600	19.5	1400	11.8
19	8.0	2400	12.0	1100	10.0
20	7.0	0800	14.0	1400	10.5
21	5.5	0600	17.0	1300	11.2
22	0.0	0600	16.0	1500	8.0
23	4.5	0400	10.0	1600	7.2
24	8.0	0100	11.0	1400	9.5
25	7.5	2400	14.0	1800	10.8
26	5.0	0400	26.0	1400	15.5
27	10.0	0200	28.0	1100	19.0
28	10.0	0400	21.0	1300	15.5
29	7.5	0400	26.0	1400	16.8
30	9.5	0200	20.0	1600	14.8
MEAN					11.2
SE					0.59

Table G-53 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY					
1	8.0	2400	19.5	1400	17.8
2	5.5	0700	20.0	1600	12.8
3	5.5	0500	15.0	1300	10.2
4	11.0	2400	21.5	1300	16.2
5	9.0	2400	19.0	1100	14.0
6	4.2	0500	21.5	1600	12.8
7	6.0	0400	18.0	1500	12.0
8	11.0	2400	23.0	1400	17.0
9	6.0	0500	15.0	1300	10.5
10	7.5	0200	19.5	1300	13.5
11	6.5	0400	25.0	1500	15.8
12	13.0	2400	26.0	1500	19.5
13	6.5	0600	23.8	1400	15.2
14	5.0	2400	15.0	1600	10.0
15	3.2	0100	15.5	1300	9.4
16	4.0	0400	12.0	1600	8.0
17	0.0	0700	17.8	1600	8.9
18	3.5	0500	12.5	1900	8.0
19	10.0	0500	27.0	1900	18.5
20	13.0	0800	26.0	1700	19.5
21	12.8	0400	23.0	1400	17.9
22	22.2	0100	30.0	1000	26.1
23	12.5	2400	28.0	0700	20.2
24	11.0	0200	28.0	1200	19.5
25	11.5	0200	31.8	0900	21.6
26	14.5	2400	34.5	1000	24.5
27	13.5	0200	24.0	1100	18.8
28	22.8	0200	23.0	0600	22.9
29	--	--	--	--	--
30	12.5	2400	19.8	0100	16.2
31	8.0	0600	18.0	1500	13.0
MEAN					15.7
SE					0.90

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUN					
1	5.0	0600	22.5	1500	13.8
2	12.0	0400	23.5	1600	17.8
3	8.0	0600	23.0	1800	15.5
4	8.5	0600	31.0	1300	19.8
5	11.0	0500	32.5	1300	21.8
6	17.0	0200	34.0	1300	25.5
7	18.5	0500	35.5	1400	27.0
8	19.0	0500	34.0	1300	26.5
9	20.0	0500	36.0	1200	28.0
10	20.0	0500	36.0	1300	28.0
11	19.0	2400	35.5	1300	27.3
12	15.0	0400	33.5	1400	24.3
13	20.0	0200	37.0	1300	28.5
14	20.0	2400	32.5	1400	26.3
15	11.0	2400	23.0	1300	17.0
16	7.0	0500	26.0	1300	16.5
17	17.0	2200	19.5	1100	18.3
18	17.0	0100	23.5	1800	20.3
19	19.0	2400	32.0	1200	25.5
20	15.0	2400	28.0	1200	21.5
21	10.5	0500	28.0	1300	19.3
22	11.0	0400	30.0	1500	20.5
23	15.0	0400	28.5	1700	21.8
24	19.0	0100	24.0	1200	21.5
25	15.0	2400	28.0	1400	21.5
26	13.5	0600	26.0	1400	19.8
27	12.0	0400	32.0	1200	22.0
28	19.0	0400	32.0	1200	25.5
29	19.0	0400	31.5	1100	25.3
30	19.0	0400	24.5	1500	21.8
MEAN					22.3
SE					0.74

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL					
1	19.5	0200	22.5	1200	21.0
2	19.0	0400	29.5	1500	24.2
3	18.0	2400	29.0	1200	23.5
4	16.0	0500	30.5	1200	23.2
5	21.5	0400	30.5	1400	26.0
6	20.5	0400	28.0	1500	24.2
7	15.0	2400	28.5	1300	21.8
8	11.0	0500	25.0	1500	18.0
9	9.5	0500	23.5	1400	16.5
10	14.0	0500	25.0	1800	19.5
11	19.0	0600	33.0	1500	26.0
12	19.0	0800	32.0	1700	25.5
13	17.0	0700	32.0	1800	24.5
14	18.0	0800	35.0	1600	26.5
15	20.5	0800	35.0	1600	27.8
16	18.5	2400	30.0	1500	24.2
17	12.5	0800	28.0	1600	20.2
18	17.0	2400	24.0	1700	20.5
19	--	--	--	--	--
20	--	--	--	--	--
21	--	--	--	--	--
22	--	--	--	--	--
23	--	--	--	--	--
24	--	--	--	--	--
25	12.0	2400	24.5	1400	18.2
26	9.5	0400	27.0	1300	18.2
27	14.5	2400	22.0	1000	18.2
28	14.0	0400	22.5	1400	18.2
29	11.5	0500	24.0	1400	17.8
30	13.5	0500	24.5	1300	19.0
31	12.0	0500	28.0	1300	20.0
MEAN					21.7
SE					0.67

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
AUG					
1	14.5	0600	30.0	1400	22.2
2	18.0	0500	28.5	1400	23.2
3	17.5	0300	23.5	1300	20.5
4	18.0	0300	26.0	1400	22.0
5	16.0	2400	21.0	1800	18.5
6	16.0	0100	28.0	1400	22.0
7	17.5	0400	29.0	1500	23.2
8	16.5	0500	27.5	1300	22.0
9	16.5	0500	30.0	1400	23.2
10	20.5	0100	24.0	1400	22.2
11	19.5	2400	25.0	1500	22.2
12	19.0	0200	26.0	1400	22.5
13	17.5	0600	26.5	1200	22.0
14	18.5	0300	29.0	1500	23.8
15	17.0	0500	27.0	1500	22.0
16	14.5	0300	29.0	1600	21.8
17	13.0	0400	22.5	1400	17.8
18	10.0	0700	22.0	1500	16.0
19	12.0	0200	23.0	1700	17.5
20	8.5	2400	19.0	1400	13.8
21	4.0	0600	21.5	1500	12.8
22	7.5	0200	26.0	1300	16.8
23	15.5	0700	24.0	1400	19.8
24	--	--	--	--	--
25	--	--	--	--	--
26	--	--	--	--	--
27	--	--	25.0	1400	--
28	11.0	0500	26.0	1200	18.5
29	15.5	0500	25.0	1400	20.2
30	17.5	2200	28.5	1300	23.0
31	11.5	2400	25.5	1400	18.5
MEAN					20.3
SE					0.57

Table G-53 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP					
1	8.5	0500	23.5	1400	11.8
2	10.0	0100	24.0	1500	17.0
3	13.0	2400	25.5	1100	19.2
4	8.0	2400	18.0	1200	13.0
5	5.5	2400	17.0	1400	11.2
6	2.0	0400	14.5	1300	8.2
7	0.0	0600	18.0	1500	9.0
8	3.5	0600	20.0	1200	11.8
9	6.5	0700	21.0	1400	13.8
10	14.0	2400	23.0	1200	18.5
11	13.0	0200	26.0	1400	19.5
12	10.0	2400	21.5	1400	15.8
13	8.0	0500	24.5	1200	16.2
14	13.0	2400	19.5	1200	16.2
15	2.5	2400	13.5	1100	8.0
16	0.0	0400	14.0	1300	7.0
17	-1.0	0400	16.5	1400	7.8
18	1.0	0600	18.5	1400	9.8
19	1.0	0700	20.0	1400	10.5
20	6.0	0700	24.5	1500	15.2
21	6.5	0800	20.0	1400	13.2
22	4.0	0600	23.0	1600	13.5
23	9.0	0700	26.0	1400	17.5
24	16.0	0400	23.0	1300	19.5
25	15.0	0200	26.5	1300	20.8
26	5.5	2300	16.0	0100	10.8
27	1.5	0600	17.5	1500	9.5
28	0.5	0300	6.0	1800	3.2
29	--	--	--	--	--
30	--	--	--	--	--
MEAN					13.1
SE					0.85

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
OCT					
1	--	--	--	--	--
2	0.5	2400	10.0	1600	5.2
3	-3.0	0600	13.5	1700	5.2
4	1.5	0900	14.0	1600	7.8
5	0.0	0900	14.0	1700	7.0
6	-2.5	0700	13.0	1600	5.2
7	-2.0	0800	14.0	1300	6.0
8	7.0	0700	15.0	1500	11.0
9	10.0	0100	18.5	1500	14.2
10	8.5	2400	18.5	1200	13.5
11	4.0	2400	17.0	1300	10.5
12	3.0	0200	17.5	1400	10.2
13	4.0	0200	18.5	1500	11.2
14	1.0	0700	19.0	1500	10.0
15	0.0	0500	22.0	1400	11.0
16	8.0	0100	24.0	1200	16.0
17	9.0	0200	19.0	1400	14.0
18	15.5	0100	25.5	1600	20.5
19	13.5	0400	26.0	1400	19.8
20	13.0	2300	26.5	1400	19.8
21	14.0	0100	25.5	1500	19.8
22	16.0	2400	24.5	1300	20.2
23	13.5	0700	17.0	1100	15.2
24	13.0	2400	17.0	1300	15.0
25	11.0	0600	21.0	1300	16.0
26	13.0	0100	20.0	1500	16.5
27	16.0	0100	26.0	1300	21.0
28	15.5	0400	27.5	1200	21.5
29	7.5	2400	14.5	1500	11.0
30	3.0	0600	19.0	1400	11.0
31	7.0	2300	17.0	0900	12.0
MEAN					13.2
SE					0.94

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
NOV					
1	8.5	0100	16.5	2400	12.5
2	-0.5	2400	17.0	0200	8.2
3	-4.5	0700	9.0	1400	2.2
4	-1.5	0100	12.0	1800	5.2
5	8.5	2200	15.0	1500	11.8
6	2.5	2400	10.0	0100	6.2
7	-3.5	2400	6.5	1500	1.5
8	-6.0	0700	9.0	1400	1.5
9	-1.5	0500	11.5	2200	5.0
10	6.5	2400	16.0	1300	11.2
11	6.5	0100	14.0	1100	10.2
12	0.0	2200	6.5	0100	3.2
13	0.0	0100	3.5	1600	1.8
14	-3.5	2400	9.0	1400	2.8
15	-4.5	0200	12.0	1500	3.8
16	1.5	2400	8.0	1000	4.8
17	-0.5	0800	8.0	1500	3.8
18	0.0	0600	8.0	1400	4.0
19	-3.5	2400	2.5	0100	-0.5
20	-6.0	0400	1.0	1400	-2.5
21	-3.5	0100	5.0	1300	0.8
22	-4.0	2400	6.0	1400	1.0
23	-6.0	0400	6.5	1400	0.2
24	-3.0	0600	10.5	1500	3.8
25	-3.0	0800	11.5	1600	4.2
26	-3.5	0700	13.0	1500	4.8
27	-1.5	0300	15.5	1500	7.0
28	11.0	2400	20.0	1600	4.5
29	4.0	2400	11.0	0100	7.0
30	0.0	0700	12.0	1400	6.0
MEAN					4.5
SE					0.66

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
DEC					
1	6.5	2400	11.5	1300	9.0
2	1.5	0700	9.5	1100	5.5
3	1.0	0700	8.5	1400	4.8
4	-1.5	2300	4.0	1400	1.2
5	-3.5	0800	3.5	1400	0.0
6	0.5	0100	4.5	1400	2.5
7	-5.0	1800	0.0	0100	-2.5
8	-5.0	2400	4.5	1400	-0.2
9	-6.5	0600	6.5	1400	0.0
10	-1.0	0100	6.0	1500	2.5
11	2.5	0100	5.0	1200	3.8
12	1.0	0300	5.0	1400	3.0
13	3.0	0600	8.5	1600	5.8
14	2.5	2000	6.0	0100	4.2
15	1.0	2400	8.0	1600	4.5
16	1.0	0100	7.5	2100	4.2
17	3.5	2300	15.5	1400	9.5
18	-1.0	2400	13.0	1400	6.0
19	-2.5	0400	3.5	2300	0.5
20	-3.0	2200	6.0	1400	1.5
21	-3.5	0400	4.5	2400	0.5
22	1.0	2400	12.0	1400	6.5
23	-4.0	0800	4.5	1600	0.2
24	-5.5	0800	9.5	1500	2.0
25	-6.0	2400	6.0	0400	0.0
26	-7.5	0300	0.0	1700	-3.8
27	-3.5	0600	0.5	1500	-1.5
28	0.0	0100	3.5	1500	1.8
29	0.5	0100	15.0	2400	7.8
30	-1.5	2400	16.0	0100	7.2
31	-6.5	0800	2.0	1800	-2.2
MEAN					2.7
SE					0.61

Table G-54

Barometric pressure (in Hg) and direction of change at 1200 and 2400 hours daily at the Susquehanna SES Biological Laboratory, 1984.

DATE	1200	CHANGE	2400	CHANGE
JAN				
1	30.67	+	30.56	-
2	30.38	-	30.32	+
3	30.33	-	30.14	-
4	29.96	-	29.92	+
5	29.95	-	29.77	-
6	29.66	+	29.74	+
7	29.93	+	30.00	+
8	30.03	+	30.18	+
9	30.43	-	30.29	-
10	30.17	0	30.12	+
11	30.37	+	30.55	+
12	30.75	+	30.80	+
13	30.66	-	30.51	-
14	30.45	-	30.48	+
15	30.50	-	30.42	-
16	30.27	-	30.26	+
17	30.23	-	30.34	+
18	30.25	-	30.03	-
19	30.07	+	30.24	+
20	30.31	+	30.41	+
21	30.53	+	30.54	+
22	30.64	+	30.57	-
23	30.55	-	30.37	-
24	30.03	-	29.87	-
25	29.75	-	29.90	+
26	30.07	-	29.99	-
27	29.80	-	29.83	+
28	29.98	-	29.84	-
29	29.78	-	29.86	+
30	29.81	-	29.63	-
31	29.83	+	30.03	+

DATE	1200	CHANGE	2400	CHANGE
FEB				
1	30.16	+	30.26	+
2	30.33	-	30.19	-
3	29.95	-	29.80	-
4	29.75	-	29.66	-
5	29.54	-	29.65	+
6	29.83	+	29.96	+
7	30.11	+	30.32	+
8	30.37	-	30.25	-
9	30.22	+	30.36	+
10	30.38	-	30.26	-
11	30.17	-	30.21	+
12	30.32	+	30.33	+
13	30.33	-	30.20	-
14	30.04	-	29.99	+
15	29.98	+	30.13	+
16	30.15	-	30.12	-
17	30.06	-	29.99	-
18	30.00	+	30.07	+
19	30.02	-	29.72	-
20	29.77	+	29.78	-
21	29.68	-	29.90	+
22	30.04	-	29.97	-
23	29.89	-	29.63	-
24	29.67	-	29.62	-
25	29.45	+	29.88	+
26	30.13	+	30.26	+
27	30.27	-	29.91	-
28	29.31	-	29.11	+
29	29.47	+	29.70	+

DATE	1200	CHANGE	2400	CHANGE
MAR				
1	29.79	+	29.96	+
2	29.95	+	30.06	+
3	30.17	+	30.27	+
4	30.36	-	30.23	-
5	29.95	-	29.74	-
6	29.81	+	29.89	+
7	30.01	+	30.17	+
8	30.14	-	29.97	+
9	30.19	+	30.30	+
10	30.31	-	30.11	-
11	29.86	+	30.32	+
12	30.58	+	30.58	-
13	30.46	-	30.15	-
14	30.26	+	30.46	+
15	30.41	-	30.20	-
16	30.05	-	30.24	+
17	30.37	-	30.30	-
18	30.23	-	30.11	-
19	30.05	-	30.03	-
20	29.93	-	29.84	-
21	29.40	-	29.54	+
22	29.57	+	29.70	+
23	29.84	+	30.11	+
24	30.13	-	30.05	-
25	29.95	-	29.81	+
26	29.86	0	29.96	+
27	29.78	-	29.81	-
28	29.70	-	29.35	-
29	29.09	+	29.48	+
30	29.66	+	29.84	+
31	29.94	+	30.01	+

DATE	1200	CHANGE	2400	CHANGE
APR				
1	30.05	+	30.10	+
2	30.12	+	30.18	+
3	30.31	+	30.25	-
4	30.17	-	29.78	-
5	29.50	-	29.47	+
6	29.57	+	29.66	+
7	29.83	+	30.09	+
8	30.22	+	30.34	+
9	30.36	0	30.36	-
10	30.13	-	30.05	-
11	30.00	-	30.01	+
12	30.00	-	29.98	+
13	29.99	+	30.03	+
14	30.05	-	29.94	-
15	29.86	-	29.77	-
16	29.49	-	29.50	+
17	29.52	+	29.68	+
18	29.75	+	29.86	+
19	29.95	+	29.99	+
20	30.00	+	30.02	+
21	30.08	+	30.22	+
22	30.20	-	30.00	-
23	--	--	--	--
24	29.44	+	29.53	+
25	29.69	+	29.92	+
26	29.99	-	30.02	+
27	30.06	+	30.12	+
28	30.22	+	30.29	0
29	30.28	-	30.10	-
30	29.93	-	29.82	+

Table G-54 (cont.)

DATE	1200	CHANGE	2400	CHANGE
MAY				
1	29.90	+	29.92	+
2	29.98	-	29.90	0
3	29.87	-	29.55	-
4	29.31	-	29.57	+
5	29.84	+	30.00	+
6	30.08	-	30.08	+
7	30.06	-	29.97	-
8	29.63	-	29.69	+
9	29.72	+	29.84	+
10	29.95	+	30.02	+
11	29.93	-	29.82	-
12	29.79	-	29.97	+
13	29.99	-	29.80	+
14	29.96	+	30.00	+
15	30.00	0	30.07	+
16	30.08	+	30.17	+
17	30.21	-	30.22	+
18	30.14	-	29.95	-
19	29.78	-	29.76	+
20	29.79	-	29.86	+
21	29.98	+	30.02	+
22	30.03	+	29.92	-
23	29.90	0	29.90	0
24	29.88	-	29.89	+
25	29.87	-	29.86	0
26	29.89	+	30.18	+
27	30.17	-	30.14	-
28	30.03	-	29.88	+
29	--	--	29.97	+
30	29.97	+	29.98	0
31	29.94	-	29.93	+

DATE	1200	CHANGE	2400	CHANGE
JUN				
1	29.85	-	29.80	-
2	29.73	-	29.84	+
3	29.82	-	29.88	+
4	29.97	-	30.01	+
5	30.08	-	30.03	+
6	30.07	-	30.06	+
7	30.08	-	30.05	+
8	30.07	-	29.98	+
9	30.00	-	30.00	+
10	30.03	-	29.99	+
11	30.00	-	30.09	+
12	30.17	-	30.08	-
13	30.00	-	29.96	-
14	29.92	-	30.03	+
15	30.22	+	30.30	+
16	30.32	-	30.23	-
17	30.14	-	29.98	-
18	29.89	-	29.76	-
19	29.89	+	30.00	+
20	30.05	+	30.10	+
21	30.08	-	30.09	+
22	30.06	-	30.01	-
23	30.01	-	29.98	-
24	29.89	-	29.84	-
25	29.87	-	29.86	+
26	29.87	-	29.83	+
27	29.80	-	29.81	+
28	29.89	+	29.90	+
29	29.90	0	29.90	-
30	29.89	-	29.85	-

DATE	1200	CHANGE	2400	CHANGE
JUL				
1	29.84	+	29.96	+
2	30.02	-	29.98	-
3	29.98	-	29.96	-
4	29.86	-	29.79	-
5	27.76	-	29.80	+
6	29.86	-	29.75	+
7	29.87	+	29.99	+
8	30.09	+	30.10	+
9	30.14	-	30.06	-
10	29.97	-	29.87	-
11	29.77	-	29.70	+
12	29.84	+	29.91	+
13	30.00	+	30.03	+
14	30.10	+	30.06	-
15	30.01	-	29.87	-
16	29.79	-	29.77	+
17	29.86	+	29.77	-
18	29.72	-	29.84	+
19	30.06	+	30.08	0
20	30.17	+	30.09	-
21	30.15	+	30.17	+
22	30.22	+	30.16	-
23	30.17	0	30.00	-
24	29.95	-	29.97	+
25	30.10	+	30.13	+
26	30.10	-	30.01	-
27	29.85	-	30.03	+
28	30.18	+	30.24	+
29	30.29	+	30.27	-
30	30.23	-	30.20	-
31	30.16	-	30.12	+

DATE	1200	CHANGE	2400	CHANGE
AUG				
1	30.10	0	30.12	+
2	30.13	+	30.10	-
3	30.03	-	30.00	-
4	30.01	+	29.98	0
5	30.00	+	29.98	+
6	29.94	-	29.84	-
7	29.75	-	29.78	+
8	29.83	+	29.87	+
9	29.92	+	29.94	+
10	29.96	0	29.92	-
11	29.93	+	29.96	+
12	30.00	+	30.01	+
13	30.02	0	30.00	+
14	29.98	-	29.93	+
15	29.99	+	29.97	+
16	29.98	+	29.92	+
17	29.93	+	29.98	+
18	29.90	+	29.83	-
19	29.82	+	29.86	+
20	29.97	+	30.07	+
21	30.14	-	30.12	+
22	30.00	-	29.81	-
23	29.81	+	29.90	+
24	29.98	+	30.08	+
25	30.16	+	30.16	+
26	30.17	-	30.11	-
27	30.05	-	30.02	+
28	29.95	-	29.93	+
29	29.89	-	29.87	+
30	29.75	-	29.72	+
31	29.80	+	29.90	+

Table G-54 (cont.)

