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September 6, 1979

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Mr. Donald E. Sells, Acting Branch Chief
Environmental Projects Branch 2
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
ANNUAL ENVIRONMENTAL REPORTS
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DOCKET NOS. 50-387
50-388

Dear Mr. Sells:

Attached are forty (40) copies of the following annual environmental reports:

1. Ecological Studies of the Susquehanna River In the Vicinity of the Susquehanna Steam Electric Station, Annual Report for 1978, Prepared by Ichthyological Associates, Inc.

2. Susquehanna Steam Electric Station Radiological Environmental Monitoring Program, 1978 Annual Report, Prepared By Radiation Management Corporation.

If you have any questions, please contact me.

Very truly yours,

N. W. Curtis

N. W. Curtis
Vice President - Engineering & Construction

NWC:cem
Attachments

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RMC-TR-79-01

SUSQUEHANNA STEAM ELECTRIC STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

Prepared for

Pennsylvania Power and Light Company

by

Radiation Management Corporation

APRIL 1979

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SUMMARY

During 1978 Radiation Management Corporation (RMC) conducted the radiological environmental monitoring program (REMP) for Pennsylvania Power and Light Company (PP&L) for the Susquehanna Steam Electric Station (SES). This report presents the analytical results for samples taken during 1978. A total of 581 thermoluminescent dosimeter measurements and samples including surface water, fish, sediment, air particulates, air iodine, well water, potable water, milk, food products, game and fodder crops were collected in 1978.

A variety of radionuclides, both naturally-occurring and man-made, were detected in the environs of the Susquehanna SES. In March, immediately following the Peoples Republic of China's atmospheric nuclear weapon test, significant increases in radionuclide concentrations in various media were observed. Annual seasonal variations resulting from the spring atmospheric inversion are also observed in the air particulate samples. The detection of these events shows that the Susquehanna SES REMP is sensitive to fluctuations in the radiological characteristics of the environment around Susquehanna SES. No other unusual radionuclide concentrations or ambient radiation levels were observed as part of the routine environmental surveillance program.

INTRODUCTION

The Susquehanna SES will contain 2 BWR generating units, each with a capacity of about 1050 MWe. Units #1 and #2 are scheduled for commercial operation in 1981 and 1982, respectively. This site is located on a 1075 acre tract along the Susquehanna River, five miles northeast of Berwick in Salem Township, Luzerne County, Pennsylvania.

The area surrounding the site can be generally characterized as rural with forest and agricultural lands predominating. More specific information on the demography, hydrology, meteorology and land use characteristics of the local area may be found in the Environmental Report(1), the Safety Analysis Report(2) and the Environmental Statement - C.P. (3) for Susquehanna SES.

RMC has previously reported results for the radiological environmental monitoring program (REMP) from 1972-1977 (4-9); the present document continues the series with coverage for 1978. It presents in detail the type and number of samples analyzed, the analyses performed and the data generated. Data are discussed and compared with those from previous years.

PROGRAM

The investigational phase of the REMP began in 1972 and will continue until 2 years prior to operation for Unit #1. At that time the preoperational phase of the program will be initiated and will continue until initial criticality, when the operational phase of the program will be instituted and continue thereafter. The preoperational and operational programs will be designed utilizing the guidance in NUREG-0473, Draft Radiological Effluent Technical Specifications for BWR's (10). The investigational phase of the program was designed:

1. To establish baseline radiological characteristics of the environs of Susquehanna SES for comparison with future data;

2. To assure that media sampled and analyzed are sensitive to fluctuations in the radiological characteristics of the Susquehanna SES environs; and assure that the program will be responsive to station radioeffluent discharge;

3. To establish potential critical pathways of station radioeffluent to man.

Samples for the 1978 REMP were taken from the aquatic, atmospheric and terrestrial environments with emphasis on those media which would yield data for the evaluation of radiation dose to man. Sediment also was sampled and analyzed as a potentially sensitive indicator of the buildup of environmental radioactivity. Specific sampling locations were chosen on the basis of potential water use, site meteorology, local demography and land uses.

Environmental sampling locations were divided into two classes, indicator and control. Indicator samples are those collected at locations which are expected to manifest future station effects, if any exist, and were selected on the basis of distance from the site, topography, hydrology, meteorology, demography, and drainage characteristics. Control samples are collected at locations which it is believed will be unaffected by station operation. These provide a basis by which to evaluate fluctuations in radioactivity at indicator locations in relation to natural phenomena and fallout after the station is operational.

Table 1 summarizes the Susquehanna REMP for 1978. Appendix A describes and summarizes the entire investigational program as performed in 1978. Appendix B describes the RMC coding system, which specifies sample type and locations. Also in Appendix B, Table B-1 gives the pertinent information on individual sampling locations, while maps B-1 and B-2 show the sampling locations. This report provides information to Pennsylvania Power and Light Company, regulatory agencies, and the general public toward the stated objectives.

Sample Collection

The aquatic environment around Susquehanna SES was examined by analyzing samples of surface water, fish and sediment. Surface water samples were collected in new unuse two gallon containers at four locations monthly. Sample containers were rinsed three times with the sample medium prior to collection. Fish samples were collected in spring and in late summer at both the control and the indicator locations. These samples were prepared by fillet, and frozen for shipment to RMC. Susquehanna River sediment was sampled at three locations; near the planned outfall area, a few miles downstream in the Hess Island area and upstream near Gould Island. The biological consultants to PP&L, collected the samples and performed the species identification.

The atmospheric environment was examined by analyzing air particulates and air iodine. Air particulates were collected weekly at five locations on Gelman type-A/E, glass fiber filters with low-volume air samplers. Air sample volumes were measured with temperature-compensated dry-gas meters. Air iodine was collected on a one inch deep Mine Safety Appliance charcoal cartridges connected in series behind the particulate filter at the Berwick Hospital (12E1) and the PP&L roof (7H1) locations.

The terrestrial environment was examined by analyzing samples of well water, potable water, milk, pasture grass, game and locally grown food products. Well water and potable water samples were collected in new polyethylene containers which had been rinsed with the sample medium prior to collection. Milk and food products were purchased directly from local farmers. Game samples were obtained by hunting or from road killed animals.

Data Interpretation

The radioanalytical and ambient radiation data collected during 1978, together with that collected previously, will be used as a baseline with which operational data may be compared. Several factors are important in the interpretation of the data. These factors are discussed here to avoid repetition in sections that follow.

Within the data tables (Appendix C) a 95% (±2 sigma) confidence interval is supplied for each result above the minimum detectable level (MDL). Numerically, the MDL is equal to 3 times the square root of the dividend resulting from the background counts divided by the square of the background counting time. The square root result is then divided by a dpm/picoCurie conversion factor, the counting efficiency and the sample volume. The MDL is reported when the 2 sigma error exceeds 100% of the calculated activity. The 2 sigma intervals represent the range of values into which 95% of repeated analyses of the same sample would fall. The MDLs quoted for particular sample types (Table C-16) are nominal values. The actual MDLs are calculated for each sample analyzed and will show variability due to the amount of sample analyzed, the length of time between sample collection and counting, the length of time a particular sample was counted and fluctuations in counting background.

It is characteristic of environmental monitoring data that many results occur at or below the MDL. In this report, all results occurring at or below the relevant MDL were reported as being "less than" the MDL value.

Results for each type of sample were grouped according to the analysis performed. Means and standard deviations of these results were calculated when applicable. The calculated standard deviations of grouped data (by location or over time) represent sample rather than analytical variability. For these calculations any values below MDL were considered to be at the MDL. Thus, these averages were biased high and the corresponding standard deviations were biased low. Averages were not calculated when a group of data was composed of many (>50%) MDL values.

RESULTS AND DISCUSSION

All environmental samples and TLDs were analyzed by standard RMC procedures(11). A synopsis of the analytical procedures used appears in Appendix D. Since the precision and accuracy of the analytical results is of paramount importance, RMC devotes a fraction (usually 15-20%) of all analyses to quality control (QC). The results of RMC's QC program for 1978 are included in a separate RMC report (12). One important aspect in maintaining laboratory quality control is RMC's participation in the USEPA inter-laboratory comparison program. This data appears in RMC's annual QC report and is also presented as Appendix E to this report.

The analytical results of the 1978 REMP have been divided into four categories: aquatic, atmospheric, terrestrial and direct radiation. The individual samples and analyses within each category display the unique radiological characteristics of that type of environment. The analytical results for the 1978 program are summarized in Appendix A. The data for individual samples are presented in tabular form in Appendix C.

Aquatic Environment

The radiological characteristics of the aquatic environs of Susquehanna SES were studied by analyzing samples of surface water, fish and sediment.

Surface Water

Susquehanna River water was sampled at three locations. Daily grab samples were collected at 12H1 (Merck Company) then composited into a monthly sample. A monthly sample was also composited from weekly grabs at station 6S1 (near planned outfall area). A monthly grab sample was collected at location 12F1 (Berwick Bridge). One additional monthly grab surface water sample was collected at the Glen Brook Reservoir (13E1).

Each monthly surface water sample was analyzed for beta emitters. Quarterly composites for each location were analyzed for gamma emitters and H-3.

Concentrations of beta emitters in untreated surface water samples ranged from 1.3 to 15 pCi/l, with 26 of 48 samples showing detectable activity. Tritium concentrations ranged between <66 and 125 pCi/l and averaged 88 pCi/l. The gross beta results were essentially the same as those obtained in 1972 to 1977 (4-9). The average tritium concentrations in surface water samples shows a gradual decline for this same period. This is likely the result of a reduction in atmospheric nuclear detonations. Average H-3 concentrations for all locations since 1973 were graphed in figure 1. A least squares exponential curve, fit to this data, yielded a negative slope (indicating decay or decline) with a correlation coefficient of - 0.79. This is reasonably good correlation for environmental data. No gamma emitters were observed in any of the surface water samples.

Fish

Various species of fish were sampled during 1978 at two locations. The species included were: brown bullhead, walleye, white sucker and channel catfish. Strontium-89 and Sr-90 analyses were performed on the flesh portions of these samples. Strontium-89 was not detected in any of the 12 samples. Strontium-90 was detected in 4 of the 12 samples ranging between <0.004 and 0.008 pCi/g(wet).

Gamma spectrometry of the flesh portions of all fish samples detected concentrations of two nuclides above MDL; K-40 and Cs-137. Naturally occurring K-40 was detected in all samples and averaged 2.8 pCi/g(wet). Cesium-137 was detected in 5 of the 12 samples, ranging from <0.004 to 0.014 pCi/g(wet). All fish results were consistent with those previously found. Since the station is not in operation, and there are no other major nuclear power installations in the area, the man-made nuclides observed were attributed to nuclear weapons testing fallout.

Sediment

Sediment samples were taken from three locations in the Susquehanna River. Samples were taken in the proposed outfall area (6A1), downstream near Hess Island (11C1) and upstream near Gould Island (2B1). All samples were analyzed by Ge(Li) gamma spectrometry. Naturally-occurring K-40, Ra-226, and Th-232 were detected in all samples. Naturally-occurring Be-7 was also observed in three of the five samples analyzed. The man-made nuclides detected included Cs-137, Mn-54, Ru-106, Sb-125, Ce-141 and Ce-144. Of these nuclides only Cs-137 was detected in all the samples. These nuclides have been observed periodically throughout the investigational phase of the program. Since the station is not in operation, and there are no other major power nuclear installations in the area, the man-made nuclides observed were attributed to nuclear weapons testing fallout.

Atmospheric Environment

The atmospheric environment in the vicinity of Susquehanna SES was examined by analyzing filtered air for I-131 and samples of air particulates for beta and gamma emitters. Samples of air particulates were collected continuously on filter paper and exchanged weekly at five stations; the biological laboratory (5S3), WSW of the site (12E1), the Mocanaqua Substation (1D1) near Pond Hill NE of the site (3D1), and the PP&L roof in Allentown (7H1). Air iodine was collected on Mine Safety Appliance charcoal cartridges in series with the air particulate filter at station 12E1 (WSW of site) and analyzed for I-131. Beginning in May, airborne iodine was also collected on charcoal cartridges at the Allentown station, 7H1.

The gross beta concentration of each weekly sample was determined. These concentrations ranged from 0.018 to 0.908 pCi/cubic meter for the on-site (5S3) samples; from 0.018 to 1.170 pCi/cubic meter for Berwick (12E1) samples; from 0.018 to 1.930 pCi/cubic meter for the Mocanaqua (1D1) samples; from 0.022 to 1.140 pCi/cubic meter for Pond Hill (3D1) samples; and from 0.017 to 1.060 pCi/cubic meter for the Allentown (7H1) samples. The annual average value was 0.094 pCi/cubic meter for all indicator locations. The gross beta results for the Susquehanna SES site vicinity (plotted in figure 2) show a gradual increasing trend with the approach of spring. This trend is the result of the atmospheric inversion which occurs annually during the spring season in the northern hemisphere (13) and has been observed in many recent years at the site. The significant increase observed in March can be attributed to fallout from the Peoples Republic of China's atmospheric nuclear weapon test of March 14, 1978. Similar increases were observed over the northeastern portion of the United States during this period.

Quarterly composites of air particulate filters from each location were analyzed by gamma spectrometry. Naturally occurring Be-7 was detected in all 19 samples. Fallout nuclides including Nb-95, Zr-95, Ru-103, Ru-106, Sb-125, I-131, I-132, Te-132, Cs-137, BaLa-140, Ce-141 and Ce-144 were detected in many of the composites following the nuclear weapons test which occurred in March 1978. The concentrations observed during 1978 were similar to those of 1977(9) and showed the same trends as the gross beta values of the previous years.

Of the 82 air iodine samples analyzed, only one showed detectable concentrations of I-131. When the peak of the Chinese fallout occurred during the third week of March, iodine-131 was detected at a concentration of 0.055 and 0.070 pCi/cubic meter.

Terrestrial Environment

The terrestrial environment in the vicinity of Susquehanna SES was examined by analyzing samples of well water, potable water, milk, food products, pasture, grass and game.

Well Water

The two wells (the biological laboratory, 5S2; and Berwick, 12F1) were sampled quarterly for tritium. Tritium levels were consistent with those observed in previous years and ranged between <69 and 138 pCi/l for the eight samples analyzed.

Potable Water

Composite samples of treated potable water samples were taken quarterly at the Berwick and Danville Water Companies and analyzed for tritium, beta emitters, Sr-89 and Sr-90. Tritium concentrations ranged between 75 and 152 pCi/l. This range is similar to that observed in Susquehanna River water samples (76 to 125 pCi/l). Gross beta concentrations averaged 2.6 pCi/l. Strontium-89 activity (0.4 and 0.9 pCi/l) was detected in two of the eight samples with the MDL of the other samples ranging from 0.6 to 0.9 pCi/l. One sample had Sr-90 activity (0.3 pCi/l) with the MDLs ranging between 0.4 and 0.8 pCi/l.

Milk

Milk from three locations was collected quarterly and analyzed for I-131, Sr-89, Sr-90 and gamma emitters. The 12 quarterly milk samples showed results which were consistent with previous years. Iodine-131 was detected in two samples taken in March with a concentration of 0.15 and 4.7 pCi/l. Strontium-89 was detected in 5 of the 12 samples and ranged from <1.2 to 3.5 pCi/l. Strontium-90 was detected in all of the samples ranging between 1.1 and 12 pCi/l. The gamma emitters K-40 (900 to 1600 pCi/l) and Cs-137 (1.9 to 7.9 pCi/l) were detected at expected environmental levels in all the samples. Both the I-131 and Cs-137 activities noted are the results of atmospheric nuclear weapons testing.

Food Products

A variety of food products were sampled and analyzed for gamma emitters. These included apples, cabbage, corn, beef, chicken and eggs. Natural K-40 was detected in all samples at normal environmental levels and ranged between 0.5 and 5.4 pCi/g(wet). All other gamma emitting nuclides were below their respective MDLs.

Fodder Crops

During the third quarter of 1978 pasture grass was added to the investigational phase of the REMP. The samples collected from a local farm (15A2) was obtained quarterly and analyzed by gamma spectrometry. Naturally-occurring Be-7 and K-40 were the only nuclides observed with Be-7 ranging between 1.5 and 9.1 pCi/g-dry while the K-40 activity ranged between 3.4 and 13 pCi/g-dry.

Game

Three game samples (two squirrel and one deer) were taken and analyzed for gamma emitters. Naturally-occurring K-40 was detected in all samples as expected, ranging from 2.1 to 2.8 pCi/gram(wet). Cesium-137 was also detected in all game samples at concentrations of 0.29 pCi/gram(wet) for the deer sample and 0.57 and 2.3 pCi/g(wet) for the two squirrel samples. These results are similar to results obtained in previous years for these sample types. This phenomenon in squirrels was the subject of a more detailed investigational study presented in the 1975 annual report (7).

A statistical analysis of the K-40 and the Cs-137 concentrations in food products versus game was performed utilizing the gamma spectrometry data on these samples. The statistical test used was the Mann-Whitney Test (the nonparametric counterpart of the t-test) which utilizes a system of ranking to determine whether two random groups of samples are from different distributions (14). At the 99% confidence level, no significant difference in K-40 was observed in game versus food products. At this same confidence level, Cs-137 concentrations were significantly higher in the game samples.

<u>Direct Radiation</u>

Direct radiation measurements were made on a quarterly basis at 9 locations using $CaSO_4$ (Tm) thermoluminescent dosimeters. A total of 36 quarterly TLD packets were collected and analyzed. These analyses yielded an average dose rate of 6.02 mrads/standard month. All TLD results presented in this report have been normalized to a standard month (30.4 days) to eliminate the apparent differences in data caused by the variations in exposure periods.

The projected annual dose from direct radiation computed from these results is about 72 mrads, or 72 mrems assuming a quality factor of 1. The EPA terrestrial and cosmic radiation dose rate calculated for the Wilkes-Barre area is 82 mrem/year, neglecting any neutron contribution (15). This compares with the average TLD measured dose rate of 72 mrem/year. This difference is not unexpected since the EPA values are gross general averages for an area and do not take into consideration specific terrestrial variations. Although the total annual dose appears to be increasing from 1974 to the present (67 to 72 mrads), the increase is probably attributed to normal environmental variability due to the terrestrial component of the total dose and also to program TLD station changes. The TLD's agree with the Shonka measurements taken in 1978 which indicate a slight increase in dose from 1973 (16). The monthly average dose rates for all monitoring locations since 1973 are plotted in Figure 3. The differences observed between locations or between sampling periods were similar to those found previously (4-9).

CONCLUSIONS

The Radiological Environmental Monitoring Program for Susquehanna SES was conducted during 1978 as a continuation of the program initiated in 1972. The data collected during 1978 further develops a baseline for comparison with future operational data.

From the results obtained and the analysis performed on the data it can be concluded that the levels and fluctuations of radioactivity in environmental samples were as expected for this environment. Aquatic samples consisting of surface water, aquatic organisms, and sediment were chosen and reflect the normal background radiation found in this environment. Charcoal cartridges used to detect the presence of airborne iodine along with airborne particulate matter were also analyzed. Airborne radioiodine was observed in one sample and was attributed to the atmospheric nuclear test on March 14, 1978. The particulate matter was similar to that observed throughout the Northeast portion of the country. In addition milk, well water, drinking water, game and various food products, including green leafy vegetables were sampled. The results obtained from the analyses of these samples were similar to the expected values of radioactivity usually associated with the samples. Radioiodine was observed in two milk samples that were collected and analyzed immediately following the atmospheric nuclear test of March 14, 1978. The activity detected was attributed to that test. Direct radiation levels were relatively low and approximately the same at all locations. Based on the analyses of these samples it can be concluded that no unusual radiological characteristics were observed in the environs of the Susquehanna Steam Electric Station.

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(10) United States Nuclear Regulatory Commission, NUREG-0473, Draft Radiological Effluent Technical Specifications for BWR's Revision 1, October 1978.

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(15) Oakley, Donald T., Natural Radiation Exposure in the United States, ORP/SID 72-1, United States Environmental Protection Agency, June 1972.

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TABLE 1

SYNOPSIS OF THE SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1978

SAMPLE TYPE	SAMPLING FREQUENCY	LOCATION	NUMBER COLLECTED	TYPE	ANALYSIS FREQUENCY	NUMBER PERFORMED
AQUATIC ENVIRONMENT						
Surface Water	M	4	48	Gross Beta	M	48
				H-3	QC	16
				Gamma	QC	16
Fish (Flesh)	SA	2	12	Gamma	SA	12
				Sr-89	SA	12
				Sr-90	SA	12
Sediment	SA	3	5	Gamma	SA	5
ATMOSPHERIC ENVIRONMENT						
Air Particulates	W	5	249	Gross Beta	W	249
				Gamma	QC	20
Air Iodine	W	2	82	I-131	W	82
TERRESTRIAL ENVIRONMENT						
Well Water	Q	2	8	H-3	Q	8
Drinking Water	Q	2	8	H-3	Q	8
				Gross Beta	Q	8
				Sr-89	Q	8
				Sr-90	Q	8
Milk	Q	3	12	I-131	Q	12
				Sr-89	Q	12
				Sr-90	Q	12
				Gamma	Q	12
Fodder Crops	Q	1	2	Gamma	Q	2
Food Products	A	4	5	Gamma	A	5
Game	A	2	3	Gamma	A	3
Beef and Poultry	SA	2	4	Gamma	SA	4
DIRECT RADIATION						
Dosimeters (TLDs)	Q	9	144	Gamma dose rate	Q	144

FIG. 1 AVERAGE CONCENTRATIONS OF TRITIUM IN SURFACE WATER IN THE VICINITY OF THE SUSQUEHANNA SES 1973 THROUGH 1978

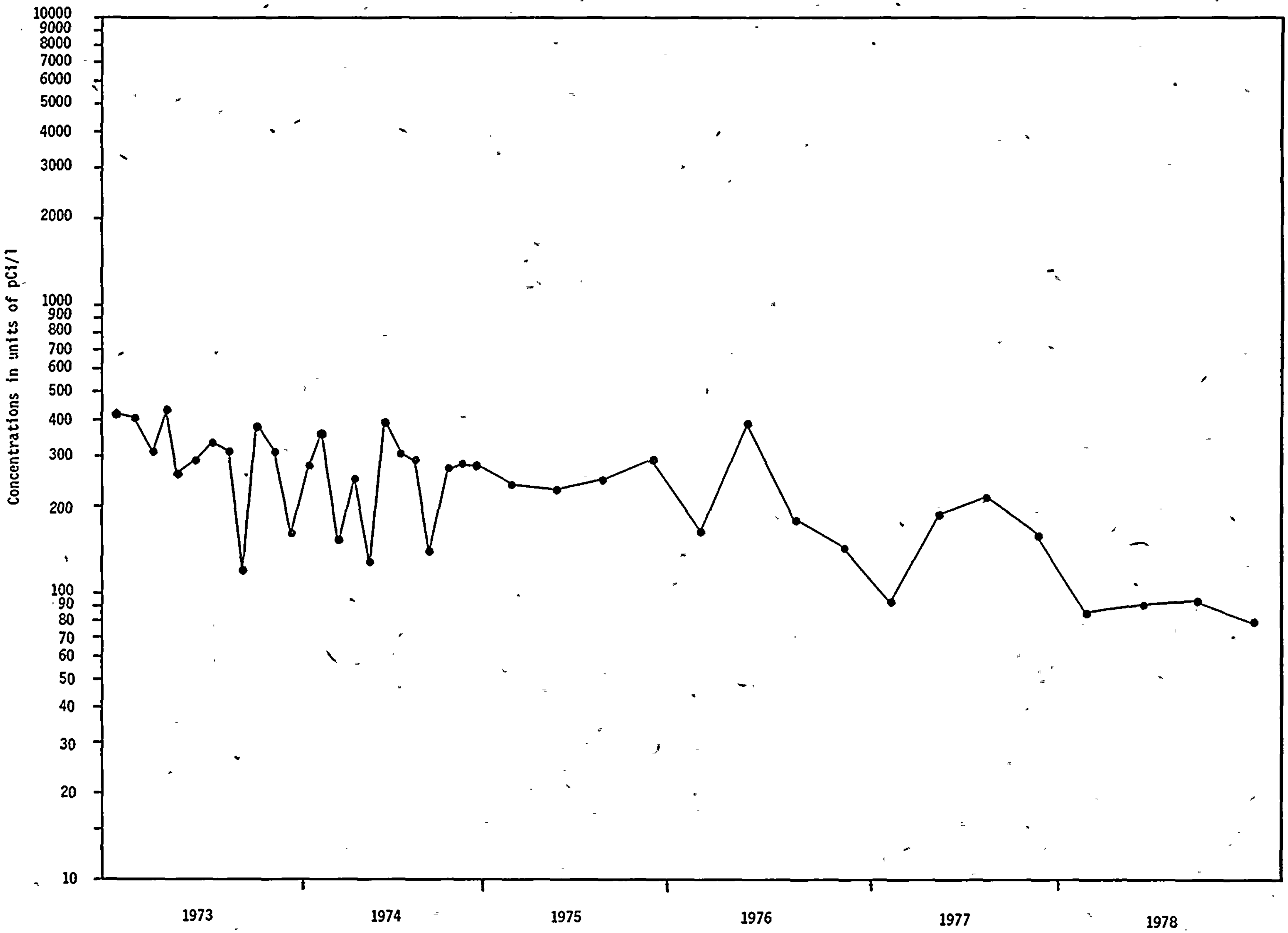


FIG. 2 Gross Beta Activity in Air Particulates In the Vicinity of the Susquehanna SES Site 1978