DATE	1200	CHANGE	2400	CHANGE	DATE	1200	CHANGE	2400	CHANGE
SEP					OCT				
1	29.97	+	30.01	+	1	30.00	-	30.00	+
2	29.94	-	29.82	-	2	29.99	0	29.97	-
3	29.74	-	29.73	+	3	29.82	-	29.80	+
4	29.87	+	29.96	+	4	30.06	+	30.10	+
5	30.06	+	30.13	+	5	30.23	+	30.39	+
6	30.22	+	30.29	+	6	30.51	+	30.46	+
7	30.39	+	30.37	-	7	30.45	0	30.35	-
8	30.40	+	30.32	-	8	30.25	-	30.16	-
9	30.22	-	30.07	-	9	30.20	+	30.19	+
10	29.97	-	29.92	-	10	30.26	+	30.27	+
11	29.90	-	29.91	+	11	30.30	+	30.23	-
12	30.13	+	30.14	0	12	30.13	-	30.07	0
13	30.08	-	29.89	-	13	29.98	-	29.88	-
14	29.88	-	29.84	-	14	29.82	-	29.85	+
15	29.82	+	30.10	+	15	29.94	+	29.97	+
16	30.23	+	30.29	+	16	30.07	+	30.16	+
17	30.40	+	30.36	+	17	30.17	-	30.12	0
18	30.29	-	30.11	-	18	30.10	-	30.03	-
19	29.95	-	29.83	-	19	29.94	-	29.90	+
20	29.72	-	29.71	+	20	30.02	+	30.06	+
21	29.96	+	30.10	+	21	30.00	-	29.98	+
22	30.22	+	30.19	+	22	30.03	+	30.06	+
23	30.16	-	30.08	-	23	30.20	+	30.21	+
24	30.07	-	30.01	-	24	30.26	+	30.28	+
25	29.97	-	29.84	-	25	30.38	+	30.18	-
26	30.01	+	30.23	+	26	30.14	-	30.16	+
27	30.36	+	30.29	-	27	30.19	+	30.08	-
28	30.26	-	30.15	-	28	30.01	-	29.99	0
29	30.14	0	30.11	+	29	30.07	+	30.22	+
30	30.15	+	30.05	-	30	30.24	-	30.25	+
					31	30.39	+	30.45	+
NOV					DEC				
1	30.34	-	30.00	-	1	29.92	+	30.13	+
2	30.08	+	30.37	+	2	30.29	+	30.24	-
3	30.34	-	30.28	-	3	29.94	-	30.16	+
4	30.11	-	29.83	-	4	30.27	+	30.40	+
5	29.69	-	29.77	+	5	30.49	+	30.03	-
6	29.92	+	30.12	+	6	29.68	-	29.84	+
7	30.32	+	30.40	+	7	30.10	+	30.04	-
8	30.43	-	30.35	-	8	29.99	-	30.19	+
9	30.27	-	30.10	-	9	30.30	+	30.21	-
10	29.94	-	29.83	-	10	29.99	-	29.97	0
11	29.71	-	29.77	+	11	30.08	+	30.05	-
12	29.84	+	29.93	+	12	29.96	-	29.89	-
13	29.96	+	30.04	+	13	30.01	+	30.28	+
14	30.20	+	30.31	+	14	30.47	+	30.46	0
15	30.20	-	29.94	-	15	30.39	-	30.47	+
16	29.95	+	30.07	+	16	30.45	-	30.23	-
17	30.13	+	30.21	+	17	30.14	-	30.08	-
18	30.17	-	30.00	-	18	30.12	+	30.24	+
19	30.01	+	30.18	+	19	29.93	-	29.95	+
20	30.30	+	30.43	+	20	30.04	+	30.20	+
21	30.54	+	30.59	+	21	30.23	+	29.78	-
22	30.60	0	30.42	-	22	29.79	+	30.12	+
23	30.28	-	30.22	+	23	30.29	+	30.20	-
24	30.17	-	30.16	+	24	30.06	-	29.86	-
25	30.26	+	30.25	+	25	30.38	+	30.56	+
26	30.30	+	30.34	+	26	30.62	+	30.60	0
27	30.37	+	30.21	-	27	30.44	-	30.32	-
28	29.98	-	29.75	-	28	30.13	-	29.97	-
29	29.80	+	29.89	+	29	29.94	-	29.88	-
30	29.91	+	29.74	-	30	30.26	+	30.43	+
					31	30.36	-	30.21	-

Table G-55

Daily precipitation (cm), weather conditions, and fog (0700-0800 h) at the Susquehanna SES Biological Laboratory, 1984. Plume at Susquehanna SES cooling towers 1 and 2 indicated as + = present or - = absent; -- indicates data not collected.

DATE	PRECIPITATION (CM)	WEATHER	FOG	PLUME 1	PLUME 2
JAN					
1	R	--	--	--	--
2	0.0	CLOUDY	NONE	-	-
3	0.0	CLOUDY	NONE	-	-
4	0.03	CLOUDY	NONE	-	-
5	0.0	CLOUDY	NONE	-	-
6	T	CLOUDY	NONE	-	-
7	R	--	--	--	--
8	R	--	--	--	--
9	0.23	CLEAR	NONE	-	-
10	0.10	CLOUDY	NONE	-	-
11	0.81	PARTLY CLOUDY	NONE	-	-
12	0.0	CLEAR	NONE	-	-
13	0.0	CLOUDY	NONE	-	-
14	R	--	--	--	--
15	R	--	--	--	--
16	0.28	CLOUDY	NONE	-	-
17	T	SNOW	NONE	-	-
18	0.10	CLOUDY	NONE	-	-
19	0.38	CLOUDY	NONE	-	-
20	0.0	CLEAR	NONE	-	-
21	R	--	--	--	--
22	R	--	--	--	--
23	0.0	CLEAR	NONE	-	-
24	0.66	SLEET	LIGHT	-	-
25	0.71	FOG	DENSE	-	-
26	0.0	CLEAR	NONE	-	-
27	0.0	CLEAR	NONE	-	-
28	R	--	--	--	--
29	R	--	--	--	--
30	0.0	CLOUDY	NONE	-	-
31	0.0	CLOUDY	NONE	-	-
TOTAL	3.30				
FEB					
1	0.0	CLEAR	NONE	-	-
2	0.0	CLEAR	NONE	-	-
3	0.0	CLOUDY	NONE	-	-
4	R	--	--	--	--
5	R	--	--	--	--
6	1.02	CLEAR	NONE	-	-
7	0.0	CLOUDY	NONE	-	-
8	0.0	CLOUDY	NONE	-	-
9	0.0	PARTLY CLOUDY	NONE	-	-
10	0.0	CLEAR	NONE	-	-
11	R	--	--	--	--
12	R	--	--	--	--
13	0.41	FOG	LIGHT	-	-
14	0.03	LIGHT RAIN	NONE	-	-
15	2.18	LIGHT RAIN	NONE	-	-
16	0.25	PARTLY CLOUDY	NONE	-	-
17	0.0	CLOUDY	NONE	-	-
18	R	--	--	--	--
19	R	--	--	--	--
20	1.88	CLOUDY	NONE	-	-
21	T	CLOUDY	NONE	-	-
22	0.03	CLEAR	NONE	+	-
23	0.0	CLEAR	NONE	+	-
24	0.84	CLOUDY	LIGHT	+	-
25	R	--	--	--	--
26	R	--	--	--	--
27	1.04	CLOUDY	NONE	-	-
28	0.36	HEAVY RAIN	NONE	-	-
29	0.56	LIGHT RAIN	NONE	+	-
TOTAL	8.60				

Table G-55 (cont.)

DATE	PRECIPITATION (CM)	WEATHER	FOG	PLUME 1	PLUME 2
MAR					
1	T	PARTLY CLOUDY	NONE	+	-
2	0.0	PARTLY CLOUDY	NONE	+	-
3	R	--	--	--	--
4	R	--	--	--	--
5	0.05	SNOW	NONE	-	-
6	0.81	CLOUDY	NONE	-	-
7	0.0	CLEAR	NONE	-	-
8	0.0	CLEAR	NONE	-	-
9	0.61	PARTLY CLOUDY	NONE	-	-
10	R	--	--	--	--
11	R	--	--	--	--
12	0.03	CLEAR	NONE	-	-
13	0.33	SNOW	NONE	-	-
14	0.61	CLOUDY	NONE	-	-
15	0.0	CLEAR	NONE	-	-
16	0.0	CLOUDY	NONE	-	-
17	R	--	--	--	--
18	R	--	--	--	--
19	0.10	CLOUDY	NONE	-	-
20	T	CLOUDY	NONE	-	-
21	0.0	CLOUDY	NONE	-	-
22	1.65	CLOUDY	NONE	-	-
23	0.25	CLOUDY	NONE	+	-
24	R	--	--	--	--
25	R	--	--	--	--
26	T	CLEAR	NONE	+	-
27	0.0	PARTLY CLOUDY	NONE	+	-
28	1.07	HEAVY RAIN	NONE	+	-
29	2.49	SNOW	NONE	+	-
30	0.79	SNOW	NONE	+	-
31	R	--	--	--	--
TOTAL	8.79				
APR					
1	R	--	--	--	--
2	0.03	CLEAR	NONE	+	-
3	0.0	CLEAR	NONE	+	-
4	0.03	CLOUDY	NONE	+	-
5	1.42	LIGHT RAIN	NONE	+	-
6	4.22	CLOUDY	NONE	+	-
7	R	--	--	--	--
8	R	--	--	--	--
9	0.05	PARTLY CLOUDY	NONE	+	-
10	0.0	CLEAR	NONE	+	-
11	0.0	CLEAR	NONE	+	-
12	0.0	CLEAR	NONE	+	-
13	0.0	CLOUDY	NONE	+	-
14	R	--	--	--	--
15	R	--	--	--	--
16	1.98	HEAVY RAIN	NONE	+	-
17	0.91	LIGHT RAIN	LIGHT	+	-
18	0.03	FOG	DENSE	--	--
19	0.03	CLOUDY	NONE	+	-
20	R	--	--	--	--
21	R	--	--	--	--
22	R	--	--	--	--
23	1.22	CLOUDY	NONE	+	-
24	0.53	RAIN, FOG	DENSE	-	-
25	0.89	HEAVY RAIN	NONE	+	-
26	0.03	CLEAR	NONE	+	-
27	0.0	PARTLY CLOUDY	NONE	+	-
28	R	--	--	--	--
29	R	--	--	--	--
30	1.60	LIGHT RAIN	NONE	+	-
TOTAL	12.97				

Table G-55 (cont.)

DATE	PRECIPITATION (CM)	WEATHER	FOG	PLUME 1	PLUME 2
MAY					
1	0.15	CLEAR	NONE	+	-
2	0.0	CLEAR	NONE	+	-
3	0.0	PARTLY CLOUDY	NONE	+	-
4	2.74	CLOUDY	NONE	+	-
5	R	--	--	--	--
6	R	--	--	--	--
7	0.05	PARTLY CLOUDY	NONE	+	-
8	0.43	LIGHT RAIN	NONE	+	-
9	1.30	CLEAR	NONE	+	-
10	0.03	CLOUDY	NONE	+	-
11	0.0	CLOUDY	NONE	+	-
12	R	--	--	--	--
13	R	--	--	--	--
14	1.45	CLOUDY	NONE	+	-
15	0.05	CLOUDY	NONE	+	-
16	0.10	PARTLY CLOUDY	NONE	+	-
17	0.0	CLEAR	NONE	+	-
18	0.0	CLOUDY	NONE	+	-
19	R	--	--	--	--
20	R	--	--	--	--
21	2.95	CLOUDY	NONE	+	-
22	0.0	CLEAR	NONE	+	-
23	0.0	CLOUDY	NONE	+	-
24	1.19	FOG	DENSE	--	--
25	0.0	CLEAR	NONE	+	-
26	R	--	--	--	--
27	R	--	--	--	--
28	R	--	--	--	--
29	6.05	HEAVY RAIN	NONE	+	-
30	1.55	RAIN	LIGHT	+	-
31	0.23	PARTLY CLOUDY	NONE	+	-
TOTAL	18.27				
JUN					
1	0.0	FOG	DENSE	--	--
2	R	--	--	--	--
3	R	--	--	--	--
4	0.46	CLEAR	NONE	+	-
5	0.0	PARTLY CLOUDY	NONE	+	-
6	T	CLOUDY, HAZY	NONE	+	-
7	T	PARTLY CLOUDY	LIGHT	+	-
8	0.0	PARTLY CLOUDY	LIGHT	+	-
9	R	--	--	--	--
10	R	--	--	--	--
11	0.0	HAZY	NONE	+	-
12	0.0	CLEAR	NONE	+	-
13	0.0	HAZY	NONE	+	-
14	0.56	FOG	LIGHT	+	-
15	0.0	CLOUDY	NONE	+	+
16	R	--	--	--	--
17	R	--	--	--	--
18	3.68	LIGHT RAIN	LIGHT	+	-
19	2.51	CLOUDY	LIGHT	+	-
20	0.0	PARTLY CLOUDY	NONE	+	+
21	0.0	CLEAR	NONE	+	+
22	0.0	CLEAR	NONE	+	-
23	R	--	--	--	--
24	R	--	--	--	--
25	2.46	HAZY	NONE	+	+
26	0.18	HAZY	LIGHT	+	+
27	0.05	PARTLY CLOUDY	NONE	+	+
28	0.05	FOG	DENSE	--	--
29	0.0	HAZY	NONE	+	+
30	R	--	--	--	--
TOTAL	9.95				

Table G-55 (cont.)

DATE	PRECIPITATION (CM)	WEATHER	FOG	PLUME 1	PLUME 2
JUL					
1	R	LIGHT	--	--	--
2	6.63	CLOUDY	LIGHT	+	+
3	0.64	PARTLY CLOUDY	--	+	+
4	R	--	--	--	--
5	0.03	CLOUDY, HAZY	NONE	+	+
6	0.41	CLOUDY	LIGHT	+	+
7	R	--	--	--	--
8	R	--	--	--	--
9	0.61	CLOUDY	LIGHT	+	+
10	T	CLOUDY	NONE	+	+
11	0.64	HEAVY RAIN	NONE	+	+
12	0.36	CLEAR	NONE	+	+
13	T	FOG	DENSE	--	--
14	R	--	--	--	--
15	R	--	--	--	--
16	0.03	CLOUDY	LIGHT	+	+
17	0.41	FOG	DENSE	--	--
18	2.21	LIGHT RAIN	NONE	+	+
19	0.10	CLEAR	NONE	+	+
20	0.0	PARTLY CLOUDY	NONE	-	-
21	R	--	--	--	--
22	R	--	--	--	--
23	0.20	CLOUDY	NONE	+	+
24	0.03	LIGHT RAIN	NONE	+	+
25	0.0	PARTLY CLOUDY	NONE	+	+
26	0.0	PARTLY CLOUDY	NONE	+	-
27	2.79	CLOUDY	NONE	+	-
28	R	--	--	--	--
29	R	--	--	--	--
30	0.41	CLOUDY, HAZY	LIGHT	+	-
31	0.03	CLOUDY	LIGHT	+	-
TOTAL	15.53				
AUG					
1	0.0	HAZY	NONE	+	-
2	0.18	HAZY	NONE	+	-
3	0.20	CLOUDY, FOG	DENSE	--	--
4	R	--	--	--	--
5	R	--	--	--	--
6	1.22	CLOUDY, FOG	DENSE	--	--
7	0.03	LIGHT RAIN	LIGHT	+	-
8	0.38	FOG	DENSE	-	-
9	0.0	CLOUDY	LIGHT	+	+
10	3.89	HAZY	NONE	+	+
11	R	--	--	--	--
12	R	--	--	--	--
13	0.43	CLEAR	NONE	+	+
14	0.03	HAZY	NONE	+	+
15	0.05	PARTLY CLOUDY	NONE	+	-
16	0.0	PARTLY CLOUDY	LIGHT	--	--
17	0.25	FOG	DENSE	--	--
18	R	--	--	--	--
19	R	--	--	--	--
20	1.14	CLEAR	NONE	+	+
21	0.0	FOG	DENSE	--	--
22	T	FOG	DENSE	--	--
23	2.03	CLOUDY	NONE	+	+
24	0.0	PARTLY CLOUDY	NONE	+	+
25	R	--	--	--	--
26	R	--	--	--	--
27	0.0	FOG	DENSE	-	-
28	0.0	CLEAR	LIGHT	+	+
29	T	CLOUDY, HAZY	NONE	+	-
30	0.28	HAZY	LIGHT	+	-
31	3.84	PARTLY CLOUDY	DENSE	+	-
TOTAL	13.95				

Table G-55 (cont.)

DATE	PRECIPITATION (CM)	WEATHER	FOG	PLUME 1	PLUME 2
SEP					
1	R	--	--	--	--
2	R	--	--	--	--
3	R	--	--	--	--
4	0.23	CLOUDY	NONE	+	+
5	0.0	FOG	LIGHT	+	+
6	0.0	FOG	DENSE	--	--
7	0.0	FOG	DENSE	--	--
8	R	--	--	--	--
9	R	--	--	--	--
10	0.0	PARTLY CLOUDY	NONE	+	+
11	0.0	CLOUDY	NONE	+	+
12	0.05	CLEAR	NONE	+	+
13	0.0	FOG	DENSE	+	+
14	T	CLOUDY	NONE	+	+
15	R	--	--	--	--
16	R	--	--	--	--
17	0.46	FOG	DENSE	--	--
18	T	FOG	DENSE	--	--
19	T	FOG	DENSE	+	+
20	T	FOG	LIGHT	+	+
21	0.0	CLEAR	NONE	+	+
22	R	--	--	--	--
23	R	--	--	--	--
24	0.03	HAZY	NONE	+	+
25	0.0	HAZY	NONE	+	+
26	0.20	LIGHT RAIN	NONE	+	+
27	0.25	PARTLY CLOUDY	NONE	+	+
28	0.38	CLOUDY	NONE	+	+
29	R	--	--	--	--
30	R	--	--	--	--
TOTAL	1.60				
OCT					
1	0.89	LIGHT RAIN	NONE	+	+
2	0.53	CLOUDY	NONE	+	+
3	T	FOG	DENSE	+	+
4	0.03	CLEAR	NONE	+	+
5	0.0	FOG	DENSE	--	--
6	R	--	--	--	--
7	R	--	--	--	--
8	0.03	CLOUDY	NONE	+	+
9	T	CLOUDY	LIGHT	+	+
10	0.03	CLOUDY	LIGHT	+	+
11	0.0	PARTLY CLOUDY	LIGHT	+	+
12	T	FOG	DENSE	--	--
13	R	--	--	--	--
14	R	--	--	--	--
15	0.03	PARTLY CLOUDY	NONE	+	+
16	0.0	PARTLY CLOUDY	NONE	+	-
17	0.0	CLOUDY	NONE	+	-
18	0.0	CLOUDY	NONE	+	-
19	0.0	CLOUDY	LIGHT	+	+
20	R	--	--	--	--
21	R	--	--	--	--
22	1.12	LIGHT RAIN	LIGHT	--	--
23	2.16	CLOUDY	NONE	+	+
24	T	CLOUDY	NONE	+	+
25	0.05	FOG	DENSE	--	--
26	0.15	LIGHT RAIN	LIGHT	+	+
27	R	--	--	--	--
28	R	--	--	--	--
29	1.24	CLOUDY	LIGHT	+	+
30	0.20	FOG	DENSE	+	-
31	0.0	CLEAR	NONE	+	-
TOTAL	6.46				

Table G-55 (cont.)

DATE	PRECIPITATION (CM)	WEATHER	FOG	PLUME 1	PLUME 2
NOV					
1	0.0	PARTLY CLOUDY	NONE	+	-
2	0.28	CLOUDY	NONE	+	-
3	R	--	--	--	--
4	R	--	--	--	--
5	2.16	LIGHT RAIN	LIGHT	-	-
6	0.03	PARTLY CLOUDY	NONE	+	-
7	0.0	PARTLY CLOUDY	NONE	+	-
8	0.0	CLEAR	NONE	+	-
9	0.03	PARTLY CLOUDY	NONE	+	-
10	R	--	--	--	--
11	R	--	--	--	--
12	1.32	CLOUDY	NONE	+	-
13	0.25	CLOUDY	NONE	+	-
14	0.0	CLEAR	NONE	+	-
15	0.0	PARTLY CLOUDY	NONE	+	-
16	0.10	CLEAR	NONE	+	-
17	R	--	--	--	--
18	R	--	--	--	--
19	0.0	CLOUDY	NONE	+	-
20	0.0	CLEAR	NONE	+	-
21	0.13	CLEAR	NONE	+	-
22	R	--	--	--	--
23	R	--	--	--	--
24	R	--	--	--	--
25	R	--	--	--	--
26	0.0	CLEAR	NONE	+	-
27	0.0	PARTLY CLOUDY	NONE	+	-
28	0.03	CLOUDY	NONE	+	-
29	5.87	RAIN & SNOW	NONE	+	-
30	T	FOG	DENSE	+	-
TOTAL	10.20				
DEC					
1	R	--	--	--	--
2	R	--	--	--	--
3	0.48	RAIN	NONE	+	-
4	0.64	PARTLY CLOUDY	NONE	+	-
5	0.0	PARTLY CLOUDY	NONE	+	-
6	1.52	CLOUDY	LIGHT	--	--
7	0.03	PARTLY CLOUDY	NONE	+	-
8	R	--	--	--	--
9	R	--	--	--	--
10	0.0	CLOUDY	NONE	+	-
11	0.18	FOG	DENSE	--	--
12	0.0	CLOUDY	NONE	+	-
13	0.03	PARTLY CLOUDY	LIGHT	+	-
14	T	CLOUDY	NONE	+	-
15	R	--	--	--	--
16	R	--	--	--	--
17	0.28	CLOUDY	LIGHT	+	-
18	0.0	CLEAR	DENSE	+	-
19	0.10	RAIN & SLEET	NONE	+	-
20	0.38	PARTLY CLOUDY	NONE	+	-
21	0.0	CLOUDY	NONE	+	-
22	R	--	--	--	--
23	R	--	--	--	--
24	R	--	--	--	--
25	R	--	--	--	--
26	2.44	CLOUDY	NONE	-	-
27	0.89	SNOW	NONE	-	-
28	0.48	FOG	DENSE	-	-
29	R	--	--	--	--
30	R	--	--	--	--
31	0.23	PARTLY CLOUDY	NONE	+	-
TOTAL	7.68				

R = Rainfall amount accumulated into next reading.
T = Trace (<0.02 cm).

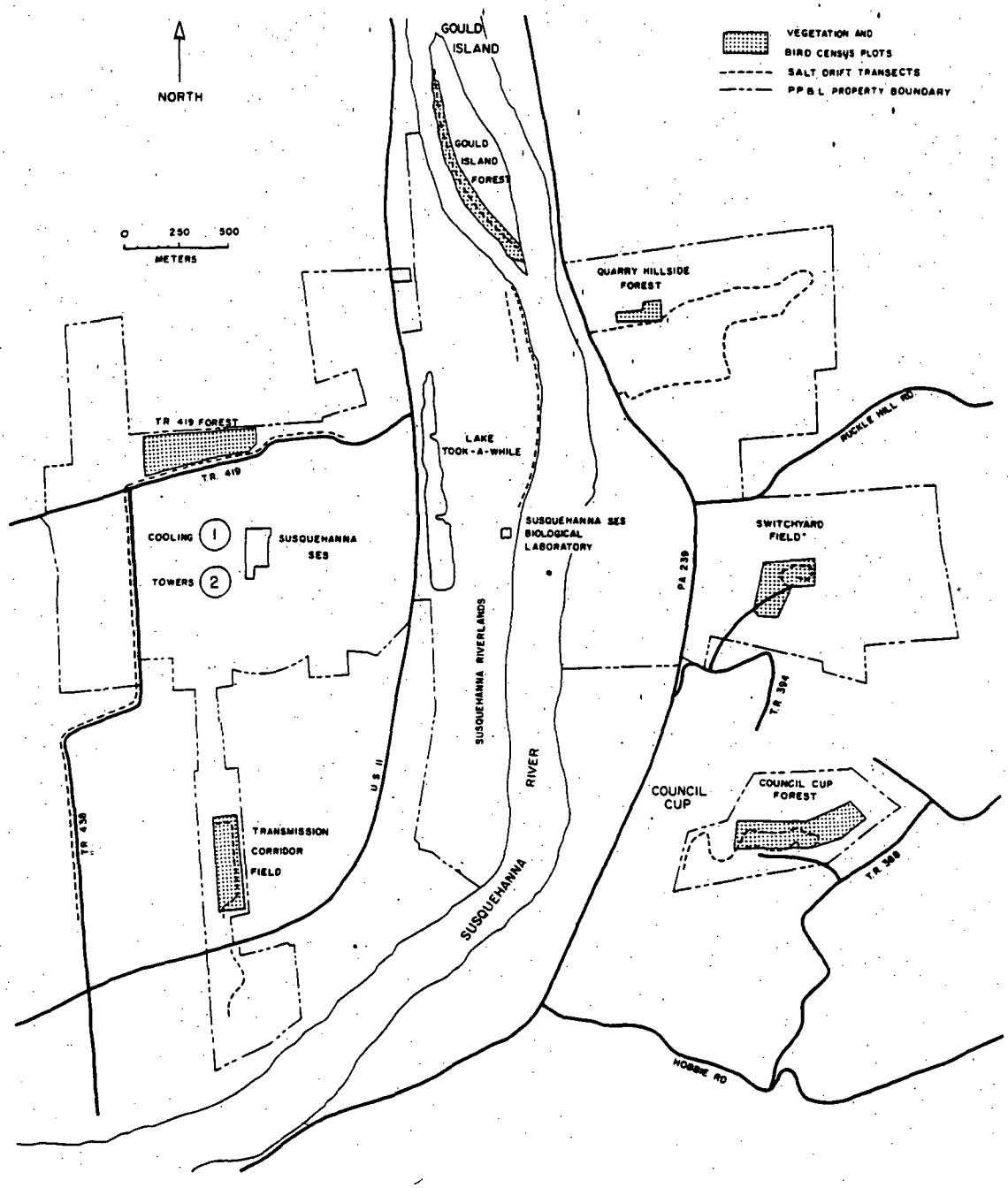

Fig. G-1

Location of vegetation and bird census plots and salt drift transects in the vicinity of the Susquehanna SES site, 1984.

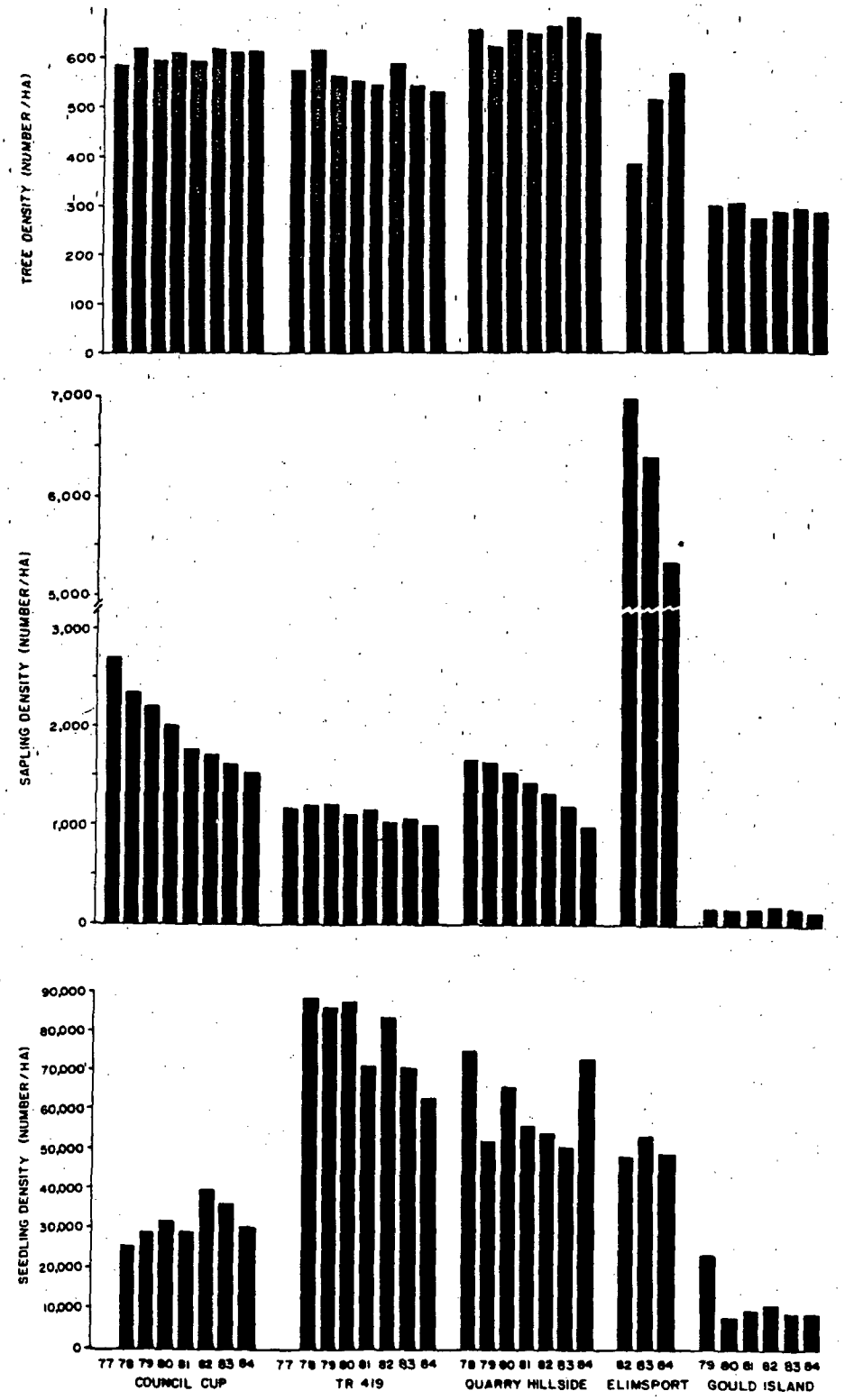

Fig. G-2

Tree, sapling, and seedling density for forest plots, 1977-84.

BIRDS

by

Douglas A. Gross and James D. Montgomery

TABLE OF CONTENTS

Page

ABSTRACT..... 288

INTRODUCTION..... 289

PROCEDURES
- Seasonal Counts..... 289
- Breeding Bird Studies..... 291
- River Bird Counts..... 292
- Bird Impaction..... 292

RESULTS AND DISCUSSION..... 293
- Seasonal Counts..... 294
- Breeding Bird Studies..... 298
- River Bird Counts..... 301
- Bird Impaction..... 302

REFERENCES CITED..... 305

LIST OF TABLES

Table

H-1 Species of birds observed near the Susquehanna SES, 1973-74 and 1977-84..... 308

H-2 Pennsylvania classified birds observed near the Susquehanna SES, 1977-84..... 311

H-3 Frequency (F), mean density (MD), and relative density (RD) of birds observed in Council Cup Forest during winter, spring, summer, and autumn counts, 1984..... 312

H-4 Frequency . . . TR419 Forest. . . 1984..... 313

H-5 Frequency . . . Switchyard Field . . . 1984..... 314

Table		Page
H-6	Frequency (F), mean density (MD), and relative density (RD) of birds observed in Transmission Corridor Field during winter, spring, summer, and autumn counts, 1984	315
H-7	Significant results of Friedman's two-way analysis of variance test and Page's distribution-free test of ordered alternatives of bird densities in different seasons in Council Cup and TR419 Forests, 1978-84, and Switchyard and Transmission Corridor Fields, 1979-84	316
H-8	Number, density (no./km^2), and relative density (RD) of breeding pairs observed in Council Cup and TR419 Forests and Switchyard and Transmission Corridor Fields during the breeding bird studies, 17 February through 14 September 1984	318
H-9	Significant results of Spearman's rank correlation coefficient (r_s), between breeding bird densities and years observed, 1979-84	319
H-10	Number of water birds observed during eight counts on the Susquehanna River, 24 February through 25 April 1984	320
H-11	Weekly bird impaction totals from Unit 1 and 2 cooling towers, 19 March through 8 June 1984	321
H-12	Weekly . . . 20 August through 9 November 1984	322

LIST OF FIGURES

Fig.		
H-1	Phenological occurrence of birds observed near the Susquehanna SES, 1984	323
H-2	Total mean density of birds in each season in Council Cup Forest and TR419 Forest, 1979-84	328
H-3	Total . . . Switchyard Field and Transmission Corridor Field, 1979-84	329
H-4	Total breeding bird densities in Council Cup and TR419 Forests and Switchyard and Transmission Corridor Fields, 1979-84	330
H-5	Total number of impacted birds collected at the Unit 1 and 2 cooling towers of the Susquehanna SES during spring and autumn migrations from 1978 through 1984, with the elevation of each tower during the same period	331

ABSTRACT

Bird studies were conducted near the Susquehanna SES during 1984, the second year of plant operation, in order to make comparisons with preoperational data. There were 197 species and two hybrids observed in 1984. An immature bald eagle, a species listed as endangered by the U.S. Department of the Interior, was observed at Beach Haven in October. Breeding bird studies in two forest and two abandoned field plots revealed that 57 species nested in or adjacent to the plots. Breeding bird studies and seasonal bird counts conducted in the same plots showed that the densities of most species were similar to past years; however, some significant density changes were found in all plots. These changes can be attributed to natural causes rather than operation of the Susquehanna SES. Most changes in bird densities in the field plots were increasing trends associated with vegetational succession. Some changes in bird densities in the forest plots appear to be associated with the recent mild winters or changes in gypsy moth larvae abundance. River bird counts were conducted during spring migration; an average of 198 water birds of 23 species and one hybrid was observed. In the bird impaction study of the Unit 1 and 2 cooling towers, 24 birds of at least 11 species were collected during spring and autumn migrations. Almost all of these birds were small passerines known to be nocturnal migrants. Nearly all impactions occurred when at least one of the cooling towers was operational. Fewer impacted birds were collected in 1984 than in previous years, but it is uncertain if this was due to operation of the towers or other factors.

INTRODUCTION

Preliminary studies of birds at the Suquehanna SES site were conducted from 1971 through 1974 and preoperational studies were conducted from January 1977 through August 1982 (Ichthyological Associates, Inc. 1973-74; Burton 1976; Ruhe 1978; Ruhe and Montgomery 1979; Gross et al. 1980, 1982; Gross and Montgomery 1981, 1983). During preoperational studies, data were collected on bird populations near the Susquehanna SES (within 8 km) and bird impaction mortality at both cooling towers. Postoperational studies, begun in September 1982 (Gross and Montgomery 1983) and conducted throughout 1983 (Gross and Montgomery 1984), and 1984 were a continuation of the preoperational work with the objectives of monitoring changes in bird populations and evaluating impact mortality which might have been caused by operation of the power plant.

PROCEDURES

Seasonal Counts

In 1984, seasonal bird counts were conducted in four plots: Council Cup Forest, Township Road 419 (TR419) Forest, Switchyard Field, and Transmission Corridor Field (Fig. G-1). Each plot was selected because it 1) was relatively uniform in habitat, 2) contained vegetation representative of the Susquehanna SES site, and 3) would remain relatively undisturbed during plant operation. Council Cup Forest (6.00 hectares) and TR419 Forest (11.05 ha) were wooded, and Switchyard Field (5.96 ha) and Transmission Corridor Field (4.34 ha) were abandoned fields undergoing secondary vegetation succession. A series of transect lines were surveyed in each plot and flagged at a distance dependent upon vegetation density.

Seven counts were done in each plot in winter (15 December - 28 February), spring (1 March - 23 May), summer (24 May - 31 July), and autumn (22 August - 30 November). All winter, spring, and autumn counts were begun prior to 0900 hours, and each summer count was started within 30 minutes of sunrise. A route along the transect lines was followed in such a way as to cover all sections of the plot without overlap. Each bird was counted and identified either visually or aurally. Identifications were made in the field or in the laboratory, using the references listed in Gross and Montgomery (1984). Nomenclature follows the American Ornithologists' Union Checklist (1984). Time and weather conditions were recorded at the start and end of each count. Counts were not conducted during periods of inclement weather, such as heavy rains or high winds. The following were calculated for bird species in each plot:

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

$$\text{Mean Density} = \frac{\text{number of a species/km}^2}{\text{total number of counts}}$$

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

The 1984 data were compared to data compiled since 1979 using two nonparametric statistical tests: Friedman's two-way analysis of variance (Siegel 1956) and Page's distribution-free test for ordered alternatives (Hollander and Wolfe 1973). Friedman's test (S) was used to detect significant changes in the numbers of each species and Page's test (L) was used to detect linear trends among years. In both tests, the 5% probability level was used to determine significance.

Breeding Bird Studies

Breeding bird counts were conducted simultaneously with seasonal counts. In each plot, twelve counts were made between 12 April and 31 July. Observations of breeding bird activity began on 17 February and nest searches continued until 14 September. Birds were counted by the spot-mapping method in which each contact with a bird was located and registered on a daily count map (Hall 1964, Robbins 1970). The species, sex, and behavioral activity (e.g. singing, aggression, nest building) were noted for each bird. Counts were begun within 30 minutes of sunrise, when activity was greatest.

Data from the counts were analyzed to estimate the number of breeding pairs of each species. Registered contacts on the daily count maps were transferred to species maps for each plot. The number of breeding pairs (i.e. home ranges or territories) was usually found by counting the number of clusters formed by the registrations of conspicuous territorial males. The number of breeding pairs was rounded to the nearest half number. The locations of nests, female birds, contacts between pair members, and territorial encounters provided supplemental data. Some birds were separable from their neighbors because they were banded. For each species, the following were calculated:

$$\text{Density} = \frac{\text{number of breeding pairs}}{\text{km}^2}$$

$$\text{Relative Density} = \frac{\text{number of breeding pairs of a species}}{\text{total number of breeding pairs of all species}}$$

The Spearman's rank correlation coefficient was used to measure the degree of association between breeding bird densities and the years those densities

occurred from 1979 through 1984 (Siegel 1956); the 5% probability level was used to determine significance. This test can also be used in trend analysis (Conover 1971). In each plot testing was confined to species with a density of at least two pairs in one of the years studied.

River Bird Counts

In spring, water birds were identified and counted from a boat on a 16-km section of the Susquehanna River from the Shickshinny-Mocanaqua Bridge to the Berwick-Nescopeck Bridge. Eight counts were made from 24 February through 25 April 1984. Each count was begun between 0800 and 1000 hours and lasted about 2.5 hours.

Bird Impaction

Collections of impacted birds were made at the Unit 1 and 2 cooling towers during 1984 spring and autumn migrations. Each hyperbolic natural draft tower is 165 m tall with diameters at the base, throat, and top of 128 m, 86 m, and 92 m, respectively. Both towers are illuminated with five, 480-volt aircraft warning strobe lights on the top and seven, 480-volt high-intensity mercury vapor lamps around the lintel, about 12 m above ground level. The towers are about 100 m apart and aligned south to north, with Unit 1 the more northerly (Fig. G-1). They are located approximately 1,400 m west of the Susquehanna River and 650 m south of a ridge which extends east and west along the site boundary. The top of the Unit 1 tower is 381 m above mean sea level, 6 m higher than the top of the Unit 2 tower. Within 1 km of the towers, ground elevations range from 160 m above msl near the river to approximately 325 m on the ridge. Both towers exceed the highest point on the ridge by about 50 m.

Systematic searches for impacted birds were begun prior to 0900 hours on weekdays, excluding holidays, from 19 March through 8 June and from 20 August through 9 November. Each search included the tower base, cold water outlet, basin interior, and an area extending at least 10 m out from the base. Impacted birds were tagged to record date and point of discovery. Floating specimens were collected with a dipnet and those impinged on the trash screens at the cold water outlet were removed using a rake. Weather conditions were noted daily at the Susquehanna SES site and augmented with data recorded at the Biological Laboratory (Tables G-53 through G-55); Susquehanna SES meteorological tower; at Avoca, Pennsylvania, by the National Oceanic and Atmospheric Administration (NOAA 1984); and at locations in eastern Pennsylvania by Weather Services Corporation.

An attempt was made to collect all impacted birds during each search; however, specimens recovered from the turbulent, discolored water in the tower basins were often in various stages of decay, indicating that they had probably impacted one or more days before collection. All data were, therefore, tabulated in 5-day groups to reduce day-to-day carryover of impacted birds.

RESULTS AND DISCUSSION

From 1973-74 and 1977-84, 236 species and two hybrids have been observed within 8 km of the Susquehanna SES (Table H-1). The phenological occurrence of the 197 species and two hybrids observed near the Susquehanna SES in 1984 is treated diagramatically in Fig. H-1. Of these, the common barn-owl and western kingbird were observed here for the first time and 24 species were listed as

Pennsylvania classified birds (Pennsylvania Game Commission 1983). An immature bald eagle, a federally listed endangered species (U.S. Department of Interior 1979), was observed at Beach Haven in October. The status of all species on these lists which have been observed near the Susquehanna SES since 1977 is presented in Table H-2.

Seasonal Counts

The total mean densities of birds in each plot and in each season from 1979 through 1984 are presented in Figs. H-2 and H-3. The populations are divided into two categories: permanent residents (Wood 1979) and migrants. Permanent residents usually stay in the same area throughout the year while migrants move from one region to another on a seasonal basis. Seasonal bird count data for 1984 are presented by plot in Tables H-3 through H-6. Significant results of nonparametric statistical tests performed to detect seasonal trends in species densities in each plot are presented in Table H-7.

Council Cup Forest

At least 66 species were observed in Council Cup Forest during 1984 (Table H-3). The number of species ranged from 11 in winter to at least 51 in spring. The total mean density was higher than the average of the five previous years in all seasons except autumn (Fig. H-2). Eleven species demonstrated significantly increasing trends in density over the last four to six years, while two species demonstrated decreasing trends (Table H-7). Permanent residents as a group have increased significantly during the winter (Spearman's rank correlation = 0.90, $P<0.05$). One of these, the black-capped chickadee was

the most common species (highest mean density) in all seasons while another, the tufted titmouse, showed significant increasing trends in all seasons. More migratory species showed trends than in past years. The wood thrush demonstrated an increasing trend in spring over the past six years and in summer over the past four years. Two other species which overwinter in the American tropics, the eastern wood-pewee and ovenbird (American Ornithologist's Union 1983), also showed increasing trends in summer while a third, the scarlet tanager, decreased.

TR419 Forest

More species (76) were observed in TR419 Forest in 1984 than in any other plot (Table H-4). Seasonally, the number of species ranged from 15 in winter to 58 in spring. The black-capped chickadee was the most common species in all seasons except spring when the yellow-rumped warbler was more common. More yellow-rumped warblers were observed in the spring of 1984 than in any past year. Overall, there have been fewer changes in bird densities in TR419 Forest than in Council Cup Forest, with a nearly equal number of significant increasing and decreasing trends. Nine of these trends were reported last year (Gross and Montgomery 1984), but there were seven new trends in 1984. These include five trends by species which did not demonstrate trends before 1984: increases by the ovenbird in both spring and summer and decreases by the brown-headed cowbird in summer and the American robin and rufous-sided towhee in autumn. The black-capped chickadee demonstrated an increasing trend in all seasons but autumn and another hole-nesting permanent resident, the tufted titmouse (Wood 1977), significantly increased from 1979 through 1984 in both spring and summer. Similar increasing trends and relatively high densities by

both species also occurred in Council Cup Forest. Three fruit-eating migrants, the American robin, cedar waxwing, and white-throated sparrow comprised only 15% of the total autumn mean density. These low densities have occurred in alternate years since 1979. The decline of the American robin in autumn counts coincided with a decline in the percent cover by flowering dogwood saplings, *Cornus florida*, (Table G-21) the fruits of which have been observed to be a major food item of migrating robins.

Switchyard Field

The number of bird species in Switchyard Field and their densities continued to be higher than in the first years of this study. There were 64 species observed in 1984 (Table H-5), whereas in 1979 there were only 39 species (Gross et al. 1980) and in 1980 only 46 (Gross and Montgomery 1981). In all seasons except winter, the total mean density of birds was higher than the average of the prior five years; but, in all seasons except spring, density was lower in 1984 than 1983 (Fig. H-3). The number of species observed in both spring and summer were higher than in any previous year. Thirteen species demonstrated significant trends in density from 1979 through 1984 and all but one of these trends were increases (Table H-7). Most species that increased were foliage-gleaners, feeding on insects found on leaves, and many were species associated with shrubby habitats. These birds have benefitted from the increases in the cover provided by the saplings, shrubs, and vines in the plot (Table G-50). Species which feed in grassy areas, such as sparrows, continued to maintain fairly high densities because parts of the plot remained open. Increased abundance of woody plants have also benefitted fruit-eating birds.

Greater coverage, and hence, fruit production of dogwoods (*Cornus* spp.) and arrowwood (*Viburnum dentatum*) accounted, at least in part, for the high autumn densities of gray catbird and white-throated sparrow. The most common bird in Switchyard Field varied seasonally with the black-capped chickadee in winter, the field sparrow in both spring and summer, and the European starling in autumn. As in previous years (Gross and Montgomery 1983), starlings roosted and nested in the transmission structures in and near the plot.

Transmission Corridor Field

As in Switchyard Field, the number of species and their densities have increased in Transmission Corridor Field probably as a result of increased shrub and sapling cover. More species were observed than in past years in all seasons except winter. At least 53 species were observed in 1984, 37 of these in autumn counts (Table H-6). By contrast only 36 species were observed in 1980 (Gross and Montgomery 1981). The densities of nine species have shown significant increasing trends from 1979 to 1984 in at least one season (Table H-7). The red-winged blackbird decreased in spring and summer; this change was discussed previously (Gross and Montgomery 1984). Densities of five species did not show trends previously: American robin, gray catbird, cedar waxwing, yellow warbler, and northern cardinal. Most of the increasing trends involved species which nest and forage in the shrubby section of the plot where gray dogwood (*Cornus racemosa*) has increased in percent cover since 1979 (Table G-52). The field sparrow was the most common species in both spring and summer, demonstrating increasing density trends since 1979 in both seasons, and other sparrows (with similar habitat preferences), the American tree sparrow

and song sparrow were the most common species in winter and autumn, respectively. Much of the plot remains fairly open and grassy, accounting for the density of these species.

Breeding Bird Studies

A total of 57 species of breeding birds occurred in the four study plots (Table H-8). There were 36 species in TR419 Forest, 29 in Switchyard Field, 27 in Council Cup Forest, and 19 in Transmission Corridor Field. The ovenbird was the most common breeding bird (highest breeding bird density) in Council Cup Forest, and shared this designation in TR419 Forest with the black-capped chickadee and scarlet tanager. The field sparrow was the most common breeding species in both Switchyard Field and Transmission Corridor Field.

The total breeding bird density in Council Cup Forest was the highest recorded in that plot, but only slightly higher than in 1983 (Fig. H-4). There has been a tendency for the total breeding density to be greater in recent years (Table H-9). As has been discussed previously, the increases in densities by some species, particularly the permanent residents, may be the result of the fairly mild winters of recent years and a long-term effect of the abundance of gypsy moth larvae and consequent tree defoliation in 1980-82 (Gross and Montgomery 1984). One of the permanent residents, the black-capped chickadee, has increased significantly since 1979. Two limb-nesting species, the eastern wood-pewee and chipping sparrow have also increased significantly. The density of the eastern wood-pewee in 1984 was more than twice that of any previous year. The increase by the chipping sparrow was more gradual, resulting from chipping sparrows nesting in the pine-dominated areas of the

plot in 1983 and 1984 rather than just outside the plot as they had previously. The ovenbird, the most common breeding species, had a density in 1984 that was higher than in the previous five years.

In TR419 Forest, the total breeding bird density has increased significantly since 1979 (Table H-9) to 1984 when the highest density was observed (Fig. H-4). More breeding species (36) were observed than in any previous year except 1983 (37). Limb-nesting species continued to be the largest group, having increased significantly since 1979. Two common limb-nesters, the red-eyed vireo and scarlet tanager, have increased significantly since 1979. Another group, the cavity-nesting species, have also tended to have higher densities in recent years. Significant increasing trends by two permanent residents, the black-capped chickadee and tufted titmouse, accounted for most of this change. As in Council Cup, the affects of recent mild winters and the gypsy moth infestation in earlier years of this study may have affected the breeding bird populations in this forest plot. The breeding density of the ovenbird increased markedly in 1984 to a level more than twice that of any of the previous five years.