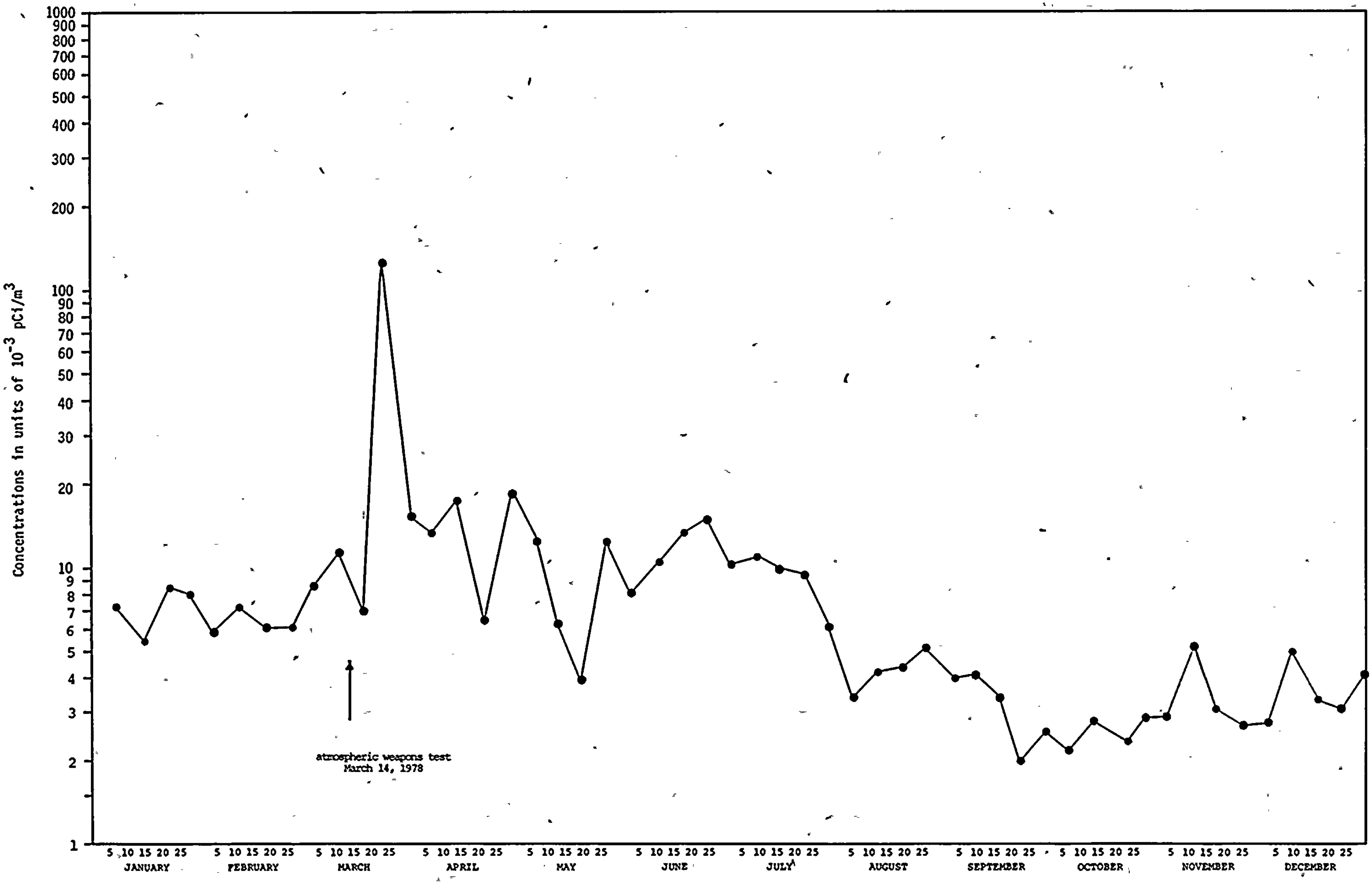
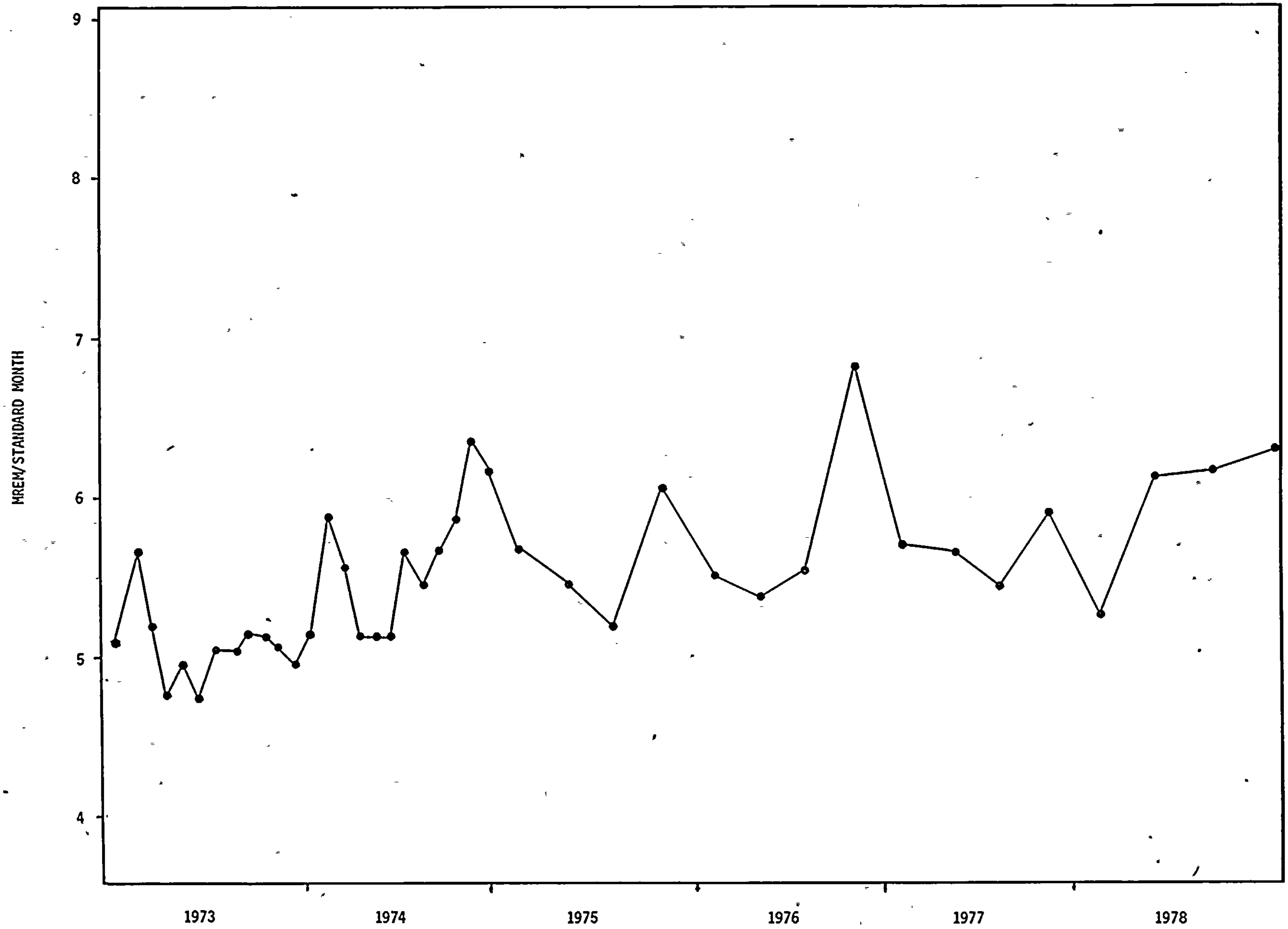


FIG. 3 AVERAGE AMBIENT RADIATION LEVELS IN THE VICINITY OF THE SUSQUEHANNA SES
1973 THROUGH 1978



APPENDIX A

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

APPENDIX A

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Susquehanna SES   Docket No.: 50-387 & 50-388

Luzerne, Pa.   January 1 to December 31, 1978

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	MINIMUM DETECTABLE LEVEL (MDL) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATION MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Surface Water (pCi/l)	Gross Beta 48	1.3	4.0 (26/48) (2.5-15)	12F1 5.2 mi WSW	4.8 (8/12) (2.6-15)	N/A	0
	H-3 16	77	101 (7/16) (76-125)	12F1 5.2 mi WSW	125 (2/4) (125)		0
	Gamma 16 None Detected			N/A			
Well Water (pCi/l)	H-3 8	69	106 (6/8) (78-138)	12F2 5.2 mi WSW	112 (4/4) (78-138)	N/A	0
Drinking Water (pCi/l)	H-3 8	79	101 (5/8) (75-152)	12F2 5.2 mi WSW	127 (3/4) (106-152)	N/A	0
	Gross Beta 8	1.7	3.1 (5/8) (2.2-4.5)	12H2 20 mi WSW	3.3 (3/4) (2.2-4.5)		0
	Sr-89 8	0.6	0.7 (2/8) (0.4-0.9)	12H2 20 mi WSW	0.7 (2/4) (0.4-0.9)		0
	Sr-90 8	0.4	- (0/8) -	N/A			0
Fish (pCi/g-wet)	Sr-89 12	0.01	- (0/12) -	N/A			0
	Sr-90 12	0.004	0.007 (1/6) (0.007)	IND 0.9 mi ESE	0.007 (1/6) (0.007)	0.005 (3/6) (0.004-0.008)	0
	Gamma 12 K-40	-	2.7 (6/6) (2.3-3.3)	IND 0.9 mi ESE	2.7 (6/6) (2.3-3.3)	2.8 (6/6) (1.6-4.0)	0
	Cs-137	0.005	0.010 (2/6) (0.007-0.013)	IND 0.9 mi ESE	0.010 (2/6) (0.007-0.013)	0.012 (3/6) (0.008-0.014)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	MINIMUM DETECTABLE LEVEL (MDL) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATIONS MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Sediment (pCi/g(dry)	Gamma 5						
	Be-7	0.2	0.5 (2/4) (0.4-0.6)	6A2 0.8 mi ESE	0.5 (2/2) (0.4-0.6)	0.4 (1/1) (0.4)	0
	K-40	-	10.4 (4/4) (9.1-14)	6A2 0.8 mi ESE	11.6 (2/2) (9.1-14)	11 (1/1) (11)	0
	Mn-54	0.02	0.02 (2/4) (0.02)	6A2 0.8 mi ESE	0.2 (1/2) (0.2)	- (0/1) -	0
	Ru-106	0.2	0.4 (1/4) (0.4)	6A2 0.8 mi ESE	0.4 (1/2) (0.4)	0.3 (1/1) (0.3)	0
	Sb-125	0.05	0.06 (1/4) (0.06)	6A2 0.8 mi ESE	0.06 (1/2) (0.06)	- (0/1) -	0
	Cs-137	-	0.15 (4/4) (0.06-0.25)	6A2 0.8 mi ESE	0.17 (2/2) (0.09-0.25)	0.21 (1/1) (0.21)	0
	Ce-141	0.03	- (0.4) -	2B1 1.6 mi NNE	0.03 (1/1) (0.03)	0.03 (1/1) (0.03)	0
	Ce-144	0.02	0.5 (1/4) (0.5)	6A2 0.8 mi ESE	0.5 (1/2) (0.5)	0.4 (1/1) (0.4)	0
	Ra-226	-	0.74 (4/4) (0.66-0.92)	6A2 0.8 mi ESE	0.80 (2/2) (0.68-0.92)	0.78 (1/1) (0.78)	0
	Th-232	-	0.85 (4/4) (0.78-1.0)	6A2 0.8 mi ESE	0.9 (2/2) (0.8-1.0)	0.84 (1/1) (0.84)	0
Air Iodine (10^{-3} pCi/m^3)	I-131 82	2.5	55 (1/52) (55)	12E1 5.1 mi WSW	55 (1/52) (55)	- (0/30) -	0
Air Particulates (10^{-3} pCi/m^3)	Gross Beta 249	5	97 (249/249) (17-1930)	1D1 3.7 mi N	114 (41/41) (18-1930)	102 (52/52) (17-1060)	0
	Gamma 19						
	Be-7	-	69 (15/15) (54-106)	3D1 3.2 mi NE	79 (4/4) (63-106)	59 (4/4) (40-70)	0
	Zr-95	1.0	2.4 (5/15) (1.2-4.9)	5S3 0.7 mi E	4.9 (1/4) (4.9)	2.3 (2/4) (1.6-2.9)	0
	Nb-95	0.6	2.9 (7/15) (2.2-4.5)	12E1 5.1 mi WSW	3.4 (2/4) (2.2-4.5)	2.2 (2/4) (1.7-2.7)	0
	Ru-103	0.6	5.2 (5/15) (0.8-8.8)	12E1 5.1 mi WSW	7.2 (1/4) (8.8)	7.2 (1/4) (7.2)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED		MINIMUM DETECTABLE LEVEL (MDL) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATIONS MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Air Particulates	Ru-106		6.0	12 (7/15) (10-15)	3D1 3.2 mi NE	13 (2/4) (11-15)	10 (2/4) (8-11)	0
(10^{-3} pCi/m^3)	Sb-125		1.0	3.2 (5/15) (2.3-4.1)	12E1 5.1 mi WSW	3.5 (1/4) (3.5)	2.3 (1/4) (2.3)	0
	I-131		0.4	7.8 (3/15) (7.3-8.7)	3D1 3.2 mi NE	8.7 (1/4) (8.7)	9.6 (1/4) (9.6)	0
	I-132		0.5	0.8 (2/15) (0.6-0.9)	12E1 5.1 mi WSW	0.9 (1/4) (0.9)	- (0/4) -	0
	Te-132		0.3	9.1 (2/15) (4.2-14)	12E1 5.1 mi WSW	14 (1/4) (14)	- (0/4) -	0
	Cs-137		0.8	2.1 (12/15) (1.0-4.8)	5S3 0.7 mi E	3.2 (3/4) (2.0-4.8)	1.8 (4/4) (1.2-2.5)	0
	BaLa-140		0.7	11 (3/15) (8.1-13)	12E1 5.1 mi WSW	13 (1/4) (13)	10 (1/4) (10)	0
	Ce-141		1.0	2.9 (7/15) (0.6-5.3)	7H1 47 mi SW	5.5 (1/4) (5.5)	5.5 (1/4) (5.5)	0
	Ce-144		4.0	29 (12/15) (4-42)	3D1 3.2 mi NE	31 (2/4) (20-42)	15 (4/4) (5-21)	0
Milk (pCi/l)	Sr-89	12	1.2	2.4 (5/8) (1.5-3.5)	12B2 1.2 mi WSW	2.8 (2/4) (2.1-3.5)	- (0/4) -	0
	Sr-90	12	-	5.3 (8/8) (1.1-12)	12B2 1.2 mi WSW	8.3 (4/4) (4.5-12)	4.7 (4/4) (2.8-8.2)	0
	I-131	12	0.04	2.4 (2/8) (0.15-4.7)	12B2 1.2 mi WSW	4.7 (1/4) (4.7)	- (0/4) -	0
	Gamma	12						
	K-40		-	1250 (8/8) (900-1600)	12B1 1.7 mi WSW	1325 (4/4) (1000-1600)	1375 (4/4) (1000-1700)	0
	Cs-137		-	5.2 (8/8) (1.9-7.9)	12B2 1.2 mi WSW	6.9 (4/4) (6.0-7.9)	4.9 (4/4) (1.9-9.8)	0
Fodder Crops (pCi/g-dry)	Gamma	2						
	Be-7		-	5.3 (2/2) (1.5-9.1)	15A2 0.8 mi NNW	5.3 (2/2) (1.5-9.1)	No Control Location	0
	K-40		-	8.2 (2/2) (3.4-13)	15A2 0.8 mi NNW	8.2 (2/2) (3.4-13)		0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED		MINIMUM DETECTABLE LEVEL (MDL) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATIONS MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Fruit & Vegetables	Gamma	5						
(pCi/g-dry)	K-40		-	1.5 (4/4) (0.5-2.5)	2H1 21 mi NNE	2.8 (1/1) (2.8)	2.8 (1/1) (2.8)	0
Game	Gamma	3						
(pCi/g-wet)	K-40			2.5 (3/3) (2.1-2.8)	Site Vicinity	2.8 (1/1) (2.8)	N/A	0
	Cs-137			1.1 (3/3) (0.3-2.3)	Site Vicinity	2.3 (1/1) (2.3)		0
Meat & Poultry	Gamma	4						
(pCi/g-wet)	K-40			2.4 (4/4) (1.0-5.4)	12B2 1.2 mi WSW	5.4 (1/1) (5.4)	N/A	0
Ambient Radiation (mrem)	TLD	36	0.1	6.3 (28/28) (4.46-7.96)	12F1 5.2 mi WSW	7.39 (4/4) (7.22-7.55)	4.99 (8/8) (4.35-5.85)	0

(1) The MDLs quoted are the lowest actual MDLs obtained in the various media during the reporting period. A typical gamma MDL was determined for each searched for nuclide as found on Table C-16. Where all nuclides were >MDL for a specific media no MDL was listed.

(2) Mean and range based upon detectable measurements only. Fraction of detectable measurements is indicated in parentheses.

APPENDIX B

SAMPLE DESIGNATION

APPENDIX B

Table B-1 lists the sampling locations and includes both the distance and direction from the Susquehanna SES and the media sampled at each location. Maps B-1 and B-2 show the sampling locations with respect to the Susquehanna SES.

Sample Designation

Samples are identified by a three part code. The first two letters are the power station identification code, in this case "SS" for Susquehanna Steam Electric Station. The next three letters are for the media sampled.

AIO	=	Air Iodine	FPP	=	Food Products, Poultry
AQF	=	Fish	GAD	=	Game, Deer
AQS	=	Sediment	GAS	=	Game, Squirrel
APT	=	Air Particulates	IDM	=	Immersion Dose (TLD)
FPB	=	Food Products, Beef	MLK	=	Milk
FPE	=	Food Products, Eggs	PAS	=	Pasture Grass
FPF	=	Food Products, Fruit	PWT	=	Potable Water, Treated
FPG	=	Food Products, Grain	SWA	=	Surface Water
FPL	=	Food Products, Leafy Vegetables	WWA	=	Well Water

The last four symbols are a location code based on direction and distance from the site. Of these, the first two represent each of the 16 angular sectors of 22-1/2 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction; i.e., 2=NNE, 3=NE, 4=ENE, etc. The next digit is a letter which represents the radial distance from the station:

S	=	On-site location	E	=	4-5 miles off-site
A	=	0-1 miles off-site	F	=	5-10 miles off-site
B	=	1-2 miles off-site	G	=	10-20 miles off-site
C	=	2-3 miles off-site	H	=	>20 miles off-site
D	=	3-4 miles off-site			

The last number is the station numerical designation within each sector and zone; e.g. 1, 2, 3, ...

Specific information about the individual sampling locations is given in table B-1. Maps B-1 and B-2 show the locations of sampling stations with respect to the site.

TABLE B-1

SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1978

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
IND**	0.8 mile , Outfall Area	AQF
2S1	0.7 mile NNE, Near Site Boundary	GAS
3S1	0.8 mile NE, Off Route 11	IDM, GAD
4S1	0.8 mile ENE, Off Route 11	IDM
5S1	0.7 mile E, North of Biological Consultants	IDM
5S2	0.4 mile, E Site - Peach Stand	WWA
5S3	0.7 mile E, Site - Biological Consultants	APT
6S1	0.9 mile ESE, Outfall Area	SWA
7S1	0.3 mile SE, On 230 KV tower	IDM
11S1	0.3 mile SW, On 230 KV tower	IDM
6A2	0.8 mile ESE, Outfall Area	AQS
15A2	0.8 mile NNW, Local Farm, At Site Boundary	PAS
2B1	1.6 mile NNE, Gould Island	AQS
7B1	1.5 mile SE, Heller Orchard	FPF
12B1	1.7 mile WSW, Shultz Farm	MLK, FPA, FPG
12B2	1.2 mile WSW, Young Farm	MLK, FPE, FPP
12B3	1.4 mile WSW, Kisner Farm	FPB
11C1	2.0 mile SW, Hess Island	AQS
1D1	3.7 mile N, Near Moquanaqua Substation	IDM
3D1	3.2 mile NE, Pond Hill	APT
11D1	4.3 mile SW, Vegetable Farm	FPL

TABLE B-1 (cont.)

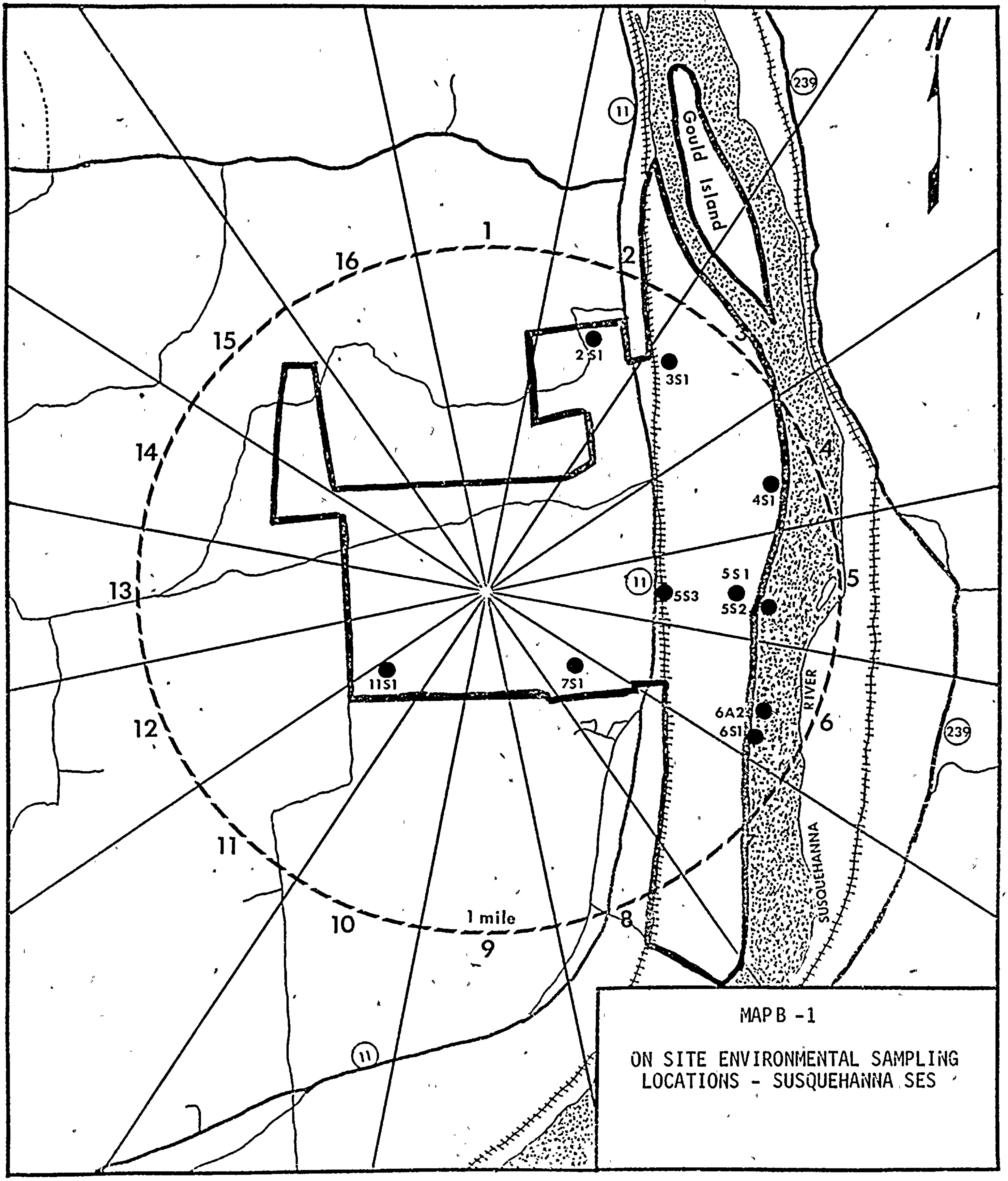
SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1978

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
12E1	5.1 mile WSW, Berwick Hospital	APT, AIO
13E1	4.5 mile W, Glen Brook Reservoir	SWA
12F1	5.2 mile WSW, Berwick	IDM, SWA
12F2	5.2 mile WSW, Berwick Water Co.	WWA, PWT
2G1	30 mile NNE, Near Falls, PA	AQF
9G1	19 mile S, Davis Farm	MLK
2H1	21 mile NNE, Vegetable Stand	FPL
7H1	47 mile SE, PP&L roof, Allentown	APT, AIO, IDM
7H2	40 mile SE, Crystal Springs Dairy	MLK
8H1	92 mile SSE, RMC roof, Philadelphia	IDM
12H1	26 mile WSW, Merck Co.	SWA
12H2	26 mile WSW, Danville Water Company	PWT

* All distances measured from vent.

** No actual location is indicated since fish are sampled over an area which extends through 3 sectors (5, 6 and 7) near the outfall area.

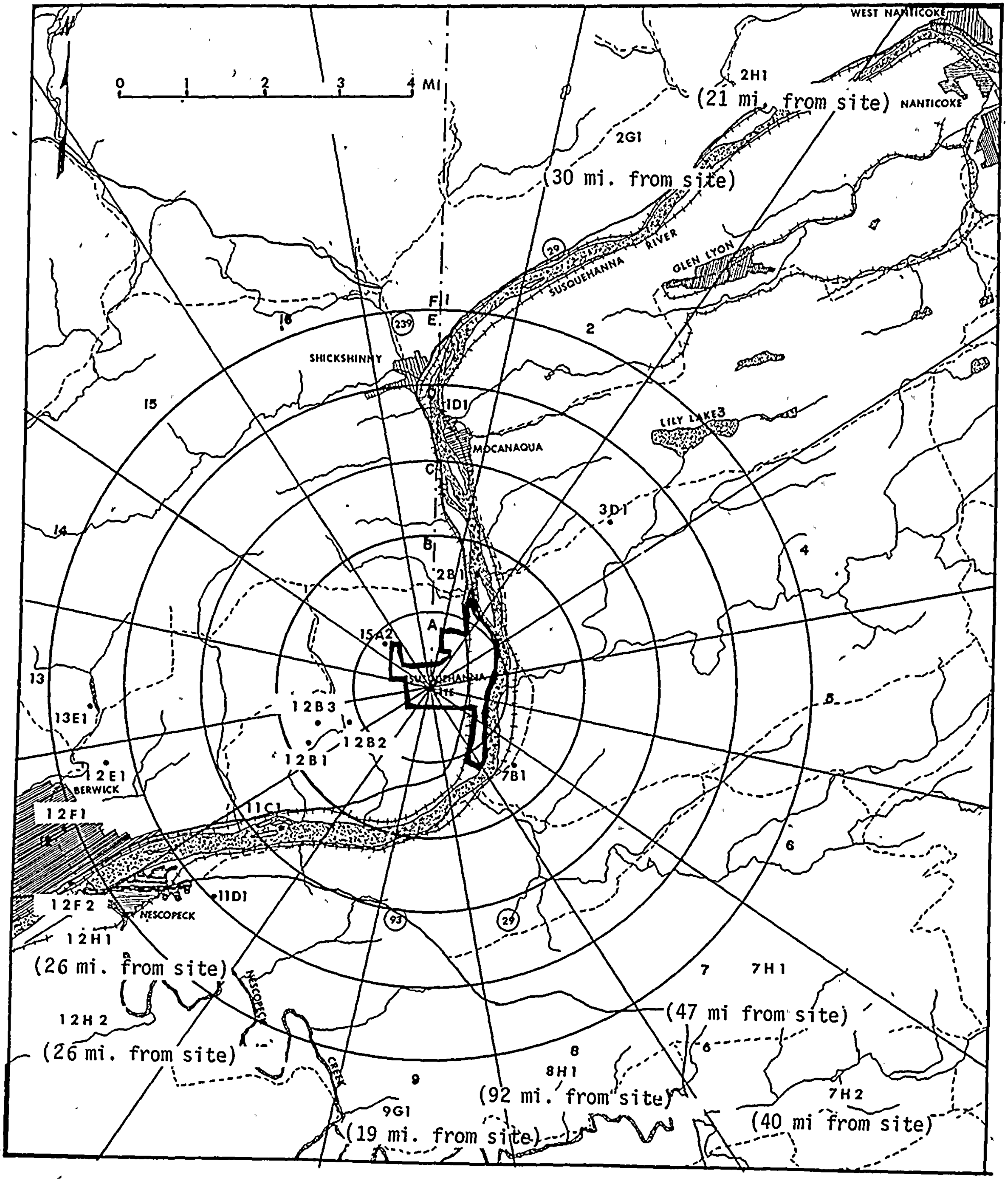


MAP B -1

ON SITE ENVIRONMENTAL SAMPLING LOCATIONS - SUSQUEHANNA SES

MAP B-2

OFF SITE ENVIRONMENTAL SAMPLING LOCATIONS - SUSQUEHANNA SES



APPENDIX C

DATA TABLES

APPENDIX C

DATA TABLES

APPENDIX C (cont.)

DATA TABLES

TABLE C-1

CONCENTRATIONS OF BETA EMITTERS IN SURFACE WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-SWA-6S1	2.6±2.2	2.7±1.8	8.8±2.4	<2.1	4.3±2.1	3.7±2.0
SS-SWA-12F1	3.6±2.3	2.6±1.8	15±3	<2.1	<1.8	3.1±1.9
SS-SWA-12H1	<3.0	2.6±1.8	6.2±2.2	<2.1	<1.8	3.3±2.0
SS-SWA-13E1	<3.0	<1.6	3.5±2.0	<2.1	<1.8	1.9±1.8
Average	3.1±0.8	2.4±1.0	8.4±9.8	<2.1	2.4±2.5	3.0±1.6

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVERAGE
SS-SWA-12F1	<2.7	2.5±1.4	3.1±1.8	3.7±2.2	4.2±2.2	<2.5	3.6±3.6
SS-SWA-12F1	<2.7	3.2±1.4	2.7±1.8	3.3±2.2	4.5±2.2	<2.5	3.9±7.1
SS-SWA-12H1	<2.7	2.6±1.4	3.3±1.8	4.2±2.3	3.8±2.2	<2.5	3.2±2.3
SS-SWA-13E1	<2.7	<1.3	<1.6	<2.0	<1.9	<2.5	2.2±1.3
Average	<2.7	2.4±1.6	2.7±1.5	3.3±1.9	3.6±2.3	<2.5	3.2±4.3

TABLE C-2

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITE SAMPLES OF SURFACE WATER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JAN to MARCH	APRIL to JUNE	JULY to SEPT	OCT to DEC
SS-SWA-6S1	All <MDL	All <MDL	All <MDL	All <MDL
SS-SWA-12F1	All <MDL	All <MDL	All <MDL	All <MDL
SS-SWA-12H1	All <MDL	All <MDL	All <MDL	All <MDL
SS-SWA-13E1	All <MDL	All <MDL	All <MDL	All <MDL

* Typical MDLs are given in Table C-16.