The total breeding bird density in Switchyard Field continued to increase in 1984 to a level over 2-fold greater than in 1979, probably as a consequence of old field plant succession (Fig. H-4). The number of breeding species increased from 14 in 1979 (Gross et al. 1980) to 29 in 1984 (Table H-8). Five limb-nesting species demonstrated significant increasing trends since 1979: willow flycatcher, gray catbird, yellow warbler, prairie warbler, and American goldfinch. Other species such as the cedar waxwing, have become relatively common (high relative density) in the plot or appear to be invasive from nearby

woodlots and hedgerows. Three species new in 1984, the red-eyed vireo, American redstart, and rose-breasted grosbeak, are examples of the latter. Since 1979, the breeding density of two groups, the ground-nesting species and limb-nesting species, increased significantly. During this period, several woody plant species increased significantly in percent cover (Table G-50) and have formed a shrub and sapling canopy in some areas and dense thickets in others. In addition to furnishing physical support for nests, woody plants provided foraging habitat for birds which are insectivorous foliage-gleaners (warblers), flycatchers (willow flycatcher), or fruit-eaters (cedar waxwing). Parts of the plot remained open and grassy, providing a diversity of habitats for other species. One of the species which prefer grassy areas, the field sparrow, had the highest breeding density in the plot and has increased significantly since 1979.

As in Switchyard Field, the breeding density in Transmission Corridor Field increased significantly since 1979 (Table H-9) as a result of old field plant succession. The breeding density in 1984 was nearly 2-fold greater than in 1979 (Fig. H-4) and there were more than twice as many breeding species (19) in 1984 (Table H-8) than in 1979 when there were only nine (Gross et al. 1980). Over this period, the density of limb-nesting species increased significantly to a level 3-fold greater than in 1979. Two limb-nesting species, the willow flycatcher and yellow warbler, demonstrated increasing trends in that time. Although fewer significant increases were found in woody plant species in Transmission Corridor Field (Table G-52) than in Switchyard Field (Table G-50), these changes were sufficient to affect the breeding densities of birds which use shrubs and saplings for nesting and foraging. The field sparrow was the

most common breeding species in 1984 and the densities of both it and the song sparrow increased significantly since 1979. Together these two species comprised 54% of the breeding pairs in the plot. The 1984 total breeding bird density was 18% lower than the 1983 density, but this change appeared to be due to natural variation in nest-site selection by species such as the cedar waxwing and northern cardinal, which also nest in the adjacent woodlot and hedgerows.

In summary, changes in seasonal and breeding densities in each plot can be attributed to natural causes rather than operation of the Susquehanna SES. This is supported by noting that the changes in seasonal bird densities and breeding bird densities in plots nearest the Susquehanna SES (TR419 Forest and Transmission Corridor Field) are similar to changes which occurred in plots further away from the plant (Council Cup Forest and Switchyard Field). Although significant density trends occurred in each plot, those trends in the forest plots were probably due to the effect of changing gypsy moth larvae abundance and recent mild winters while trends in the field plots were a result of plant succession.

River Bird Counts

A mean of 198 water birds of 23 species and one hybrid was observed in eight river bird counts conducted from 24 February through 25 April (Table H-10). This mean was 46% above the average number of water birds observed in counts conducted from 1977 through 1983. The Canada goose, common merganser, and mallard composed 69% of the total number observed in 1984 counts. Almost all of the Canada geese were observed on either 2 or 19 March. Only the mallard and common merganser was observed on all counts.

Bird Impaction

In 1984, 24 birds of at least 11 species were collected during systematic searches for impacted birds at Unit 1 and 2 cooling towers of the Susquehanna SES. During spring migration in 1984, 11 birds of eight species were collected from 19 March through 8 June (Table H-11); one specimen was found at the Unit 1 tower and 10 specimens at the Unit 2 tower. During autumn migration, 13 birds of at least seven species were collected from 20 August through 9 November (Table H-12); nine specimens were found at the Unit 1 tower and four specimens at the Unit 2 tower. In addition to these birds, three bats were collected. A big brown bat (*Eptesicus fuscus*) and a little brown myotis (*Myotis lucifugus*) were found at the Unit 2 tower in the spring and a little brown myotis was found in the autumn at the Unit 1 tower (Burt and Grossenheider 1964, Hall and Kelson 1959).

Almost all bird species were small passerines known to be nocturnal migrants (Terres 1980). Most of these birds migrate long distances to wintering grounds in the American tropics. The three most commonly collected species were the red-eyed vireo (5), Blackburnian warbler (4), and common yellowthroat (4). Together they composed 54% of the birds collected. A Cooper's hawk, a Pennsylvania "species of concern" (Pennsylvania Game Commission 1983) was found on 4 April 1984, in the water of the Unit 2 cooling tower basin adjacent to an impacted rock dove. Both birds had large cranial bruises with crown feathers missing indicating that they probably impacted head-on into the tower during a high-speed pursuit of the rock dove by the Cooper's hawk. No federally listed threatened or endangered species were collected in 1984, nor have any been found since the study began in 1978.

The total number of spring impactions was less in 1984 than in any previous year (Fig. H-5). No more than three birds were collected on any morning and no more than three specimens were found of any species. Most spring impactions were associated with warm fronts entering Pennsylvania from the west or south. In spring, the northern movement of birds often follows a warm front when warm moist air flows from the Gulf of Mexico and the Caribbean accompanied by a falling barometer (Pettingill 1970). All spring impactions occurred when only the Unit 1 tower was operating with a visible plume.

Fewer birds impacted on the cooling towers in the autumn of 1984 than in any previous year (Fig. H-5). No more than four specimens were collected on any of the nine days birds were found. This contrasts markedly with the large daily collections of 79 and 81 birds made in 1981 (Gross et al. 1982) and 26 and 34 birds in 1982 (Gross and Montgomery 1983). But similar to past years, most autumn impactions were associated with the passage of cold fronts moving through Pennsylvania from the northwest. South-bound migration is heaviest in this region during cold front movement (Pettingill 1970). All but one of the autumn impactions at the Unit 1 tower occurred when the tower was functional, but three of the four impactions at the Unit 2 tower apparently occurred when it was not creating a plume.

The low numbers of bird impactions in the autumns of 1983 and 1984 occurred when at least one of the towers was operating throughout most of the migration season. At least three factors associated with operation may warn approaching birds of the towers: 1) visible plume, 2) air turbulence, and 3) noise. The plume can be several hundred meters in length and is well-illuminated by aircraft warning lights which make it visible for long

distances, especially at the high altitudes where migrant birds usually fly (Bellrose 1971). Wind currents and the resulting air turbulence caused by the operation of a natural draft tower probably make flight difficult for lightweight birds and may discourage them from flying too close. Generally, noise levels near an operating medium or large cooling tower range from 80 to 90 dBA and are caused principally by the resonance of air drafts and waterfalls in the tower (Edmunds et al. 1975). This broad-band low-frequency noise is within the hearing range of most birds (Terres 1980) and may alert them to the presence of the towers.

The cooling tower lights may attract night-flying birds to the towers, but apparently not from great distances. Night-flying birds are sometimes attracted to, then blinded by, bright lights, accounting for impactions on tall buildings (Pettingill 1970). When cloud ceiling is low and birds tend to fly below the clouds at low altitudes, nocturnal migrants are confused by tower lights (Cochran and Graber 1958). However, it seems that the direction of movement by nocturnally migrant birds flying at higher altitudes is not overtly affected by nuclear power plant lights and the birds are not drawn to operating towers from great distances (Marsden et al. 1980).

Although at this point, it might be concluded that operation of the cooling towers deters bird impaction; the number of impactions recorded during the preoperational phase showed high variability and operational phase data may eventually demonstrate a similar pattern. Furthermore, this variability may be caused by factors not associated with tower operation. For example, fewer bird impactions may have occurred in the autumns of 1983 and 1984 because of the lack of strong cold fronts normally associated with waves of nocturnal

migrants. Limited additional data collection is planned, particularly when both towers are commercially operational, before any conclusions are made about the effect of tower operation on bird mortality.

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Table H-1

Species of birds observed near the Susquehanna SES, 1973-74 and 1977-84. An asterisk (*) denotes new species observed in 1984.

Gaviidae
- *Gavia stellata* - red-throated loon
- *G. immer* - common loon

Podicipedidae
- *Podilymbus podiceps* - pied-billed grebe
- *Podiceps auritus* - horned grebe
- *P. grisegena* - red-necked grebe

Phalacrocoracidae
- *Phalacrocorax auritus* - double-crested cormorant

Ardeidae
- *Botaurus lentiginosus* - American bittern
- *Ixobrychus exilis* - least bittern
- *Ardea herodias* - great blue heron
- *Casmerodius albus* - great egret
- *Egretta thula* - snowy egret
- *E. caerulea* - little blue heron
- *Bubulcus ibis* - cattle egret
- *Butorides striatus* - green-backed heron
- *Nycticorax nycticorax* - black-crowned night-heron

Threskiornithidae
- *Plegadis falcinellus* - glossy ibis

Anatidae
- *Cygnus columbianus* - tundra swan
- *Chen caerulescens* - snow goose
- *Branta bernicla* - brant
- *B. canadensis* - Canada goose
- *Aix sponsa* - wood duck
- *Anas crecca* - green-winged teal
- *A. rubripes* - American black duck
- *A. platyrhynchos* - mallard
- *A. platyrhynchos x A. rubripes* - mallard-black duck
- *A. acuta* - northern pintail
- *A. discors* - blue-winged teal
- *A. strepera* - gadwall
- *A. americana* - American wigeon
- *Aythya valisineria* - canvasback
- *A. americana* - redhead
- *A. collaris* - ring-necked duck
- *A. marila* - greater scaup
- *A. affinis* - lesser scaup
- *Clangula hyemalis* - oldsquaw
- *Melanitta nigra* - black scoter
- *M. perspicillata* - surf scoter
- *M. fusca* - white-winged scoter
- *Bucephala clangula* - common goldeneye
- *B. albeola* - bufflehead
- *Lophodytes cucullatus* - hooded merganser
- *Mergus merganser* - common merganser
- *M. serrator* - red-breasted merganser
- *Oxyura jamaicensis* - ruddy duck

Cathartidae
- *Cathartes aura* - turkey vulture

Accipitridae
- *Pandion haliaetus* - osprey
- *Haliaeetus leucocephalus* - bald eagle
- *Circus cyaneus* - northern harrier
- *Accipiter striatus* - sharp-shinned hawk
- *A. cooperii* - Cooper's hawk
- *A. gentilis* - northern goshawk
- *Buteo lineatus* - red-shouldered hawk
- *B. platypterus* - broad-winged hawk
- *B. swainsoni* - Swainson's hawk
- *B. jamaicensis* - red-tailed hawk
- *B. lagopus* - rough-legged hawk

Falconidae
- *Falco sparverius* - American kestrel
- *F. columbarius* - merlin
- *F. peregrinus* - peregrine falcon

Phasianidae
- *Phasianus colchicus* - ring-necked pheasant
- *Bonasa umbellus* - ruffed grouse
- *Meleagris gallopavo* - wild turkey
- *Colinus virginianus* - northern bobwhite

Rallidae
- *Rallus limicola* - Virginia rail
- *Porzana carolina* - sora
- *Gallinula chloropus* - common moorhen
- *Fulica americana* - American coot

Charadriidae
- *Pluvialis squatarola* - black-bellied plover
- *Charadrius semipalmatus* - semipalmated plover
- *C. vociferus* - killdeer

Scolopacidae
- *Tringa melanoleucus* - greater yellowlegs
- *T. flavipes* - lesser yellowlegs
- *T. solitaria* - solitary sandpiper
- *Actitis macularia* - spotted sandpiper
- *Calidris pusillus* - semipalmated sandpiper
- *C. minutilla* - least sandpiper
- *C. fuscicollis* - white-rumped sandpiper
- *C. melanotos* - pectoral sandpiper
- *Limnodromus griseus* - short-billed dowitcher
- *Gallinago gallinago* - common snipe
- *Scolopax minor* - American woodcock
- *Phalaropus tricolor* - Wilson's phalarope

Laridae
- *Larus atricilla* - laughing gull
- *L. philadelphia* - Bonaparte's gull
- *L. delawarensis* - ring-billed gull
- *L. argentatus* - herring gull
- *L. marinus* - great black-backed gull
- *Sterna hirundo* - common tern

Table H-1 (cont.)

Columbidae
Columba livia - rock dove
Zenaida macroura - mourning dove

Cuculidae
Coccyzus erythropthalmus - black-billed cuckoo
C. americanus - yellow-billed cuckoo

Tytonidae
**Tyto alba* - common barn-owl

Strigidae
Otus asio - eastern screech-owl
Bubo virginianus - great horned owl
Asio otus - long-earned owl
A. flammeus - short-eared owl

Caprimulgidae
Chordeiles minor - common nighthawk

Apodidae
Chaetura pelagica - chimney swift

Trochilidae
Archilochus colubris - ruby-throated hummingbird

Alcedinidae
Ceryle alcyon - belted kingfisher

Picidae
Melanerpes erythrocephalus - red-headed woodpecker
M. carolinus - red-bellied woodpecker
Sphyrapicus varius - yellow-bellied sapsucker
Picoides pubescens - downy woodpecker
P. villosus - hairy woodpecker
Colaptes auratus - northern flicker
Dryocopus pileatus - pileated woodpecker

Tyrannidae
Contopus borealis - olive-sided flycatcher
C. virens - eastern wood-pewee
Empidonax flaviventris - yellow-bellied flycatcher
E. virescens - acadian flycatcher
E. traillii - willow flycatcher
E. minimus - least flycatcher
Sayornis phoebe - eastern phoebe
Myiarchus crinitus - great crested flycatcher
**Tyrannus verticalis* - western kingbird
T. tyrannus - eastern kingbird

Alaudidae
Eremophila alpestris - horned lark

Hirundinidae
Progne subis - purple martin
Tachycineta bicolor - tree swallow
Stelgidopteryx serripennis - northern rough-winged swallc
Riparia riparia - bank swallow
Hirundo pyrrhonota - cliff swallow
H. rustica - barn swallow

Corvidae
Cyanocitta cristata - blue jay
Corvus brachyrhynchos - American crow
C. ossifragus - fish crow
C. corax - common raven

Paridae
Parus atricapillus - black-capped chickadee
P. bicolor - tufted titmouse

Sittidae
Sitta canadensis - red-breasted nuthatch
S. carolinensis - white-breasted nuthatch

Certhiidae
Certhia americana - brown creeper

Troglodytidae
Thryothorus ludovicianus - Carolina wren
Troglodytes acdon - house wren
T. troglodytes - winter wren
Cistothoros palustris - marsh wren

Muscicapidae
Regulus satrapa - golden-crowned kinglet
R. calendula - ruby-crowned kinglet
Polioptila caerulea - blue-gray gnatcatcher
Sialia sialis - eastern bluebird
Catharus fuscescens - veery
C. minimus - gray-cheeked thrush
C. ustulata - Swainson's thrush
C. guttata - hermit thrush
Hylocichla mustelina - wood thrush
Turdus migratorius - American robin

Mimidae
Dumetella carolinensis - gray catbird
Mimus polyglottos - northern mockingbird
Toxostoma rufum - brown thrasher

Motacillidae
Anthus spinoletta - water pipit

Table H-1 (cont.)

Bombycillidae
Bombycilla cedrorum - cedar waxwing

Laniidae
Lanius ludovicianus - loggerhead shrike

Sturnidae
Sturnus vulgaris - European starling

Vireonidae
Vireo griseus - white-eyed vireo
V. solitarius - solitary vireo
V. flavifrons - yellow-throated vireo
V. gilvus - warbling vireo
V. philadelphicus - Philadelphia vireo
V. olivaceus - red-eyed vireo

Emberizidae
Vermivora pinus - blue-winged warbler
V. chrysoptera - golden-winged warbler
V. chrysoptera x V. pinus - Brewster's warbler
V. peregrina - Tennessee warbler
V. celata - orange-crowned warbler
V. ruficapilla - Nashville warbler
Parula americana - northern parula
Dendroica petechia - yellow warbler
D. pensylvanica - chestnut-sided 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. fusca - Blackburnian warbler
D. dominica - yellow-throated warbler
D. pinus - pine warbler
D. discolor - prairie warbler
D. palmarum - palm warbler
D. castanea - bay-breasted warbler
D. striata - blackpoll warbler
D. cerulea - cerulean warbler
Mniotilta varia - black-and-white warbler
Setophaga ruticilla - American redstart
Protonotaria citrea - prothonotary warbler
Helmitheros vermivorus - worm-eating warbler
Seiurus aurocapillus - ovenbird
S. noveboracensis - northern waterthrush
S. motacilla - Louisiana waterthrush
Oporornis formosus - Kentucky warbler
O. agilis - Connecticut warbler
O. philadelphia - mourning warbler
Geothlypis trichas - common yellowthroat
Wilsonia citrina - hooded warbler
W. pusilla - Wilson's warbler
W. canadensis - Canada warbler
Icteria virens - yellow-breasted chat
Piranga rubra - summer tanager
P. olivacea - scarlet tanager
Cardinalis cardinalis - northern cardinal
Pheucticus ludovicianus - rose-breasted grosbeak
Guiraca caerulea - blue grosbeak
Passerina cyanea - indigo bunting
Spiza americana - dickcissel
Pipilo erythrophthalmus - rufous-sided towhee
Spizella arborea - American tree sparrow
S. passerina - chipping sparrow
S. pusilla - field sparrow

Emberizidae (cont.)
Pooecetes gramineus - vesper sparrow
Passerculus sandwichensis -savannah sparrow
Ammodramus savannarum - grasshopper sparrow
A. caudacuta - sharp-tailed sparrow
Passerella iliaca - fox sparrow
Melospiza melodia - song sparrow
M. lincolnii - Lincoln's sparrow
M. georgiana - swamp sparrow
Zonotrichia albicollis - white-throated sparrow
Z. leucophrys - white-crowned sparrow
Junco hyemalis - dark-eyed junco
Plectrophenax nivalis - snow bunting
Dolichonyx oryzivorus - bobolink
Agelaius phoeniceus - red-winged blackbird
Sturnella magna - eastern meadowlark
Euphagus carolinus - rusty blackbird
Quiscalus quiscula - common grackle
Molothrus ater - brown-headed cowbird
Icterus spurius - orchard oriole
I. galbula - northern oriole

Fringillidae
Pinicola enucleator - pine grosbeak
Carpodacus purpureus - purple finch
C. mexicanus - house finch
Loxia leucoptera - white-winged crossbill
Carduelis flammea - common redpoll
C. pinus - pine siskin
C. tristis - American goldfinch
Coccothraustes vespertinus - evening grosbeak

Passeridae
Passer domesticus - house sparrow

Table H-2

Pennsylvania classified birds observed near the Susquehanna SES site, 1977-84.

Category*/Species	1984 Status Near Site
Extirpated	
Osprey	Common migrant along the Susquehanna River.
† Peregrine falcon	Not observed in 1984; last sighting, 3 October 1982.
Common tern	Two observed along the Susquehanna River, 25 April 1984.
Loggerhead shrike	Not observed in 1984; last sighting, 23 April 1983.
Endangered	
† Bald eagle	An immature, banded in 1984 as a nestling at Tupper Lake, New York, was observed along the Susquehanna River at Beach Haven, 5-10 October 1984.
Short-eared owl	Not observed in 1984; last sighting, 30 December 1977.
Threatened	
American bittern	One observed in Susquehanna Riverlands, 26 September 1984.
Least bittern	Single birds observed in Susquehanna Riverlands, 22-26 May and 4 October 1984.
Species of Concern	
Great blue heron	Common migrant at most bodies of water.
Cooper's hawk	One impacted on Unit 2 cooling tower, 4 April 1984; uncommon in all seasons; pairs apparently nested near TR419 Forest and Switchyard Field.
Red-shouldered hawk	None observed in 1984; last sighting, 14 October 1983.
Northern harrier	Uncommon migrant and winter resident in Susquehanna Riverlands.
Northern bobwhite	Not observed in 1984; last sighting, 30 January 1978.
Common barn-owl	A pair with young observed in Beach Haven, 6-11 July 1984.
Red-headed woodpecker	An immature observed in Susquehanna Riverlands, 9-11 September 1984.
Purple martin	Several pairs nested in birdhouses located in Nescopeck.
Marsh wren	Uncommon migrant in Susquehanna Riverlands.
Eastern bluebird	Four pairs nested in Susquehanna Riverlands, others near Council Cup; increasingly common migrant and winter resident.
Grasshopper sparrow	Uncommon migrant in Transmission Corridor Field and Susquehanna Riverlands; no evidence of nesting observed in 1984.
Vesper sparrow	Uncommon migrant in Transmission Corridor Field and Susquehanna Riverlands; a pair apparently nested in a field near Council Cup Forest.
Status Undetermined	
Sharp-shinned hawk	Most frequently observed migrant hawk at Council Cup Overlook; uncommon elsewhere in all seasons.
Northern goshawk	None observed in 1984; last sighting, 30 April 1982.
Long-eared owl	None observed in 1984; last sighting, 4 October 1982.
Yellow-bellied sapsucker	Uncommon migrant in forested areas.
Least flycatcher	Uncommon migrant in open woods and field edges; a pair apparently nested in Susquehanna Riverlands.
Bobolink	Uncommon migrant in open fields; no evidence of nesting in 1984.

Table H-3

Frequency (F), mean density (MD), and relative density (RD) of birds observed in Council Cup Forest during winter, spring, summer, and autumn counts, 1984.

SPECIES	WINTER			SPRING			SUMMER			AUTUMN		
	F	MD	RD	F	MD	RD	F	MD	RD	F	MD	RD
SHARP-SHINNED HAWK	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0
RUFFED GROUSE	0.29	4.8	1.6	0.14	2.4	0.3	0.00	0.0	0.0	0.57	28.6	3.5
YELLOW-BILLED CUCKOO	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0
YELLOW-BELLIED SAPSUCKER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	4.8	0.6
DOWNY WOODPECKER	1.00	35.7	12.2	0.43	7.1	1.0	0.86	31.0	3.6	0.71	21.4	2.6
HAIRY WOODPECKER	0.43	11.9	4.1	0.29	7.1	1.0	0.71	16.7	1.9	0.14	2.4	0.3
NORTHERN FLICKER	0.00	0.0	0.0	0.29	4.8	0.6	0.86	19.0	2.2	0.14	4.8	0.6
PILEATED WOODPECKER	0.14	2.4	0.8	0.00	0.0	0.0	0.14	4.8	0.6	0.14	2.4	0.3
EASTERN WOOD-PEWEE	0.00	0.0	0.0	0.14	11.9	1.6	0.86	54.8	6.4	0.43	42.9	5.2
LEAST FLYCATCHER	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.00	0.0	0.0
EMPIDONAX FLYCATCHER SP.	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.3
EASTERN PHOEBE	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.14	4.8	0.6
GREAT CRESTED FLYCATCHER	0.00	0.0	0.0	0.43	19.0	2.6	1.00	40.5	4.7	0.29	4.8	0.6
EASTERN KINGBIRD	0.00	0.0	0.0	0.14	14.3	1.9	0.00	0.0	0.0	0.00	0.0	0.0
BLUE JAY	0.29	4.8	1.6	0.71	52.4	7.0	0.86	71.4	8.3	0.86	38.1	4.6
AMERICAN CROW	0.00	0.0	0.0	0.43	9.5	1.3	0.00	0.0	0.0	0.00	0.0	0.0
BLACK-CAPPED CHICKADEE	1.00	78.6	26.8	1.00	97.6	13.1	1.00	145.2	16.9	1.00	173.8	21.2
TUFTED TITMOUSE	0.71	38.1	13.0	1.00	35.7	4.8	0.86	38.1	4.4	0.57	42.9	5.2
RED-BREASTED NUTHATCH	0.29	4.8	1.6	0.57	16.7	2.2	0.00	0.0	0.0	0.00	0.0	0.0
WHITE-BREASTED NUTHATCH	0.86	31.0	10.6	0.29	11.9	1.6	0.71	11.9	1.4	0.86	33.3	4.1
BROWN CREEPER	0.71	23.8	8.1	0.43	16.7	2.2	0.86	21.4	2.5	0.14	2.4	0.3
HOUSE WREN	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.3
GOLDEN-CROWNED KINGLET	0.71	57.1	19.5	0.00	0.0	0.0	0.00	0.0	0.0	0.43	28.6	3.5
RUBY-CROWNED KINGLET	0.00	0.0	0.0	0.14	23.8	3.2	0.00	0.0	0.0	0.43	31.0	3.8
BLUE-GRAY GNATCATCHER	0.00	0.0	0.0	0.57	14.3	1.9	0.29	9.5	1.1	0.00	0.0	0.0
GRAY-CHEEKED THRUSH	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.00	0.0	0.0
SWAINSON'S THRUSH	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
HERMIT THRUSH	0.00	0.0	0.0	0.43	26.2	3.5	0.00	0.0	0.0	0.14	2.4	0.3
WOOD THRUSH	0.00	0.0	0.0	0.57	26.2	3.5	1.00	59.5	6.9	0.29	7.1	0.9
AMERICAN ROBIN	0.00	0.0	0.0	0.29	7.1	1.0	0.43	9.5	1.1	0.29	7.1	0.9
CEDAR WAXWING	0.00	0.0	0.0	0.00	0.0	0.0	0.71	26.2	3.0	0.57	45.2	5.5
SOLITARY VIREO	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.29	7.1	0.9
RED-EYED VIREO	0.00	0.0	0.0	0.29	11.9	1.6	1.00	66.7	7.7	0.57	28.6	3.5
TENNESSEE WARBLER	0.00	0.0	0.0	0.29	9.5	1.3	0.00	0.0	0.0	0.29	7.1	0.9
ORANGE-CROWNED WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.3
NASHVILLE WARBLER	0.00	0.0	0.0	0.29	9.5	1.3	0.00	0.0	0.0	0.43	11.9	1.4
CHESTNUT-SIDED WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	7.1	0.9
MAGNOLIA WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	7.1	0.9
CAPE MAY WARBLER	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.29	14.3	1.7
BLACK-THROATED BLUE WARBLER	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.14	7.1	0.9
YELLOW-RUMPED WARBLER	0.00	0.0	0.0	0.86	85.7	11.5	0.00	0.0	0.0	0.29	23.8	2.9
BLACK-THROATED GREEN WARBLER	0.00	0.0	0.0	0.43	14.3	1.9	0.00	0.0	0.0	0.29	14.3	1.7
BLACKBURNIAN WARBLER	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.14	2.4	0.3
PINE WARBLER	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
BAY-BREASTED WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.57	28.6	3.5
BLACKPOLL WARBLER	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.57	52.4	6.4
BLACK-AND-WHITE WARBLER	0.00	0.0	0.0	0.57	21.4	2.9	0.86	21.4	2.5	0.43	9.5	1.2
AMERICAN REDSTART	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.00	0.0	0.0
WORM-EATING WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.29	4.8	0.6	0.00	0.0	0.0
OVENBIRD	0.00	0.0	0.0	0.57	31.0	4.2	1.00	78.6	9.1	0.43	11.9	1.4
LOUISIANA WATERTHRUSH	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
COMMON YELLOWTHROAT	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0
SCARLET TANAGER	0.00	0.0	0.0	0.43	16.7	2.2	0.43	14.3	1.7	0.14	4.8	0.6
NORTHERN CARDINAL	0.00	0.0	0.0	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0
ROSE-BREASTED GROSBEAK	0.00	0.0	0.0	0.43	9.5	1.3	0.86	26.2	3.0	0.00	0.0	0.0
INDIGO BUNTING	0.00	0.0	0.0	0.14	4.8	0.6	0.29	4.8	0.6	0.14	7.1	0.9
RUFOUS-SIDED TOWHEE	0.00	0.0	0.0	0.14	2.4	0.3	0.71	14.3	1.7	0.29	4.8	0.6
CHIPPING SPARROW	0.00	0.0	0.0	0.29	11.9	1.6	0.71	23.8	2.8	0.14	4.8	0.6
FIELD SPARROW	0.00	0.0	0.0	0.14	2.4	0.3	0.29	7.1	0.8	0.00	0.0	0.0
DARK-EYED JUNCO	0.00	0.0	0.0	0.29	4.8	0.6	0.00	0.0	0.0	0.43	19.0	2.3
RED-WINGED BLACKBIRD	0.00	0.0	0.0	0.14	2.4	0.3	0.14	2.4	0.3	0.00	0.0	0.0
COMMON GRACKLE	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
BROWN-HEADED COWBIRD	0.00	0.0	0.0	0.86	38.1	5.1	0.29	9.5	1.1	0.00	0.0	0.0
NORTHERN ORIOLE	0.00	0.0	0.0	0.43	7.1	1.0	0.14	7.1	0.8	0.00	0.0	0.0
PURPLE FINCH	0.00	0.0	0.0	0.00	0.0	0.0	0.29	4.8	0.6	0.00	0.0	0.0
AMERICAN GOLDFINCH	0.00	0.0	0.0	0.29	11.9	1.6	0.29	4.8	0.6	0.29	11.9	1.4
EVENING GROSBEAK	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
	-	292.9	100.0	-	745.2	100.0	-	861.9	100.0	-	821.4	100.0

Table H-4

Frequency (F), mean density (MD), and relative density (RD) of birds observed in TR419 Forest during winter, spring, summer, and autumn counts, 1984.

SPECIES	WINTER			SPRING			SUMMER			AUTUMN		
	F	MD	RD	F	MD	RD	F	MD	RD	F	MD	RD
TURKEY VULTURE	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.00	0.0	0.0
COOPER'S HAWK	0.00	0.0	0.0	0.00	0.0	0.0	0.29	2.6	0.5	0.00	0.0	0.0
BROAD-WINGED HAWK	0.00	0.0	0.0	0.29	3.9	0.7	0.00	0.0	0.0	0.00	0.0	0.0
RUFFED GROUSE	0.29	2.6	1.3	0.14	1.3	0.2	0.29	2.6	0.5	0.14	1.3	0.2
WILD TURKEY	0.14	3.9	1.9	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0
YELLOW-BILLED CUCKOO	0.00	0.0	0.0	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0
GREAT HORNED OWL	0.00	0.0	0.0	0.00	0.0	0.0	0.14	1.3	0.2	0.14	1.3	0.2
RUBY-THROATED HUMMINGBIRD	0.00	0.0	0.0	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0
DOWNY WOODPECKER	0.86	14.2	7.0	0.86	12.9	2.4	1.00	22.0	3.9	1.00	23.3	3.7
HAIRY WOODPECKER	0.43	3.9	1.9	0.43	5.2	1.0	0.00	0.0	0.0	0.71	7.8	1.2
NORTHERN FLICKER	0.00	0.0	0.0	0.71	10.3	1.9	0.71	10.3	1.8	0.43	5.2	0.8
PILEATED WOODPECKER	0.29	3.9	1.9	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0
EASTERN WOOD-PEWEE	0.00	0.0	0.0	0.14	3.9	0.7	1.00	24.6	4.4	0.29	6.5	1.0
LEAST FLYCATCHER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.9	0.6
EASTERN PHOEBE	0.00	0.0	0.0	0.43	5.2	1.0	0.00	0.0	0.0	0.00	0.0	0.0
GREAT CRESTED FLYCATCHER	0.00	0.0	0.0	0.29	5.2	1.0	0.14	1.3	0.2	0.14	1.3	0.2
EASTERN KINGBIRD	0.00	0.0	0.0	0.14	2.6	0.5	0.00	0.0	0.0	0.00	0.0	0.0
BARN SWALLOW	0.00	0.0	0.0	0.14	3.9	0.7	0.00	0.0	0.0	0.00	0.0	0.0
BLUE JAY	0.14	5.2	2.5	0.57	32.3	6.1	1.00	36.2	6.5	1.00	47.8	7.5
AMERICAN CROW	0.00	0.0	0.0	0.43	6.5	1.2	0.43	9.0	1.6	0.00	0.0	0.0
BLACK-CAPPED CHICKADEE	1.00	63.3	31.2	1.00	63.3	11.9	1.00	68.5	12.2	1.00	90.5	14.2
TUFTED TITMOUSE	0.86	20.7	10.2	1.00	29.7	5.6	1.00	40.1	7.1	1.00	28.4	4.5
RED-BREASTED NUTHATCH	0.86	7.8	3.8	0.29	3.9	0.7	0.00	0.0	0.0	0.00	0.0	0.0
WHITE-BREASTED NUTHATCH	0.57	7.8	3.8	0.14	1.3	0.2	0.29	3.9	0.7	0.86	10.3	1.6
BROWN CREEPER	0.57	7.8	3.8	0.71	16.8	3.1	0.14	1.3	0.2	0.57	7.8	1.2
CAROLINA WREN	0.14	1.3	0.6	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0
HOUSE WREN	0.00	0.0	0.0	0.14	2.6	0.5	0.00	0.0	0.0	0.00	0.0	0.0
GOLDEN-CROWNED KINGLET	0.86	22.0	10.8	0.00	0.0	0.0	0.00	0.0	0.0	0.43	12.9	2.0
RUBY-CROWNED KINGLET	0.00	0.0	0.0	0.14	5.2	1.0	0.00	0.0	0.0	0.43	3.9	0.6
BLUE-GRAY GNATCATCHER	0.00	0.0	0.0	0.43	16.8	3.1	0.57	9.0	1.6	0.00	0.0	0.0
SWAINSON'S THRUSH	0.00	0.0	0.0	0.14	3.9	0.7	0.00	0.0	0.0	0.00	0.0	0.0
WOOD THRUSH	0.00	0.0	0.0	0.43	11.6	2.2	1.00	42.7	7.6	0.43	10.3	1.6
AMERICAN ROBIN	0.14	1.3	0.6	0.43	3.9	0.7	0.57	6.5	1.2	0.57	37.5	5.9
GRAY CATBIRD	0.00	0.0	0.0	0.14	1.3	0.2	0.86	23.3	4.1	0.14	1.3	0.2
CEDAR WAXWING	0.00	0.0	0.0	0.00	0.0	0.0	0.29	3.9	0.7	0.57	34.9	5.5
SOLITARY VIREO	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.43	6.5	1.0
WARBLING VIREO	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.00	0.0	0.0
RED-EYED VIREO	0.00	0.0	0.0	0.14	6.5	1.2	1.00	29.7	5.3	0.57	20.7	3.2
TENNESSEE WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.9	0.6
NASHVILLE WARBLER	0.00	0.0	0.0	0.14	5.2	1.0	0.00	0.0	0.0	0.14	2.6	0.4
NORTHERN PARULA	0.00	0.0	0.0	0.14	3.9	0.7	0.00	0.0	0.0	0.14	1.3	0.2
CHESTNUT-SIDED WARBLER	0.00	0.0	0.0	0.29	2.6	0.5	0.14	1.3	0.2	0.29	3.9	0.6
MAGNOLIA WARBLER	0.00	0.0	0.0	0.14	2.6	0.5	0.00	0.0	0.0	0.29	2.6	0.4
CAPE MAY WARBLER	0.00	0.0	0.0	0.29	3.9	0.7	0.00	0.0	0.0	0.57	9.0	1.4
BLACK-THROATED BLUE WARBLER	0.00	0.0	0.0	0.14	2.6	0.5	0.00	0.0	0.0	0.14	2.6	0.4
YELLOW-RUMPED WARBLER	0.00	0.0	0.0	0.43	75.0	14.0	0.00	0.0	0.0	0.29	9.0	1.4
BLACK-THROATED GREEN WARBLER	0.00	0.0	0.0	0.43	6.5	1.2	0.00	0.0	0.0	0.43	12.9	2.0
BLACKBURNIAN WARBLER	0.00	0.0	0.0	0.57	11.6	2.2	0.00	0.0	0.0	0.43	11.6	1.8
PINE WARBLER	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.14	1.3	0.2
PRAIRIE WARBLER	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.00	0.0	0.0
BAY-BREASTED WARBLER	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.43	10.3	1.6
BLACKPOLL WARBLER	0.00	0.0	0.0	0.14	2.6	0.5	0.00	0.0	0.0	0.71	16.8	2.6
CERULEAN WARBLER	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.00	0.0	0.0
BLACK-AND-WHITE WARBLER	0.00	0.0	0.0	0.57	15.5	2.9	1.00	18.1	3.2	0.57	11.6	1.8
AMERICAN REDSTART	0.00	0.0	0.0	0.57	16.8	3.1	0.71	12.9	2.3	0.43	6.5	1.0
WORM-EATING WARBLER	0.00	0.0	0.0	0.29	2.6	0.5	0.43	3.9	0.7	0.14	1.3	0.2
OVENBIRD	0.00	0.0	0.0	0.57	18.1	3.4	1.00	49.1	8.8	0.57	15.5	2.4
CONNECTICUT WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	1.3	0.2
COMMON YELLOWTHROAT	0.00	0.0	0.0	0.14	1.3	0.2	0.14	1.3	0.2	0.29	2.6	0.4
HOODED WARBLER	0.00	0.0	0.0	0.29	3.9	0.7	0.71	10.3	1.8	0.00	0.0	0.0
CANADA WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	2.6	0.4
SCARLET TANAGER	0.00	0.0	0.0	0.43	15.5	2.9	1.00	40.1	7.1	0.71	18.1	2.8
NORTHERN CARDINAL	0.00	0.0	0.0	0.86	14.2	2.7	1.00	33.6	6.0	0.71	20.7	3.2
ROSE-BREASTED GROSBEAK	0.00	0.0	0.0	0.29	7.8	1.5	1.00	19.4	3.5	0.29	3.9	0.6
INDIGO BUNTING	0.00	0.0	0.0	0.14	1.3	0.2	0.29	7.8	1.4	0.14	2.6	0.4
RUFOUS-SIDED TOWHEE	0.00	0.0	0.0	0.29	3.9	0.7	0.29	5.2	0.9	0.14	1.3	0.2
SONG SPARROW	0.00	0.0	0.0	0.14	1.3	0.2	0.00	0.0	0.0	0.00	0.0	0.0
WHITE-THROATED SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	20.7	3.2
DARK-EYED JUNCO	0.00	0.0	0.0	0.29	7.8	1.5	0.00	0.0	0.0	0.29	5.2	0.8
COMMON GRACKLE	0.00	0.0	0.0	0.00	0.0	0.0	0.14	1.3	0.2	0.14	64.6	10.1
BROWN-HEADED COWBIRD	0.00	0.0	0.0	0.71	20.7	3.9	0.71	11.6	2.1	0.00	0.0	0.0
ORCHARD ORIOLE	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	1.3	0.2
NORTHERN ORIOLE	0.00	0.0	0.0	0.43	6.5	1.2	0.14	1.3	0.2	0.14	5.2	0.8
PURPLE FINCH	0.00	0.0	0.0	0.29	7.8	1.5	0.00	0.0	0.0	0.00	0.0	0.0
AMERICAN GOLDFINCH	0.00	0.0	0.0	0.29	5.2	1.0	0.14	1.3	0.2	0.14	1.3	0.2
EVENING GROSBEAK	0.29	37.5	18.5	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0
	-	203.0	100.0	-	533.9	100.0	-	561.1	100.0	-	637.4	100.0

Table H-5

Frequency (F), mean density (MD), and relative density (RD) of birds observed in Switchyard Field during winter, spring, summer, and autumn counts, 1984.

SPECIES	WINTER			SPRING			SUMMER			AUTUMN		
	F	MD	RD	F	MD	RD	F	MD	RD	F	MD	RD
RING-NECKED PHEASANT	0.00	0.0	0.0	0.00	0.0	0.0	0.17	11.2	0.9	0.00	0.0	0.0
RUFFED GROUSE	0.00	0.0	0.0	0.00	0.0	0.0	0.17	5.6	0.4	0.00	0.0	0.0
AMERICAN WOODCOCK	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.2
MOURNING DOVE	0.00	0.0	0.0	0.00	0.0	0.0	0.33	22.4	1.8	0.00	0.0	0.0
BLACK-BILLED CUCKOO	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.2
RUBY-THROATED HUMMINGBIRD	0.00	0.0	0.0	0.29	4.8	0.6	0.17	5.6	0.4	0.00	0.0	0.0
DOWNY WOODPECKER	0.14	2.4	3.0	0.00	0.0	0.0	0.17	2.8	0.2	0.00	0.0	0.0
NORTHERN FLICKER	0.00	0.0	0.0	0.29	24.0	3.1	0.33	5.6	0.4	0.57	26.4	1.9
WILLOW FLYCATCHER	0.00	0.0	0.0	0.00	0.0	0.0	1.00	55.9	4.4	0.14	4.8	0.4
LEAST FLYCATCHER	0.00	0.0	0.0	0.29	9.6	1.2	0.00	0.0	0.0	0.00	0.0	0.0
EASTERN PHOEBE	0.00	0.0	0.0	0.14	2.4	0.3	0.50	8.4	0.7	0.29	12.0	0.9
GREAT CRESTED FLYCATCHER	0.00	0.0	0.0	0.00	0.0	0.0	0.17	2.8	0.2	0.00	0.0	0.0
EASTERN KINGBIRD	0.00	0.0	0.0	0.43	9.6	1.2	0.83	14.0	1.1	0.00	0.0	0.0
BARN SWALLOW	0.00	0.0	0.0	0.00	0.0	0.0	0.17	8.4	0.7	0.00	0.0	0.0
BLUE JAY	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.43	9.6	0.7
BLACK-CAPPED CHICKADEE	1.00	33.6	42.4	0.43	14.4	1.8	0.00	0.0	0.0	0.29	9.6	0.7
TUFTED TITMOUSE	0.43	7.2	9.1	0.00	0.0	0.0	0.00	0.0	0.0	0.14	2.4	0.2
HOUSE WREN	0.00	0.0	0.0	0.14	2.4	0.3	0.17	2.8	0.2	0.57	38.4	2.8
WINTER WREN	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	4.8	0.4
RUBY-CROWNED KINGLET	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.14	4.8	0.4
BLUE-GRAY GNATCATCHER	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.14	2.4	0.2
EASTERN BLUEBIRD	0.14	4.8	6.1	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0
HERMIT THRUSH	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	4.8	0.4
AMERICAN ROBIN	0.00	0.0	0.0	0.29	7.2	0.9	0.50	11.2	0.9	0.43	47.9	3.5
GRAY CATBIRD	0.00	0.0	0.0	0.43	43.1	5.5	1.00	134.2	10.5	0.71	67.1	4.9
NORTHERN MOCKINGBIRD	0.00	0.0	0.0	0.29	4.8	0.6	0.00	0.0	0.0	0.00	0.0	0.0
BROWN THRASHER	0.00	0.0	0.0	0.57	12.0	1.5	0.50	14.0	1.1	0.29	9.6	0.7
CEDAR WAXWING	0.14	2.4	3.0	0.14	4.8	0.6	0.33	16.8	1.3	0.57	26.4	1.9
EUROPEAN STARLING	0.29	12.0	15.2	1.00	26.4	3.4	1.00	64.3	5.1	0.86	397.9	29.1
WHITE-EYED VIREO	0.00	0.0	0.0	0.29	4.8	0.6	0.00	0.0	0.0	0.00	0.0	0.0
SOLITARY VIREO	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	9.6	0.7
RED-EYED VIREO	0.00	0.0	0.0	0.00	0.0	0.0	0.17	2.8	0.2	0.29	7.2	0.5
BLUE-WINGED WARBLER	0.00	0.0	0.0	0.43	9.6	1.2	0.67	11.2	0.9	0.00	0.0	0.0
GOLDEN-WINGED WARBLER	0.00	0.0	0.0	0.43	9.6	1.2	0.83	22.4	1.8	0.00	0.0	0.0
TENNESSEE WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	9.6	0.7
YELLOW WARBLER	0.00	0.0	0.0	0.43	38.4	4.9	1.00	95.1	7.5	0.00	0.0	0.0
CHESTNUT-SIDED WARBLER	0.00	0.0	0.0	0.14	4.8	0.6	0.17	2.8	0.2	0.00	0.0	0.0
MAGNOLIA WARBLER	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.14	2.4	0.2
YELLOW-RUMPED WARBLER	0.00	0.0	0.0	0.29	7.2	0.9	0.00	0.0	0.0	0.29	36.0	2.6
PRAIRIE WARBLER	0.00	0.0	0.0	0.57	33.6	4.3	0.83	33.6	2.6	0.14	2.4	0.2
PALM WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	7.2	0.5
AMERICAN REDSTART	0.00	0.0	0.0	0.29	4.8	0.6	0.33	11.2	0.9	0.00	0.0	0.0
WORM-EATING WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.17	2.8	0.2	0.00	0.0	0.0
COMMON YELLOWTHROAT	0.00	0.0	0.0	0.43	83.9	10.7	1.00	151.0	11.9	0.57	71.9	5.3
WILSON'S WARBLER	0.00	0.0	0.0	0.14	4.8	0.6	0.00	0.0	0.0	0.00	0.0	0.0
YELLOW-BREASTED CHAT	0.00	0.0	0.0	0.43	14.4	1.8	1.00	53.1	4.2	0.00	0.0	0.0
SCARLET TANAGER	0.00	0.0	0.0	0.00	0.0	0.0	0.50	8.4	0.7	0.00	0.0	0.0
NORTHERN CARDINAL	0.00	0.0	0.0	0.71	28.8	3.7	0.83	19.6	1.5	1.00	40.7	3.0
ROSE-BREASTED GROSBEAK	0.00	0.0	0.0	0.43	14.4	1.8	0.50	14.0	1.1	0.00	0.0	0.0
INDIGO BUNTING	0.00	0.0	0.0	0.00	0.0	0.0	1.00	30.8	2.4	0.00	0.0	0.0
RUFOUS-SIDED TOWHEE	0.00	0.0	0.0	0.57	31.2	4.0	1.00	39.1	3.1	0.71	59.9	4.4
AMERICAN TREE SPARROW	0.29	12.0	15.2	0.00	0.0	0.0	0.00	0.0	0.0	0.14	12.0	0.9
CHIPPING SPARROW	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
FIELD SPARROW	0.00	0.0	0.0	0.86	134.2	17.2	1.00	206.9	16.3	0.71	55.1	4.0
SONG SPARROW	0.00	0.0	0.0	1.00	88.7	11.3	1.00	86.7	6.8	0.86	86.3	6.3
LINCOLN'S SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.43	12.0	0.9
SWAMP SPARROW	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.00	0.0	0.0
WHITE-THROATED SPARROW	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.43	182.2	13.3
WHITE-CROWNED SPARROW	0.00	0.0	0.0	0.14	2.4	0.3	0.00	0.0	0.0	0.29	14.4	1.1
DARK-EYED JUNCO	0.14	2.4	3.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	33.6	2.5
RED-WINGED BLACKBIRD	0.14	2.4	3.0	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0
BROWN-HEADED COWBIRD	0.00	0.0	0.0	0.57	31.2	4.0	0.67	11.2	0.9	0.00	0.0	0.0
NORTHERN ORIOLE	0.00	0.0	0.0	0.00	0.0	0.0	0.17	11.2	0.9	0.29	7.2	0.5
AMERICAN GOLDFINCH	0.00	0.0	0.0	0.43	47.9	6.1	1.00	72.7	5.7	0.71	43.1	3.2
	-	79.1	100.0	-	781.4	100.0	-	1272.4	100.0	-	1366.3	100.0

Table H-6

Frequency (F), mean density (MD), and relative density (RD) of birds observed in Transmission Corridor Field during winter, spring, summer, and autumn counts, 1984.