TABLE C-3

CONCENTRATIONS OF TRITIUM IN QUARTERLY COMPOSITE SAMPLES OF SURFACE WATER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NUMBER	JAN to MARCH	APRIL to JUNE	JULY to SEPT	OCT to DEC	ANNUAL AVERAGE
SS-SWA-6S1	110±75	<80	91±63	89±73	93±25
SS-SWA-12F1	<79	125±76	125±67	<77	102±54
SS-SWA-12H1	76±75	<80	92±70	<77	81±15
SS-SWA-13E1	<79	<80	<66	<77	76±13
Quarterly Average	86±32	91±45	94±48	80±12	88±35

TABLE C-4

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89** AND -90 IN FISH FLESH
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NUMBER	SAMPLE TYPE	SAMPLE DATE	Sr-89	Sr-90	K-40	Cs-137
SS-AQF-IND	Bullhead	5-08-78	<0.01	<0.006	2.3±0.2	0.007±0.006
SS-AQF-IND	Walleye	5-08-78	<0.01	<0.006	2.6±0.3	<0.005
SS-AQF-IND	White Sucker	5-08-78	<0.01	<0.007	2.4±0.2	<0.004
SS-AQF-IND	Channel Catfish	9-13-78 to 9-14-78	<0.01	<0.004	3.3±0.3	0.013±0.007
SS-AQF-IND	White Sucker	9-20-78	<0.02	0.007±0.004	2.7±0.3	<0.004
SS-AQF-IND	Walleye	9-20-78 to 10-17-78	<0.01	<0.005	3.0±0.3	<0.005
SS-AQF-IND	Channel Catfish	5-10-78 to 5-12-78	<0.01	<0.006	1.6±0.2	0.013±0.007
SS-AQF-2G1	Walleye	5-10-78 to 5-12-78	<0.01	0.004±0.004	2.2±0.2	0.014±0.006
SS-AQF-2G1	White Sucker	5-10-78 to 5-12-78	<0.02	0.008±0.006	4.0±0.4	<0.004
SS-AQF-2G1	Channel Catfish	9-27-78 to 9-28-78	<0.01	<0.005	2.8±0.3	0.008±0.007
SS-AQF-2G1	White Sucker	9-27-78	<0.01	0.004±0.003	2.8±0.3	<0.006
SS-AQF-2G1	Walleye	9-27-78	<0.02	<0.005	3.3±0.3	<0.005

* All other gamma emitters searched for were <MDL; typical MDLs are given in Table C-16.
** Sr-89 results are decay corrected to the sample stop date.

TABLE C-5

CONCENTRATIONS OF GAMMA EMITTERS* IN SEDIMENT SAMPLES
FROM THE SUSQUEHANNA RIVER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(dry) ± 2 sigma

STATION NO.	SS-AQS-6A2		SS-AQS-11C1		SS-AQS-2B1
DATE	5-22-78	9-12-78	5-22-78	9-12-78	9-26-78
Be-7	0.4±0.2	0.6±0.3	<0.1	<0.2	0.4±0.2
K-40	9.1±0.9	14±1	9.3±0.9	9.1±0.9	11±1
Mn-54	0.02±0.02	<0.02	0.02±0.01	<0.02	<0.02
Ru-106	<0.2	0.4±0.2	<0.1	<0.1	0.3±0.2
Sb-125	<0.05	0.06±0.05	<0.04	<0.05	<0.05
Cs-137	0.09±0.02	0.25±0.03	0.19±0.03	0.06±0.03	0.21±0.03
Ce-141	<0.03	<0.02	<0.02	<0.03	0.03±0.02
Ce-144	<0.1	0.5±0.1	<0.09	<0.1	0.4±0.1
Ra-226	0.68±0.07	0.92±0.09	0.66±0.07	0.70±0.07	0.78±0.08
Th-232	0.8±0.1	1.0±0.1	0.84±0.09	0.78±0.09	0.84±0.09

* All other gamma emitters searched for were <MDL; typical MDLs are given in Table C-16.

TABLE C-6

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

SAMPLE START DATE	SAMPLE STOP DATE	STATION NO. SS-APT-5S3	SS-APT-12E1	SS-APT-3D1	SS-APT-1D1*	AVERAGE**	SAMPLE START DATE	SAMPLE STOP DATE	STATION NO. SS-APT-7H1
12-31-77	1-07-78	70±7	67±7	80±8		72±14	1-03-78	1-11-78	171±20
1-07-78	1-15-78	53±5	55±5	50±5		53±5	1-11-78	1-17-78	68±7
1-15-78	1-22-78	83±8	86±9	88±9		86±5	1-17-78	1-23-78	88±9
1-22-78	1-28-78	86±9	78±8	74±7		79±12	1-23-78	1-30-78	56±6
1-28-78	2-04-78	61±6	59±6	57±6		59±4	1-30-78	2-08-78	55±6
2-04-78	2-11-78	70±7	74±7	76±8		73±6	2-08-78	2-13-78	78±8
2-11-78	2-19-78	61±6	64±6	58±6		61±6	2-13-78	2-21-78	48±5
2-19-78	2-26-78	60±6	62±6	61±6		61±2	2-21-78	2-28-78	68±7
2-26-78	3-04-78	84±8	89±9	87±9		87±5	2-28-78	3-06-78	94±9
3-04-78	3-11-78	111±11	114±11	110±11		112±4	3-06-78	3-13-78	117±12
3-11-78	3-18-78	73±7	62±6	77±8		71±16	3-13-78	3-20-78	89±9
3-18-78***	3-24-78	908±91	1170±120	1140±110	1930±190	1287±889	3-20-78	3-27-78	1060±110
3-24-78	4-01-78	149±15	144±14	155±15	159±16	152±13	3-27-78	4-03-78	214±21
4-01-78	4-07-78	126±13	133±13	131±13	132±13	131±6	4-03-78	4-10-78	181±18
4-07-78	4-14-78	181±18	171±17	192±19	165±17	177±24	4-10-78	4-17-78	265±27
4-14-78	4-22-78	62±6	66±7	65±7	65±7	65±3	4-17-78	4-24-78	222±22
4-22-78	4-30-78	182±18	194±19	193±19	183±18	188±13	4-24-78	5-01-78	199±20
4-30-78	5-07-78	129±13	127±13	124±12	117±12	124±11	5-01-78	5-08-78	153±15
5-07-78	5-13-78	72±7	56±6	63±6	62±6	63±13	5-08-78	5-15-78	71±7
5-13-78	5-20-78	39±4	41±4	37±4	37±4	39±4	5-15-78	5-22-78	91±9
5-20-78	5-27-78	119±12	124±12	132±13	118±12	123±13	5-22-78	5-30-78	83±8
5-27-78	6-03-78	80±8	79±8	79±8	85±9	81±6	5-30-78	6-05-78	143±14
6-03-78	6-11-78	99±10	117±12	108±11	102±10	107±16	6-05-78	6-12-78	130±13
6-11-78	6-18-78	155±16	135±14	136±14	124±12	138±26	6-12-78	6-19-78	171±17
6-18-78	6-25-78	147±15	158±16	147±15	146±15	150±11	6-19-78	6-26-78	79±8
6-25-78	7-02-78	101±10	104±10	109±11	99±10	103±9	6-26-78	7-05-78	129±13

TABLE C-6 (cont.)

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

SAMPLE START DATE	SAMPLE STOP DATE	SS-APT-5S3	STATION NO. SS-APT-12E1	SS-APT-3D1	SS-APT-1D1	AVERAGE**	SAMPLE START DATE	SAMPLE STOP DATE	STATION NO. SS-APT-7H1
7-02-78	7-09-78	105±10	114±11	111±11	109±11	110±8	7-05-78	7-10-78	181±18
7-09-78	7-16-78	107±11	96±10	106±11	85±9	99±21	7-10-78	7-17-78	112±11
7-16-78	7-23-78	93±9	95±10	98±10	95±10	95±4	7-17-78	7-24-78	59±6
7-23-78	7-30-78	61±6	60±6	60±6	61±6	61±1	7-24-78	7-31-78	44±5
7-30-78	8-06-78	37±4	35±4	37±4	37±4	37±2	7-31-78	8-08-78	44±5
8-06-78	8-13-78	37±4	44±4	48±5	39±4	42±10	8-08-78	8-16-78	50±5
8-13-78	8-20-78	42±4	44±5	44±4	44±4	44±2	8-16-78	8-22-78	50±6
8-20-78	8-27-78	53±5	50±5	47±5	59±6	52±10	8-22-78	8-28-78	56±6
8-27-78	9-04-78	42±4	39±4	39±4	41±4	40±3	8-28-78	9-05-78	53±5
9-04-78	9-10-78	45±5	36±4	40±4	42±4	41±8	9-05-78	9-11-78	54±6
9-10-78	9-17-78	32±3	36±4	34±4	35±4	34±3	9-11-78	9-18-78	48±5
9-17-78	9-23-78	18±3	20±3	22±3	18±3	20±4	9-18-78	9-25-78	30±4
9-23-78	9-30-78	26±3	25±3	28±3	23±3	26±4	9-25-78	10-02-78	22±3
9-30-78	10-07-78	24±3	18±3	23±3	22±3	22±5	10-02-78	10-09-78	24±4
10-07-78	10-14-78	28±3	29±3	27±3	27±3	28±2	10-09-78	10-16-78	18±4
10-14-78	10-23-78	25±3	20±2	25±3	27±3	24±6	10-16-78	10-23-78	38±5
10-23-78	10-29-78	28±4	31±4	30±4	28±3	29±3	10-23-78	10-30-78	17±3
10-29-78	11-04-78	20±6	34±4	33±4	29±4	29±13	10-30-78	11-06-78	38±5
11-04-78	11-12-78	43±5	52±5	53±6	58±6	52±12	11-06-78	11-13-78	37±5
11-12-78	11-18-78	33±4	31±4	32±4	32±3	32±2	11-13-78	11-20-78	19±3
11-18-78	11-26-78	28±3	26±3	28±3	24±3	27±4	11-20-78	11-28-78	23±4
11-26-78	12-03-78	26±3	29±4	29±4	26±3	28±3	11-28-78	12-05-78	32±5
12-03-78	12-10-78	37±4	39±4	37±4	88±10	50±50	12-05-78	12-11-78	43±6
12-10-78	12-17-78	35±4	34±4	34±4	33±4	34±2	12-11-78	12-19-78	17±3
12-17-78	12-24-78	29±3	34±4	31±4	28±3	31±5	12-19-78	12-27-78	39±4
12-24-78	12-31-78	44±4	39±4	43±4	43±4	42±4	12-27-78	1-03-79	30±5
Average		86±248	91±317	92±309	114±588	97±371			102±297

* Station 1D1 was placed in operation on March 21, 1978; therefore, the first collection period was from March 21 to March 24, 1978.

** Average of indicator stations.

*** Elevated gross beta observed during the period between March 18 and March 27, 1978 is the result of the atmospheric nuclear weapons test by the Peoples Republic of China on March 14, 1978.

TABLE C-7

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Zr-95	Nb-95	Ru-103	Ru-106	Sb-125	I-131	I-132	Te-132	Cs-137	BaLa-140	Ce-141	Ce-144
SS-APT-5S3													
12-31-77 to 4-01-78	61±9	2.0±0.8	3.1±0.7	6.0±1.0	10±4	2.3±1.7	7.3±1.5	-	<0.4	2.0±0.6	8.1±2.2	4.6±1.0	23±4
4-01-78 to 7-02-78	72±9	1.2±0.8	2.6±0.8	0.8±0.6	12±6	4.1±1.5	<0.4	-	<0.3	4.8±1.1	<0.8	0.6±0.5	30±3
7-02-78 to 9-30-78	60±10	<0.9	<0.6	<0.4	<6.0	<2.0	<0.4	-	<0.2	2.8±0.9	<0.5	<0.4	10±2
9-30-78 to 12-31-78	68±11	<1.0	<0.6	<0.6	<6.0	<2.0	<0.5	-	<0.4	<0.8	<0.9	<0.5	<3.0
SS-APT-3D1													
12-31-78 to 4-01-78	63±8	2.2±0.9	2.6±0.8	8.4±1.1	11±6	<1.0	8.7±1.5	0.6±0.4	4.2±3.4	3.1±0.8	11±2	5.3±0.7	20±3
4-01-78 to 7-02-78	83±9	<1.0	2.4±0.7	<0.6	15±6	3.3±1.6	<0.4	-	<0.4	3.8±1.0	<0.9	<0.7	42±5
7-02-78 to 9-30-78	65±14	<0.9	<0.5	<0.5	<6.0	<2.0	<0.4	-	<0.4	1.7±1.0	<0.9	<0.6	<4.0
9-30-78 to 12-31-78	106±14	<0.9	<0.6	<0.6	<6.0	<2.0	<0.6	-	<0.5	1.0±0.7	<1.0	<1.0	<5.0
SS-APT-1D1													
3-21-78 to 7-02-78	64±7	1.5±0.7	2.6±0.6	1.9±0.6	12±5	2.6±1.3	<0.3	-	<0.3	3.6±0.7	<0.6	1.4±0.9	33±4
7-02-78 to 9-30-78	55±10	<0.9	<0.5	<0.4	<6.0	<1.0	<0.3	-	<0.2	1.4±0.7	<0.7	<0.3	12±2
9-30-78 to 12-31-78	68±9	<0.7	<0.4	<0.5	<6.0	<1.0	<0.3	-	<0.4	<0.7	<1.0	1.2±1.0	4.0±3.0

TABLE C-7 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Zr-95	Nb-95	Ru-103	Ru-106	Sb-125	I-131	I-132	Te-132	Cs-137	BaLa-140	Ce-141	Ce-144
SS-APT-12E1													
12-31-77 to 4-01-78	60±13	4.9±2.9	4.5±1.3	8.8±1.6	11±8	<2.0	7.3±2.0	0.9±0.7	14±8	2.3±1.1	13±4	4.6±1.4	26±5
4-01-78 to 7-02-78	76±10	<1.0	2.2±0.8	<0.5	14±6	3.5±1.4	<0.4	-	<0.3	3.3±0.9	<0.7	<0.6	29±4
7-02-78 to 9-30-78	54±11	<1.0	<0.5	<0.4	<5.0	<1.0	<0.3	-	<0.3	1.4±0.8	<0.7	<0.5	9.0±5.0
9-30-78 to 12-31-78	76±12	<1.0	<0.6	<0.6	<5.0	<1.0	<0.6	-	<0.4	<0.8	<0.9	2.5±1.8	5.0±4.0
SS-APT-7H1													
1-03-78 to 4-03-78	40±9	2.9±1.3	2.7±0.9	7.2±1.2	8.0±6.0	<3.0	9.6±2.2	-	<0.6	1.6±0.8	10±2	5.5±1.3	21±5
4-03-78 to 7-05-78	62±11	1.6±1.6	1.7±0.8	<1.0	11±7	2.3±1.9	<0.5	-	<0.6	2.5±1.0	<1.0	<1.0	24±3
7-05-78 to 10-02-78	64±17	<1.0	<0.7	<0.5	<7.0	<2.0	<0.6	-	<0.5	1.8±1.1	<1.0	<0.7	11±6
10-02-78 to 1-03-79	70±14	<2.0	<0.9	<0.8	<7.0	<1.0	<0.8	-	<0.6	1.2±1.1	<1.0	<0.8	5.0±4.0

* All gamma emitters decay corrected to sample stop date with one exception. Since Nb-95 does not reach equilibrium with Zr-95, it was not decay corrected. All other gamma emitters are <MDL. Typical MDLs are found on Table C-16.

\- Indicates that no MDL was calculated for that nuclide.

TABLE C-8

CONCENTRATIONS OF I-131 IN FILTERED AIR IN THE VICINITY OF SUSQUEHANNA SES

Results* in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	STATION SS-AIO-12E1	START DATE	STOP DATE	STATION SS-AIO-7H1**
12-31-77	1-07-78	<3.7			
1-07-78	1-15-78	<2.9			
1-15-78	1-22-78	<3.0			
1-22-78	1-28-78	<3.6			
1-28-78	2-04-78	<4.1			
2-04-78	2-11-78	<3.9			
2-11-78	2-19-78	<3.0			
2-19-78	2-26-78	<2.9			
2-26-78	3-04-78	<3.4			
3-04-78	3-11-78	<4.0			
3-11-78	3-18-78	<3.9			
3-18-78	3-24-78	55±11***			
3-24-78	4-01-78	<3.8			
4-01-78	4-07-78	<5.0			
4-07-78	4-14-78	<3.8			
4-14-78	4-22-78	<3.3			
4-22-78	4-30-78	<3.0			
4-30-78	5-07-78	<3.3			
5-07-78	5-13-78	<3.9			
5-13-78	5-20-78	<4.4			
5-20-78	5-27-78	<4.1			
5-27-78	6-03-78	<4.1	5-30-78	6-05-78	<6.1
6-03-78	6-11-78	<3.0	6-05-78	6-12-78	<7.3
6-11-78	6-18-78	<3.7	6-12-78	6-19-78	<4.4
6-18-78	6-25-78	<3.8	6-19-78	6-26-78	<4.6
6-25-78	7-02-78	<4.7	6-26-78	7-05-78	<3.2
7-02-78	7-09-78	<3.0	7-05-78	7-10-78	<5.6
7-09-78	7-16-78	<4.0	7-10-78	7-17-78	<4.4
7-16-78	7-23-78	<4.2	7-17-78	7-24-78	<4.0
7-23-78	7-30-78	<3.6	7-24-78	7-31-78	<4.5
7-30-78	8-06-78	<3.5	7-31-78	8-08-78	<3.8
8-06-78	8-13-78	<3.8	8-08-78	8-16-78	<4.1
8-13-78	8-20-78	<5.0	8-16-78	8-22-78	<5.3
8-20-78	8-27-78	<3.7	8-22-78	8-28-78	<5.4
8-27-78	9-04-78	<2.6	8-28-78	9-05-78	<3.2
9-04-78	9-10-78	<4.2	9-05-78	9-11-78	<6.4
9-10-78	9-17-78	<3.5	9-11-78	9-18-78	<4.1
9-17-78	9-23-78	<4.7	9-18-78	9-25-78	<4.0
9-23-78	9-30-78	<4.3	9-25-78	10-02-78	****
9-30-78	10-07-78	<4.1	10-02-78	10-09-78	<4.5
10-07-78	10-14-78	<4.7	10-09-78	10-16-78	<6.0
10-14-78	10-23-78	<2.5	10-16-78	10-23-78	<5.1
10-23-78	10-29-78	<4.0	10-23-78	10-30-78	<3.9
10-29-78	11-04-78	<6.3	10-30-78	11-06-78	<5.6
11-04-78	11-12-78	<4.7	11-06-78	11-13-78	<5.2
11-12-78	11-18-78	<4.8	11-13-78	11-20-78	<4.1
11-18-78	11-26-78	<3.3	11-20-78	11-28-78	<4.4
11-26-78	12-03-78	<4.2	11-28-78	12-05-78	<7.0
12-03-78	12-10-78	<3.7	12-05-78	12-11-78	<6.8
12-10-78	12-17-78	<4.5	12-11-78	12-19-78	<4.2
12-17-78	12-24-78	<3.6	12-19-78	12-27-78	<4.4
12-24-78	12-31-78	<4.8	12-27-78	1-03-79	<5.9

* Iodine-131 results are decay corrected to sample stop date.

** Station 7H1 was placed in operation on May 30, 1978.

*** The I-131 activity observed is the result of the atmospheric nuclear weapons test by the Peoples Republic of China on March 14, 1978.

**** Cartridge was not counted because it was delayed in shipment.

TABLE C-9

CONCENTRATIONS OF TRITIUM IN WELL WATER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

DATE	STATION NO. SS-WWA-5S2	SS-WWA-12F2
3-28-78	96±73	127±74
6-28-78	<80	138±78
9-27-78	<69	78±60
12-20-78	92±68	104±69

TABLE C-10

CONCENTRATIONS OF TRITIUM, BETA EMITTERS AND Sr-89* AND -90 IN POTABLE WATER SAMPLES FROM THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	12-28-77 to 3-29-78	3-29-78 to 6-27-78	6-27-78 to 9-27-78	9-27-78 to 12-26-78
SS-PWT-12F2**				
H-3	123±75	<80	152±64	106±69
Beta	<1.8	<1.7	3.6±1.8	2.3±2.1
Sr-89	<0.9	<0.9	<0.6	<0.9
Sr-90	<0.5	<0.6	<0.4	<0.5
SS-PWT-12H2				
H-3	<79	<80	75±63	111±69
Beta	4.5±1.2	<1.7	2.2±1.7	3.1±2.2
Sr-89	0.9±0.9	0.4±0.4	<0.6	<0.8
Sr-90	<0.8	<0.4	<0.4	0.3±0.3

* Sr-89 results are decay corrected to sample stop date.

** The sampling dates for station SS-PWT-12F2 were: 3-28-78; 6-28-78; 9-27-78; and 12-26-78.

TABLE C-11

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89** AND -90 IN MILK IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. AND DATE	K-40	Sr-89	Sr-90	Cs-137
SS-MLK-12B1				
3-31-78	1400±140	1.5±1.0	2.8±0.6	1.9±1.5
6-27-78	1000±100	1.6±1.1	2.4±0.7	2.0±0.8
9-29-78	1600±160	3.5±1.9	2.4±0.8	7.4±1.4
12-26-78	1300±130	<1.2	1.1±0.5	2.8±1.0
SS-MLK-12B2				
3-31-78	1200±120	3.5±1.6	7.4±1.0	7.9±2.1
6-27-78	900±90	2.1±1.8	12±1	6.0±0.7
9-29-78	1300±130	<3.6	9.4±1.1	6.9±1.3
12-26-78	1300±130	<1.4	4.5±0.7	6.8±1.2
SS-MLK-7H2				
2-25-78	1700±170	<2.3	2.8±0.9	1.9±1.1
6-19-78	1000±100	<1.8	3.6±0.8	3.4±0.8
SS-MLK-9G1				
9-28-78	1400±140	<3.9	8.2±1.1	4.6±1.2
12-26-78	1400±140	<1.4	4.2±0.7	9.8±1.3

* All other gamma emitters searched for were <MDL; typical MDLs are found on Table C-16.

** Sr-89 results are decay corrected to the sample stop date.

TABLE C-12

CONCENTRATIONS OF I-131* IN MILK IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	3-31-78**	6-19-78	9-29-78	12-26-78
SS-MLK-12B1	0.15±0.07	<0.05	<0.07	<0.1
SS-MLK-12B2	4.7±0.5	<0.05	<0.06	<0.08
SS-MLK-7H2	<0.05(1)	<0.04	***	***
SS-MLK-9G1	***	***	<0.08	<0.07

* Iodine-131 results are decay corrected to the sample stop date.
** The I-131 activity observed at stations 12B1 and 12B2 is the result of the atmospheric nuclear weapons test by the Peoples Republic of China on March 14, 1978.
*** Sampling location changed from 7H2 to 9G1 effective 3rd quarter.

(1) Sampling date was 2-25-78.

TABLE C-13

CONCENTRATIONS OF GAMMA EMITTERS* IN FODDER CROPS IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(dry) ± 2 sigma

STATION NUMBER	SAMPLE DATE	DESCRIPTION	Be-7	K-40
SS-PAS-15A2	9-27-78	Grass	1.5±0.2	3.4±0.3
SS-PAS-15A2	1-01-79	Grass	9.1±1.5	13±2

* All other gamma emitters searched for were <MDL; typical MDLs are found on Table C-16.

TABLE C-14

CONCENTRATIONS OF GAMMA EMITTERS* IN VARIOUS FOOD AND GAME SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	K-40	Cs-137
SS-FPP-12B2	6-26-78	Chicken	5.4±0.5	<0.02
SS-FPE-12B2	6-26-78	Eggs	1.0±0.1	<0.005
SS-FPL-11D1	8-30-78	Cabbage	2.5±0.3	<0.02
SS-FPL-2H1	8-30-78	Cabbage	2.8±0.3	<0.02
SS-FPG-12B1	8-30-78	Corn	1.9±0.2	<0.004
SS-FPF-7B1	9-28-78	Apples	0.54±0.07	<0.004
SS-FPF-12B1	9-27-78	Apples	1.2±0.1	<0.004
SS-GAS-2S	11-16-78	Squirrel	2.7±0.3	0.57±0.06
SS-GAS-2S	11-20-78	Squirrel	2.1±0.3	2.3±0.2
SS-GAD-3S1	12-05-78	Deer	2.8±0.3	0.29±0.03
SS-FPB-12B3	12-26-78	Beef	2.1±0.2	<0.007
SS-FPE-12B2	12-28-78	Eggs	1.1±0.2	<0.01

* All other gamma emitters searched for were <MDL; typical MDLs are found on Table C-16.

TABLE C-15

RESULTS OF QUARTERLY TLD MEASUREMENTS IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of mrem/standard month

STATION NO.	12-31-77 to 4-04-78	4-04-78 to 6-28-78	6-28-78 to 9-29-78	9-29-78 to 12-30-78	ANNUAL AVERAGE
SS-IDM-3S1	5.44±0.43	6.40±1.23	6.19±0.33	6.52±0.91	6.14±0.97
SS-IDM-4S1	4.56±0.12	5.39±0.15	5.47±0.26	5.58±0.69	5.25±0.93
SS-IDM-5S1	4.46±0.22	4.95±0.56	5.36±0.69	5.23±0.55	5.00±0.80
SS-IDM-7S1	5.60±0.33	7.36±0.42	7.73±0.21	7.96±0.59	7.16±2.14
SS-IDM-11S1	6.21±0.63	7.09±0.50	7.34±0.58	7.56±0.71	7.05±1.18
SS-IDM-1D1	4.88±0.38	6.40±0.27	6.61±0.32	6.84±0.16	6.18±1.77
SS-IDM-12F1	7.22±0.49 (1)	7.55±0.53	7.36±0.44	7.44±0.23	7.39±0.28
SS-IDM-7H1 (2)	4.35±0.27	4.48±0.20	4.52±0.57	4.65±0.49	4.50±0.25
SS-IDM-8H1 (3)	5.60±0.33	5.85±0.14	5.17±0.16	5.27±0.40	5.47±0.62
AVERAGE	5.37±1.87	6.16±2.16	6.19±2.27	6.34±2.39	6.02±2.22

(1) Sampling dates were 1-01-78 to 4-04-78.
(2) The sampling dates for station 7H1 were: 12-29-77 to 3-31-78; 3-31-78 to 6-29-78; 6-29-78 to 9-29-78; and 9-29-78 to 1-03-79.
(3) The sampling dates for station 8H1 were: 12-28-77 to 4-07-78; 3-29-78 to 6-29-78; 6-28-78 to 10-02-78; and 9-27-78 to 1-03-79.

TABLE C-16

TYPICAL MDLs* FOR GAMMA SPECTROMETRY

NUCLIDE	SURFACE WATER (pCi/l)	AIR PARTICULATES (10^{-3} pCi/m^3)	FISH (pCi/g-wet)	MILK (pCi/l)
Be-7	-	**	-	-
Na-22	0.5	0.4	0.005	0.6
K-40	6.0	10	**	**
Cr-51	3.0	3.0	0.03	5.0
Mn-54	0.5	0.6	0.004	0.8
Co-58	0.5	0.4	0.005	0.6
Fe-59	0.9	1.0	0.01	2.0
Co-60	0.6	0.6	0.005	0.6
Zn-65	1.0	1.0	0.01	2.0
Zr-95	-	1.0	-	-
Nb-95	-	0.6	-	-
ZrNb-95	0.4	1.0	0.004	0.8
Mo-99	3.0	3.0	0.03	5.0
Ru-103	-	0.6	-	-
Ru-106	4.0	6.0	0.04	5.0
Ag-110m	0.4	1.0	0.004	0.8
Sb-125	-	1.0	-	-
Te-129m	7.0	7.0	0.06	10
I-131	0.4	0.4	0.004	0.6
Te-132	0.3	0.3	0.003	0.5
I-133	0.5	0.4	0.004	0.7
Cs-134	0.6	0.6	0.005	1.0
Cs-136	0.6	0.7	0.006	1.0
Cs-137	0.5	0.8	0.005	**
BaLa-140	0.5	0.7	0.005	0.7
Ce-141	-	1.0	-	-
Ce-144	2.0	4.0	0.01	1.0
Ra-226	0.8	1.0	0.007	1.0
Th-232	2.0	2.0	0.02	3.0

TABLE C-16 (cont.)

TYPICAL MDLs* FOR GAMMA SPECTROMETRY

NUCLIDE	VARIOUS FOOD PRODUCTS (pCi/g-wet)	MEAT AND GAME (pCi/g-wet)	SEDIMENT (pCi/g-dry)	FODDER CROPS (pCi/g-dry)
Be-7	-	-	0.2	**
Na-22	0.005	0.02	0.02	0.1
K-40	**	**	**	**
Cr-51	0.03	0.09	0.1	0.8
Mn-54	0.004	0.01	0.02	0.1
Co-58	0.005	0.02	0.02	0.1
Fe-59	0.01	0.03	0.03	0.2
Co-60	0.005	0.02	0.02	0.3
Zn-65	0.01	0.02	0.04	0.3
Zr-95	-	-	0.03	-
Nb-95	-	-	0.02	-
ZrNb-95	0.004	0.02	0.03	0.1
Mo-99	0.03	0.04	0.1	0.7
Ru-103	-	-	0.02	-
Ru-106	0.05	0.2	0.2	1.0
Ag-110m	0.004	0.01	0.05	0.1
Sb-125	-	-	0.05	-
Te-129m	0.06	0.2	0.2	2.0
I-131	0.004	0.01	0.02	0.1
Te-132	0.003	0.009	0.01	0.1
I-133	0.004	0.02	0.02	0.1
Cs-134	0.005	0.02	0.02	0.1
Cs-136	0.006	0.02	0.02	0.1
Cs-137	0.004	0.02	**	0.1
BaLa-140	0.005	0.01	0.03	0.1
Ce-141	-	-	0.03	-
Ce-144	0.01	0.04	0.1	0.07
Ra-226	0.007	0.03	**	0.2
Th-232	0.02	0.05	**	0.4

* At time of counting.
** Indicates a positive concentration was measured in all samples analyzed.
\- Indicates that no MDL was calculated for that nuclide in that media.

APPENDIX D

SYNOPSIS OF ANALYTICAL PROCEDURES

GROSS BETA ANALYSIS OF SAMPLES

Total Water (BØ)

A 250 ml aliquot is evaporated to dryness on a preweighed, 2" x 1/4", ringed planchet and reweighed. The planchet is then counted in a low background gas-flow proportional counter. Self-absorption corrections are made based on the measured residue weight and calculated thickness. The calibration standard used is Sr-90 - Y-90. A 250 ml sample of distilled water is evaporated in the same manner and used as a blank.

Air Particulates (BD)

After a decay period of three to seven days, to allow for the decay of short lived radium and thorium daughter products, the filters are counted in a gas-flow proportional counter for 20 minutes. The beta activity is calculated from the volume of air filtered. An unused filter paper is used as a blank.

Calculation of results and two sigma error

$$\frac{\text{RESULT}}{(\text{pCi/vol})} = \left[\frac{C(s+b)}{T(s+b)} - \frac{C(b)}{T(b)}\right] \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{TF}$$

$$\frac{\text{2 SIGMA ERROR}}{(\text{pCi/vol})} = 2\sqrt{\frac{C(s+b)}{T(s+b)^2} + \frac{C(b)}{T(b)^2}} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{TF}$$

where:

C(s+b)	=	gross counts of sample
C(b)	=	counts of blank
E	=	fractional Sr-90 - Y-90 counting efficiency
T(s+b)	=	number of minutes sample was counted
T(b)	=	number of minutes blank was counted
V	=	volume of aliquot utilized
TF	=	transmission factor

Calculation of minimum detectable levels (MDLs)

The detection limit is assumed to be exceeded when the counting result for the sample is different from the blank reading by at least three times the standard deviation of that background.

$$\frac{\text{MDL}}{(\text{pCi/vol})} = 3\sqrt{\frac{C(b)}{T(b)}} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{TF}$$

where:

C(b)	=	blank counts
T(b)	=	background counting period in minutes
V	=	volume of aliquot utilized
E	=	fractional Sr-90 - Y-90 counting efficiency
TF	=	transmission factor

ANALYSIS OF SAMPLES FOR TRITIUM

Water (H2)

A 15 ml aliquot of the sample is vacuum distilled to eliminate dissolved gases and non-volatile matter. The distillate is frozen in a trap cooled with a dry ice-isopropanol mixture. Eight (8) ml of the distillate are mixed with ten (10) ml of Insta-Gel liquid scintillation solution. The sample is then counted for tritium in a liquid scintillation counter. A sample of low tritium (< 50 pCi/l) water is vacuum distilled as a blank and is counted with each batch of samples. In the calculation of the result it is assumed that the condensated and original sample are of equivalent volumes. The volume change associated with the removal of dissolved gases and non-volatile matter is not significant compared to the other errors in the analysis.

RESULT (picocuries/l of water) =

$$\left[\frac{C(s+b)}{T(s+b)} - \frac{C(b)}{T(b)}\right] \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V}$$

2 SIGMA ERROR (picocuries/l of water) =

$$2\sqrt{\frac{C(s+b)}{T(s+b)^2} + \frac{C(b)}{T(b)^2}} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V}$$

where:

C(s+b) = gross counts of sample
C(b) = counts of blank
E = fractional H-3 counting efficiency
T(s+b) = number of minutes sample was counted
T(b) = number of minutes blank was counted
V = volume (ml) of distillate counted

Calculation of minimum detectable levels (MDLs)

The detection limit is assumed to be exceeded when the counting result is different from the blank reading by at least three times the standard deviation of that background.

MDL (picocuries/l) =

$$3\frac{\sqrt{C_b}}{T_b} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V}$$

where:

C(b) = blank counts
T(b) = background counting period in minutes
V = volume of distillate counted
E = fractional H-3 counting efficiency

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Total Water (TØ, SØ)

A two liter aliquot of sample is used. Stable strontium carrier is added to the liquid to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional carbonate precipitations and barium chromate separations are performed to remove suspected interferring nuclides. The purified strontium is converted to a carbonate for weighing and counting. Soon after the separation, the sample is counted in a low-background gas-flow proportional counter. After about 14 days, the sample is recounted, then Sr-89 and -90 activities are calculated on the basis of Y-90 ingrowth and Sr-89 decay. A sample of distilled water is used as a blank.

Milk (S4, T4)

A one and half liter aliquot of milk is ashed to destroy organic material and then dissolved in concentrated mineral acid. Stable strontium is added to the eluted liquid or dissolved ash to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional carbonate precipitations and barium chromate separations are performed to remove suspected interferring nuclides. The purified strontium is converted to a carbonate for weighing and counting. Soon after the separation, the sample is counted in a low-background gas-flow proportional counter. After about 14 days, the sample is recounted, then Sr-89 and -90 activities are calculated on the basis of Y-90 ingrowth and Sr-89 decay. A sample of distilled water is used as a blank.

Organic Solids (S8, T8)

A 250 g wet portion of the sample is ashed, then dissolved in concentrated acid. Stable strontium carrier is added to the solubized sample to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional carbonate precipitations, iron rare earth hydroxide scavenging, and barium chromate separations were performed. The purified strontium is connected to a carbonate for weighing and counting. Soon after the separation, the sample is counted in a low-background gas-flow proportional counter. After about 14 days, the sample is recounted, then Sr-89 and -90 activities are calculated on the basis of Y-90 ingrowth and Sr-89 decay. A sample of distilled water is used as a blank.

Calculation of results and two sigma error

$$\frac{\text{A(Sr-90)}}{\text{(pCi/vol. or wt.)}} = \frac{Z\,(\text{C(1) Total} - \text{C(1) Bkg}) - (\text{C(2) Total} - \text{C(2) Bkg})}{K\,(\text{vol. /wt.})\,(\text{eff Sr-90})\,(\text{yield})\,(\text{time})\,(2.22)}$$

$$\frac{\text{ERROR Sr-90}}{\text{(pCi/vol. or wt.)}} = \frac{2\sqrt{Z^2(\text{C(1) Total} + \text{C(1) Bkg}) + \text{C(2) Bkg} + \text{C(2) Total}}}{\sqrt{K^2}\,(\text{vol. /wt.})\,(\text{eff Sr-90})\,(\text{yield})\,(\text{time})\,(2.22)}$$

$$\frac{A(Sr\text{-}89)}{(pCi/vol.\ or\ wt.)} = \frac{F(C(1)\ Total - C(1)\ Bkg) + H(C(2)\ Total - C(2)\ Bkg)}{(vol./wt.)\ (eff\ Sr\text{-}89)\ (time)\ (yield)\ (2.22)} \div e^{\frac{-.693T(4)}{52.7}}$$

$$\frac{ERROR\ Sr\text{-}89}{(pCi/vol.\ or\ wt.)} = \frac{2\sqrt{F^2(C(1)\ Total + C(1)\ Bkg) + H^2(C(2)\ Total + C(2)\ Bkg)}}{(vol./wt.)\ (eff\ Sr\text{-}89)\ (yield)\ (time)\ (2.22)} \div e^{\frac{-.693T(4)}{52.7}}$$

where:

$Sr\text{-}89_1$	=	Sr-89 counts on first count
Sr-90	=	counts of Sr-90
$Y\text{-}90_1$	=	counts of Y-90 on first count
$Y\text{-}90_2$	=	counts of Y-90 on second count
C_1 total	=	$Sr\text{-}89_1 + Sr\text{-}90 + Y\text{-}90_1 + C_{1B} = C_{1T}$
C_2 total	=	$Sr\text{-}89_2 + Sr\text{-}90 + Y\text{-}90_2 + C_{2B} = C_{2T}$
C_1 BKG	=	BKG counts on first count $= C_{1B}$
C_2 BKG	=	BKG counts on second count $= C_{2B}$

$$Z = e^{\frac{-0.693T_3}{52.7\ days}}$$

$$K = Z\,(E_1/_R+1) - 1 - E_2/_R$$

$$R = \frac{eff\ Sr\text{-}90}{eff\ Y\text{-}90}$$

$$F = 1 - \frac{Z}{K} - Z\left(\frac{E_1}{KR}\right)$$

$$H = \left(\frac{1}{K}\right) + \frac{E_1}{KR}$$

$t_1 = T_{C1} - t_{sep}$ hours

$t_2 = t_{C2} - t'_{sep}$ days

$t_3 = t_{C2} - t_{C1}$ days

$t_4 = t_{sampling\ date} - t_{sep}$ days

counting eff. of Sr-90 = .3590 - .7082 X wt in g of strontium carbonate
counting eff. of Y-90 = .4380 - .1337 X wt in g of strontium carbonate
counting eff. of Sr-89 = .4568 - .2060 X wt in g of strontium carbonate

$$E_1 = (1 - e^{\frac{-.693T_1}{64.0 \text{ hrs.}}})$$

$$E_2 = (1 - e^{\frac{-0.693t_2}{2.667 \text{ days}}})$$

Calculation of minimum detectable levels (MDLs)

Due to the method of calculating the activity of Sr-90 in the presence of Sr-89, the form used in the NBS Handbook 80 for calculating minimum detectable activities is not applicable.

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water (IØ)

The initial stable iodide concentration in milk is determined with an iodide ion specific electrode. Thirty milligrams of stable iodide carrier is then added to four (4) liters of milk. The iodide is removed from the milk by passage through ion-exchange resin. The iodide is eluted from the resin with sodium hypochlorite, and purified by a series of solvent extractions with the final extraction into a toluene phase. The toluene phase is mixed with a toluene-based liquid scintillation solution. The sample is then counted in a beta-gated gamma coincidence detector, shielded by six inches of steel. Distilled water is used as a blank. The yield is calculated from stable iodide recovery based on an average recovered volume of 13.2 ml. Results are corrected for decay from the sampling time to the middle of the counting period, using a half-life value for I-131 of 8.06 days.

Air Cartridges (I1)

An iodine absorber composed of charcoal is emptied into an aluminum can (6 cms high by 8 cms in diameter) and counted with a NaI (Tl) detector, coupled to a multi-channel pulse height analyzer.

Calculation of results and two sigma error

The spectrum obtained is smoothed to eliminate spurious statistical noise. The presence of Iodine-131 is identified by the presence of a 364 Kev peak. The peak is fitted with a Gaussian curve and the net counting rate above the baseline projection is calculated. This counting rate is converted to activity in curie units, making allowance for counting efficiency and photon abundance. A PDP-11 computer program is used for spectrum analysis.

$$\underline{\text{RESULT}} = \left[\frac{C(s+b)}{T(s+b)} - \frac{C(b)}{T(b)}\right] \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{Y}$$

(pCi/vol)
at time of
analysis

$$\underline{\text{2 SIGMA ERROR}} = 2\sqrt{\frac{C(s+b)}{T(s+b)^2} + \frac{C(b)}{T(b)^2}} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{Y}$$

(pCi/vol)
at time of
analysis

where:

C(s+b)	=	gross counts in channels containing I-131 peak
C(b)	=	background counts in channels containing I-131 peak
T(s+b)	=	number of minutes aliquot was counted
T(b)	=	number of minutes blank was counted
E	=	I-131 counting efficiency
V	=	volume of aliquot utilized
Y	=	chemical yield of iodine (for milk or water)

ANALYSIS OF SAMPLES FOR IODINE-131 (cont.)

Calculation of minimum detectable level (MDL)

$$\frac{\text{MDL}}{(\text{pCi/vol})} = \frac{3\sqrt{6 \times C_I}}{T(s+b)} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{Y}$$

at time of analysis

where:

C_I = number of counts in the channel that would have been the centroid if a peak were there.
E = I-131 counting efficiency
V = volume of aliquot utilized
Y = chemical yield of iodine (for milk or water)
T(s+b) = number of minutes aliquot was counted

GAMMA SPECTROMETRY OF SAMPLES

Water (N1)

Four liters of sample is reduced to 100 ml and sealed in a standard container and counted with a NaI(Tl) detector coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Milk (N7)

A three liter aliquot is dried at 175°C, ashed at 500°C until no carbon residue is present, compressed and sealed in a standard container, and then counted with a NaI(Tl) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Dried Solids (N8, G8)

A large quantity of the sample is dried at a low temperature, less than 100°C. A 100 gram aliquot (or the total sample if less than 100 grams) is taken, compressed to unit density, sealed in a standard container, and counted with a NaI(Tl) or Ge(Li) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Air Dried Solids (NA)

A large quantity of sample is air dried. A 100 gram aliquot (or the total sample if less than 100 grams) is taken, compressed to unit density, sealed in a standard container and counted with a NaI(Tl) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Air Particulate (GB)

All samples received for the month are mixed and sealed in the standard container, and counted with the high resolution Ge(Li) detector, coupled to a multi-channel pulse-height analyzer.

Calculation of result and two sigma error

The spectrum obtained is smoothed to eliminate spurious statistical noise. Peaks are identified by changes in the slope of the gross spectrum. Identified individual peaks are fitted with Gaussian curves and the net counting rate above the baseline projection is calculated. This counting rate is converted to activity in curie units, making allowance for counting efficiency and photon abundance. A PDP-11 computer program was introduced for spectrum unfolding.

$$\underline{\text{RESULT}} = \left[\frac{C(s+b)}{T(s+b)} - \frac{C(b)}{T(b)}\right] \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{\text{Gamma Ab}}$$

(pCi/vol or wt.)

$$\underline{\text{2 SIGMA ERROR}} = 2\sqrt{\frac{C(s+b)}{T(s+b)^2} + \frac{C(b)}{T(b)^2}} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{\text{Gamma Ab}}$$

(pCi/vol or wt.)

where:

C(s+b)	=	gross counts in channels containing peak of nuclide being quantized
C(b)	=	background counts in channels containing peak of nuclide being quantized
T(s+b)	=	number of minutes aliquot was counted
T(b)	=	number of minutes blank was counted
E	=	measured from efficiency curve for a given energy
Gamma Ab	=	fractional gamma abundance
V	=	volume or wt. of aliquot utilized

Calculation of minimum detectable levels (MDLs)

$$\underline{\text{MDL}} = \frac{3\sqrt{6 \times C_I}}{T(s+b)} \times \frac{1}{2.22} \times \frac{1}{E} \times \frac{1}{V} \times \frac{1}{\text{Gamma Ab}}$$

(pCi/vol or wt)

where:

C_I	=	number of counts in the channel that would have been the centroid if a peak were there.
Eff	=	measured from efficiency curve for a given energy
Gamma Ab	=	fractional gamma abundance (specific for each nuclide)
V	=	volume or wt. of aliquot utilized
T(s+b)	=	number of minutes aliquot was counted

ENVIRONMENTAL DOSIMETRY (DØ)

Measurement Techniques

Each dosimeter utilized is a capillary tube containing calcium sulfate (Tm) powder as the TLD material. This was chosen primarily for its high light output, minimal thermally induced signal loss (fading), and lack of self-dosing. The energy response curve has been flattened by a complex multiple element energy compensation shield supplied by Panasonic Corporation, manufacturer of the TLD reader. The four dosimeters per station are sealed in a polyethylene bag to demonstrate integrity at time of measurement. Visible through the bag are the sample placement instructions. One set of TLDs is placed in a lead shield at RMC and represents a zero dose. The TLDs are then taken and placed in the field stations; one field TLD set is placed in a field lead shield on the RMC roof and is used in calculating the intransit dose.

Following the pre-designated exposure period the TLD is heated with hot gas and the luminescense measured with a TLD reader. Data are normalized to standard machine conditions by correcting machine settings to zero before read out. Data are corrected for in-transit dose using a set of TLDs which is kept in a lead shield in the field and only exposed during transit. Average dose per exposure period, and its error, are calculated.

The basic calibration is in mR exposure to a standard Cs-137 source. This is converted to absorbed dose in tissue by the factor : 0.9555 rad/ Roentgen and to dose equivalent by using a quality factor of 1.

Calculation of results and two sigma error

$$\text{gross TLD}(i) = \text{TLD}(i) - \text{IO} \times \frac{\text{LSN}}{\text{LS}} - \text{DO}(i)\ \text{CF}(i) \times 0.955 \text{ mrad}$$

$$\text{ITD} = \text{NET}(\text{site0}) - \text{NET}(\text{rmc0}) \times \frac{\text{D}(\text{site0})}{\text{D}(\text{rmc0})}$$

$$\text{NET TLD}(i) = \text{gross TLD}(i) - \text{ITD}$$

$$\underline{\text{AVG}} = \frac{\sum_{i=1}^{n} \text{NET TLD}(i)}{n} \times \frac{\text{D}(\text{std})}{\text{D}(\text{EX})}$$

$$\underline{\text{ERROR}}\ (95\%\ \text{CL}) = t(n-1) \times \frac{\text{sigma NET TLD}(i)}{n} \times \frac{\text{D}(\text{STD})}{\text{D}(\text{EX})}$$

where:

gross TLD(i)	=	individual TLD reading corrected to standard instrument conditions
TLD(i)	=	gross reading of dosimeter i
NET TLD(i)	=	net dose obtained during exposure period in the field
IO	=	instrument zero
LS	=	instrument light source reading
DO(i)	=	zero for dosimeter, i
CF(i)	=	calibration factor for dosimeter i
ITD	=	in-transit dose
NET(site)O	=	mean of n dosimeters in site lead shield
NET (rmc)O	=	mean of n dosimeters in RMC lead shield
D(siteO)	=	exposure period of siteO
D(rmcO)	=	exposure period of rmcO
AVG	=	mean exposure per standard exposure period at a given station
n	=	number of readings
D(EX)	=	days exposed
D(STD)	=	days in standard exposure period
t(n-1)	=	t-distribution (student) factor for 95% CL
sigma NET TLD(i)	=	standard deviation of n readings of NET TLD(i)
LSN	=	light source normal reading
ERROR	=	the 95% confidence limit error of AVG

APPENDIX E

RESULTS OF INTER-LABORATORY COMPARISON PROGRAM

RMC participates in the EPA radiological interlaboratory comparison (cross check) program. This participation includes a number of analyses on various sample media as found in the Susquehanna SES REMP. As a result of participation in the program an objective measure of analytical precision and accuracy as well as a bias estimation in RMC results is obtained. Reference 12 discusses discrepancies between the data when they occurred.

INTER-LABORATORY COMPARISONS
GROSS ALPHA AND BETA IN WATER
(pCi/liter and AIR PARTICULATES (pCi/sample)

TABLE E-1

DATE	RMC #	TYPE OF RADIATION	RMC MEAN±S.D.	EPA MEAN±S.D.	All Participants MEAN±S.D.
JANUARY	89840	alpha	7±1	7±5	7±3
1978	Water	beta	43±1	39±5	37±6
MARCH	90819	alpha	10±2	11±5	12±3
1978	APT	beta	40±2	38±5	40±4
MARCH	90820	alpha	16±2	20±5	
1978	Water	beta	30±3	29±5	(1)
APRIL	91888	alpha	19±2	20±5	20±7
1978	Water	beta	58±1	59±5	57±10
MAY	92636	alpha	14±2	13±5	13±4
1978	Water	beta	25±1	18±5	20±4
JUNE	93393	alpha	10±1	10±5	11±2
1978	APT	beta	40±1	36±5	39±3
JULY	94118	alpha	25±2	22±6	17±6
1978	Water	beta	42±1	30±5	32±7
SEPTEMBER	96793	alpha	2±1	5±5	6±2
1978	Water	beta	13±1	10±5	11±2
OCTOBER	98135	alpha	17±1	19±5	19±8
1978	Water	beta	41±1	34±5	35±8
NOVEMBER	98577	alpha	12±1	11±5	11±3
1978	Water	beta	29±1	26±5	26±4

(1) No final EPA report was received.

INTER-LABORATORY COMPARISONS
TRITIUM IN WATER
All results in pCi/liter

TABLE E-2

DATE	RMC#	RMC MEAN±S.D.	EPA MEAN±S.D.	All Participants MEAN±S.D.
APRIL 1978	91628 Water	2180±144	2220±349	2198±267
APRIL 1978	91888 Water	<59	0	
JUNE 1978	93135 Water	2230±147	2270±249	2259±252
AUGUST 1978	95018 Water	1168±49	1230±330	1245±209

INTER-LABORATORY COMPARISONS
STRONTIUM-89 AND STRONTIUM-90

TABLE E-3

DATE	RMC#	ISOTOPE	UNITS	RMC MEAN±S.D.	EPA MEAN±S.D.	All Participants MEAN±S.D.
MARCH 1978	90337 Food Prod.(1)	Sr-89 Sr-90				
MARCH 1978	90819 APT	Sr-90	pCi/sample	4±1	8±1.5	7±2
APRIL 1978	91888 Water	Sr-89 Sr-90	pCi/l pCi/l	16±1 8±1	21±5 10±1.5	21±3 9±1
APRIL 1978	91948 Milk	Sr-89 Sr-90	pCi/l pCi/l	82±24 <10	101±5 9±1.5	92±10 9±2
JUNE 1978	93381 APT	Sr-90	pCi/sample	8±1	9±1.5	9±2
JULY 1978	93535 Food Prod.	Sr-89 Sr-90	pCi/kg pCi/kg	38±4 22±1	39±5 15±1.5	36±4 17±4
JULY 1978	94132 Milk	Sr-89 Sr-90	pCi/l pCi/l	26±1 41±4	41±5 49±2.5	35±9 46±9
OCTOBER 1978	98135 Water	Sr-89 Sr-90	pCi/l pCi/l	5±1 5±1	10±5 5±1.5	10±3 5±1

(1) Sample lost during analysis.

INTER-LABORATORY COMPARISONS: GAMMA
Results reported in pCi/liter for milk and water, pCi/sample for air particulates, and pCi/kilogram for food products except K which is reported in mg/kilogram

TABLE E-4

DATE	RMC #	ISOTOPE	RMC MEAN±S.D.	EPA MEAN±S.D.	All Participants MEAN±S.D.
FEBRUARY 1978	90047 Water	Cr-51	<17	0	
		Co-60	38±1	34±5	33±5
		Zn-65	29±1	29±5	29±5
		Ru-106	36±1	36±5	39±9
		Cs-134	52±1	52±2	49±6
		Cs-137	<2	0	
MARCH 1978	90337 Food Prod.	I-131	70±5	74±5	72±7
		Cs-137	52±1	41±5	39±4
		Ba-140	<4	0	
		K-40	4100±200	2930±147	2823±306
MARCH 1978	90819 APT	Cs-137	36±10	22±5	23±5
APRIL 1978	91638 Water	Cr-51	<15	0	
		Co-60	46±2	49±5	49±4
		Ru-106	83±8	113±6	100±19
		Cs-134	61±2	74±5	72±7
		Cs-137	<2	0	
APRIL 1978	91888 Water	Co-60	17±1	20±5	21±3
		Cs-134	8±1	15±5	19±5
		Cs-137	<1	0	
APRIL 1978	91948 Milk	I-131	66±3	82±5	82±9
		Cs-137	23±2	23±5	25±3
		Ba-140	<3	0	
		K-40	1510±50	1500±75	1541±102
JUNE 1978	93173 Water	Cr-51	90±12	102±5	99±19
		Co-60	19±2	22±5	22±3
		Zn-65	52±5	54±5	51±7
		Ru-106	43±4	58±5	56±12
		Cs-134	20±2	22±5	21±4
		Cs-137	31±3	30±5	32±4
JUNE 1978	93393 APT	Cs-137	16±2	18±5	20±5
JULY 1978	93535 Food Prod.	I-131	71±3	83±5	82±6
		Cs-137	40±2	37±5	38±4
		Ba-140	<1	0	
		K-40	2507±62	2800±140	2744±205

INTER-LABORATORY COMPARISONS: GAMMA (cont.)
Results reported in pCi/liter for milk and water, pCi/sample for air particulates, and pCi/kilogram for food products except K which is reported in mg/kilogram

TABLE E-4

DATE	RMC #	ISOTOPE	RMC MEAN±S.D.	EPA MEAN±S.D.	All Participants MEAN±S.D.
JULY 1978	94132 Milk	I-131	<3	0	
		Cs-137	48±3	53±5	54±4
		Ba-140	<2	0	
		K-40	1359±29	1560±78	1547±116
AUGUST 1978	94903 Water	Cr-51	106±11	105±5	106±21
		Co-60	29±1	27±5	27±4
		Zn-65	58±5	62±5	61±11
		Ru-106	48±6	41±5	41±11
		Cs-134	8±1	9±5	10±2
		Cs-137	15±1	15±5	16±3
OCTOBER 1978	97770 Water	Cr-51	152±18	117±6	126±32
		Co-60	29±1	23±5	23±4
		Zn-65	85±2	82±5	82±10
		Ru-106	42±3	46±5	47±14
		Cs-134	25±1	25±5	25±4
		Cs-137	131±1	125±6	127±11
OCTOBER 1978	98135 Water	Co-60	<2	0	
		Cs-134	9±1	10±5	10±4
		Cs-137	13±1	13±5	13±4

APPENDIX F

COW AND GARDEN SURVEY

TABLE F-1

NEAREST MILK

Sector	Distance (Miles)
1 N	>5
2 NNE	>5
3 NE	3.8
4 ENE	>5
5 E	2.2
6 ESE	2.4
7 SE	2.5
8 SSE	2.5
9 S	2.4
10 SSW	2.5
11 SW	2.5
12 WSW	1.6
13 W	4.9
14 WNW	>5
15 NW	.7
16 NNW	4.1

TABLE F-2

MILK COWS TO 3 MILES

Sector	Distance (Miles)
1 N	>5
2 NNE	>5
3 NE	3.8
4 ENE	>5
5 E	2.2
6 ESE	2.4,2.6,2.7
7 SE	2.5
8 SSE	2.5
9 S	2.4
10 SSW	2.5
11 SW	2.5
12 WSW	1.6,2.0
13 W	4.9
14 WNW	>5
15 NW	.7
16 NNW	4.1

TABLE F-3

NEAREST VEGETABLE GARDEN

Sector	Distance (Miles)
1 N	0.5
2 NNE	0.9
3 NE	2.3
4 ENE	2.8
5 E	0.7
6 ESE	1.5
7 SE	0.4
8 SSE	0.4
9 S	1.2
10 SSW	0.6
11 SW	0.8
12 WSW	1.2
13 W	0.7
14 WNW	1.3
15 NW	0.7
16 NNW	0.7

TABLE F-4

NEAREST RESIDENCE IN EACH SECTOR WITHIN FIVE MILES OF THE SITE

Sector	Distance (Miles)
1 N	0.710
2 NNE	1.045
3 NE	2.273
4 ENE	2.367
5 E	1.326
6 ESE	0.473
7 SE	0.378
8 SSE	0.701
9 S	1.136
10 SSW	0.757
11 SW	0.800
12 WSW	1.089
13 W	1.183
14 WNW	0.710
15 NW	0.805
16 NNW	0.757

7909070381

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

Annual Report for 1978

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July 1979

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INTRODUCTION

The Susquehanna Steam Electric Station (Susquehanna SES) consists of two boiling water reactors, each with an electrical generating capacity of 1,050 megawatts. It is located on a 435-ha site in Salem Township, Luzerne County, 8 km northeast of Berwick, Pennsylvania. Commercial operation of Unit 1 is scheduled to begin in Feburary 1981 and Unit 2 in May 1982. 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.

Ecological studies have been conducted near the Susquehanna SES by Ichthyological Associates, Inc. (IA) since 1971. The Susquehanna River, from which the Susquehanna SES will withdraw cooling water, has been investigated since the beginning of the studies, whereas terrestrial investigations of the site were initiated in 1972, discontinued in 1975, and reinstated in the spring of 1977. The overall objective of these studies has been to establish an ecological baseline of existing conditions in the river and on the site prior to operaticn of the Susquehanna SES. Data from studies prior to 1978 have been presented in annual progress reports from 1971 through 1977 (see page 293).

Throughout 1978, various physicochemical characteristics of the river were analyzed, and its algal, macroinvertebrate, and fish populations were monitored. Terrestrial investigations of the site dealt with studies of flora, vegetation, and birds. Descriptions of sampling procedures, detailed data tabulations, and interpretation of the results are presented in this annual progress report for 1978.