	WINTER			SPRING			SUMMER			AUTUMN		
SPECIES	F	MD	RD	F	MD	RD	F	MD	RD	F	MD	RD
MALLARD	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.3	0.00	0.0	0.0
AMERICAN WOODCOCK	0.00	0.0	0.0	0.14	3.3	0.5	0.14	3.3	0.3	0.00	0.0	0.0
RUBY-THROATED HUMMINGBIRD	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.5
NORTHERN FLICKER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.5
WILLOW FLYCATCHER	0.00	0.0	0.0	0.14	6.6	1.0	1.00	88.9	7.3	0.00	0.0	0.0
EMPIDONAX FLYCATCHER SP.	0.00	0.0	0.0	0.14	3.3	0.5	0.00	0.0	0.0	0.00	0.0	0.0
EASTERN PHOEBE	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	26.3	3.9
WESTERN KINGBIRD	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	6.6	1.0
EASTERN KINGBIRD	0.00	0.0	0.0	0.14	3.3	0.5	0.14	3.3	0.3	0.00	0.0	0.0
TREE SWALLOW	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.3	0.00	0.0	0.0
BANK SWALLOW	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.3	0.00	0.0	0.0
BARN SWALLOW	0.00	0.0	0.0	0.29	9.9	1.4	0.43	9.9	0.8	0.00	0.0	0.0
BLUE JAY	0.00	0.0	0.0	0.14	23.0	3.3	0.00	0.0	0.0	0.29	6.6	1.0
AMERICAN CROW	0.14	3.3	4.3	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0
BLACK-CAPPED CHICKADEE	0.14	3.3	4.3	0.43	19.7	2.9	0.29	13.2	1.1	0.14	3.3	0.5
TUFTED TITMOUSE	0.00	0.0	0.0	0.00	0.0	0.0	0.14	6.6	0.5	0.14	6.6	1.0
HOUSE WREN	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.43	19.7	2.9
RUBY-CROWNED KINGLET	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	6.6	1.0
BLUE-GRAY GNATCATCHER	0.00	0.0	0.0	0.14	3.3	0.5	0.00	0.0	0.0	0.14	3.3	0.5
EASTERN BLUEBIRD	0.00	0.0	0.0	0.14	6.6	1.0	0.00	0.0	0.0	0.71	59.2	8.7
AMERICAN ROBIN	0.00	0.0	0.0	0.43	29.6	4.3	0.71	75.7	6.2	0.29	9.9	1.4
GRAY CATBIRD	0.00	0.0	0.0	0.29	16.5	2.4	0.86	59.2	4.9	0.14	6.6	1.0
NORTHERN MOCKINGBIRD	0.00	0.0	0.0	0.14	3.3	0.5	0.00	0.0	0.0	0.14	6.6	1.0
CEDAR WAXWING	0.00	0.0	0.0	0.00	0.0	0.0	0.71	59.2	4.9	0.14	9.9	1.4
EUROPEAN STARLING	0.00	0.0	0.0	0.14	9.9	1.4	0.14	3.3	0.3	0.00	0.0	0.0
TENNESSEE WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.5
NASHVILLE WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	6.6	1.0
YELLOW WARBLER	0.00	0.0	0.0	0.29	13.2	1.9	0.86	42.8	3.5	0.00	0.0	0.0
YELLOW-RUMPED WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.29	82.3	12.1
PRAIRIE WARBLER	0.00	0.0	0.0	0.29	6.6	1.0	0.00	0.0	0.0	0.00	0.0	0.0
PALM WARBLER	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	6.6	1.0
COMMON YELLOWTHROAT	0.00	0.0	0.0	0.43	16.5	2.4	1.00	65.8	5.4	0.43	59.2	8.7
NORTHERN CARDINAL	0.14	6.6	8.7	0.43	9.9	1.4	0.86	36.2	3.0	0.43	13.2	1.9
ROSE-BREASTED GROSBEAK	0.00	0.0	0.0	0.14	3.3	0.5	0.00	0.0	0.0	0.00	0.0	0.0
BLUE GROSBEAK	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.5
INDIGO BUNTING	0.00	0.0	0.0	0.00	0.0	0.0	0.43	16.5	1.3	0.14	3.3	0.5
RUFOUS-SIDED TOWHEE	0.00	0.0	0.0	0.14	3.3	0.5	0.29	6.6	0.5	0.14	3.3	0.5
AMERICAN TREE SPARROW	0.43	32.9	43.5	0.14	9.9	1.4	0.00	0.0	0.0	0.14	36.2	5.3
FIELD SPARROW	0.00	0.0	0.0	0.71	240.3	34.9	1.00	286.4	23.5	0.86	79.0	11.6
VESPER SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.5
SAVANNAH SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	9.9	1.4
GRASSHOPPER SPARROW	0.00	0.0	0.0	0.14	3.3	0.5	0.00	0.0	0.0	0.14	6.6	1.0
SONG SPARROW	0.14	3.3	4.3	1.00	154.7	22.5	1.00	250.2	20.5	0.86	121.8	17.9
LINCOLN'S SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.43	19.7	2.9
WHITE-THROATED SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	6.6	1.0
WHITE-CROWNED SPARROW	0.00	0.0	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.5
DARK-EYED JUNCO	0.14	26.3	34.8	0.00	0.0	0.0	0.00	0.0	0.0	0.14	9.9	1.4
RED-WINGED BLACKBIRD	0.00	0.0	0.0	0.29	9.9	1.4	0.57	13.2	1.1	0.00	0.0	0.0
EASTERN MEADOWLARK	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.3	0.14	9.9	1.4
COMMON GRACKLE	0.00	0.0	0.0	0.43	56.0	8.1	0.57	65.8	5.4	0.00	0.0	0.0
BROWN-HEADED COWBIRD	0.00	0.0	0.0	0.14	6.6	1.0	0.29	6.6	0.5	0.14	3.3	0.5
ORCHARD ORIOLE	0.00	0.0	0.0	0.00	0.0	0.0	0.14	3.3	0.3	0.00	0.0	0.0
NORTHERN ORIOLE	0.00	0.0	0.0	0.00	0.0	0.0	0.29	9.9	0.8	0.00	0.0	0.0
AMERICAN GOLDFINCH	0.00	0.0	0.0	0.43	16.5	2.4	0.86	82.3	6.7	0.14	13.2	1.9
	-	75.7	100.0	-	688.0	100.0	-	1221.2	100.0	-	681.4	100.0

Table H-7

Significant results of Friedman's two-way analysis of variance test and Page's distribution-free test of ordered alternatives of bird densities in different seasons in Council Cup and TR419 Forests, 1978-84, and Switchyard and Transmission Corridor Fields, 1979-84 (* = P<0.05, ** = P<0.01). DF for Friedman's statistic equals one less than the number of years tested.

SPECIES	SEASON	YEARS	FRIEDMAN'S STATISTIC (χ^2)	PAGE'S 'L' STATISTIC	TREND
			COUNCIL CUP FOREST		
TUFTED TITMOUSE	WINTER	5	6.600	338.5*	+
WHITE-BREASTED NUTHATCH	WINTER	5	8.029	340.5*	+
BROWN CREEPER	WINTER	5	4.000	338.5*	+
GOLDEN-CROWNED KINGLET	WINTER	5	6.029	338.5*	+
DOWNY WOODPECKER	SPRING	6	6.980	556.0*	-
BLUE JAY	SPRING	6	6.837	563.5**	+
TUFTED TITMOUSE	SPRING	6	9.122	566.5**	+
WOOD THRUSH	SPRING	6	6.286	552.0*	+
YELLOW-RUMPED WARBLER	SPRING	6	6.551	564.0**	+
NORTHERN FLICKER	SUMMER	6	16.449*	565.5*	+
EASTERN WOOD-PEWEE	SUMMER	6	11.122	578.0**	+
BLACK-CAPPED CHICKADEE	SUMMER	6	19.429**	602.5**	+
TUFTED TITMOUSE	SUMMER	6	7.408	560.5*	+
WOOD THRUSH	SUMMER	4	4.243	189.0*	+
OVENBIRD	SUMMER	6	10.041	571.5**	+
SCARLET TANAGER	SUMMER	6	15.653*	554.0*	-
TUFTED TITMOUSE	AUTUMN	6	8.633	555.0*	+
			TR419 FOREST		
BLACK-CAPPED CHICKADEE	WINTER	5	11.857*	342.5*	+
GOLDEN-CROWNED KINGLET	WINTER	5	13.200*	322.5	
BLACK-CAPPED CHICKADEE	SPRING	6	7.449	558.5*	+
TUFTED TITMOUSE	SPRING	6	17.673**	591.0**	+
OVENBIRD	SPRING	6	5.449	552.0*	+
NORTHERN CARDINAL	SPRING	6	11.673	550.5*	-
BROWN-HEADED COWBIRD	SPRING	6	15.143*	525.5	
EASTERN WOOD-PEWEE	SUMMER	6	10.122	555.5*	+
GREAT CRESTED FLYCATCHER	SUMMER	6	7.122	561.0*	-
BLACK-CAPPED CHICKADEE	SUMMER	6	11.245	569.5**	+
TUFTED TITMOUSE	SUMMER	6	12.490	573.5**	+
WOOD THRUSH	SUMMER	6	13.735*	545.5	
CEDAR WAXWING	SUMMER	6	13.959*	517.5	
BLACK-AND-WHITE WARBLER	SUMMER	6	19.490**	517.0	
OVENBIRD	SUMMER	3	10.571*	94.0**	+
HOODED WARBLER	SUMMER	6	15.673*	554.0*	+
ROSE-BREASTED GROSBEAK	SUMMER	4	11.100*	189.0*	-
RUFOUS-SIDED TOWHEE	SUMMER	6	16.429*	597.0**	-
BROWN-HEADED COWBIRD	SUMMER	6	7.000	564.0**	-
BLUE JAY	AUTUMN	6	13.796*	508.5	
AMERICAN ROBIN	AUTUMN	6	4.122	550.5*	-
RUFOUS-SIDED TOWHEE	AUTUMN	6	9.653	575.0**	-

Table H-7 (cont.)

SPECIES	SEASON	YEARS	FRIEDMAN'S STATISTIC (χ^2)	PAGE'S 'L' STATISTIC	TREND
			SWITCHYARD FIELD		
BLACK-CAPPED CHICKADEE	WINTER	5	6.600	347.0**	+
GRAY CATBIRD	SPRING	6	5.000	551.5*	+
EUROPEAN STARLING	SPRING	6	14.592*	552.0*	+
YELLOW WARBLER	SPRING	6	4.714	555.0*	+
PRAIRIE WARBLER	SPRING	6	4.816	555.5*	+
FIELD SPARROW	SPRING	6	15.082*	554.0*	+
SONG SPARROW	SPRING	6	15.878*	587.0**	+
WILLOW FLYCATCHER	SUMMER	6	21.796**	601.0**	+
GRAY CATBIRD	SUMMER	6	27.082**	619.0**	+
CEDAR WAXWING	SUMMER	6	9.306	557.5*	+
EUROPEAN STARLING	SUMMER	6	13.122*	532.0	
YELLOW WARBLER	SUMMER	6	24.367**	613.5**	+
COMMON YELLOWTHROAT	SUMMER	6	15.857*	531.5	
YELLOW-BREASTED CHAT	SUMMER	6	11.776	550.0*	+
SONG SPARROW	SUMMER	6	12.857*	530.0	
AMERICAN GOLDFINCH	SUMMER	6	13.000*	564.0**	+
COMMON YELLOWTHROAT	AUTUMN	6	8.735	561.5*	-
NORTHERN CARDINAL	AUTUMN	6	15.000*	583.0**	+
AMERICAN GOLDFINCH	AUTUMN	6	18.796**	558.5*	+
			TRANSMISSION CORRIDOR FIELD		
FIELD SPARROW	SPRING	5	5.086	338.0*	+
RED-WINGED BLACKBIRD	SPRING	5	16.257**	365.5**	-
WILLOW FLYCATCHER	SUMMER	6	23.041**	600.5**	+
AMERICAN ROBIN	SUMMER	6	9.898	569.0**	+
GRAY CATBIRD	SUMMER	6	6.041	563.0**	+
CEDAR WAXWING	SUMMER	6	6.980	554.0*	+
YELLOW WARBLER	SUMMER	6	10.837	572.5**	+
NORTHERN CARDINAL	SUMMER	6	13.714*	583.5**	+
RUFOUS-SIDED TOWHEE	SUMMER	4	11.014*	187.5	
RED-WINGED BLACKBIRD	SUMMER	6	12.245	572.0**	-
COMMON GRACKLE	SUMMER	6	5.571	550.0**	+
AMERICAN GOLDFINCH	SUMMER	6	5.265	553.0*	+

Table H-8

Number, density (no./km^2), and relative density (RD) of breeding pairs observed in Council Cup and TR419 Forests and Switchyard and Transmission Corridor Fields during the breeding bird studies, 17 February through 14 September 1984.

NEST LOCATION/SPECIES	COUNCIL CUP FOREST			TR419 FOREST			SWITCHYARD FIELD			TC FIELD		
	PAIRS	DENSITY	RD	PAIRS	DENSITY	RD	PAIRS	DENSITY	RD	PAIRS	DENSITY	RD
GROUND												
✓ MALLARD	0	0	0	0	0	0	0	0	0	1.0	23	2.9
✓ RUFFED GROUSE	0	0	0	+	0	0	0	0	0	0	0	0
BLUE-WINGED WARBLER	0	0	0	0	0	0	1.0	17	1.4	0	0	0
GOLDEN-WINGED WARBLER	0	0	0	0	0	0	1.0	17	1.4	0	0	0
✓ BLACK-AND-WHITE WARBLER	2.0	33	4.1	3.0	27	4.6	0	0	0	0	0	0
WORM-EATING WARBLER	0	0	0	1.0	9	1.5	0	0	0	0	0	0
✓ OVENBIRD	6.5	108	13.3	6.0	54	9.2	0	0	0	0	0	0
✓ COMMON YELLOWTHROAT	0	0	0	+	0	0	9.5	158	13.6	2.5	58	7.2
✓ RUFOUS-SIDED TOWHEE	0.5	8	1.0	+	0	0	3.0	50	4.3	+	0	0
✓ FIELD SPARROW	0	0	0	0	0	0	11.0	183	15.7	10.0	230	29.0
✓ SONG SPARROW	0	0	0	0	0	0	6.5	108	9.3	8.5	196	24.6
TOTAL	9.0	149	18.4	10.0	90	15.4	32.0	533	45.7	22.0	507	63.8
LEDGE												
✓* EASTERN PHOEBE	0	0	0	0	0	0	+	0	0	0	0	0
BARN SWALLOW	0	0	0	0	0	0	0	0	0	+	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0
CAVITY												
✓ DOWNY WOODPECKER	1.5	25	3.1	2.5	23	3.8	0	0	0	0	0	0
✓ HAIRY WOODPECKER	0.5	8	1.0	+	0	0	0	0	0	0	0	0
✓ NORTHERN FLICKER	+	0	0	1.0	9	1.5	+	0	0	0	0	0
PILEATED WOODPECKER	+	0	0	+	0	0	0	0	0	0	0	0
✓ GREAT CRESTED FLYCATCHER	2.5	42	5.1	+	0	0	0	0	0	0	0	0
✓ BLACK-CAPPED CHICKADEE	6.0	100	12.2	6.0	54	9.2	+	0	0	+	0	0
TUFTED TITMOUSE	1.5	25	3.1	4.0	36	6.2	0	0	0	0	0	0
WHITE-BREASTED NUTHATCH	1.0	17	2.0	+	0	0	0	0	0	0	0	0
BROWN CREEPER	1.0	17	2.0	1.0	9	1.5	0	0	0	0	0	0
✓ HOUSE WREN	0	0	0	+	0	0	+	0	0	0	0	0
✓* EUROPEAN STARLING	0	0	0	0	0	0	1.5	25	2.1	0	0	0
TOTAL	14.0	233	28.6	14.5	131	22.3	1.5	25	2.1	0	0	0
LIMB												
COOPER'S HAWK	0	0	0	+	0	0	0	0	0	0	0	0
BROAD-WINGED HAWK	0	0	0	+	0	0	0	0	0	0	0	0
✓ GREAT HORNED OWL	+	0	0	+	0	0	0	0	0	0	0	0
RUBY-THROATED HUMMINGBIRD	0	0	0	0	0	0	+	0	0	0	0	0
EASTERN WOOD-PEWEE	4.0	67	8.2	3.0	27	4.6	0	0	0	0	0	0
✓ WILLOW FLYCATCHER	0	0	0	0	0	0	2.5	42	3.6	3.0	69	8.7
✓* EASTERN KINGBIRD	0	0	0	0	0	0	0.5	8	0.7	+	0	0
✓ BLUE JAY	2.5	42	5.1	4.0	36	6.2	0	0	0	0	0	0
✓ AMERICAN CROW	0	0	0	+	0	0	0	0	0	0	0	0
BLUE-GRAY GNATCATCHER	1.0	17	2.0	0.5	5	0.8	0	0	0	0	0	0
✓ WOOD THRUSH	3.0	50	6.1	5.0	45	7.7	0	0	0	0	0	0
✓ AMERICAN ROBIN	+	0	0	1.0	9	1.5	0.5	8	0.7	1.5	34	4.3
✓ GRAY CATBIRD	0	0	0	2.5	23	3.8	6.0	100	8.6	1.5	34	4.3
✓ BROWN THRASHER	0	0	0	0	0	0	1.0	17	1.4	0	0	0
✓ CEDAR WAXWING	2.0	33	4.1	1.0	9	1.5	2.0	33	2.9	+	0	0
WHITE-EYED VIREO	0	0	0	0	0	0	+	0	0	0	0	0
✓ RED-EYED VIREO	5.0	83	10.2	5.0	45	7.7	+	0	0	0	0	0
✓ YELLOW WARBLER	0	0	0	0	0	0	6.0	100	8.6	2.0	46	5.8
✓ PRAIRIE WARBLER	0	0	0	0	0	0	3.5	58	5.0	0	0	0
✓ AMERICAN REDSTART	0	0	0	2.5	23	3.8	1.0	17	1.4	0	0	0
HOODED WARBLER	0	0	0	1.0	9	1.5	0	0	0	0	0	0
✓ YELLOW-BREASTED CHAT	0	0	0	0	0	0	2.0	33	2.9	0	0	0
✓ SCARLET TANAGER	2.5	42	5.1	6.0	54	9.2	0	0	0	0	0	0
✓ NORTHERN CARDINAL	0	0	0	3.0	27	4.6	2.0	33	2.9	+	0	0
✓ ROSE-BREASTED GROSBEAK	1.5	25	3.1	2.0	18	3.1	1.0	17	1.4	0	0	0
✓ INDIGO BUNTING	+	0	0	+	0	0	2.5	42	3.6	0.5	12	1.4
CHIPPING SPARROW	1.5	25	3.1	0	0	0	0	0	0	0	0	0
✓ RED-WINGED BLACKBIRD	0	0	0	0	0	0	0	0	0	0.5	12	1.4
✓ COMMON GRACKLE	0	0	0	0	0	0	0	0	0	+	0	0
✓ NORTHERN ORIOLE	0.5	8	1.0	0.5	5	0.8	0	0	0	0	0	0
PURPLE FINCH	+	0	0	0	0	0	0	0	0	0	0	0
✓ AMERICAN GOLDFINCH	0	0	0	0	0	0	5.0	83	7.1	3.0	69	8.7
TOTAL	23.5	392	48.0	37.0	335	56.9	35.5	591	50.7	12.0	276	34.8
SOCIAL PARASITE												
BROWN-HEADED COWBIRD	2.5	42	5.1	3.5	32	5.4	1.0	23	1.4	0.5	8	1.4
TOTAL	49.0	817	—	65.0	588	—	70.0	1174	—	34.5	795	—

✓ NESTING OF THESE SPECIES WAS CONFIRMED IN AT LEAST ONE PLOT BY OBSERVING NEST OR FLEDGLINGS.
* NESTED ON TRANSMISSION TOWERS OR SWITCHYARD EQUIPMENT.
\+ A PAIR MAINTAINED LESS THAN 0.5 OF A HOME RANGE IN THE DESIGNATED PLOT.

Table H-9

Significant results of Spearman's rank correlation coefficient (r_s) between breeding bird densities and years observed, 1979-84 (* = P<0.05, ** = P<0.01).

SPECIES OR GROUP	r_s	TREND
	COUNCIL CUP FOREST	
EASTERN WOOD-PEWEE	0.886*	+
BLACK-CAPPED CHICKADEE	0.829*	+
CHIPPING SPARROW	0.914*	+
CAVITY-NESTING SPECIES	0.986**	+
LIMB-NESTING SPECIES	0.886*	+
TOTAL	0.943**	+
	TR419 FOREST	
BLACK-CAPPED CHICKADEE	1.000**	+
TUFTED TITMOUSE	0.957**	+
RED-EYED VIREO	0.943**	+
SCARLET TANAGER	0.900*	+
CAVITY-NESTING SPECIES	0.971**	+
LIMB-NESTING SPECIES	0.943**	+
TOTAL	0.943**	+
	SWITCHYARD FIELD	
WILLOW FLYCATCHER	0.886*	+
GRAY CATBIRD	0.929*	+
YELLOW WARBLER	0.986**	+
PRAIRIE WARBLER	0.986**	+
FIELD SPARROW	0.971*	+
AMERICAN GOLDFINCH	0.900*	+
GROUND-NESTING SPECIES	0.943**	+
LIMB-NESTING SPECIES	1.000**	+
TOTAL	1.000**	+
	TRANSMISSION CORRIDOR FIELD	
WILLOW FLYCATCHER	0.929*	+
YELLOW WARBLER	0.957**	+
FIELD SPARROW	0.843*	+
SONG SPARROW	0.843*	+
GROUND-NESTING SPECIES	0.886*	+
LIMB-NESTING SPECIES	0.900*	+
TOTAL	0.943**	+

Table H-10

Number of water birds observed during eight counts on the Susquehanna River, 24 February through 25 April 1984.