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 river bed in this stretch is 0.3 m/km and the average width is about 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 maintain pools, some of which are several kilometers long. In times of high flow the river level commonly increases 3 m or more, and its flow characteristics resembles an open channel. Upriver from the site, the "Wyoming Region" of the northern anthracite coal field lies beneath or adjacent to the river. Acid mine drainages from this area, which enter from abandoned strip and shaft mines, degrade the water quality at the site (Gale et al. 1976).

Terrestrial studies were done on either the site or on adjacent PP&L properties. Elevations of the site range from 150 m above mean sea level on the river flood plain to a maximum of 325 m near the northwest property line. About 40% of this land is flat and the remainder is hilly rather than mountainous. This area is located within the Ridge and Valley Section of the Appalachian Valley Province (Fenneman 1938).

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PHYSICOCHEMICAL ANALYSES

by

Walter J. Soya and Theodore V. Jacobsen

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ABSTRACT

Physicochemical data were collected from the Susquehanna River near the Susquehanna SES site throughout 1978. Range in river temperature was from -0.1 to 30.0 C; flow from 28 to 2,172 m^3/s; and level from 148.21 to 152.97 m above mean sea level. Despite construction activities, data were similar upriver from the intake and downriver from the discharge. Although acid mine drainages from sources upriver continue to pollute the river at the site, analyses of physicochemical data from 1973 through 1978 revealed significantly improved water quality. The magnitude of diel fluctuations in temperature, dissolved oxygen, and pH varied seasonally.

INTRODUCTION

This report presents physicochemical data collected from the Susquehanna River near the Susquehanna SES in 1978. The objective since 1971 has been to establish a baseline of water quality parameters for evaluation of possible effects on the river as a result of the operation of the Susquehanna SES. Records of similar physicochemical data are in annual reports from 1971 through 1977 (Ichthyological Associates 1972, 1973, 1974; Smith and Soya 1976, Jacobsen and Soya 1976, 1977; and Soya and Jacobsen 1978).

PROCEDURES

Physicochemical data were collected at the Susquehanna SES Biological Laboratory and the SSES and Bell Bend sampling sites (Fig. A-1). The laboratory is on the river's west bank, 465 m upriver from the center of the Susquehanna SES intake structure. The SSES site is about 190 m upriver from the intake structure. The Bell Bend site is about 740 m downriver from the Susquehanna SES discharge diffuser. Both sites are about 40 m from the west bank.

River temperature, level, and flow were monitored at the laboratory (Table A-1). Temperature and depth of the river were recorded continuously on seven-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) past the laboratory. Daily means of the temperature and level recordings were determined by averaging hourly values from 0100 through 2400 h. Daily minimum and maximum values and their respective hours of occurrence were tabulated. When either a minimum or maximum value remained constant for several hours in a day, only the first hour of occurrence was 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 from October through December. 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 temperatures, Secchi disc depth, and prevailing weather conditions were also determined at each site (Table A-1). River level and flow at collection time were also tabulated with the SSES data.

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

Diel physicochemical data were collected at SSES once per month from April through September during periods of stable river levels. Air and water temperature, dissolved oxygen, and pH were monitored at 3-hour intervals. Methods for collection and analysis were the same as previously described with the exception that replicate analyses were not performed for pH and dissolved oxygen.

The 1978 physicochemical data collected at SSES 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, and 2) a trend among years was present. Friedman's two-way analysis of variance test (S) was used in the first determination and Page's distribution-free test (L) for ordered alternatives in the second (Hollander and Wolfe 1973). The tests were based on monthly mean values; only complete sampling years (1973-78) were used.

Personnel from the PP&L Water Laboratory collected physicochemical data from the river once each month at the Susquehanna SES Biological Laboratory (Fig. A-1). Water temperature and dissolved oxygen were measured in the field; all other determinations were made at the PP&L Laboratory according to *Standard Methods* (APHA 1975) or *Methods for Chemical Analysis of Water and Wastes* (EPA 1974).

RESULTS AND DISCUSSION

Throughout 1978, the river temperature ranged from -0.1 C, recorded on 8 days from 3 January through 15 March, to 30.0 C on 23 July (Table A-2). The minimum daily mean temperature 0.0 C was recorded on 12 days from 4 January through 5 February and the maximum daily mean temperature, 28.2 C, occurred on 23 July. The daily mean temperature varied least in February (Standard Error = 0.03), and most in May (SE = 0.67). The minimum monthly mean temperature, 0.2 C, occurred in January and February and the maximum, 24.8 C, in August.

Daily water temperature ranges of 0.5 C or greater occurred in all months and in 98% of the days from April through September (Table A-2). Fluctuations of 3.0 C or greater occurred in July, August, and September.

The maximum daily fluctuation, 4.1 C, occurred on 23 August.

The river level ranged from 148.21 m above mean sea level (msl) on 16 and 17 September to 152.97 m above msl on 28 January and 23 March (Table A-3). The minimum daily mean river level (148.23 m above msl) occurred on 16 and 17 September and the maximum (152.87 m above msl) on 23 March. The daily mean river level varied least in July (SE = 0.016) and most in March (SE = 0.276). The lowest monthly mean level (148.39 m above msl) occurred in July and the highest (150.58 m above msl) in April.

River flow ranged from 28 m^3/s on 16 and 17 September to 3,172 m^3/s on 28 January and 23 March (calculated from minimum and maximum river levels). Daily mean flow was least (31 m^3/s) on 16 and 17 September and greatest (3,057 m^3/s) on 23 March (Table A-4). The daily mean flow varied least in July (SE = 3.1) and most in March (SE = 187.7). The monthly mean flow was lowest in July (60 m^3/s) and highest in March (1,086 m^3/s).

Physicochemical data from the SSES and Bell Bend sites (Tables A-5 through A-16) are summarized in Table A-17. Data collected upriver from the intake structure (SSES) and downriver from the discharge diffuser (Bell Bend) were similar throughout 1978. This is of particular interest because most of the river-related work associated with the construction of the Susquehanna SES intake structure and discharge diffuser was accomplished in 1978.

Statistical analyses of physicochemical data collected at SSES from 1973 through 1978 showed improved water quality of the river similar to that observed from 1973 through 1976 (Jacobsen and Soya 1977) and from 1973 through 1977 (Soya and Jacobsen 1978). Using Friedman's test, significant differences were found among years for pH ($S = 30.155$, $DF = 5$, $P<0.001$), total alkalinity ($S = 15.133$, $DF = 4$, $P<0.01$), dissolved oxygen ($S = 16.512$, $DF = 5$, $P<0.01$), total iron ($S = 19.381$, $DF = 5$, $P<0.01$), dissolved iron ($S = 22.976$, $DF = 5$, $P<0.001$), and turbidity ($S = 17.595$, $DF = 5$, $P<0.01$). Page's test showed a significant increasing trend among years for pH ($L = 1,027$, $P<0.001$), total alkalinity ($L = 599$, $P<0.001$), and dissolved oxygen ($L = 962$, $P<0.01$), and a significant decreasing trend for total iron ($L = 991$, $P<0.001$) and turbidity ($L = 993$, $P<0.001$). A significant decrease was also found for sulfate ($L = 936$, $P<0.05$) even though no significance was found among years with Friedman's test. No decrease could be detected in the concentrations of dissolved iron. Several of these trends can be seen in plots of monthly mean values for selected parameters from 1972 through 1978 (Figs. A-2 and A-3). River water quality began to improve in 1972 with the termination of pumping mine water into the river at several locations upstream from the Susquehanna SES site (Jacobsen and Soya 1976). Mine pollution, however, has not ceased completely because some effluents continue to enter by gravity flow.

In each of the three intervals that physicochemical data were tested for trends (1973-76, 1973-77, and 1973-78), four parameters have consistently shown significantly improved water quality. Dissolved oxygen and pH have increased whereas total iron and turbidity have decreased. In addition, an increase in total alkalinity (sampling began in 1974) occurred in the 1974-77 and 1974-78 intervals. The trend was significant in the first interval ($P<0.05$) and highly significant in the second ($P<0.001$).

Trends in other parameters, such as sulfate, specific conductance, and dissolved iron, have not always been so conclusively supportive of improved water quality. However, when changes in these trends are considered with regard to seasonal fluctuations in river flow and temperature, the overall results also reflect better water quality.

Sulfate exhibited a significant decrease in the 1973-76 interval, no trend in 1973-77, and a second significant decrease in the 1973-78 interval. Variability in river flow during the last year of each interval probably affected the results, since sulfate concentrations are inversely related to flow (Figs. A-2 and A-3). From 1973 through 1978, the highest annual river flow occurred in 1976, followed by a lower than average flow in 1977 and the lowest flow in 1978 (Fig. A-2). In 1977 and 1978, sulfate ions should have been successively more concentrated. Therefore, even if the number of sulfate ions had decreased, it would not be evident because of an increase in sulfate concentrations due to decreased flow. This is probably what occurred in 1977 when the trend was terminated. In 1978, however, the trend reoccurred despite the low flow conditions.

Significant decreases found in specific conductance during the 1973-76 and 1973-77 intervals were not detected in the 1973-78 interval.

Because specific conductance is also inversely related to river flow, discontinuance of the trend was probably caused by unseasonally low flows from September through December in 1978 (Fig. A-2). Specific conductance was unusually high during this period (Fig. A-2) as dissolved minerals remained concentrated in the river water. Consequently, the average specific conductance for 1978 (based on Friedman's ranked sums) was higher than in the previous three years, and the downward trend ended.

A significant decrease in dissolved iron occurred during the 1973-77 interval. It was initiated by a relatively low concentration of dissolved iron in 1977, a year when mean river temperature was the highest recorded since constant monitoring began in 1974. Gale et al. (1976) demonstrated that dissolved iron concentrations in river water decrease as temperature increases. In 1978, the river temperature moderated, dissolved iron increased, and no trend was found for the 1973-78 interval. It is likely that the decrease in dissolved iron will reoccur in future years, particularly if amounts of total iron continue to decrease.

Diel studies at SSES in April and May 1978, were characterized by relatively little change in temperature, dissolved oxygen, and pH (Table A-18). Air temperature fluctuated more on the sampling date in April than in May, but, diel changes in water temperature were only 0.5 C on both dates. Overall, dissolved oxygen concentrations increased from 2400 h through 1200 h then decreased. The range, however, was less than 0.5 mg/l in each study. The pH values were nearly constant on both sampling dates.

Diel fluctuations in temperature, dissolved oxygen, and pH were most pronounced during studies in June, July, and August (Table A-18). Minimum values for these parameters occurred between 2400 h and 0900 h and maximum values were recorded from 1500 h through 2100 h. The largest change in pH occurred in the June study when it increased from 7.4 at 0900 h to 8.1 at 1500 h. Maximum fluctuations in water temperature and dissolved oxygen were found in August. Water temperature rose from 23.0 C at 0600 h to 26.0 C at 1800 h and dissolved oxygen increased from 7.40 mg/l at 0600 h to 10.60 mg/l at 1500 h.

In the September diel study, fluctuations in most parameters moderated in comparison to data collected during the three previous studies (Table A-18). Water temperature fluctuated only 1.5 C despite a 12.0 C increase in air temperature. Dissolved oxygen changed less than 2 mg/l as it increased from 8.30 at 0600 h to 10.10 mg/l at 1800 h. The pH ranged from 7.5 to 7.7.

A total of 50 water quality parameters was analyzed each month from samples collected at the Susquehanna SES Biological Laboratory by personnel from the PP&L Water Laboratory (Table A-19). The relatively high concentrations of iron, sulfate, aluminum, manganese, and magnesium in the samples indicates that coal mine pollution persisted at the site. Total iron concentrations in 7 of the 12 samples exceeded the 1.5 mg/l limit established for the river by the Pennsylvania Department of Environmental Resources (DER 1971). Total maganese concentrations, however, did not surpass the DER limit of 1.0 mg/l in any month.

Major cation and anion composition was similar to that found in 1977 (Soya and Jacobsen 1978). Calcium ($\bar{x}$ = 1.53 me/l) was the dominant cation in all samples. The dominant anion in each sample was either bicarbonate ($\bar{x}$ = 1.07 me/l) or sulfate ($\bar{x}$ = 1.11 me/l).

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Table A-1. Physicochemical parameters and methods of analyses, 1978.

Parameter	Method	Reference
River level (depth)	Seven-day continuous recordings from an ACCO Bristol, Model No. G500-15 bubbler-type water level gauge	ACCO (1971)
River flow	River flow = 215.8 + 322.3 (river level -149) + 106.4 (river level $-149)^2$	HP (1972)
River temperature	Seven-day continuous recordings from a calibrated, Leeds and Northrup Speedomax Thermistor-type, Model R temperature recorder	APHA (1975)
	Calibrated, mercury thermometer	APHA (1975)
Air temperature	Calibrated, mercury thermometer	APHA (1975)
Dissolved oxygen	Azide modification of Winkler, proprietory reagents (Jan-Jun)	APHA (1975)
	Azide modification of Winkler (Jul-Dec)	APHA (1975)
pH	Glass electrode	APHA (1975)
Total alkalinity	Potentiometric titration	APHA (1975)
Specific conductance	Self-contained conductivity meter	APHA (1975)
Sulfate	Turbidimetric	APHA (1975)
Total iron	Atomic absorption spectrophotometric determination of extractable iron	APHA (1975)
Dissolved iron	Atomic absorption of spectrophotometric determination of dissolved iron	APHA (1975)
Total residue	Evaporation at 105 C	APHA (1975)
Fixed total residue	Ignition of total residue at 550 C	APHA (1975)
Nonfiltrable residue	Residue retained on a glass fiber filter, dried at 105 C	APHA (1975)
Filtrable residue	Evaporation of a filtered aliquot, dried at 180 C	APHA (1975)
Turbidity	Nephelometric	APHA (1975)
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, 1978.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN					
1	0.1	0100	0.3	1200	0.2
2	0.0	1800	0.3	0200	0.2
3	-0.1	1800	0.1	0100	0.1
4	-0.1	1700	0.1	0100	0.0
5	-0.1	0500	0.2	2300	0.1
6	0.1	0100	0.2	1300	0.1
7	0.1	0900	0.8	1800	0.5
8	0.8	0100	2.0	2300	1.2
9	0.9	2300	2.7	1300	2.0
10	0.0	1600	0.8	0100	0.1
11	0.0	0500	0.1	0100	0.0
12	0.0	0100	0.1	2300	0.0
13	0.0	1600	0.1	0100	0.1
14	0.1	0100	0.2	1300	0.1
15	0.0	1700	0.2	1100	0.1
16	0.0	0100	0.1	2300	0.0
17	0.0	0500	0.1	0100	0.1
18	0.1	0100	0.1	0100	0.1
19	0.0	2100	0.1	0100	0.1
20	0.0	1600	0.1	0100	0.1
21	0.1	0100	0.2	1400	0.1
22	0.0	0100	0.1	1200	0.1
23	0.0	0100	0.1	0900	0.0
24	0.0	0100	0.2	1400	0.1
25	0.0	0100	0.1	0600	0.1
26	0.0	1700	0.3	0500	0.1
27	0.0	0100	0.1	0800	0.0
28	0.0	0100	0.0	0100	0.0
29	0.0	0100	0.0	0100	0.0
30	0.0	0100	0.1	0700	0.0
31	0.0	0100	0.0	0100	0.0
MEAN					0.2
SE					0.07

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
FEB					
1	-0.1	0100	0.2	1300	0.0
2	0.0	0100	0.2	1300	0.1
3	0.0	0100	0.2	1300	0.1
4	0.0	0100	0.2	1300	0.1
5	0.0	0100	0.0	0100	0.0
6	0.0	0100	0.2	0900	0.1
7	0.0	0100	0.3	1500	0.1
8	0.0	0100	0.5	1300	0.2
9	0.0	0100	0.3	1300	0.1
10	-0.1	2400	0.2	1300	0.1
11	-0.1	0100	0.2	1200	0.1
12	0.0	0100	0.3	1300	0.1
13	0.0	0100	0.3	1200	0.2
14	0.0	0300	0.5	1500	0.2
15	0.0	0100	0.5	1400	0.2
16	0.0	0200	0.7	1400	0.4
17	0.2	0800	0.6	1800	0.3
18	-0.1	0600	0.3	1700	0.1
19	0.0	0600	0.6	1500	0.2
20	0.0	0400	0.5	1600	0.3
21	0.0	0500	0.4	1600	0.2
22	0.0	0200	0.6	1300	0.3
23	0.0	0400	0.8	1300	0.4
24	0.1	0400	0.8	1400	0.4
25	0.2	0800	0.9	1600	0.5
26	0.4	0800	1.1	1400	0.7
27	0.3	0700	0.9	1300	0.6
28	0.2	0600	0.9	1300	0.5
MEAN					0.2
SE					0.03

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR					
1	0.2	2200	1.0	1200	0.6
2	0.1	0200	1.1	1300	0.5
3	0.0	1800	0.7	0800	0.3
4	0.0	0100	1.0	1600	0.4
5	0.1	0100	1.1	1500	0.4
6	0.0	0700	1.2	1400	0.5
7	0.0	0700	1.8	1400	0.8
8	0.3	2400	1.1	1200	0.8
9	0.3	0100	1.1	1300	0.8
10	0.8	0500	1.4	1400	1.0
11	0.6	0700	1.8	1400	1.1
12	1.1	0100	1.8	1200	1.4
13	1.1	0100	2.2	1300	1.6
14	1.1	2100	1.9	0700	1.6
15	-0.1	1900	1.1	0100	0.7
16	0.1	0100	0.6	1600	0.2
17	0.1	0100	0.7	1500	0.4
18	0.3	0700	1.1	1600	0.7
19	0.9	0100	2.1	2100	1.5
20	1.9	0600	2.9	1500	2.5
21	2.8	0500	3.9	1800	3.3
22	2.4	2400	3.8	0100	3.3
23	1.9	0700	2.3	0100	2.0
24	2.3	0100	3.2	1600	2.9
25	2.2	2400	3.0	0100	2.7
26	1.9	0800	2.2	0100	2.0
27	1.8	0400	2.2	2200	2.0
28	2.2	0100	2.9	1600	2.6
29	2.9	0100	3.7	1700	3.3
30	3.2	0400	3.9	1500	3.6
31	3.2	0500	4.2	2100	3.7
MEAN					1.6
SE					0.20

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
APR					
1	4.1	0600	5.7	2100	4.8
2	5.1	0700	5.9	1800	5.5
3	4.1	2400	5.7	0100	4.8
4	3.3	0900	4.1	0100	3.6
5	3.7	0100	4.3	1400	4.1
6	3.9	0700	4.9	1900	4.4
7	8	0500	5.3	2300	5.0
8	5.1	0500	6.1	1600	5.6
9	5.2	0600	5.9	1500	5.6
10	5.1	0600	5.8	1800	5.5
11	5.6	0600	6.5	2400	6.0
12	6.4	0500	7.8	2200	7.1
13	7.8	0600	8.5	1900	8.1
14	8.1	0600	8.6	2400	8.3
15	7.8	2400	8.6	0100	8.1
16	7.2	0800	7.8	0100	7.3
17	6.9	0600	7.2	1400	7.0
18	6.7	0700	7.8	1400	7.3
19	7.3	2000	7.8	0100	7.4
20	7.2	0500	7.7	2200	7.4
21	7.2	1200	7.7	0100	7.3
22	7.0	0800	8.0	1600	7.6
23	7.1	0700	8.2	1700	7.8
24	8.1	0600	8.8	2100	8.4
25	8.7	0600	10.2	2400	9.5
26	10.1	0500	10.8	2400	10.4
27	10.8	0100	11.3	1500	11.0
28	10.9	0200	12.3	1600	11.6
29	11.7	0500	13.0	1400	12.4
30	12.1	0600	13.2	1700	12.7
MEAN					7.4
SE					0.44

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY					
1	11.7	2400	12.6	1300	12.1
2	11.3	0600	12.3	1400	11.8
3	11.2	0400	12.8	1400	11.9
4	11.2	0400	12.0	1400	11.6
5	10.3	2400	11.4	0100	11.0
6	10.1	0400	10.4	1600	10.2
7	10.0	0700	10.6	2200	10.3
8	10.1	0500	10.5	1500	10.4
9	10.2	0100	11.5	2000	10.9
10	11.3	0500	11.9	1200	11.7
11	11.1	0500	12.9	1600	12.1
12	13.0	0100	13.9	1700	13.4
13	13.8	0100	13.9	0400	13.9
14	13.2	2400	13.9	0100	13.7
15	12.0	1600	13.2	0100	12.6
16	11.9	2200	12.4	1400	12.1
17	11.2	2200	11.9	0100	11.5
18	11.2	0100	12.0	2000	11.5
19	11.8	0400	13.5	2400	12.5
20	13.5	0100	15.5	2400	14.4
21	15.5	0100	16.7	2000	16.0
22	15.8	0600	16.8	2300	16.3
23	16.3	0800	16.9	0100	16.7
24	15.9	2400	16.8	0100	16.3
25	15.8	0600	16.9	1600	16.4
26	16.4	0400	18.1	1600	17.3
27	17.9	0100	19.3	1700	18.6
28	19.2	0100	21.1	1700	20.2
29	20.8	0100	22.2	1600	21.6
30	21.3	0700	23.1	1500	22.4
31	22.4	0400	24.0	1500	23.3
MEAN					14.3
SE					0.67

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUN					
1	23.0	0400	24.4	1500	23.6
2	22.5	0500	24.1	1500	23.4
3	21.9	2400	23.5	0100	22.8
4	20.5	0800	21.7	0100	21.0
5	19.9	0700	21.2	1600	20.4
6	19.1	0600	20.8	1600	19.9
7	19.1	0600	19.8	0100	19.3
8	19.0	0500	19.9	1600	19.4
9	19.2	0600	20.1	1500	19.7
10	18.8	0700	20.2	1700	19.6
11	19.2	0500	20.8	1600	20.1
12	20.2	0500	21.9	1400	21.2
13	20.0	2400	21.6	0100	21.2
14	18.9	2400	20.0	1400	19.5
15	18.2	0400	19.7	1600	18.9
16	18.0	0500	19.4	1600	18.8
17	18.1	2400	18.9	0100	18.8
18	17.9	0500	19.9	1600	18.9
19	19.6	0400	21.9	1600	20.8
20	20.7	0500	22.7	1500	21.7
21	21.9	0300	23.0	1500	22.4
22	22.1	0400	23.5	1500	22.7
23	22.0	0900	23.6	1500	22.8
24	22.0	0500	23.6	1700	22.7
25	22.1	0600	23.9	1600	23.1
26	22.3	2300	23.1	0100	22.6
27	22.0	0600	23.6	1500	22.7
28	22.9	0600	24.9	1400	24.0
29	23.5	0500	25.5	1400	24.4
30	23.5	0600	25.1	1400	24.2
MEAN					21.4
SE					0.33

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JUL					
1	22.6	0700	24.6	1500	23.5
2	21.9	0700	23.3	1600	22.6
3	20.3	2400	22.1	0100	21.4
4	19.2	2400	20.1	0100	19.8
5	18.7	0600	21.4	1600	19.9
6	19.7	0700	22.4	1500	21.1
7	21.1	0600	23.6	1400	22.4
8	22.3	2400	24.9	1400	23.1
9	22.1	0500	24.3	1200	23.2
10	23.0	0400	27.0	1500	25.1
11	23.9	2400	26.1	1400	25.1
12	22.7	0700	26.1	1600	24.2
13	22.8	0700	25.9	1500	24.3
14	23.2	0700	24.9	1400	23.9
15	23.3	0800	26.9	1600	24.8
16	23.7	0700	25.7	1700	24.5
17	23.5	0700	25.3	1800	24.3
18	23.5	0600	26.5	1500	24.8
19	23.8	0600	26.9	1600	24.8
20	24.9	0600	27.8	1500	26.1
21	25.4	0600	28.4	1600	26.8
22	26.2	0700	29.5	1700	27.6
23	26.9	0700	30.0	1700	28.2
24	26.8	0700	29.1	1500	27.7
25	25.0	2400	26.4	0100	25.8
26	24.2	0700	26.9	1600	25.5
27	24.5	0700	27.2	1700	25.8
28	24.2	0800	26.7	1700	25.3
29	23.1	0800	25.4	1700	24.2
30	23.1	0800	25.3	1700	24.0
31	22.0	2400	23.0	0100	22.2
MEAN					24.3
SE					0.37

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
AUG					
1	21.8	0600	23.5	1800	22.5
2	21.9	0600	24.9	1600	23.1
3	22.6	0600	25.1	1600	23.7
4	23.7	0600	25.5	1500	24.3
5	23.5	0600	24.0	1300	23.8
6	23.7	0600	25.2	1600	24.4
7	24.2	0600	25.2	1400	24.8
8	23.4	2400	24.6	1300	24.1
9	23.1	0600	23..	1800	23.6
10	23.6	0600	24.1	1600	23.8
11	23.2	0600	24.0	1500	23.7
12	23.2	0800	24.7	1500	23.9
13	23.7	0800	25.1	1600	24.3
14	24.0	0600	25.9	1700	25.0
15	24.8	0600	26.6	1500	25.7
16	25.8	0600	27.3	1500	26.6
17	26.1	0600	28.2	1500	27.1
18	26.0	0700	28.2	1500	27.0
19	25.7	0700	28.2	1600	26.8
20	25.0	2400	26.8	0100	26.1
21	23.9	0700	27.1	1500	25.2
22	23.2	0700	26.9	1500	24.9
23	23.0	0600	27.1	1700	25.0
24	23.6	0700	27.1	1700	25.3
25	24.5	2400	26.2	1600	25.2
26	23.9	0600	27.2	1600	25.2
27	23.2	0700	26.0	1400	24.6
28	23.8	0700	25.1	1600	24.5
29	23.8	0700	26.8	1700	25.2
30	24.1	0800	25.3	1800	24.6
31	22.9	2400	24.3	0100	23.5
MEAN					24.8
SE					0.20

Table A-2 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP						OCT					
1	22.5	0800	24.9	1500	23.5	1	16.1	0600	17.3	1600	16.6
2	22.2	0700	24.8	1500	23.2	2	15.4	2400	16.5	1700	16.0
3	22.4	0700	24.0	1300	23.1	3	14.5	0900	17.4	1500	15.8
4	22.1	0700	24.0	1500	22.7	4	15.1	0600	16.2	1600	15.6
5	21.1	0800	24.6	1700	22.7	5	15.0	0700	16.8	1500	15.6
6	21.8	0700	25.1	1700	23.3	6	--	--	--	--	--
7	22.6	0700	24.8	1700	23.6	7	--	--	--	--	--
8	21.0	2400	22.8	0100	21.7	8	--	--	--	--	--
9	20.3	0700	22.9	1600	21.1	9	--	--	--	--	--
10	19.3	0800	21.9	1400	20.5	10	--	--	--	--	--
11	19.9	0800	21.8	1800	20.0	11	12.2	0400	14.8	1200	13.4
12	20.3	0800	22.0	1400	21.1	12	13.2	0200	15.2	1200	14.2
13	19.1	0900	21.7	1600	20.2	13	14.1	0500	15.7	1600	14.8
14	18.9	0600	21.0	1400	19.7	14	13.9	2400	14.9	0100	14.5
15	18.7	0500	20.4	1700	19.4	15	12.9	2400	14.0	1300	13.4
16	18.8	0700	21.1	1700	19.5	16	12.1	0800	12.9	0100	12.4
17	18.3	0700	20.8	1700	19.6	17	11.4	2400	12.2	1400	11.8
18	19.8	0900	21.8	1800	20.5	18	10.8	2300	11.3	0100	11.0
19	19.2	2300	20.1	0100	19.7	19	10.7	0800	11.0	1300	10.8
20	19.0	0700	19.9	1700	19.3	20	10.6	2400	11.0	1300	10.8
21	18.8	0500	20.3	1600	19.5	21	10.1	0700	11.2	1400	10.6
22	19.2	2400	19.9	1400	19.8	22	10.2	0800	11.8	1400	11.0
23	19.0	0600	19.8	1400	19.3	23	11.0	0600	12.0	1400	11.5
24	18.5	0800	19.2	1400	18.9	24	10.8	0700	11.9	1300	11.1
25	18.1	0900	19.2	1400	18.7	25	10.0	0800	11.3	1400	10.6
26	17.4	0700	19.2	1400	18.3	26	10.8	0400	11.2	1800	11.0
27	17.0	0800	18.2	1500	17.6	27	10.9	0800	11.5	1500	11.2
28	16.5	2400	18.2	1500	17.1	28	10.7	0800	11.4	1300	11.0
29	16.0	0700	18.0	1500	16.6	29	10.2	0800	10.9	1300	10.5
30	15.5	0800	17.9	1500	16.4	30	9.8	2400	10.2	1300	10.0
						31	9.5	0700	10.0	1300	9.8
MEAN					20.2	MEAN					12.5
SE					0.37	SE					0.43
NOV						DEC					
1	9.2	0700	10.0	1300	9.6	1	2.3	0600	3.1	1200	2.7
2	9.0	0700	9.8	1300	9.3	2	2.3	0700	3.0	1400	2.7
3	8.7	0700	9.6	1300	9.1	3	2.3	0800	2.7	2400	2.4
4	8.9	0700	9.6	1400	9.2	4	2.7	0100	3.2	1500	3.0
5	8.9	0800	9.8	1300	9.2	5	3.2	0100	4.1	1300	3.6
6	8.9	0600	9.9	1300	9.4	6	3.3	0600	4.1	1300	3.7
7	9.2	0600	9.7	1300	9.4	7	3.6	0700	3.9	1300	3.8
8	9.2	0600	9.8	1400	9.3	8	3.7	0200	4.0	2400	3.8
9	8.5	0700	9.3	1300	8.8	9	4.0	0100	4.1	1200	4.1
10	8.3	0700	9.7	1200	8.8	10	2.6	2400	4.0	0100	3.3
11	8.4	0500	9.4	1400	8.9	11	1.5	2000	2.6	0100	1.9
12	8.8	0800	9.2	1400	8.9	12	1.3	0800	1.6	1400	1.5
13	8.2	1900	8.8	0100	8.4	13	1.3	0600	1.7	1200	1.6
14	8.2	0100	9.0	1400	8.6	14	1.2	2400	1.8	1200	1.6
15	8.2	0700	9.2	1500	8.7	15	1.1	0600	1.4	1400	1.3
16	8.2	2400	9.3	1300	8.8	16	1.1	0700	1.6	1300	1.3
17	7.9	0500	8.8	2300	8.1	17	1.3	2300	1.8	1300	1.6
18	8.5	2400	9.0	0300	8.8	18	1.0	0700	1.3	1500	1.2
19	8.2	2400	9.0	1400	8.6	19	0.3	2000	1.0	0100	0.6
20	7.6	2400	8.6	1300	8.0	20	0.1	1100	0.3	0100	0.2
21	6.6	2400	7.5	0100	7.0	21	0.1	0100	0.6	1900	0.3
22	5.8	2300	6.5	0100	6.1	22	0.1	0800	0.3	1400	0.2
23	5.4	1000	5.8	0100	5.5	23	0.1	0100	0.2	1200	0.1
24	5.5	0700	5.9	1300	5.7	24	0.1	0100	0.2	1400	0.2
25	4.8	2400	5.7	0100	5.3	25	0.1	2100	0.2	0100	0.2
26	3.9	2400	4.8	0100	4.3	26	0.1	0100	0.2	1300	0.1
27	2.9	2400	3.9	0100	3.3	27	0.0	0100	0.2	1300	0.1
28	2.3	2400	2.9	0100	2.8	28	0.0	0100	0.2	1200	0.1
29	2.1	0600	2.7	1300	2.3	29	0.0	0800	0.1	0100	0.1
30	2.2	0100	3.0	1300	2.7	30	0.0	0100	0.1	1100	0.1
						31	0.1	0100	0.2	1200	0.2
MEAN					7.4	MEAN					1.5
SE					0.42	SE					0.25

Table A-3. Daily minimum, maximum, and mean level (m above msl) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1978.

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
JAN					
1	149.62	0100	149.65	1700	149.63
2	149.62	0100	149.62	0100	149.62
3	149.59	1500	149.65	1000	149.62
4	149.34	2000	149.59	0100	149.48
5	149.19	2000	149.43	0500	149.33
6	149.25	0100	149.37	2100	149.29
7	149.28	0700	149.34	0100	149.31
8	149.31	0100	149.40	2200	149.33
9	149.43	0100	152.51	2400	150.82
10	152.57	0100	152.94	1800	152.80
11	151.72	2400	152.79	0100	152.20
12	151.02	2400	151.69	0100	151.37
13	150.68	2400	150.99	0100	150.82
14	150.50	1900	150.68	0100	150.56
15	150.32	1700	150.50	0100	150.41
16	150.01	2300	150.32	0100	150.16
17	149.89	1900	150.01	0100	149.94
18	149.80	1400	149.89	0100	149.85
19	149.56	2200	149.80	0100	149.68
20	149.34	2300	149.56	0100	149.49
21	149.34	0100	149.86	0500	149.61
22	149.34	2100	149.53	0100	149.45
23	149.34	0100	149.50	0900	149.44
24	149.40	2000	149.56	0800	149.47
25	149.40	0100	149.53	2400	149.44
26	149.53	0100	151.42	2400	150.27
27	151.42	0100	152.94	2400	152.44
28	152.36	2400	152.97	0300	152.72
29	151.57	2400	152.33	0100	151.92
30	151.02	2300	151.54	0100	151.26
31	150.65	2100	151.02	0100	150.82
MEAN					150.34
SE					0.198

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
FEB					
1	150.44	1800	150.65	0100	150.53
2	150.26	1400	150.44	0100	150.33
3	150.01	2100	150.26	0100	150.12
4	149.80	1800	150.01	0100	149.92
5	149.65	1800	149.86	0600	149.76
6	149.59	2200	149.68	0800	149.63
7	149.25	1000	149.56	0100	149.35
8	149.16	2200	149.34	0700	149.27
9	149.16	0100	149.40	2400	149.26
10	149.40	0100	149.53	0900	149.46
11	149.37	2300	149.53	0900	149.45
12	149.37	0100	149.50	0900	149.43
13	149.40	1800	149.46	0700	149.42
14	149.37	1600	149.43	0600	149.40
15	149.28	1900	149.40	0100	149.35
16	149.13	2100	149.31	0900	149.24
17	149.13	0100	149.19	0900	149.17
18	149.16	0100	149.19	0700	149.18
19	149.13	2000	149.22	1000	149.18
20	149.04	2400	149.19	1300	149.13
21	149.04	0100	149.10	0900	149.07
22	148.98	2200	149.04	1200	149.02
23	148.98	0100	149.07	1000	149.01
24	148.95	0100	148.98	1400	148.96
25	148.95	0100	149.04	1100	149.01
26	149.01	0100	149.04	0800	149.03
27	149.01	2100	149.04	0100	149.04
28	148.95	2100	149.01	0100	149.00
MEAN					149.38
SE					0.078

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAR					
1	148.92	2400	148.98	1100	148.96
2	148.92	0100	148.95	0800	148.94
3	148.85	2400	148.95	0800	148.92
4	148.82	2400	148.89	0900	148.85
5	148.79	2200	148.85	0700	148.83
6	148.73	0400	148.85	2000	148.78
7	148.79	0300	148.89	1700	148.82
8	148.82	0300	148.95	1500	148.89
9	148.85	0300	148.92	1600	148.88
10	148.85	0100	148.89	0800	148.87
11	148.85	0100	148.85	0100	148.85
12	148.85	0100	148.89	0500	148.88
13	148.92	0100	148.98	2400	148.94
14	148.95	1600	149.13	2400	149.02
15	149.16	0100	150.56	2400	149.77
16	150.62	0100	151.29	1700	151.06
17	150.84	2400	151.26	0100	151.07
18	150.41	2300	150.81	0100	150.59
19	150.17	2100	150.38	0100	150.26
20	150.17	0100	150.32	2100	150.23
21	150.32	0100	150.68	2400	150.45
22	150.71	0100	152.57	2400	151.73
23	152.60	0100	152.97	1400	152.87
24	152.73	2400	152.88	0100	152.83
25	151.99	2400	152.73	0100	152.45
26	151.54	1600	151.96	0100	151.68
27	151.60	0100	152.18	2400	151.84
28	152.21	0100	152.85	1700	152.67
29	152.48	2400	152.82	0100	152.67
30	152.06	2400	152.48	0100	152.33
31	151.54	2400	152.06	0100	151.79
MEAN					150.35
SE					0.276

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
APR					
1	151.38	2000	151.54	0100	151.45
2	151.42	0100	152.12	2400	151.66
3	152.06	2400	152.36	1100	152.26
4	151.54	2400	152.02	0100	151.79
5	151.42	0900	151.51	0100	151.45
6	151.60	0100	151.90	1700	151.80
7	151.60	1800	151.81	0100	151.67
8	151.63	0100	151.75	1600	151.69
9	151.45	2400	151.72	0100	151.60
10	151.02	2400	151.45	0100	151.24
11	150.71	2400	151.02	0100	150.87
12	150.65	1200	150.71	0100	150.67
13	150.68	0100	150.81	1700	150.74
14	150.65	2400	150.78	0100	150.72
15	150.47	2400	150.65	0100	150.54
16	150.29	2400	150.47	0100	150.39
17	150.10	2100	150.29	0100	150.21
18	149.95	2300	150.10	0100	150.03
19	149.80	2300	149.92	0100	149.86
20	149.77	0600	149.80	0100	149.78
21	149.77	0100	149.92	2400	149.82
22	149.95	0100	150.29	1500	150.18
23	150.07	2400	150.26	0100	150.18
24	149.86	2300	150.07	0100	149.95
25	149.71	2000	149.86	0100	149.76
26	149.56	2400	149.68	0100	149.63
27	149.46	2200	149.56	0100	149.51
28	149.34	2200	149.46	0100	149.40
29	149.28	1700	149.34	0100	149.30
30	149.19	1400	149.28	0100	149.24
MEAN					150.58
SE					0.162

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN	DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
MAY						JUN					
1	149.16	1700	149.19	0100	149.18	1	148.85	2300	148.92	0100	148.90
2	149.10	1400	149.16	0100	149.12	2	148.76	2300	148.85	0100	148.81
3	149.04	2000	149.10	0100	149.06	3	148.76	0100	148.82	0900	148.81
4	148.98	1200	149.04	0100	148.99	4	148.82	0100	148.92	1200	148.88
5	148.98	0100	149.01	2400	148.98	5	148.89	0100	148.89	0100	148.89
6	149.01	0100	149.16	2300	149.09	6	148.85	1000	148.89	0100	148.86
7	149.16	0100	149.34	2400	149.24	7	148.82	1000	148.85	0100	148.83
8	149.37	0100	149.37	0100	149.37	8	148.79	0100	148.89	2400	148.81
9	149.34	0100	149.37	0400	149.35	9	148.92	0100	149.16	1600	149.10
10	149.40	0100	149.53	2300	149.45	10	149.13	0400	149.19	2100	149.15
11	149.53	0100	149.62	1400	149.58	11	149.16	0700	149.19	0100	149.17
12	149.46	2400	149.59	0100	149.53	12	149.10	2000	149.19	0100	149.14
13	149.31	2200	149.43	0100	149.38	13	149.10	0100	149.10	0100	149.10
14	149.28	0300	149.56	2400	149.35	14	149.07	2200	149.10	0100	149.09
15	149.62	0100	150.53	2400	150.21	15	149.01	0700	149.07	0100	149.02
16	150.59	0100	151.02	1100	150.86	16	148.98	1700	149.04	0100	149.00
17	150.65	0200	150.90	2100	150.77	17	148.85	2200	148.95	0100	148.91
18	150.90	0100	151.05	1800	150.95	18	148.79	1700	148.85	0100	148.81
19	150.44	2400	150.96	0100	150.68	19	148.76	0500	148.79	0100	148.78
20	150.10	2400	150.38	0100	150.25	20	148.76	0100	148.79	2200	148.76
21	149.89	2400	150.10	0100	149.98	21	148.79	0100	148.82	2300	148.79
22	149.74	2100	149.86	0100	149.81	22	148.82	0100	148.85	0700	148.84
23	149.59	2400	149.74	0100	149.68	23	148.82	0100	148.85	1100	148.84
24	149.53	1800	149.59	0100	149.55	24	148.76	1500	148.85	0100	148.79
25	149.53	0100	149.59	1700	149.55	25	148.73	0800	148.76	0100	148.74
26	149.43	2100	149.56	0100	149.48	26	148.73	0100	148.73	0100	148.73
27	149.25	2300	149.43	0100	149.32	27	148.67	1500	148.70	0100	148.69
28	149.13	2000	149.22	0100	149.18	28	148.61	1600	148.67	0100	148.64
29	149.07	1600	149.13	0100	149.09	29	148.58	0700	148.61	0100	148.59
30	149.01	2000	149.07	0100	149.02	30	148.52	1500	148.58	0100	148.54
31	148.92	1600	148.98	0100	148.95						
MEAN					149.58	MEAN					148.87
SE					0.105	SE					0.030
JUL						AUG					
1	148.46	1500	148.52	0100	148.48	1	148.31	0100	148.40	2100	148.35
2	148.46	0100	148.46	0100	148.46	2	148.40	0100	148.40	0100	148.40
3	148.46	0100	148.49	1800	148.46	3	148.40	0100	148.40	0100	148.40
4	148.49	0100	148.49	0100	148.49	4	148.40	0100	148.40	0100	148.40
5	148.49	0100	148.55	2400	148.50	5	148.40	0100	148.61	2200	148.47
6	148.55	0100	148.58	0400	148.56	6	148.58	0800	148.61	0100	148.59
7	148.55	0100	148.58	0700	148.57	7	148.58	0100	149.71	2400	148.80
8	148.46	2400	148.55	0100	148.52	8	149.62	2400	149.83	0100	149.75
9	148.43	1500	148.46	0100	148.45	9	149.46	2300	149.62	0100	149.54
10	148.43	0100	148.43	0100	148.43	10	149.10	2300	149.43	0100	149.25
11	148.40	2300	148.43	0100	148.43	11	148.95	1800	149.10	0100	149.00
12	148.40	0100	148.40	0100	148.40	12	148.92	1300	148.95	0100	148.93
13	148.37	1800	148.40	0100	148.38	13	148.82	2000	148.92	0100	148.87
14	148.34	0600	148.37	0100	148.34	14	148.79	0100	148.98	2200	148.85
15	148.31	2000	148.34	0100	148.33	15	148.79	2400	148.95	0100	148.87
16	148.31	0100	148.31	0100	148.31	16	148.64	2200	148.76	0100	148.70
17	148.31	0100	148.37	2100	148.32	17	148.55	1600	148.61	0100	148.58
18	148.37	0100	148.46	2300	148.41	18	148.46	2200	148.55	0100	148.50
19	148.43	0900	148.46	0100	148.44	19	148.43	1300	148.46	0100	148.44
20	148.40	0100	148.43	1400	148.41	20	148.40	0800	148.43	0100	148.41
21	148.37	2400	148.43	0100	148.41	21	148.40	0100	148.40	0100	148.40
22	148.34	1800	148.37	0100	148.36	22	148.37	0900	148.40	0100	148.38
23	148.34	0100	148.34	0100	148.34	23	148.34	2000	148.37	0100	148.36
24	148.34	0100	148.37	0400	148.36	24	148.31	1000	148.34	0100	148.31
25	148.34	0700	148.37	0100	148.35	25	148.28	0900	148.31	0100	148.28
26	148.31	1200	148.34	0100	148.32	26	148.28	0100	148.28	0100	148.28
27	148.28	0900	148.31	0100	148.28	27	148.28	0100	148.28	0100	148.28
28	148.25	2400	148.28	0100	148.28	28	148.28	0100	148.28	0100	148.28
29	148.25	0100	148.25	0100	148.25	29	148.28	0100	148.31	1400	148.29
30	148.25	0100	148.25	0100	148.25	30	148.28	0100	148.28	0100	148.28
31	148.25	0100	148.31	2100	148.26	31	148.28	0100	148.34	2200	148.29
MEAN					148.39	MEAN					148.60
SE					0.016	SE					0.068

Table A-3 (cont.)

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
SEP					
1	148.34	0100	148.40	1800	148.37
2	148.40	0100	148.43	1300	148.41
3	148.40	0400	148.43	0100	148.40
4	148.40	0100	148.40	0100	148.40
5	148.37	2200	148.40	0100	148.38
6	148.34	1900	148.37	0100	148.36
7	148.31	0800	148.34	0100	148.32
8	148.28	0600	148.31	0100	148.28
9	148.28	1800	148.31	0100	148.29
10	148.28	0100	148.28	0100	148.28
11	148.28	0100	148.28	0100	148.28
12	148.28	0100	148.28	0100	148.28
13	148.28	0100	148.28	0100	148.28
14	148.25	0100	148.25	0100	148.25
15	148.25	0100	148.25	0100	148.25
16	148.21	1900	148.25	0100	148.23
17	148.21	0100	148.25	1800	148.23
18	148.25	0100	148.31	2200	148.27
19	148.31	0100	148.55	1100	148.45
20	148.40	0400	148.43	0100	148.41
21	148.43	0100	148.43	0100	148.43
22	148.43	0100	148.95	2300	148.64
23	148.89	2200	149.01	0500	148.95
24	148.70	2000	148.85	0100	148.76
25	148.61	1900	148.70	0100	148.64
26	148.55	1800	148.61	0100	148.58
27	148.49	2200	148.55	0100	148.52
28	148.43	1900	148.49	0100	148.46
29	148.40	1300	148.43	0100	148.41
30	148.34	2300	148.40	0100	148.37
MEAN					148.41
SE					0.031

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
OCT					
1	148.34	0100	148.34	0100	148.34
2	148.34	0100	148.34	0100	148.34
3	148.34	0100	148.34	0100	148.34
4	148.34	0100	148.34	0100	148.34
5	148.34	0100	148.34	0100	148.34
6	148.34	0100	148.37	0700	148.36
7	148.37	0100	148.43	1900	148.39
8	148.43	0100	148.43	0100	148.43
9	148.43	0100	148.46	1300	148.44
10	148.46	0100	148.46	0100	148.46
11	148.43	0700	148.46	0100	148.45
12	148.40	2200	148.43	0100	148.42
13	148.37	1300	148.40	0100	148.38
14	148.37	0100	148.46	1200	148.43
15	148.46	0100	148.61	2200	148.53
16	148.61	0100	148.67	1900	148.65
17	148.67	0100	148.98	2300	148.82
18	148.92	2300	148.98	0100	148.96
19	148.79	2200	148.92	0100	148.85
20	148.67	2400	148.79	0100	148.72
21	148.61	2000	148.67	0100	148.64
22	148.58	1900	148.61	0100	148.60
23	148.58	0100	148.61	1900	148.59
24	148.61	0100	148.61	0100	148.61
25	148.61	0100	148.61	0100	148.61
26	148.58	0100	148.58	0100	148.58
27	148.58	0100	148.61	0900	148.60
28	148.61	0100	148.79	2200	148.71
29	148.82	0100	149.10	2300	148.94
30	149.13	0100	149.22	0900	149.20
31	149.04	2300	149.19	0100	149.12
MEAN					148.59
SE					0.042

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
NOV					
1	148.92	2100	149.04	0100	148.97
2	148.82	2200	148.89	0100	148.86
3	148.76	1600	148.82	0100	148.79
4	148.70	1700	148.73	0100	148.72
5	148.67	1900	148.70	0100	148.69
6	148.67	0100	148.67	0100	148.67
7	148.64	0100	148.64	0100	148.64
8	148.61	1300	148.64	0100	148.62
9	148.58	0700	148.61	0100	148.59
10	148.55	0900	148.58	0100	148.56
11	148.55	0100	148.55	0100	148.55
12	148.55	0100	148.55	0100	148.55
13	148.52	0100	148.52	0100	148.52
14	148.52	0100	148.52	0100	148.52
15	148.49	1900	148.52	0100	148.51
16	148.46	1300	148.49	0100	148.47
17	148.46	0100	148.46	0100	148.46
18	148.46	0100	148.49	1500	148.47
19	148.49	0100	148.58	1100	148.55
20	148.58	1800	148.61	0100	148.60
21	148.58	0100	148.67	1900	148.62
22	148.67	0100	148.67	0100	148.67
23	148.64	1300	148.67	0100	148.65
24	148.64	0100	148.64	0100	148.64
25	148.61	0900	148.64	0100	148.62
26	148.61	0100	148.61	0100	148.61
27	148.61	0100	148.70	2200	148.65
28	148.70	0100	148.76	1900	148.73
29	148.76	0100	148.79	0900	148.77
30	148.70	1500	148.76	0100	148.72
MEAN					148.63
SE					0.021

DATE	MINIMUM	(TIME)	MAXIMUM	(TIME)	MEAN
DEC					
1	148.67	0900	148.70	0100	148.68
2	148.67	0100	148.67	0100	148.67
3	148.67	0100	148.67	0100	148.67
4	148.67	0100	148.73	1900	148.71
5	148.73	0100	148.76	1900	148.74
6	148.76	0100	148.76	0100	148.76
7	148.76	0100	149.01	2300	148.88
8	149.04	0100	149.10	2100	149.06
9	149.10	0100	149.31	2300	149.17
10	149.34	0100	149.71	2400	149.57
11	149.71	0100	149.92	1200	149.85
12	149.62	2300	149.83	0100	149.72
13	149.40	2300	149.59	0100	149.49
14	149.31	2000	149.40	0100	149.35
15	149.22	1500	149.31	0100	149.25
16	149.16	1200	149.19	0100	149.17
17	149.10	2200	149.16	0100	149.13
18	149.07	0900	149.10	0100	149.08
19	148.98	2400	149.07	0100	149.03
20	148.89	1300	148.98	0100	148.91
21	148.89	0100	148.92	0900	148.90
22	148.92	0100	149.01	1500	148.97
23	149.01	0100	149.19	2200	149.09
24	149.19	0100	149.28	2400	149.20
25	149.28	0100	149.31	1000	149.29
26	149.07	2100	149.28	0100	149.17
27	148.89	1300	149.04	0100	148.94
28	148.92	0100	149.04	1100	148.97
29	148.92	1500	149.01	0900	148.96
30	148.89	1600	148.98	0900	148.92
31	148.89	0100	148.92	2200	148.89
MEAN					149.07
SE					0.054

Table A-4. Daily mean flow (m^3/s) of the Susquehanna River at the Susquehanna SES Biological Laboratory, 1978.

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	461	958	203	1644	277	185	77	51	55	49	206	124
2	457	833	197	1826	256	158	73	61	63	49	173	121
3	457	710	191	2397	236	158	73	61	61	49	153	121
4	395	602	170	1943	213	179	79	61	61	49	134	131
5	334	522	164	1644	209	182	81	75	57	49	126	139
6	318	461	150	1952	246	173	95	102	53	53	121	145
7	326	342	161	1835	299	164	97	156	46	59	114	179
8	334	311	182	1853	350	158	86	517	39	67	109	236
9	1155	307	179	1773	342	249	71	421	41	69	102	274
10	2977	387	176	1472	382	267	67	303	39	73	95	434
11	2337	382	170	1191	439	274	67	216	39	71	92	567
12	1577	374	179	1051	417	263	61	194	39	65	92	503
13	1155	370	197	1099	354	249	57	176	39	57	86	399
14	978	362	222	1085	342	246	49	170	34	67	86	342
15	882	342	527	964	762	222	48	176	34	88	83	303
16	733	299	1331	869	1183	216	44	129	31	116	75	274
17	613	274	1339	762	1120	188	46	99	31	161	73	259
18	567	277	997	661	1249	158	63	81	37	203	75	242
19	484	277	791	572	1058	150	69	69	71	170	92	226
20	399	259	773	532	785	145	63	63	63	134	104	188
21	452	239	907	552	634	153	63	61	67	114	109	185
22	382	222	1889	744	547	167	53	57	114	104	121	206
23	378	219	3057	744	484	167	49	53	200	102	116	246
24	391	203	3011	618	425	153	53	44	145	106	114	285
25	378	219	2594	522	425	139	51	39	114	106	109	318
26	797	226	1844	461	395	137	46	39	99	99	106	274
27	2584	229	1989	408	330	126	39	39	86	104	116	197
28	2887	216	2832	362	277	114	39	39	73	131	137	206
29	2064		2832	322	246	102	34	41	63	197	147	203
30	1488		2469	299	222	90	34	39	55	285	134	191
31	1155		1943		200		36	41		256		182
MEAN	964	372	1086	1072	474	178	60	118	65	106	113	248
SE	144.7	36.2	187.7	110.9	54.6	9.1	3.1	20.6	6.9	11.0	5.4	19.6

Table A-5. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, January 1978.

SSES

DATE	4 JAN	11 JAN	18 JAN	24 JAN		
TIME	1330	1300	1345	1300		
RIVER LEVEL(M ABOVE MSL)	149.50	152.18	149.86	149.50		
DISCHARGE(M^3/S)	404	2320	572	404		
TEMPERATURE(C)						
AIR	-2.0	-6.0	-2.0	-1.5		
WATER	0.0	0.0	0.0	0.0		
WEATHER	SUNNY	P.CLOUDY	P.CLOUDY	P.CLOUDY		
					MEAN	SE
SECCHI DISC(CM)	158	10	92	149	102	30.5
TURBIDITY(NTU)	6.0	100	7.7	5.8	30	20.9
OXYGEN						
DISSOLVED(MG/L)	13.40	13.80	13.20	13.35	13.44	0.115
PERCENT SATURATION	93	95	91	92	93	0.8
TOTAL ALKALINITY(MG/L)	55	48	50	48	50	1.5
PH	7.2	7.3	7.2	7.1	7.2	0.04
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	242	90	190	240	191	31.8
SULFATE(MG/L)	55	12	44	45	39	8.4
IRON(MG/L)						
TOTAL	2.14	6.38	1.92	2.08	3.13	0.970
DISSOLVED	1.60	0.46	1.38	1.63	1.27	0.246
PERCENT DISSOLVED	75	7	72	78	58	15.2
RESIDUE(MG/L)						
TOTAL	150	196	130	148	156	12.6
FIXED TOTAL	110	171	96	122	125	14.6
NONFILTRABLE	2	124	8	4	35	26.7
FILTRABLE	148	72	121	150	123	16.2

BELL BEND

DATE	4 JAN	11 JAN	18 JAN	24 JAN		
TIME	1345	1300	1400	1315		
TEMPERATURE(C)						
AIR	-2.0	-6.0	-2.0	-1.5		
WATER	0.0	0.0	0.0	0.0		
WEATHER	SUNNY	P.CLOUDY	P.CLOUDY	P.CLOUDY		
					MEAN	SE
SECCHI DISC(CM)	157	10	93	149	102	30.3
TURBIDITY(NTU)	6.0	88	7.2	5.6	27	18.3
OXYGEN						
DISSOLVED(MG/L)	13.50	13.60	13.30	13.55	13.49	0.059
PERCENT SATURATION	94	94	91	94	93	0.7
TOTAL ALKALINITY(MG/L)	59	37	52	62	53	5.0
PH	7.3	7.3	7.3	7.0	7.2	0.07
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	240	95	198	235	192	30.1
SULFATE(MG/L)	55	12	44	43	39	8.3
IRON(MG/L)						
TOTAL	2.16	6.25	1.83	2.02	3.07	0.952
DISSOLVED	1.53	0.50	1.33	1.59	1.24	0.225
PERCENT DISSOLVED	71	8	73	79	58	14.9
RESIDUE(MG/L)						
TOTAL	154	203	115	148	155	16.2
FIXED TOTAL	106	174	98	116	124	15.4
NONFILTRABLE	3	126	8	4	35	27.1
FILTRABLE	149	80	120	144	123	14.1

Table A-6. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, February 1978.

SSES

DATE	1 FEB	8 FEB	15 FEB	21 FEB		
TIME	1315	1320	1330	1200		
RIVER LEVEL(M ABOVE MSL)	150.50	149.31	149.37	149.10		
DISCHARGE(M^3/S)	939	326	350	249		
TEMPERATURE (C)						
AIR	-3.0	-2.0	-2.0	-1.0		
WATER	0.0	0.0	0.0	0.0		
WEATHER	SUNNY	SUNNY	SUNNY	OVERCAST		
					MEAN	SE
SECCHI DISC(CM)	59	125	178	150	128	22.7
TURBIDITY(NTU)	10	6.4	5.5	6.8	7.2	0.9
OXYGEN						
DISSOLVED (MG/L)	13.75	13.40	13.35	13.20	13.43	0.104
PERCENT SATURATION	95	93	92	90	93	0.9
TOTAL ALKALINITY(MG/L)	45	52	57	60	54	2.9
PH	7.1	7.2	7.3	7.2	7.2	0.04
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	167	252	256	305	245	25.6
SULFATE (MG/L)	34	42	34	42	38	2.1
IRON (MG/L)						
TOTAL	1.79	2.56	1.92	2.43	2.18	0.169
DISSOLVED	1.14	2.15	1.55	1.92	1.69	0.198
PERCENT DISSOLVED	64	84	81	79	77	4.0
RESIDUE (MG/L)						
TOTAL	106	175	159	182	156	15.4
FIXED TOTAL	80	137	124	152	123	13.9
NONFILTRABLE	10	4	3	2	5	1.6
FILTRABLE	100	171	154	158	146	14.0

BELL BEND

DATE	1 FEB	8 FEB	15 FEB	21 FEB		
TIME	1330	1335	1345	1215		
TEMPERATURE (C)						
AIR	-3.0	-2.0	-2.0	-1.0		
WATER	0.0	0.0	0.0	0.0		
WEATHER	SUNNY	SUNNY	SUNNY	OVERCAST		
					MEAN	SE
SECCHI DISC(CM)	59	125	179	152	129	23.0
TURBIDITY(NTU)	9.9	6.2	5.4	6.6	7.0	0.9
OXYGEN						
DISSOLVED (MG/L)	13.90	13.50	13.40	13.30	13.53	0.118
PERCENT SATURATION	96	93	92	91	93	1.0
TOTAL ALKALINITY(MG/L)	50	53	53	64	55	2.8
PH	7.3	7.2	7.3	7.2	7.3	0.03
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	156	256	250	304	242	27.7
SULFATE (MG/L)	32	39	34	41	37	1.9
IRON (MG/L)						
TOTAL	1.76	2.55	1.94	2.37	2.16	0.164
DISSOLVED	1.02	2.07	1.47	1.87	1.61	0.208
PERCENT DISSOLVED	58	81	76	79	74	4.7
RESIDUE (MG/L)						
TOTAL	107	174	159	176	154	14.4
FIXED TOTAL	74	132	115	140	115	13.2
NONFILTRABLE	20	4	3	2	7	3.8
FILTRABLE	92	172	154	162	145	16.1

Table A-7. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, March 1978.