SPECIES	24 FEB	2 MAR	19 MAR	27 MAR	3 APR	11 APR	18 APR	25 APR	MEAN	% TOTAL
HORNED GREBE	0	0	0	1	0	0	0	0	0.1	0.1
GREAT BLUE HERON	5	5	3	6	5	3	0	2	3.6	1.8
BLACK-CROWNED NIGHT-HERON	0	0	0	0	0	0	3	0	0.4	0.2
CANADA GOOSE	26	175	378	0	10	10	8	8	76.9	38.8
WOOD DUCK	0	4	24	23	28	16	26	18	17.4	8.8
AMERICAN BLACK DUCK	10	31	18	0	1	7	3	2	9.0	4.5
MALLARD-BLACK DUCK HYBRID	0	1	0	0	0	0	0	0	0.1	0.1
MALLARD	4	103	15	16	18	22	20	18	27.0	13.6
NORTHERN PINTAIL	0	0	0	2	0	0	0	0	0.3	0.1
AMERICAN WIGEON	0	0	3	6	0	0	0	0	1.1	0.6
RING-NECKED DUCK	0	0	6	1	6	4	0	0	2.1	1.1
GREATER SCAUP	0	0	26	0	0	0	0	0	3.3	1.6
COMMON GOLDENEYE	0	0	6	2	0	0	0	0	1.0	0.5
BUFFLEHEAD	0	0	3	0	0	0	0	0	0.4	0.2
HOODED MERGANSER	4	0	32	6	11	0	0	4	7.1	3.6
COMMON MERGANSER	40	60	61	37	34	9	9	11	32.6	16.5
OSPREY	0	0	0	0	0	0	0	3	0.4	0.2
KILLDEER	0	1	0	0	0	0	0	0	0.1	0.1
SPOTTED SANDPIPER	0	0	0	0	0	0	1	0	0.1	0.1
BONAPARTE'S GULL	0	0	0	0	1	0	0	0	0.1	0.1
RING-BILLED GULL	0	0	71	6	0	0	0	2	9.9	5.0
HERRING GULL	0	0	22	0	0	0	0	0	2.8	1.4
COMMON TERN	0	0	0	0	0	0	0	2	0.3	0.1
BELTED KINGFISHER	2	0	1	2	3	2	6	0	2.0	1.0
TOTAL	91	380	669	108	117	73	76	70	198.0	

Table H-11

Weekly bird impaction totals from Unit 1 and 2 cooling towers, 19 March through 8 June 1984.

FAMILY/SPECIES	MAR		APR					MAY				JUN	
	19-23	26-30	2-6	9-13	16-20	23-27	30-4	7-11	14-18	21-25	28-1	4-8	TOTA
UNIT 1													
VIREONIDAE													
YELLOW-THROATED VIREO	0	0	0	0	0	0	0	0	1	0	0	0	1
TOTAL INDIVIDUALS	0	0	0	0	0	0	0	0	1	0	0	0	1
TOTAL SPECIES	0	0	0	0	0	0	0	0	1	0	0	0	1
UNIT 2													
ACCIPITRIDAE													
COOPER'S HAWK	0	0	1	0	0	0	0	0	0	0	0	0	1
COLUMBIDAE													
ROCK DOVE	0	0	1	0	0	0	0	0	0	0	0	0	1
VIREONIDAE													
RED-EYED VIREO	0	0	0	0	0	0	0	0	0	1	0	0	1
EMBERIZIDAE													
MAGNOLIA WARBLER	0	0	0	0	0	0	0	0	0	2	0	0	2
BLACKBURNIAN WARBLER	0	0	0	0	0	0	0	0	0	2	0	0	2
COMMON YELLOWTHROAT	0	0	0	0	0	0	0	0	1	1	1	0	3
TOTAL INDIVIDUALS	0	0	2	0	0	0	0	0	1	6	1	0	10
TOTAL SPECIES	0	0	2	0	0	0	0	0	1	4	1	0	6

Table H-12

Weekly bird impaction totals from Unit 1 and 2 cooling towers, 20 August through 9 November 1984.

FAMILY/SPECIES	AUG 20-24	AUG 27-31	SEP 4-7	SEP 10-14	SEP 17-21	SEP 24-28	OCT 1-5	OCT 8-12	OCT 15-19	OCT 22-26	OCT 29-2	NOV 5-9
UNIT 1												
MIMIDAE												
GRAY CATBIRD	0	0	0	0	1	0	0	0	0	0	0	0
VIREONIDAE												
RED-EYED VIREO	0	0	0	0	0	0	0	3	0	0	0	0
EMBERIZIDAE												
BLACKBURNIAN WARBLER	0	1	1	0	0	0	0	0	0	0	0	0
BLACKPOLL WARBLER	0	0	0	0	1	0	0	0	0	0	0	0
COMMON YELLOWTHROAT	0	0	0	0	1	0	0	0	0	0	0	0
UNIDENTIFIABLE WARBLER	0	1	0	0	0	0	0	0	0	0	0	0
TOTAL INDIVIDUALS	0	2	1	0	3	0	0	3	0	0	0	0
TOTAL SPECIES	0	2	1	0	3	0	0	1	0	0	0	0
UNIT 2												
VIREONIDAE												
SOLITARY VIREO	0	0	0	0	0	0	1	0	0	0	0	0
RED-EYED VIREO	0	0	0	0	1	0	0	0	0	0	0	0
EMBERIZIDAE												
BLACKPOLL WARBLER	0	0	0	0	0	0	0	0	1	0	0	0
OVENBIRD	0	0	0	0	1	0	0	0	0	0	0	0
TOTAL INDIVIDUALS	0	0	0	0	2	0	1	0	1	0	0	0
TOTAL SPECIES	0	0	0	0	2	0	1	0	1	0	0	0

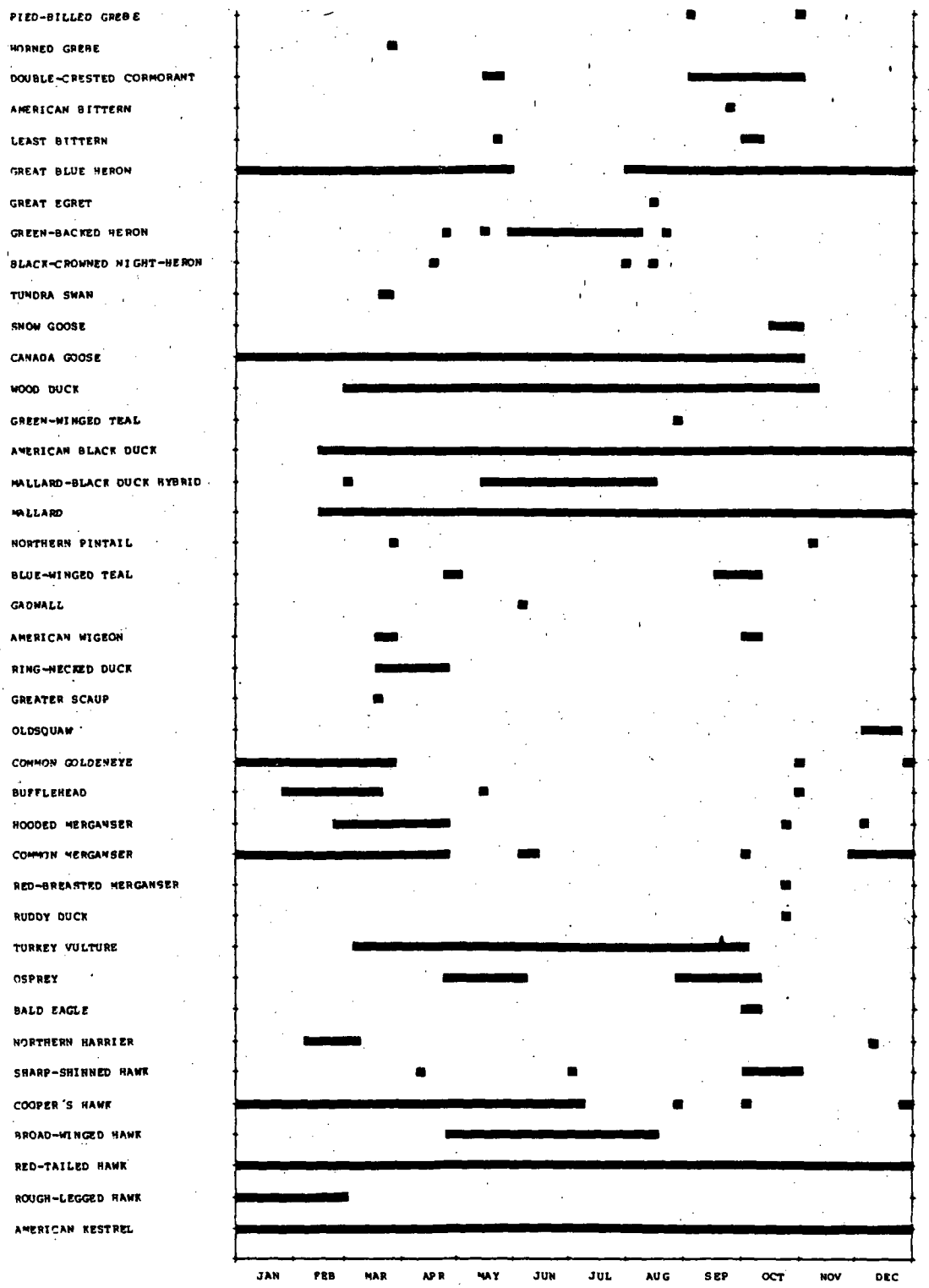

Fig. H-1

Phenological occurrence of birds observed near the Susquehanna SES, 1984.

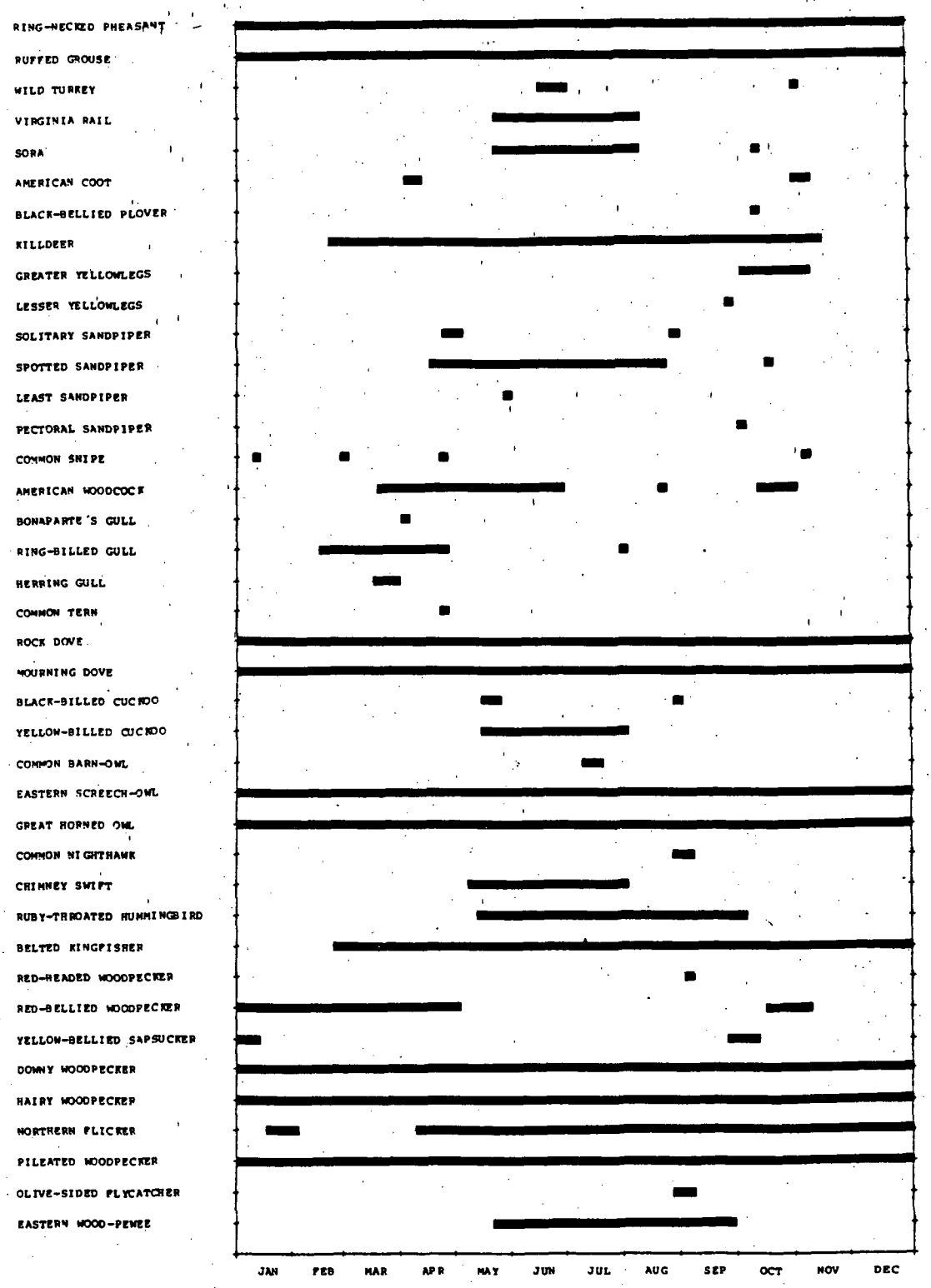
RING-NECKED PHEASANT
RUFFED GROUSE
WILD TURKEY
VIRGINIA RAIL
SORA
AMERICAN COOT
BLACK-BELLIED PLOVER
KILLDEER
GREATER YELLOWLEGS
LESSER YELLOWLEGS
SOLITARY SANDPIPER
SPOTTED SANDPIPER
LEAST SANDPIPER
PECTORAL SANDPIPER
COMMON SNIPE
AMERICAN WOODCOCK
BONAPARTE'S GULL
RING-BILLED GULL
HERRING GULL
COMMON TERN
ROCK DOVE
MOURNING DOVE
BLACK-BILLED CUCKOO
YELLOW-BILLED CUCKOO
COMMON BARN-OWL
EASTERN SCREECH-OWL
GREAT HORNED OWL
COMMON NIGHTHAWK
CHIMNEY SWIFT
RUBY-THROATED HUMMINGBIRD
BELTED KINGFISHER
RED-HEADED WOODPECKER
RED-BELLIED WOODPECKER
YELLOW-BELLIED SAPSUCKER
DOWNY WOODPECKER
HAIRY WOODPECKER
NORTHERN FLICKER
PILEATED WOODPECKER
OLIVE-SIDED FLYCATCHER
EASTERN WOOD-PEWEE
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. H-1 (cont.)

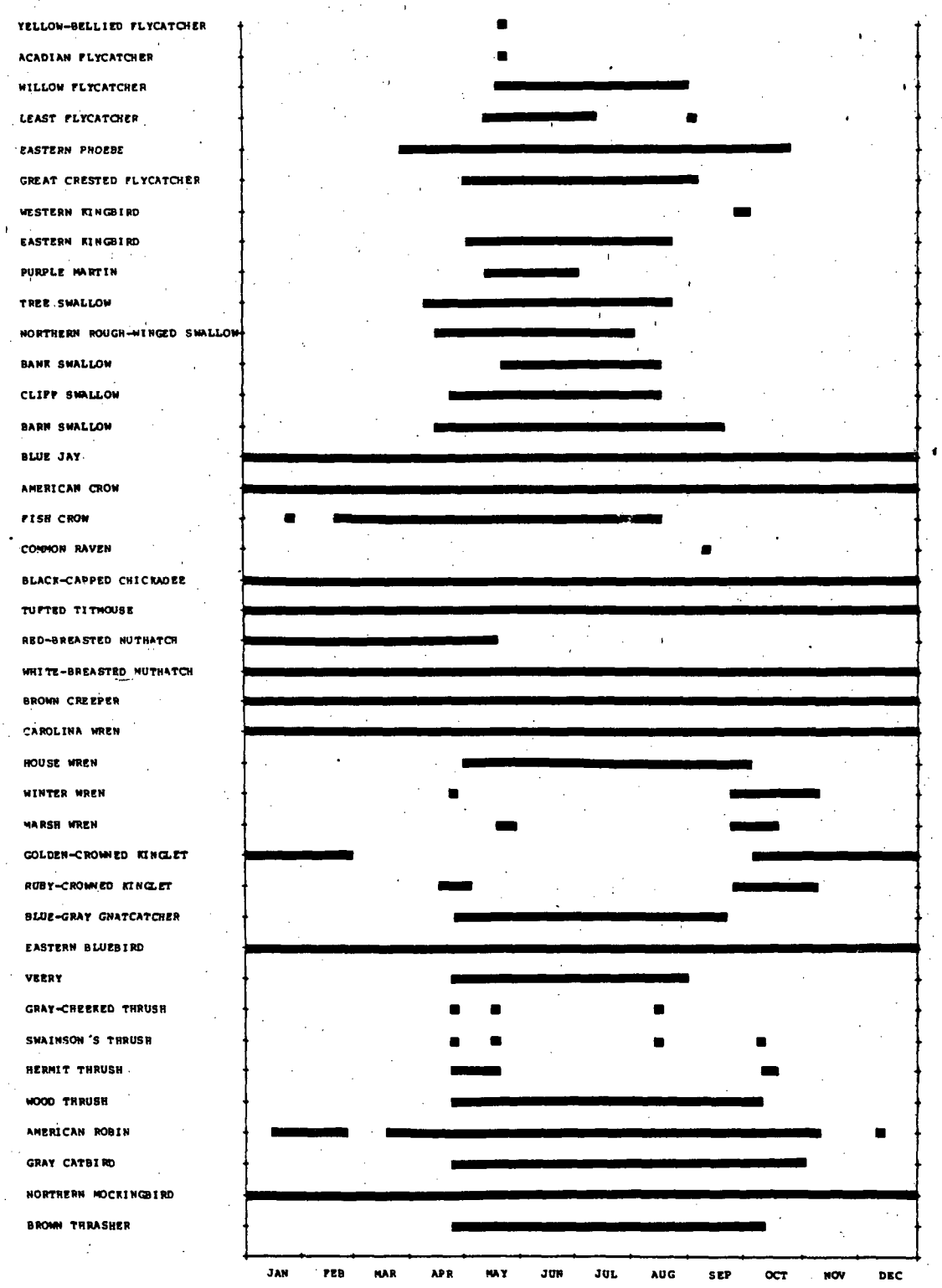
YELLOW-BELLIED FLYCATCHER
ACADIAN FLYCATCHER
WILLOW FLYCATCHER
LEAST FLYCATCHER
EASTERN PHOEBE
GREAT CRESTED FLYCATCHER
WESTERN KINGBIRD
EASTERN KINGBIRD
PURPLE MARTIN
TREE SWALLOW
NORTHERN ROUGH-WINGED SWALLOW
BANK SWALLOW
CLIFF SWALLOW
BARN SWALLOW
BLUE JAY
AMERICAN CROW
FISH CROW
COMMON RAVEN
BLACK-CAPPED CHICKADEE
TUFTED TITMOUSE
RED-BREASTED NUTHATCH
WHITE-BREASTED NUTHATCH
BROWN CREEPER
CAROLINA WREN
HOUSE WREN
WINTER WREN
MARSH WREN
GOLDEN-CROWNED KINGLET
RUBY-CROWNED KINGLET
BLUE-GRAY GNATCATCHER
EASTERN BLUEBIRD
VEERY
GRAY-CHEEKED THRUSH
SWAINSON'S THRUSH
HERMIT THRUSH
WOOD THRUSH
AMERICAN ROBIN
GRAY CATBIRD
NORTHERN MOCKINGBIRD
BROWN THRASHER
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Fig. H-1 (cont.)

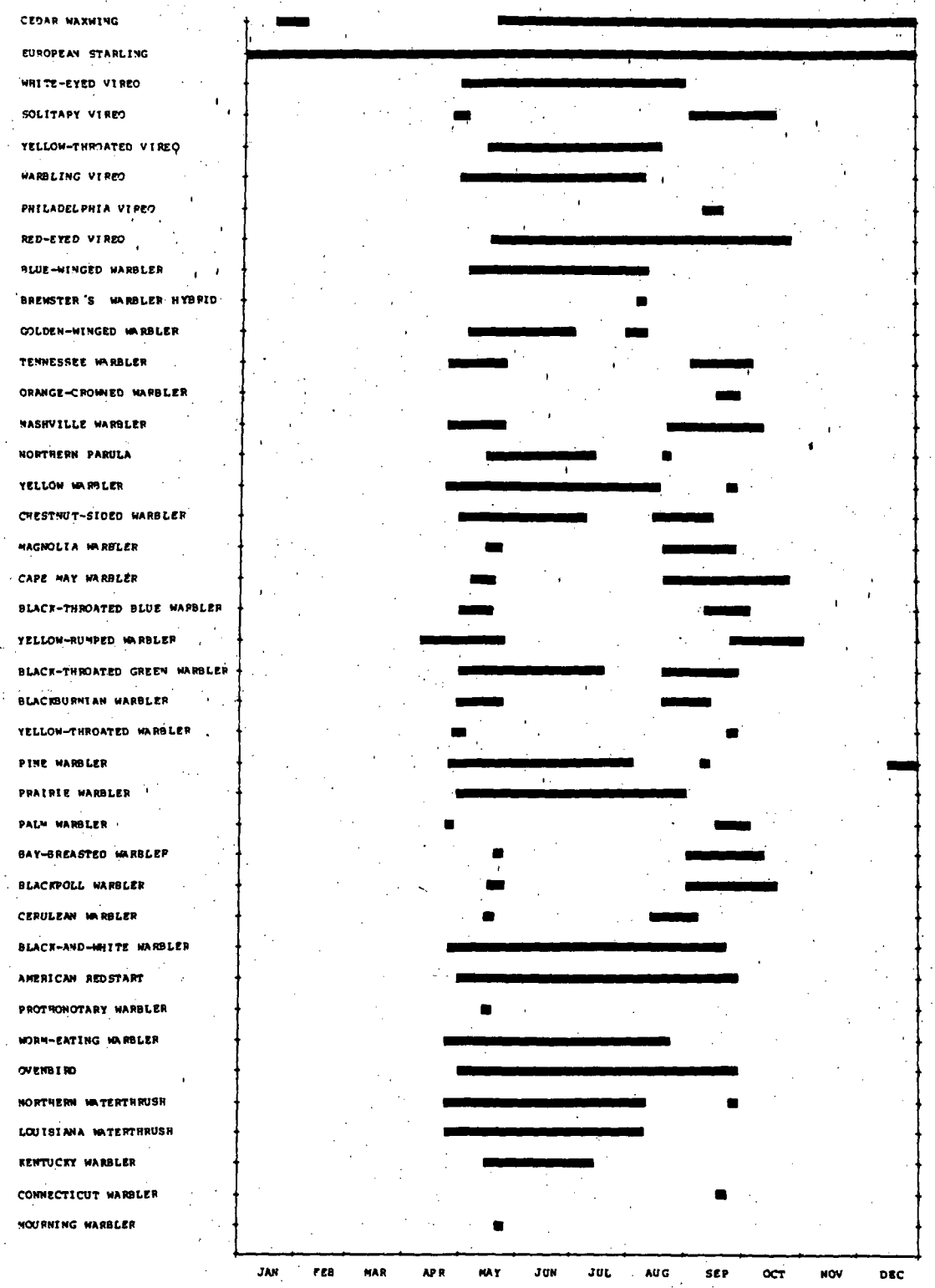
CEDAR WAXWING
EUROPEAN STARLING
WHITE-EYED VIREO
SOLITARY VIREO
YELLOW-THROATED VIREO
WARBLING VIREO
PHILADELPHIA VIREO
RED-EYED VIREO
BLUE-WINGED WARBLER
BREWSTER'S WARBLER HYBRID
GOLDEN-WINGED WARBLER
TENNESSEE WARBLER
ORANGE-CROWNED WARBLER
NASHVILLE WARBLER
NORTHERN PARULA
YELLOW WARBLER
CHESTNUT-SIDED WARBLER
MAGNOLIA WARBLER
CAPE MAY WARBLER
BLACK-THROATED BLUE WARBLER
YELLOW-RUMPED WARBLER
BLACK-THROATED GREEN WARBLER
BLACKBURNIAN WARBLER
YELLOW-THROATED WARBLER
PINE WARBLER
PRAIRIE WARBLER
PALM WARBLER
BAY-BREASTED WARBLER
BLACKPOLL WARBLER
CERULEAN WARBLER
BLACK-AND-WHITE WARBLER
AMERICAN REDSTART
PROTHONOTARY WARBLER
WORM-EATING WARBLER
OVENBIRD
NORTHERN WATERTHRUSH
LOUISIANA WATERTHRUSH
KENTUCKY WARBLER
CONNECTICUT WARBLER
MOURNING WARBLER
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Fig. H-1 (cont.)