SSES

DATE	1 MAR	8 MAR	15 MAR	22 MAR	29 MAR		
TIME	1315	1315	1200	1300	1330		
RIVER LEVEL (M ABOVE MSL)	148.98	148.92	149.56	151.99	152.66		
DISCHARGE (M^3/S)	209	191	430	2130	2820		
TEMPERATURE (C)							
AIR	-2.0	0.0	3.5	9.0	11.0		
WATER	1.0	1.5	1.0	4.0	4.0		
WEATHER	OVERCAST	OVERCAST	OVERCAST	OVERCAST	SUNNY		
						MEAN	SE
SECCHI DISC (CM)	152	140	30	12	13	69	28.7
TURBIDITY (NTU)	7.6	6.6	30	81	66	38	13.9
OXYGEN							
DISSOLVED (MG/L)	13.50	13.60	13.00	12.70	12.50	13.06	0.197
PERCENT SATURATION	95	99	92	97	96	96	1.1
TOTAL ALKALINITY (MG/L)	67	63	51	27	20	46	8.6
PH	7.2	7.4	7.4	7.1	7.0	7.2	0.07
SPECIFIC CONDUCTANCE							
AT 25 C (μMHOS/CM)	311	336	288	125	114	235	43.6
SULFATE (MG/L)	47	55	39	17	18	35	7.0
IRON (MG/L)							
TOTAL	2.36	2.31	3.89	6.75	5.14	4.09	0.774
DISSOLVED	1.60	1.53	0.74	0.21	0.30	0.88	0.270
PERCENT DISSOLVED	68	66	19	3	6	32	13.1
RESIDUE (MG/L)							
TOTAL	193	202	210	349	230	237	26.2
FIXED TOTAL	156	158	181	314	198	201	26.7
NONFILTRABLE	3	2	53	252	150	92	44.0
FILTRABLE	183	200	161	62	61	133	27.4

BELL BEND

DATE	1 MAR	8 MAR	15 MAR	22 MAR	29 MAR		
TIME	1330	1330	1215	1315	1340		
TEMPERATURE (C)							
AIR	-2.0	0.0	3.5	9.0	11.0		
WATER	1.0	1.5	1.0	4.0	4.0		
WEATHER	OVERCAST	OVERCAST	OVERCAST	OVERCAST	SUNNY		
						MEAN	SE
SECCHI DISC (CM)	150	140	29	11	13	69	28.7
TURBIDITY (NTU)	7.3	6.5	30	81	64	38	13.7
OXYGEN							
DISSOLVED (MG/L)	13.60	13.70	13.05	12.70	12.50	13.11	0.217
PERCENT SATURATION	96	99	92	97	96	96	1.0
TOTAL ALKALINITY (MG/L)	72	64	52	27	21	47	9.2
PH	7.4	7.4	7.4	7.1	7.0	7.3	0.08
SPECIFIC CONDUCTANCE							
AT 25 C (μMHOS/CM)	315	334	282	126	114	234	43.3
SULFATE (MG/L)	47	54	37	17	19	35	6.7
IRON (MG/L)							
TOTAL	2.16	2.28	4.05	6.97	5.16	4.12	0.828
DISSOLVED	1.56	1.48	0.78	0.22	0.33	0.87	0.256
PERCENT DISSOLVED	72	65	19	3	6	33	13.5
RESIDUE (MG/L)							
TOTAL	189	202	210	366	240	241	29.4
FIXED TOTAL	146	143	165	332	203	198	32.1
NONFILTRABLE	2	2	55	270	158	97	47.2
FILTRABLE	177	202	161	55	63	132	27.7

Table A-8. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, April 1978.

SSES

DATE	4 APR	7 APR	11 APR	14 APR	18 APR	21 APR	25 APR	28 APR		
TIME	1300	1345	1330	1300	1325	1345	1345	1230		
RIVER LEVEL(M ABOVE MSL)	151.75	151.63	150.84	150.71	150.01	149.80	149.77	149.40		
DISCHARGE(M3/S)	1910	1800	1170	1080	650	542	527	362		
TEMPERATURE (C)										
AIR	6.0	10.0	11.5	11.0	11.0	6.0	14.5	12.5		
WATER	4.0	5.5	6.5	8.5	8.0	7.5	10.5	12.0		
WEATHER	OVERCAST	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	OVERCAST	SUNNY	SUNNY		
									MEAN	SE
SECCHI DISC(CM)	30	20	50	50	70	88	90	120	65	11.2
TURBIDITY(NTU)	43	48	14	16	9.2	8.8	8.9	8.2	20	5.4
OXYGEN										
DISSOLVED(MG/L)	12.60	12.10	12.00	11.00	11.40	11.00	10.90	10.80	11.48	0.224
PERCENT SATURATION	97	95	96	94	96	90	98	99	96	0.9
TOTAL ALKALINITY(MG/L)	20	22	30	27	38	36	37	33	30	2.3
PH	7.0	6.8	7.1	6.7	7.2	7.0	7.1	6.6	6.9	0.07
SPECIFIC CONDUCTANCE										
AT 25 C(μMHOS/CM)	110	128	140	150	171	196	188	215	162	12.1
SULFATE(MG/L)	19	20	23	23	28	35	35	40	28	2.6
IRON (MG/L)										
TOTAL	3.49	3.42	1.62	1.69	.45	1.56	1.37	1.47	2.01	0.299
DISSOLVED	0.40	0.41	0.44	0.39	0.64	0.73	0.75	0.85	0.58	0.062
PERCENT DISSOLVED	11	12	27	23	44	47	55	58	35	6.3
RESIDUE (MG/L)										
TOTAL	160	169	110	122	124	124	124	131	133	6.8
FIXED TOTAL	138	136	84	92	92	102	90	108	105	7.0
NONFILTRABLE	83	82	27	34	16	14	10	10	35	10.3
FILTRABLE	67	73	82	90	112	124	106	134	99	8.1

BELL BEND

DATE	4 APR	7 APR	11 APR	14 APR	18 APR	21 APR	25 APR	28 APR		
TIME	1315	1355	1340	1310	1335	1355	1355	1240		
TEMPERATURE (C)										
AIR	6.0	10.0	11.0	11.0	11.0	6.0	14.5	12.5		
WATER	4.0	5.5	6.5	8.5	8.0	7.5	10.5	12.0		
WEATHER	OVERCAST	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	OVERCAST	SUNNY	SUNNY		
									MEAN	SE
SECCHI DISC(CM)	30	20	50	50	70	88	91	120	65	11.2
TURBIDITY(NTU)	45	46	15	17	9.8	8.8	8.8	8.2	20	5.4
OXYGEN										
DISSOLVED(MG/L)	12.60	12.10	11.90	11.00	11.60	11.00	10.70	10.80	11.46	0.231
PERCENT SATURATION	97	95	95	94	98	90	96	99	96	0.9
TOTAL ALKALINITY(MG/L)	20	21	29	27	38	38	36	33	30	2.4
PH	6.8	6.8	7.0	6.8	7.1	7.0	7.0	6.6	6.9	0.05
SPECIFIC CONDUCTANCE										
AT 25 C(μMHOS/CM)	109	122	140	148	170	191	188	217	161	12.4
SULFATE(MG/L)	18	19	22	23	28	35	34	38	27	2.6
IRON(MG/L)										
TOTAL	3.64	3.51	1.53	1.81	1.47	1.50	1.33	1.50	2.04	0.320
DISSOLVED	0.45	0.33	0.43	0.41	0.64	0.65	0.68	0.87	0.56	0.060
PERCENT DISSOLVED	12	9	28	23	44	43	51	58	34	6.1
RESIDUE(MG/L)										
TOTAL	162	172	110	120	126	126	126	136	135	7.1
FIXED TOTAL	139	136	79	90	91	96	88	104	103	7.5
NONFILTRABLE	88	82	28	36	16	14	10	10	36	10.6
FILTRABLE	65	74	84	92	112	122	97	134	98	7.9

Table A-9. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, May 1978.

SSES

DATE	2 MAY	5 MAY	9 MAY	12 MAY	16 MAY	19 MAY	23 MAY	26 MAY	30 MAY	MEAN	SE
TIME	1330	1330	1330	1330	1315	1320	1325	1330	1340		
RIVER LEVEL(M ABOVE MSL)	149.13	148.98	149.34	149.50	151.02	150.62	149.68	149.46	149.01		
DISCHARGE(M3/S)	259	209	338	404	1300	1020	484	387	219		
TEMPERATURE (C)											
AIR	13.0	7.5	20.5	20.5	12.5	17.0	26.0	28.0	28.0		
WATER	13.0	11.5	11.5	14.5	12.5	13.0	17.0	18.5	23.5		
WEATHER	P.CLOUDY	LT.RAIN	P.CLOUDY	OVERCAST	LT.RAIN	P.CLOUDY	OVERCAST	P.CLOUDY	SUNNY		
SECCHI DISC(CM)	112	95	150	150	30	14	80	90	60	87	15.0
TURBIDITY(NTU)	10	13	6.5	5.0	36	61	8.7	8.6	13	18	5.9
OXYGEN											
DISSOLVED(MG/L)	12.05	11.10	11.00	11.00	9.00	9.60	10.40	10.60	10.05	10.53	0.286
PERCENT SATURATION	113	101	100	108	84	91	108	113	117	104	3.5
TOTAL ALKALINITY(MG/L)	50	54	47	44	38	28	37	41	44	43	2.4
PH	7.4	7.3	7.5	7.6	7.3	7.2	7.4	7.5	7.6	7.4	0.04
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	250	277	232	210	160	138	188	205	150	201	14.9
SULFATE(MG/L)	48	56	38	32	15	26	41	44	61	40	4.6
IRON(MG/L)											
TOTAL	1.73	1.94	1.36	1.11	2.53	4.17	1.72	1.70	2.30	2.06	0.285
DISSOLVED	0.55	0.58	0.75	0.55	0.21	0.27	0.76	0.63	0.33	0.51	0.063
PERCENT DISSOLVED	32	30	55	50	8	6	44	37	14	31	5.7
RESIDUE(MG/L)											
TOTAL	149	167	142	130	199	200	142	152	164	161	7.8
FIXED TOTAL	100	117	99	85	156	155	100	102	129	116	8.1
NONFILTRABLE	6	4	4	4	101	104	16	14	14	30	13.1
FILTRABLE	146	162	148	127	94	83	139	140	159	133	8.7

BELL BEND

DATE	2 MAY	5 MAY	9 MAY	12 MAY	16 MAY	19 MAY	23 MAY	26 MAY	30 MAY	MEAN	SE
TIME	1345	1345	1345	1345	1330	1330	1335	1340	1350		
TEMPERATURE (C)											
AIR	13.0	7.5	20.5	20.5	12.5	17.0	26.0	28.0	28.0		
WATER	13.0	11.5	11.5	14.5	12.5	13.0	17.0	18.5	23.5		
WEATHER	P.CLOUDY	LT.RAIN	P.CLOUDY	OVERCAST	LT.RAIN	P.CLOUDY	OVERCAST	P.CLOUDY	SUNNY		
SECCHI DISC(CM)	110	98	150	150	30	14	80	80	60	86	15.0
TURBIDITY(NTU)	10	13	6.0	5.0	38	62	8.1	8.9	12	18	6.1
OXYGEN											
DISSOLVED(MG/L)	11.95	11.20	11.00	11.10	9.00	9.60	10.45	10.60	10.15	10.56	0.282
PERCENT SATURATION	112	102	100	108	84	91	108	113	118	104	3.5
TOTAL ALKALINITY(MG/L)	47	51	50	46	38	28	37	41	46	43	2.3
PH	7.3	7.1	7.5	7.6	7.3	7.1	7.4	7.5	7.6	7.4	0.06
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	250	279	236	210	158	138	186	202	152	201	15.1
SULFATE(MG/L)	48	54	37	29	15	25	38	42	61	39	4.6
IRON(MG/L)											
TOTAL	1.71	1.95	1.33	1.01	3.21	4.17	1.68	1.79	2.09	2.10	0.311
DISSOLVED	0.63	0.73	0.79	0.63	0.20	0.27	0.77	0.63	0.32	0.55	0.072
PERCENT DISSOLVED	37	37	59	62	7	6	46	35	15	34	6.6
RESIDUE(MG/L)											
TOTAL	149	162	134	124	210	206	142	156	169	161	9.4
FIXED TOTAL	95	113	92	86	166	162	96	104	130	116	9.5
NONFILTRABLE	4	5	2	4	111	105	18	14	14	31	14.0
FILTRABLE	145	162	148	122	92	84	128	139	159	131	8.7

Table A-10. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, June 1978.

SSES

DATE	2 JUN	6 JUN	9 JUN	13 JUN	16 JUN	20 JUN	23 JUN	27 JUN	30 JUN	MEAN	SE
TIME	1320	1335	1335	1250	1210	1310	1335	1335	1320		
RIVER LEVEL(M ABOVE MSL)	148.79	148.85	149.13	149.10	149.01	148.76	148.85	148.70	148.55		
DISCHARGE(M3/S)	153	170	259	249	219	145	170	129	92		
TEMPERATURE(C)											
AIR	23.0	17.5	22.5	16.0	18.0	24.0	21.5	27.0	25.0		
WATER	24.5	20.5	20.5	22.0	19.5	22.5	24.0	23.5	25.0		
WEATHER	P.CLOUDY	SUNNY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	P.CLOUDY	SUNNY	P.CLOUDY		
SECCHI DISC(CM)	55	45	40	43	43	45	40	40	40	43	1.5
TURBIDITY(NTU)	13	15	20	17	17	14	18	17	16	16	0.7
OXYGEN											
DISSOLVED(MG/L)	9.80	10.45	9.60	9.20	12.15	10.15	11.05	8.40	10.30	10.12	0.341
PERCENT SATURATION	116	116	105	105	133	117	131	98	123	116	3.8
TOTAL ALKALINITY(MG/L)	50	52	59	55	47	46	57	60	60	54	1.7
PH	7.4	7.5	7.5	7.6	8.2	7.4	8.2	7.6	7.9	7.7	0.10
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	297	300	295	268	245	290	297	306	345	294	8.6
SULFATE(MG/L)	62	52	48	50	47	54	50	55	72	54	2.5
IRON(MG/L)											
TOTAL	2.35	2.64	2.83	2.10	2.53	2.12	2.17	2.26	2.03	2.34	0.087
DISSOLVED	0.25	0.31	0.20	0.22	0.55	0.29	0.25	0.34	0.34	0.31	0.033
PERCENT DISSOLVED	11	12	7	10	22	14	12	15	17	13	1.4
RESIDUE(MG/L)											
TOTAL	198	220	244	182	177	200	203	206	231	207	6.9
FIXED TOTAL	152	146	166	126	120	144	145	156	168	147	5.1
NONFILTRABLE	17	25	38	27	36	23	26	19	17	25	2.4
FILTRABLE	178	200	190	166	155	176	174	193	202	182	5.0

BELL BEND

DATE	2 JUN	6 JUN	9 JUN	13 JUN	16 JUN	20 JUN	23 JUN	27 JUN	30 JUN	MEAN	SE
TIME	1330	1345	1345	1300	1220	1320	1345	1345	1330		
TEMPERATURE(C)											
AIR	23.0	17.5	22.5	16.0	18.0	24.0	21.5	27.0	25.0		
WATER	24.5	20.5	20.5	22.0	19.5	22.5	24.0	23.5	25.0		
WEATHER	P.CLOUDY	SUNNY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	P.CLOUDY	SUNNY	P.CLOUDY		
SECCHI DISC(CM)	53	45	40	44	43	45	40	40	40	43	1.3
TURBIDITY(NTU)	12	15	19	18	16	14	19	17	16	16	0.7
OXYGEN											
DISSOLVED(MG/L)	10.10	10.60	9.60	9.40	12.20	10.35	11.05	8.50	10.00	10.20	0.333
PERCENT SATURATION	120	117	105	107	133	119	131	99	119	117	3.6
TOTAL ALKALINITY(MG/L)	50	53	59	54	47	48	58	60	61	54	1.7
PH	7.4	7.5	7.5	7.6	8.1	7.5	8.1	7.6	7.7	7.7	0.08
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	297	300	300	268	245	292	297	308	345	295	8.6
SULFATE(MG/L)	62	52	48	48	46	52	50	55	73	54	2.7
IRON(MG/L)											
TOTAL	2.24	2.73	2.98	2.38	2.61	2.21	2.39	2.30	2.08	2.44	0.090
DISSOLVED	0.25	0.29	0.19	0.23	0.54	0.30	0.21	0.32	0.33	0.30	0.033
PERCENT DISSOLVED	11	11	6	10	21	14	8	14	16	12	1.4
RESIDUE(MG/L)											
TOTAL	202	228	238	186	188	202	206	204	236	210	6.1
FIXED TOTAL	154	152	159	136	120	147	144	160	171	149	4.7
NONFILTRABLE	18	26	40	30	34	24	28	20	14	26	2.6
FILTRABLE	177	206	198	171	154	177	181	192	207	185	5.5

Table A-11. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, July 1978.

SSES

DATE	4 JUL	7 JUL	11 JUL	14 JUL	18 JUL	21 JUL	25 JUL	28 JUL		
TIME	1300	1320	1320	1315	1310	1310	1320	1320		
RIVER LEVEL(M ABOVE MSL)	148.49	148.58	148.43	148.34	148.43	148.40	148.34	148.28		
DISCHARGE(M3/S)	79	99	67	49	67	61	49	39		
TEMPERATURE(C)										
AIR	17.0	27.5	22.0	24.0	27.0	30.0	21.5	23.0		
WATER	21.0	23.5	25.5	24.0	25.0	27.0	26.5	26.0		
WEATHER	LT.RAIN	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY		
									MEAN	SE
SECCHI DISC(CM)	40	35	40	50	45	40	45	45	43	1.5
TURBIDITY(NTU)	20	19	20	10	16	12	12	13	15	1.3
OXYGEN										
DISSOLVED(MG/L)	8.60	10.00	10.80	8.20	8.80	9.80	7.35	8.20	8.97	0.380
PERCENT SATURATION	96	117	131	97	107	122	91	94	107	5.0
TOTAL ALKALINITY(MG/L)	60	65	65	65	63	65	67	62	64	0.7
PH	7.5	8.1	8.0	7.5	7.5	7.8	7.5	7.5	7.7	0.08
SPECIFIC CONDUCTANCE										
AT 25 C(μMHOS/CM)	370	355	368	400	425	387	412	425	393	9.0
SULFATE(MG/L)	80	65	86	93	106	83	94	113	90	5.0
IRON(MG/L)										
TOTAL	2.71	2.38	1.83	1.51	2.31	1.83	1.68	1.90	2.02	0.135
DISSOLVED	0.37	0.19	0.09	0.08	0.21	0.19	0.21	0.18	0.19	0.030
PERCENT DISSOLVED	14	8	5	5	9	10	12	9	9	1.0
RESIDUE(MG/L)										
TOTAL	247	245	261	277	306	298	293	288	277	7.8
FIXED TOTAL	177	173	187	202	220	199	209	212	197	5.6
NONFILTRABLE	18	20	18	14	14	13	11	10	15	1.2
FILTRABLE	228	216	240	254	306	248	256	270	252	9.2

BELL BEND

DATE	4 JUL	7 JUL	11 JUL	14 JUL	18 JUL	21 JUL	25 JUL	28 JUL		
TIME	1310	1330	1330	1325	1320	1320	1330	1330		
TEMPERATURE(C)										
AIR	17.0	27.5	22.0	24.0	27.0	30.0	21.5	23.0		
WATER	21.0	23.5	25.5	24.0	25.0	27.0	26.5	26.0		
WEATHER	LT.RAIN	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY		
									MEAN	SE
SECCHI DISC(CM)	40	35	40	40	41	45	40	45	41	1.1
TURBIDITY(NTU)	20	19	20	12	15	11	11	13	15	1.3
OXYGEN										
DISSOLVED(MG/L)	8.70	9.95	10.20	8.20	9.05	9.75	7.35	7.95	8.89	0.342
PERCENT SATURATION	97	117	124	97	109	121	91	91	106	4.5
TOTAL ALKALINITY(MG/L)	60	65	66	65	62	65	67	62	64	0.8
PH	7.5	8.0	7.9	7.5	7.5	7.8	7.5	7.4	7.6	0.08
SPECIFIC CONDUCTANCE										
AT 25 C(μMHOS/CM)	370	355	370	400	425	390	416	425	394	9.0
SULFATE(MG/L)	80	65	83	93	106	86	95	113	90	5.1
IRON(MG/L)										
TOTAL	2.60	2.16	1.87	1.38	1.95	1.64	1.54	1.77	1.86	0.128
DISSOLVED	0.32	0.16	0.08	0.04	0.18	0.15	0.20	0.16	0.16	0.028
PERCENT DISSOLVED	12	7	4	3	9	9	13	9	8	1.2
RESIDUE(MG/L)										
TOTAL	248	258	256	288	315	302	298	290	282	8.2
FIXED TOTAL	179	172	186	206	222	186	210	216	197	6.2
NONFILTRABLE	18	19	18	13	14	12	10	11	14	1.2
FILTRABLE	238	225	236	254	308	250	262	275	256	8.8

Table A-12. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, August 1978.

SSES

DATE	1 AUG	4 AUG	8 AUG	11 AUG	15 AUG	18 AUG	22 AUG	25 AUG	29 AUG		
TIME	1330	1320	1320	1320	1310	1310	1310	1220	1320		
RIVER LEVEL(M ABOVE MSL)	148.34	148.40	149.77	148.98	148.85	148.49	148.37	148.28	148.28		
DISCHARGE(M3/S)	49	61	527	209	170	79	55	39	39		
TEMPERATURE(C)											
AIR	24.0	24.0	26.5	23.0	29.0	26.0	25.0	24.0	29.5		
WATER	23.0	25.0	24.5	24.0	26.0	27.0	25.0	25.5	25.5		
WEATHER	OVERCAST	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	SUNNY	OVERCAST	P.CLOUDY		
										MEAN	SE
SECCHI DISC(CM)	50	40	20	27	40	44	55	58	52	43	4.0
TURBIDITY(NTU)	13	13	56	34	15	12	13	11	12	20	4.8
OXYGEN											
DISSOLVED(MG/L)	6.80	9.05	6.05	6.40	8.70	10.45	9.75	7.00	6.40	7.84	0.522
PERCENT SATURATION	79	109	72	76	107	130	117	85	77	95	6.7
TOTAL ALKALINITY(MG/L)	64	67	68	48	53	59	62	63	64	61	2.1
PH	7.2	7.6	7.6	7.3	7.7	8.4	7.9	7.3	7.3	7.6	0.12
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	437	396	252	200	247	315	352	390	418	334	26.8
SULFATE(MG/L)	122	88	27	35	41	61	83	89	96	71	10.1
IRON(MG/L)											
TOTAL	2.02	2.00	5.03	3.00	1.85	1.50	1.65	1.63	2.07	2.31	0.351
DISSOLVED	0.30	0.24	0.17	0.51	0.45	0.21	0.26	0.26	0.37	0.31	0.036
PERCENT DISSOLVED	15	12	3	17	24	14	16	16	18	15	1.8
RESIDUE(MG/L)											
TOTAL	312	291	280	184	174	213	273	288	299	257	16.5
FIXED TOTAL	226	210	206	138	123	152	184	200	222	185	12.0
NONFILTRABLE	9	13	118	47	22	17	15	16	12	30	11.0
FILTRABLE	292	282	152	138	146	190	261	256	299	224	21.2

BELL BEND

DATE	1 AUG	4 AUG	8 AUG	11 AUG	15 AUG	18 AUG	22 AUG	25 AUG	29 AUG		
TIME	1340	1330	1330	1330	1320	1320	1320	1230	1330		
TEMPERATURE(C)											
AIR	24.0	24.0	26.5	23.0	29.0	26.0	25.0	24.0	29.5		
WATER	23.0	25.0	24.5	24.0	26.0	27.0	25.0	25.5	25.5		
WEATHER	OVERCAST	P.CLOUDY	P.CLOUDY	OVERCAST	P.CLOUDY	P.CLOUDY	SUNNY	OVERCAST	P.CLOUDY		
										MEAN	SE
SECCHI DISC(CM)	50	35	20	28	45	50	55	56	52	43	4.1
TURBIDITY(NTU)	13	12	42	34	14	11	12	11	12	18	3.7
OXYGEN											
DISSOLVED(MG/L)	6.45	9.20	6.10	6.40	9.00	10.55	9.50	6.90	6.40	7.83	0.540
PERCENT SATURATION	75	111	73	76	111	131	114	83	77	95	7.0
TOTAL ALKALINITY(MG/L)	63	67	69	46	54	61	62	64	65	61	2.2
PH	7.2	7.6	7.6	7.3	7.8	8.4	7.8	7.3	7.3	7.6	0.12
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	435	399	254	200	248	315	352	387	418	334	26.6
SULFATE(MG/L)	122	83	27	33	40	62	80	82	98	70	10.1
IRON(MG/L)											
TOTAL	1.98	1.92	4.72	2.98	1.81	1.34	1.53	1.52	1.88	2.19	0.335
DISSOLVED	0.28	0.24	0.18	0.57	0.43	0.19	0.23	0.27	0.34	0.30	0.040
PERCENT DISSOLVED	14	12	4	19	24	14	15	18	18	15	1.8
RESIDUE(MG/L)											
TOTAL	319	306	248	188	170	215	274	288	308	257	17.4
FIXED TOTAL	222	213	181	136	122	150	186	199	226	182	12.0
NONFILTRABLE	12	14	96	46	22	16	14	14	14	28	8.8
FILTRABLE	294	292	156	140	148	196	263	256	291	226	20.8

Table A-13. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, September 1978.