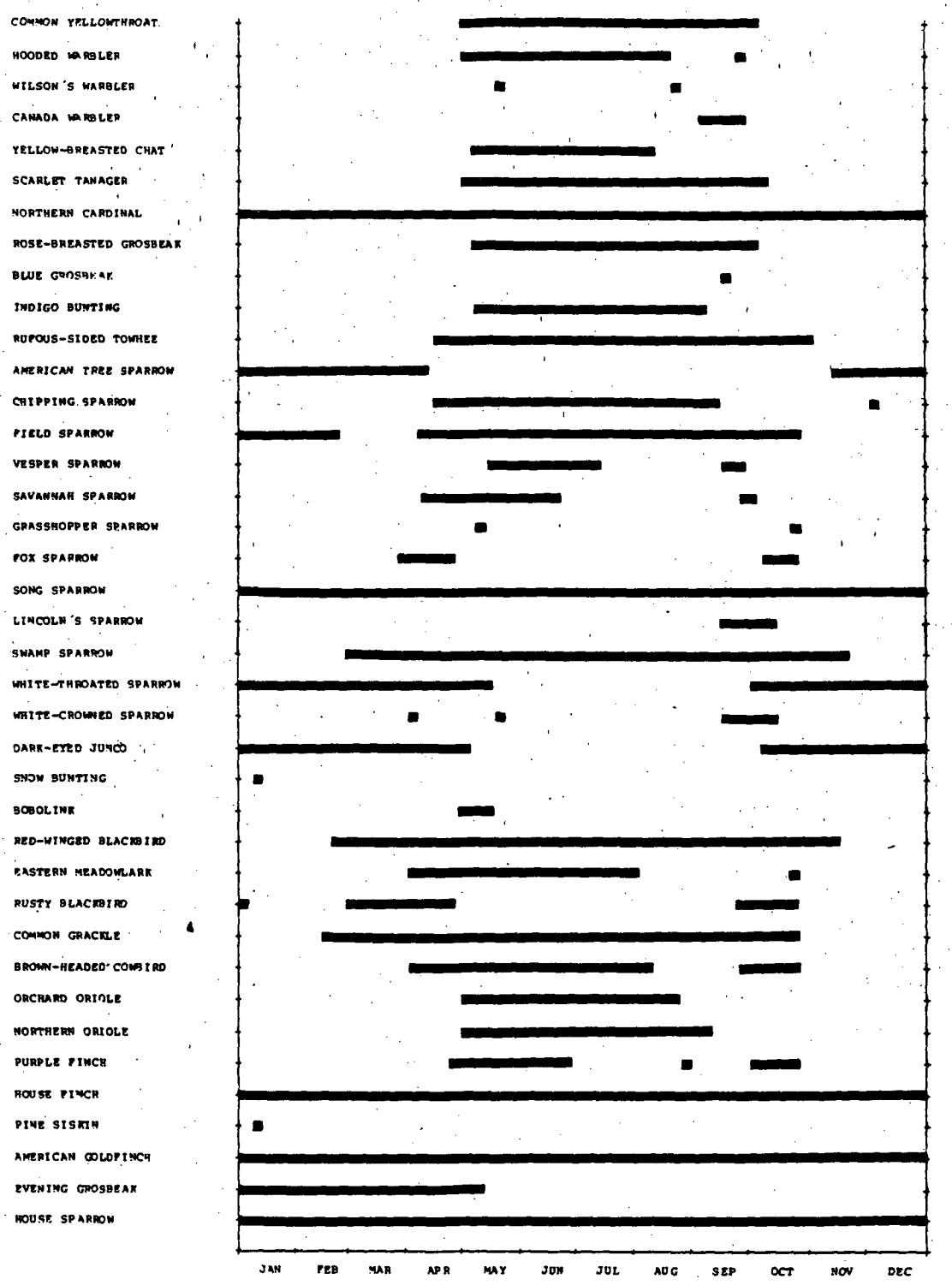
COMMON YELLOWTHROAT
HOODED WARBLER
WILSON'S WARBLER
CANADA WARBLER
YELLOW-BREASTED CHAT
SCARLET TANAGER
NORTHERN CARDINAL
ROSE-BREASTED GROSBEAK
BLUE GROSBEAK
INDIGO BUNTING
RUFOUS-SIDED TOWHEE
AMERICAN TREE SPARROW
CHIPPING SPARROW
FIELD SPARROW
VESPER SPARROW
SAVANNAH SPARROW
GRASSHOPPER SPARROW
FOX SPARROW
SONG SPARROW
LINCOLN'S SPARROW
SWAMP SPARROW
WHITE-THROATED SPARROW
WHITE-CROWNED SPARROW
DARK-EYED JUNCO
SNOW BUNTING
BOBOLINK
RED-WINGED BLACKBIRD
EASTERN MEADOWLARK
RUSTY BLACKBIRD
COMMON GRACKLE
BROWN-HEADED COWBIRD
ORCHARD ORIOLE
NORTHERN ORIOLE
PURPLE FINCH
HOUSE FINCH
PINE SISKIN
AMERICAN GOLDFINCH
EVENING GROSBEAK
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Fig. H-1 (cont.)

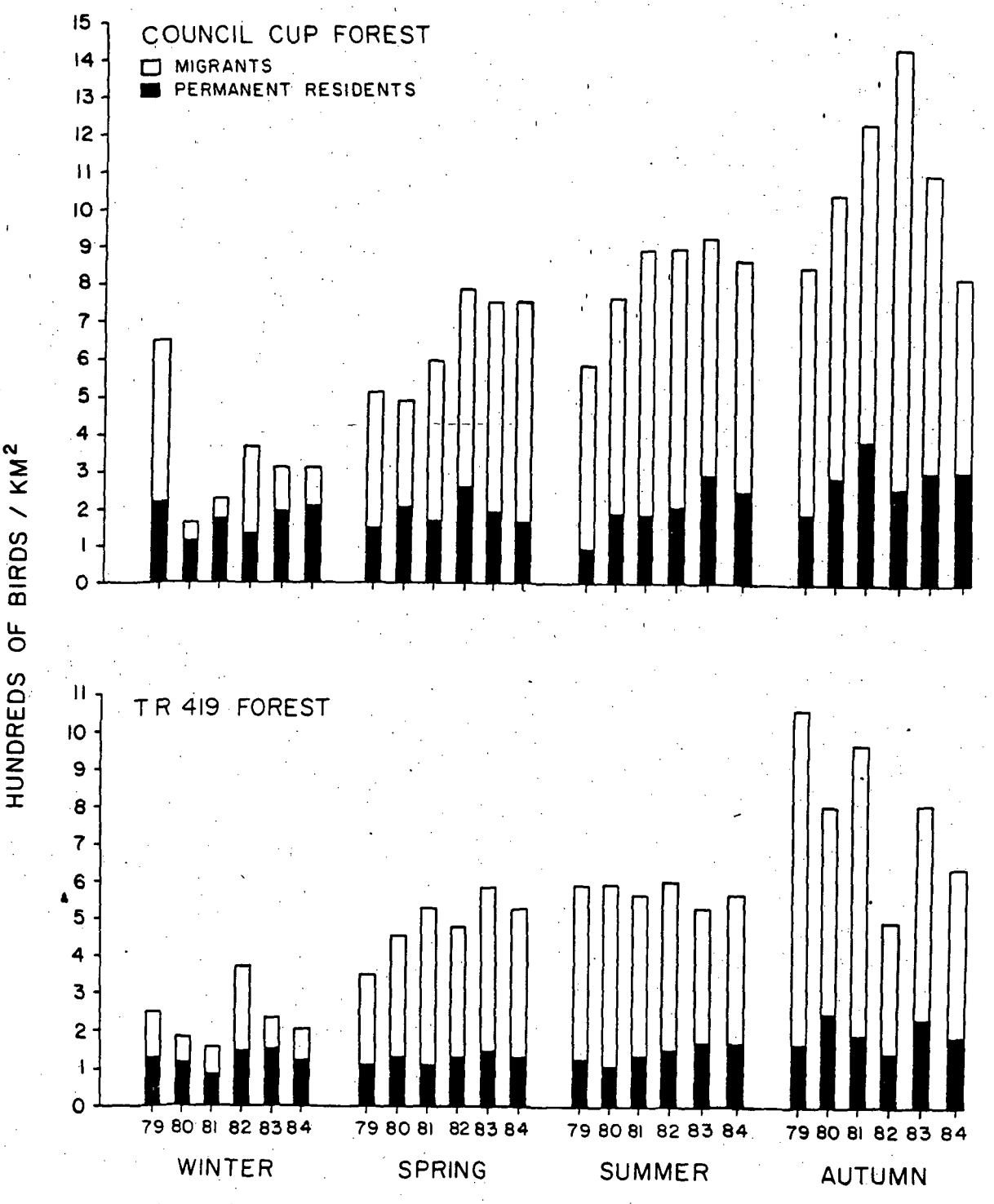

Fig. H-2

Total mean density of birds in each season in Council Cup Forest and TR419 Forest, 1978-84.

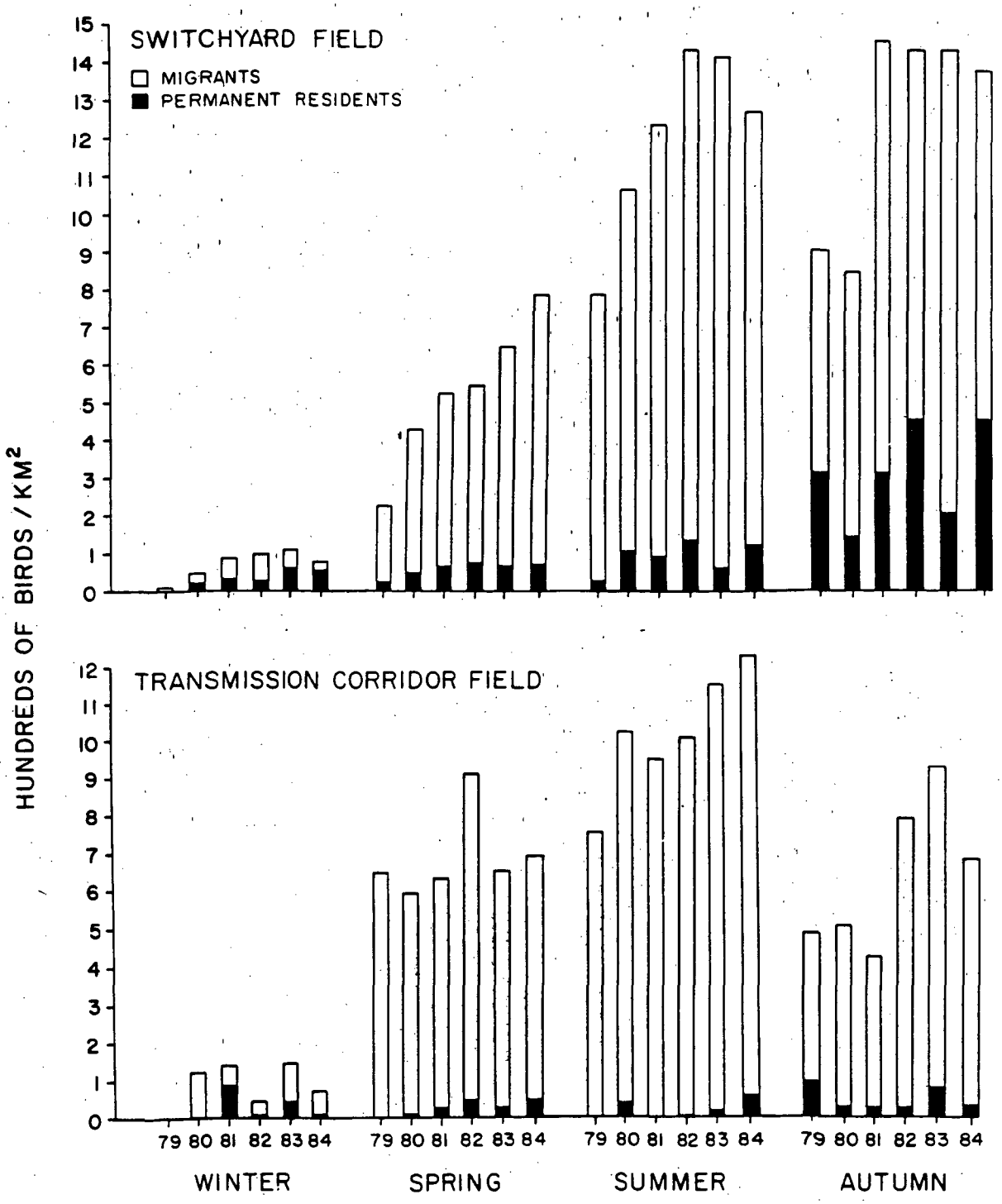

Fig. H-3

Total mean density of birds in each season in Switchyard Field (1978-84) and Transmission Corridor Field (1979-84). No counts were conducted in Transmission Corridor Field in the winter of 1979.

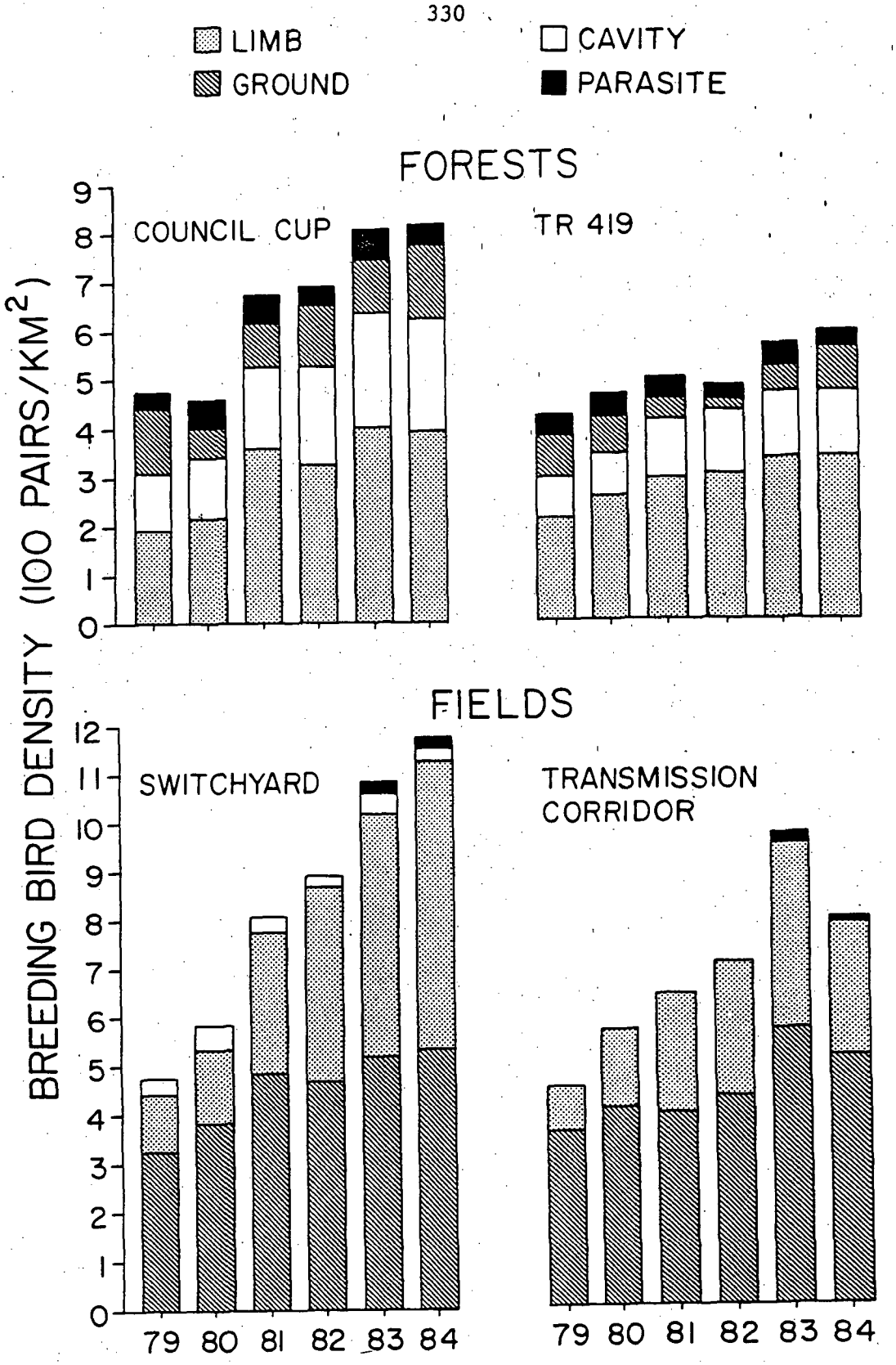

Fig. H-4

Total breeding bird densities in Council Cup and TR419 Forests and Switchyard and Transmission Corridor Fields, 1979-84.

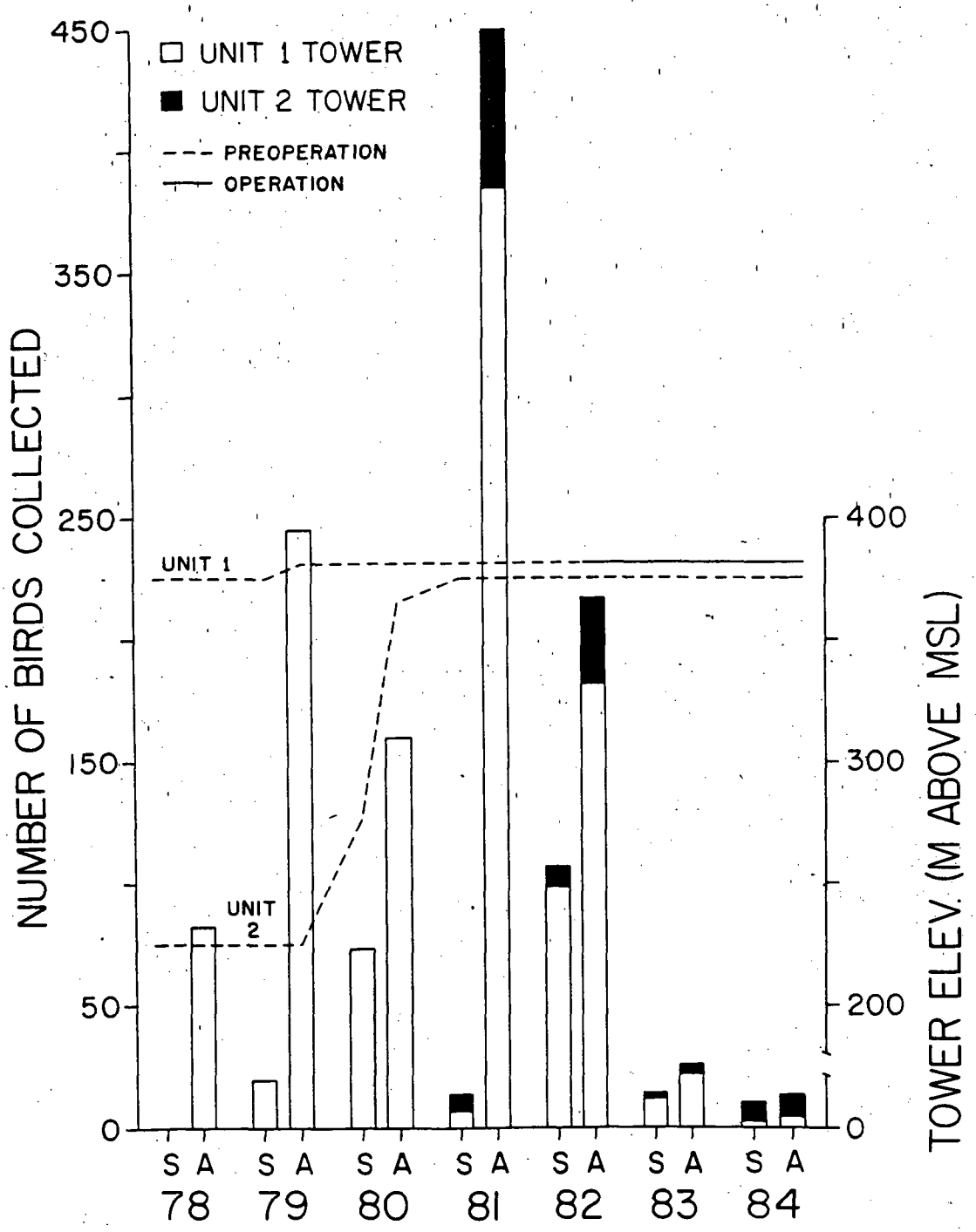

Fig. H-5

Total number of impacted birds collected at the Unit 1 and 2 cooling towers of the Susquehanna SES during spring and autumn migrations from 1978 through 1984, with the elevation of each tower during the same period. No data were collected at the Unit 1 tower before autumn 1978 and at the Unit 2 tower before spring 1981.

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Catherine C. Barski

ABSTRACTS OF SCIENTIFIC PUBLICATIONS BY THE STAFF OF THE SUSQUEHANNA SES BIOLOGICAL LABORATORY, 1984

Deutsch, W. G. 1984. Oviposition of Hydropsychidae (Trichoptera) in a large river. Can. J. Zool. 62: 1988-1994.

Scuba observations in the Susquehanna River revealed that oviposition of *Cheumatopsyche speciosa* and *Hydropsyche phalerata* began 26-44 min (mean, 33 min) after sunset and lasted for 19-30 min (mean, 24 min). Females oriented into the current on acrylic plates and oviposited in 30-60 s. *Cheumatopsyche* (probably *C. speciosa*) and *H. phalerata* egg masses contained a mean of 265 (134-504) and 367 (116-679) eggs, respectively; masses were largest and most densely packed with eggs in mid-June. *Cheumatopsyche* egg masses (84% of the 15,000 hydropsychid masses collected in 1981) were found from 21 May to 30 September; up to 980 egg masses/m^2/day occurred in mid-July. *Hydropsyche phalerata* egg masses (15% of the total) were found from 22 May to 14 September; up to 170 egg masses/m^2/day occurred in early June. Both species oviposited almost daily when river temperature exceeded 15 C. During a 30-day period when river temperature and depth were stable, there was a highly significant ($P<0.01$) positive correlation between the number of *Cheumatopsyche* egg masses and evening air temperature. Positive correlation between the number of egg masses and river current (10-47 cm/s) at eight sites was highly significant ($P<0.01$) for *H. phalerata*, but not for *Cheumatopsyche* ($P>0.05$). Hydropsychid egg masses were widely distributed over an acrylic hemisphere in a slow (15 cm/s) current, but were concentrated on the top, downstream portion in a strong (58 cm/s) current.

SCIENTIFIC PUBLICATIONS BY THE STAFF OF THE
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