SSES

DATE	1 SEP	5 SEP	8 SEP	12 SEP	15 SEP	19 SEP	22 SEP	26 SEP	29 SEP	MEAN	SE
TIME	1210	1310	1235	1333	1300	1305	1210	1200	1325		
RIVER LEVEL(M ABOVE MSL)	148.37	148.37	148.28	148.28	148.25	148.55	148.58	148.58	148.40		
DISCHARGE(M^3/S)	55	55	39	39	34	92	99	99	61		
TEMPERATURE (C)											
AIR	22.0	22.0	15.5	24.0	17.0	16.5	18.0	13.0	17.5		
WATER	23.0	23.0	22.0	21.0	19.0	20.0	20.0	19.0	18.0		
WEATHER	P.CLOUDY	SUNNY	OVERCAST	OVERCAST	OVERCAST	OVERCAST	OVERCAST	SUNNY	SUNNY		
SECCHI DISC(CM)	41	51	50	43	39	36	46	56	42	45	2.0
TURBIDITY(NTU)	17	13	12	14	16	18	16	13	13	15	0.7
OXYGEN											
DISSOLVED(MG/L)	5.90	9.80	7.30	8.40	8.70	7.90	7.20	9.30	11.80	8.48	0.542
PERCENT SATURATION	69	113	83	93	93	87	79	100	126	94	5.5
TOTAL ALKALINITY(MG/L)	63	66	64	62	61	62	66	68	58	63	1.0
PH	7.2	7.8	7.4	7.3	7.4	7.3	7.2	7.6	7.8	7.4	0.07
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	421	381	412	423	430	400	391	310	319	387	14.0
SULFATE(MG/L)	109	74	100	106	116	138	120	71	103	104	6.7
IRON(MG/L)											
TOTAL	2.61	2.16	1.91	2.11	2.30	2.47	2.80	2.00	1.82	2.24	0.104
DISSOLVED	0.65	0.23	0.13	0.21	0.20	0.20	0.42	0.47	0.20	0.30	0.055
PERCENT DISSOLVED	25	11	7	10	9	9	15	24	11	13	2.1
RESIDUE(MG/L)											
TOTAL	297	268	296	303	344	302	278	217	225	281	12.6
FIXED TOTAL	232	206	216	218	234	216	199	156	146	203	9.9
NONFILTRABLE	12	17	18	14	16	16	20	14	14	16	0.8
FILTRABLE	268	254	276	298	342	273	277	195	206	265	14.1

BELL BEND

DATE	1 SEP	5 SEP	8 SEP	12 SEP	15 SEP	19 SEP	22 SEP	26 SEP	29 SEP	MEAN	SE
TIME	1220	1320	1250	1340	1310	1315	1220	1210	1335		
TEMPERATURE (C)											
AIR	22.0	22.0	15.5	24.0	17.5	17.0	18.0	13.0	17.0		
WATER	23.0	23.0	22.0	21.0	19.0	20.0	20.0	19.0	17.0		
WEATHER	P.CLOUDY	SUNNY	OVERCAST	HVY.RAIN	OVERCAST	OVERCAST	OVERCAST	SUNNY	SUNNY		
SECCHI DISC(CM)	41	50	45	48	36	32	44	53	40	43	2.1
TURBIDITY(NTU)	18	13	13	17	16	18	13	15	13	15	0.7
OXYGEN											
DISSOLVED(MG/L)	5.70	9.35	7.55	7.90	8.70	7.90	7.00	9.35	11.50	8.33	0.524
PERCENT SATURATION	66	108	86	88	93	87	77	101	120	92	5.1
TOTAL ALKALINITY(MG/L)	64	66	64	62	62	62	66	69	58	64	1.0
PH	7.2	7.6	7.3	7.2	7.4	7.3	7.3	7.6	7.8	7.4	0.07
SPECIFIC CONDUCTANCE											
AT 25 C(μMHOS/CM)	421	381	408	422	430	408	393	310	317	388	14.1
SULFATE(MG/L)	106	75	100	106	114	143	120	71	100	104	6.9
IRON(MG/L)											
TOTAL	2.68	2.11	1.86	2.46	2.14	2.30	2.66	2.11	1.81	2.24	0.100
DISSOLVED	0.68	0.25	0.15	0.19	0.19	0.23	0.47	0.48	0.22	0.32	0.057
PERCENT DISSOLVED	25	12	8	8	9	10	10	23	12	13	2.0
RESIDUE(MG/L)											
TOTAL	301	269	302	311	352	310	284	226	230	287	12.8
FIXED TOTAL	229	207	216	220	235	214	206	160	161	205	8.6
NONFILTRABLE	16	17	18	18	17	21	20	22	16	18	0.7
FILTRABLE	276	260	286	298	336	293	280	197	206	270	14.0

Table A-14. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, October 1978.

SSES						
DATE	5 OCT	13 OCT	19 OCT	26 OCT		
TIME	1330	1345	1201	1240		
RIVER LEVEL(M ABOVE MSL)	148.34	148.40	148.85	148.58		
DISCHARGE(M3/S)	49	61	170	99		
TEMPERATURE (C)						
AIR	15.5	19.0	11.0	14.5		
WATER	16.0	15.5	11.0	11.0		
WEATHER	OVERCAST	OVERCAST	OVERCAST	LT.RAIN		
					MEAN	SE
SECCHI DISC(CM)	50	50	53	90	61	8.7
TURBIDITY(NTU)	15	12	13	7.9	12	1.3
OXYGEN						
DISSOLVED (MG/L)	9.35	11.00	10.25	10.25	10.21	0.302
PERCENT SATURATION	94	109	92	92	97	3.7
TOTAL ALKALINITY(MG/L)	60	67	74	62	66	2.8
PH	7.4	7.6	7.7	7.4	7.5	0.07
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	382	354	303	289	332	19.4
SULFATE (MG/L)	97	75	44	62	70	10.0
IRON (MG/L)						
TOTAL	2.63	2.21	2.05	2.06	2.24	0.122
DISSOLVED	0.36	0.26	0.49	1.03	0.54	0.153
PERCENT DISSOLVED	14	12	24	50	25	7.8
RESIDUE (MG/L)						
TOTAL	270	243	255	202	243	13.0
FIXED TOTAL	204	166	160	148	170	10.8
NONFILTRABLE	12	14	19	9	14	1.9
FILTRABLE	250	240	249	179	230	15.2

BELL BEND						
DATE	5 OCT	13 OCT	19 OCT	26 OCT		
TIME	1340	1355	1211	1250		
TEMPERATURE (C)						
AIR	16.0	19.0	11.0	15.0		
WATER	15.5	15.5	11.0	11.0		
WEATHER	OVERCAST	OVERCAST	OVERCAST	LT.RAIN		
					MEAN	SE
SECCHI DISC(CM)	48	50	50	97	59	8.4
TURBIDITY(NTU)	14	12	14	[illegible]	12	1.3
OXYGEN						
DISSOLVED (MG/L)	9.20	11.15	10.10	10.30	10.19	0.358
PERCENT SATURATION	92	110	91	92	96	4.1
TOTAL ALKALINITY(MG/L)	61	67	74	62	66	2.7
PH	7.4	7.6	7.6	7.4	7.5	0.05
SPECIFIC CONDUCTANCE						
AT 25 C(μMHOS/CM)	380	362	309	300	338	17.6
SULFATE (MG/L)	100	77	40	60	69	11.4
IRON (MG/L)						
TOTAL	2.42	2.26	2.00	2.14	2.21	0.080
DISSOLVED	0.37	0.25	0.44	0.88	0.49	0.123
PERCENT DISSOLVED	15	11	22	41	22	5.9
RESIDUE (MG/L)						
TOTAL	270	242	262	201	244	13.8
FIXED TOTAL	192	171	173	148	171	8.1
NONFILTRABLE	13	16	26	12	17	2.9
FILTRABLE	256	231	240	174	225	16.0

Table A-15. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, November 1978.

SSES

DATE	2 NOV	9 NOV	16 NOV	22 NOV	28 NOV		
TIME	1330	1320	1330	1340	1300		
RIVER LEVEL(M ABOVE MSL)	148.85	148.58	148.49	148.67	148.73		
DISCHARGE(M^3/S)	170	99	79	121	137		
TEMPERATURE (C)							
AIR	14.0	12.0	9.0	4.0	3.0		
WATER	9.5	9.5	9.5	6.5	3.0		
WEATHER	SUNNY	SUNNY	P.CLOUDY	OVERCAST	OVERCAST		
						MEAN	SE
SECCHI DISC(CM)	82	100	140	140	173	127	14.7
TURBIDITY(NTU)	7.0	6.5	6.0	5.6	3.4	5.7	0.6
OXYGEN							
DISSOLVED(MG/L)	10.90	10.85	10.30	10.85	12.50	11.08	0.339
PERCENT SATURATION	96	95	91	89	92	93	1.2
TOTAL ALKALINITY(MG/L)	52	58	63	60	56	58	1.7
PH	7.4	7.5	7.4	7.3	7.4	7.4	0.03
SPECIFIC CONDUCTANCE							
AT 25 C(μMHOS/CM)	229	281	310	290	258	274	12.7
SULFATE(MG/L)	43	69	59	40	36	49	5.7
IRON(MG/L)							
TOTAL	1.63	1.90	2.07	1.75	1.59	1.79	0.081
DISSOLVED	0.98	1.10	0.94	1.11	1.08	1.04	0.031
PERCENT DISSOLVED	60	58	45	63	68	59	3.5
RESIDUE(MG/L)							
TOTAL	154	202	208	179	164	181	9.6
FIXED TOTAL	118	144	154	137	118	134	6.5
NONFILTRABLE	10	6	4	4	2	5	1.2
FILTRABLE	144	178	188	158	170	168	7.0

BELL BEND

DATE	2 NOV	9 NOV	16 NOV	22 NOV	28 NOV		
TIME	1345	1330	1345	1355	1310		
TEMPERATURE (C)							
AIR	14.0	12.0	9.0	4.0	3.0		
WATER	9.5	9.5	9.5	6.5	3.0		
WEATHER	SUNNY	SUNNY	P.CLOUDY	OVERCAST	OVERCAST		
						MEAN	SE
SECCHI DISC(CM)	82	99	120	142	173	123	14.6
TURBIDITY(NTU)	6.7	7.1	6.1	5.6	3.7	5.8	0.5
OXYGEN							
DISSOLVED(MG/L)	11.00	10.80	10.20	10.80	12.40	11.04	0.334
PERCENT SATURATION	97	95	90	89	92	93	1.4
TOTAL ALKALINITY(MG/L)	53	58	62	59	56	58	1.4
PH	7.4	7.5	7.3	7.3	7.3	7.4	0.04
SPECIFIC CONDUCTANCE							
AT 25 C(μMHOS/CM)	225	279	310	290	258	272	13.3
SULFATE(MG/L)	38	69	59	38	34	48	6.3
IRON(MG/L)							
TOTAL	1.73	2.04	2.05	1.75	1.75	1.86	0.068
DISSOLVED	0.92	1.05	1.04	1.13	1.10	1.05	0.033
PERCENT DISSOLVED	53	51	51	65	63	57	2.8
RESIDUE(MG/L)							
TOTAL	152	192	206	180	169	180	8.5
FIXED TOTAL	116	140	153	143	118	134	6.6
NONFILTRABLE	12	9	6	4	4	7	1.4
FILTRABLE	146	167	191	162	170	167	6.6

Table A-16. Physicochemical data collected at SSES and Bell Bend on the Susquehanna River, December 1978.

SSES						
DATE	5 DEC	12 DEC	19 DEC	27 DEC		
TIME	1250	1340	1255	1305		
RIVER LEVEL (M ABOVE MSL)	148.73	149.71	149.04	148.89		
DISCHARGE (M^3/S)	137	498	229	182		
TEMPERATURE (C)						
AIR	6.5	2.5	-2.5	-1.5		
WATER	4.0	1.5	0.5	0.5		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	P.CLOUDY		
					MEAN	SE
SECCHI DISC (CM)	128	41	154	158	120	24.4
TURBIDITY (NTU)	4.9	18	4.6	4.8	8.1	3.0
OXYGEN						
DISSOLVED (MG/L)	12.35	12.95	13.35	13.60	13.06	0.244
PERCENT SATURATION	94	94	93	95	94	0.4
TOTAL ALKALINITY (MG/L)	54	44	44	46	47	2.1
PH	7.4	7.3	7.2	7.3	7.3	0.04
SPECIFIC CONDUCTANCE						
AT 25 C (µMHOS/CM)	271	186	199	220	219	16.7
SULFATE (MG/L)	50	24	40	34	37	4.9
IRON (MG/L)						
TOTAL	1.53	2.30	1.27	1.36	1.62	0.210
DISSOLVED	1.08	0.30	0.90	0.91	0.80	0.153
PERCENT DISSOLVED	71	13	71	67	56	12.7
RESIDUE (MG/L)						
TOTAL	164	160	123	134	145	8.9
FIXED TOTAL	111	130	85	104	108	8.3
NONFILTRABLE	5	40	3	4	13	8.1
FILTRABLE	162	128	120	117	132	9.3

BELL BEND						
DATE	5 DEC	12 DEC	19 DEC	27 DEC		
TIME	1300	1350	1305	1315		
TEMPERATURE (C)						
AIR	6.5	2.5	-2.5	-1.5		
WATER	4.0	1.5	0.5	0.5		
WEATHER	P.CLOUDY	P.CLOUDY	P.CLOUDY	P.CLOUDY		
					MEAN	SE
SECCHI DISC (CM)	133	41	150	162	122	24.6
TURBIDITY (NTU)	5.2	18	4.6	4.7	8.1	2.9
OXYGEN						
DISSOLVED (MG/L)	12.35	12.90	13.40	13.60	13.06	0.250
PERCENT SATURATION	94	93	93	95	94	0.4
TOTAL ALKALINITY (MG/L)	54	44	44	46	47	2.1
PH	7.3	7.3	7.2	7.3	7.3	0.02
SPECIFIC CONDUCTANCE						
AT 25 C (µMHOS/CM)	270	187	199	219	219	16.4
SULFATE (MG/L)	50	24	37	37	37	4.7
IRON (MG/L)						
TOTAL	1.60	2.31	1.31	1.40	1.66	0.203
DISSOLVED	1.10	0.26	0.91	0.85	0.78	0.162
PERCENT DISSOLVED	69	11	69	61	53	12.5
RESIDUE (MG/L)						
TOTAL	167	165	132	135	150	8.4
FIXED TOTAL	126	124	96	106	113	6.5
NONFILTRABLE	5	41	4	5	14	8.1
FILTRABLE	166	122	118	106	128	11.7

Table A-17. Minimum, maximum, monthly weighted mean, and standard error for each physicochemical parameter measured at SSES and Bell Bend on the Susquehanna River, 1978.

PARAMETER	SSES				BELL BEND			
	MINIMUM	MAXIMUM	MEAN	SE	MINIMUM	MAXIMUM	MEAN	SE
SECCHI DISC(CM)	10	178	68	10.9	10	179	67	10.8
TURBIDITY(NTU)	3	100	16	3.0	4	88	16	2.8
OXYGEN								
DISSOLVED(MG/L)	5.90	13.80	9.89	1.046	5.70	13.90	9.89	1.053
PERCENT SATURATION	69	133	90	8.4	66	133	90	8.4
TOTAL ALKALINITY(MG/L)	20	74	49	5.3	20	74	50	5.4
PH	6.6	8.4	6.8	0.62	6.6	8.4	6.8	0.62
SPECIFIC CONDUCTANCE								
AT 25 C(μMHOS/CM)	90	437	254	31.6	95	435	254	31.8
SULFATE(MG/L)	12	138	52	8.2	12	143	51	8.2
IRON								
TOTAL(MG/L)	1.11	6.75	2.20	0.269	1.01	6.97	2.19	0.270
DISSOLVED(MG/L)	0.08	2.15	0.63	0.143	0.04	2.07	0.62	0.138
PERCENT DISSOLVED	3	84	31	6.7	3	81	30	6.5
RESIDUE(MG/L)								
TOTAL	106	349	191	22.7	107	366	192	23.2
FIXED TOTAL	80	314	142	16.5	74	332	141	16.5
NONFILTRABLE	2	252	25	7.0	2	270	26	7.3
FILTRABLE	61	342	163	21.6	55	336	163	21.9

Table A-18. Diel physicochemical data collected at SSES on the Susquehanna River, 1978.

DATE	TIME	RIVER LEVEL (M ABOVE MSL)	TEMPERATURE (C) AIR	TEMPERATURE (C) WATER	DISSOLVED OXYGEN (MG/L)	PH
	2400	149.71	9.5	10.5	10.60	7.3
	0300	149.68	7.5	10.5	10.70	7.3
	0600	149.68	6.0	10.5	10.80	7.3
	0900	149.65	7.5	10.5	10.80	7.3
26 APRIL	1200	149.62	10.5	11.0	10.80	7.4
	1500	149.62	11.5	11.0	10.75	7.4
	1800	149.59	9.0	11.0	10.60	7.4
	2100	149.59	8.0	11.0	10.60	7.4
	2400	149.56	6.0	11.0	10.45	7.4
	2400	149.62	14.0	17.0	9.70	7.2
	0300	149.59	14.0	17.0	9.60	7.2
	0600	149.56	14.5	17.0	9.60	7.2
	0900	149.56	15.0	17.0	9.80	7.2
24 MAY	1200	149.56	15.0	17.0	9.80	7.2
	1500	149.56	15.5	17.0	9.70	7.3
	1800	149.53	15.5	16.5	9.60	7.2
	2100	149.53	15.5	16.5	9.60	7.2
	2400	149.53	15.0	16.5	9.40	7.2
	2400	148.82	20.0	22.5	9.10	7.4
	0300	148.82	19.0	22.5	8.80	7.4
	0600	148.85	19.0	22.5	8.20	7.4
	0900	148.85	20.0	22.5	8.60	7.4
22 JUNE	1200	148.85	20.0	23.0	9.60	7.6
	1500	148.85	21.5	23.5	10.60	7.8
	1800	148.85	23.0	23.5	10.90	8.1
	2100	148.85	18.0	23.5	10.35	7.9
	2400	148.85	15.5	23.0	9.75	7.7
	2400	148.34	19.0	25.0	6.80	7.5
	0300	148.34	18.0	25.0	6.40	7.3
	0600	148.34	18.0	25.0	5.80	7.3
	0900	148.34	19.0	25.5	7.00	7.3
26 JULY	1200	148.34	20.0	26.0	8.20	7.4
	1500	148.34	20.0	26.0	8.40	7.6
	1800	148.34	21.5	26.5	8.60	7.5
	2100	148.34	21.0	26.5	8.20	7.5
	2400	148.34	20.5	26.0	7.55	7.5
	2400	148.37	17.0	24.0	8.00	7.4
	0300	148.37	15.5	23.5	7.80	7.4
	0600	148.37	16.0	23.0	7.40	7.4
	0900	148.37	20.0	24.0	8.35	7.5
23 AUGUST	1200	148.37	22.0	25.0	9.10	7.6
	1500	148.34	25.0	25.5	10.60	7.9
	1800	148.34	24.0	26.0	10.50	8.0
	2100	148.34	24.0	26.0	9.30	7.7
	2400	148.34	18.0	25.0	7.50	7.5
	2400	148.61	12.5	18.0	8.70	7.5
	0300	148.61	8.0	17.5	8.60	7.5
	0600	148.58	6.5	17.5	8.30	7.6
	0900	148.58	8.5	18.0	8.60	7.5
26 SEPTEMBER	1200	148.58	13.0	19.0	9.30	7.6
	1500	148.58	15.0	19.0	9.90	7.6
	1800	148.58	18.5	18.5	10.10	7.7
	2100	148.55	9.0	18.0	9.35	7.6
	2400	148.55	8.0	17.5	8.80	7.5

Table A-19. Physicochemical data collected from the Susquehanna River at the Susquehanna SES Biological Laboratory by the Pennsylvania Power and Light Company, Hazleton, Pennsylvania, 1978.

Sample Number	175	176	177	178	179	180	181	182	183	184	185	186
Date	16 Jan	15 Feb	6 Mar	10 Apr	2 May	12 Jun	10 Jul	7 Aug	11 Sep	9 Oct	6 Nov	5 Dec
Time	0955	1425	1335	1310	0910	1330	1252	1226	1322	1230	1252	1323
River temperature(F)	32	32	33.8	41.9	51.8	71.6	78.3	75.2	68.0	56.3	51.8	37.8
Color (Pt-Co units)	40.5	58.1	73.0	36.5	55.4	60.8	67.6	39.2	40.5	56.7	62.1	54.0
Turbidity (FTU)	11.0	5.5	8.8	17.0	8.7	12.0	15.0	11.0	8.5	9.1	4.7	4.8
pH at 25 C	7.4	7.3	7.3	7.2	7.7	8.3	8.3	7.7	7.4	7.6	7.5	7.5
Specific conductance at 25 C (µmhos/cm)	165	260	325	145	265	255	380	335	415	360	260	275
Analysis (mg/l)												
Suspended matter	11.2	3.2	1.9	28.6	4.3	24.5	6.5	12.2	6.5	8.0	4.2	4.2
Ammonia nitrogen (as N)	0.30	0.47	0.65	0.17	0.20	0.26	0.17	0.21	0.25	0.28	0.37	0.57
Nitrate nitrogen (as N)	0.97	1.06	1.13	0.74	0.57	0.36	0.41	0.21	0.42	0.63	0.59	0.83
Phenolphthalein alkalinity (as $CaCO_3$)	--	--	--	--	--	--	2.4	--	--	--	--	--
Methyl orange alkalinity (as $CaCO_3$)	35	53	62	28	54	52	65	64	62	64	52	53
Total hardness (as $CaCO_3$)	66.5	101.2	127.4	48.3	96.9	97.4	140.9	124.7	160.2	138.7	100.6	101.4
Total dissolved solids at 103 C.	107.0	158.2	200.8	82.0	148.6	149.4	238.4	190.4	273.2	232.8	159.8	164.0
Loss on ignition	31.0	46.0	55.6	28.8	44.2	49.6	61.6	68.0	75.2	78.8	50.4	49.6
Silicon dioxide (SiO_2)	4.74	4.85	3.71	3.83	0.80	0.51	2.23	0.97	2.17	0.57	1.08	1.43
Calcium (Ca)	19.5	29.3	36.0	14.7	28.4	28.1	38.1	34.4	41.7	39.0	28.9	29.2
Magnesium (Mg)	4.3	6.8	9.1	2.8	6.3	6.6	11.1	9.4	13.6	10.0	6.9	6.9
Sodium (Na)	5.9	8.3	11.4	4.9	7.4	9.2	12.4	14.4	15.9	14.7	9.9	11.7
Potassium (K)	1.4	1.4	1.85	1.60	1.2	1.57	1.79	1.97	2.32	1.87	1.84	1.56
Carbonate (CO_3)	--	--	--	--	--	--	2.4	--	--	--	--	--
Bicarbonate (HCO_3)	42.7	64.7	75.6	34.2	65.9	63.4	74.4	78.1	75.6	78.1	63.4	64.7
Sulfate (SO_4)	30.7	50.0	63.8	20.7	47.2	46.5	74.5	58.2	91.6	67.0	46.2	45.8
Chloride (Cl)	8.5	10.9	15.2	6.7	10.3	12.1	14.6	20.6	21.2	18.8	11.5	16.4
Nitrate (NO_3)	4.30	4.7	5.04	3.28	2.50	1.60	1.25	0.92	1.84	2.80	2.60	3.70
Phosphate (PO_4)	0.15	0.05	0.06	0.10	0.06	0.11	0.10	0.10	0.07	0.28	0.22	0.24
Total mineral solids	122.1	180.9	221.7	93.0	170.1	169.6	232.9	219.0	266.1	232.9	172.3	181.6
Dissolved oxygen (O_2)	13.4	15+	14.2	13.6	10.4	11.9	9.8	9.0	9.2	12.3	14.8	14.4
Ion Analysis (me/l)												
Positive ions												
Calcium (Ca)	0.97	1.46	1.80	0.73	1.42	1.40	1.90	1.72	2.08	1.95	1.44	1.46
Magnesium (Mg)	0.35	0.56	0.75	0.23	0.52	0.54	0.91	0.77	1.12	0.82	0.57	0.57
Sodium (Na)	0.26	0.36	0.49	0.21	0.32	0.40	0.54	0.63	0.69	0.64	0.43	0.51
Potassium (K)	0.04	0.04	0.05	0.04	0.03	0.04	0.05	0.05	0.06	0.05	0.05	0.04
Total	1.62	2.42	3.09	1.21	2.29	2.38	3.40	3.17	3.95	3.46	2.49	2.58
Negative ions												
Carbonate (CO_3)	--	--	--	--	--	--	0.08	--	--	--	--	--
Bicarbonate (HCO_3)	0.70	1.06	1.24	0.56	1.08	1.04	1.22	1.28	1.24	1.28	1.04	1.06
Sulfate (SO_4)	0.64	1.04	1.33	0.43	0.98	0.97	1.55	1.21	1.91	1.39	0.96	0.95
Chloride (Cl)	0.24	0.31	0.43	0.19	0.29	0.34	0.41	0.58	0.60	0.53	0.32	0.46
Nitrate (NO_3)	0.07	0.08	0.08	0.05	0.04	0.03	0.02	0.01	0.03	0.05	0.04	0.06
Phosphate (PO_4)	0.00	0.00	0.00	0.00	Trace	Trace	Trace	0.00	0.00	0.01	0.01	0.01
Total	1.65	2.49	3.08	1.23	2.39	2.38	3.28	3.08	3.78	3.26	2.37	2.54
Trace Metal Analysis (mg/l)												
Iron (Fe), total	1.32	1.84	2.32	1.37	1.60	1.77	1.07	1.63	0.06	1.76	1.62	1.43
Iron (Fe), dissolved	0.75	1.04	0.34	0.20	0.03	0.05	0.02	0.00	0.01	0.01	0.86	0.75
Aluminum (Al), total	0.4	0.3	0.1	0.7	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2
Aluminum (Al), dissolved	0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Manganese (Mn), total	0.19	0.31	0.50	0.13	0.28	0.27	0.39	0.38	0.56	0.39	0.33	0.30
Manganese (Mn), dissolved	0.19	0.31	0.49	0.08	0.24	0.13	0.29	0.23	0.50	0.34	0.33	0.27
Copper (Cu), total	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01
Copper (Cu), dissolved	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00
Zinc (Zn), total	0.02	0.02	0.03	0.02	0.03	0.03	0.06	0.02	0.05	0.05	0.02	0.01
Zinc (Zn), dissolved	0.01	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.01
Nickel (Ni), total	0.01	0.03	0.04	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.03	0.04
Nickel (Ni), dissolved	0.01	0.03	0.04	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.00

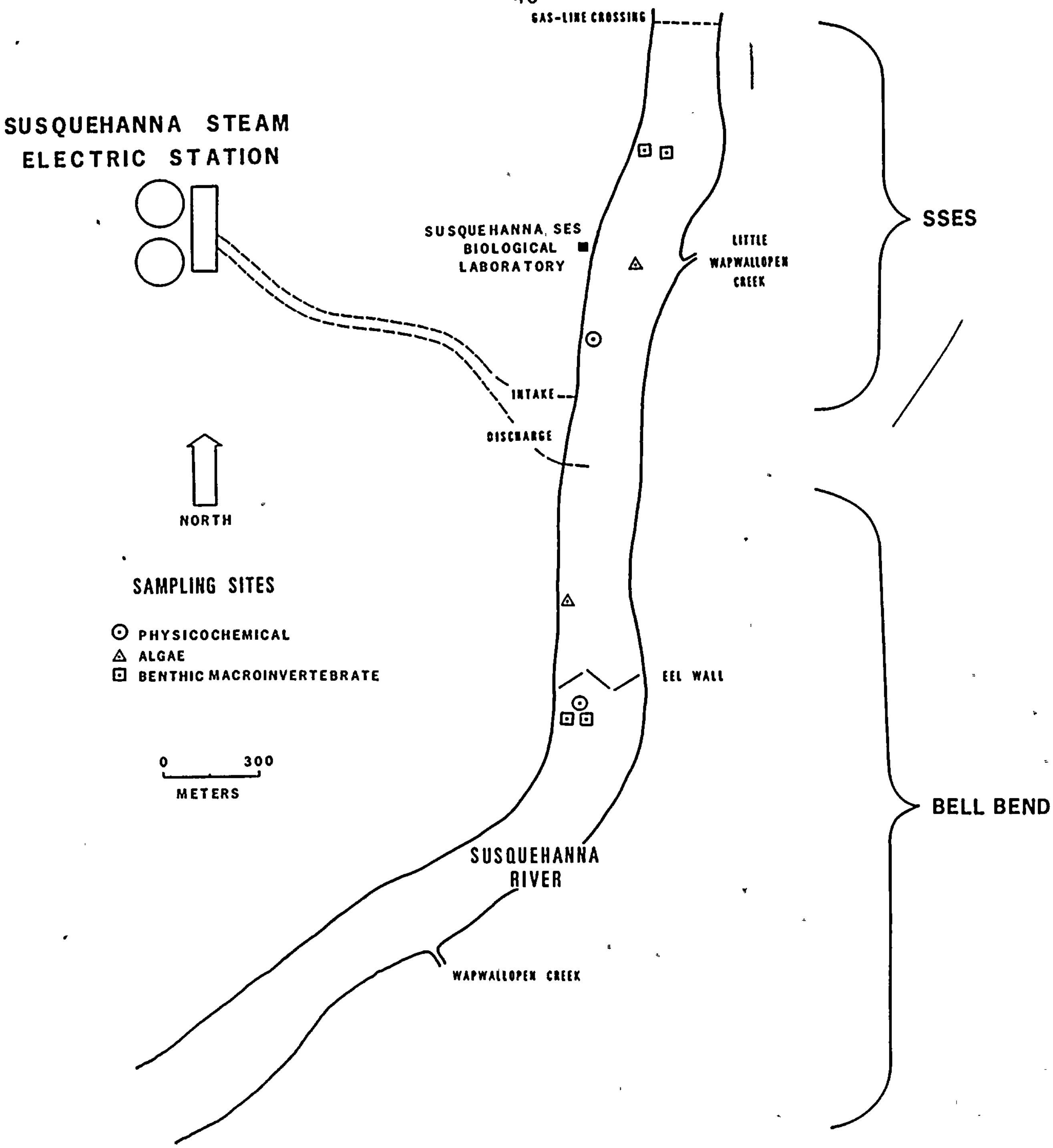

Fig. A-1. Physicochemical, algae, and benthic macroinvertebrate sampling sites at SSES and Bell Bend on the Susquehanna River, 1978.

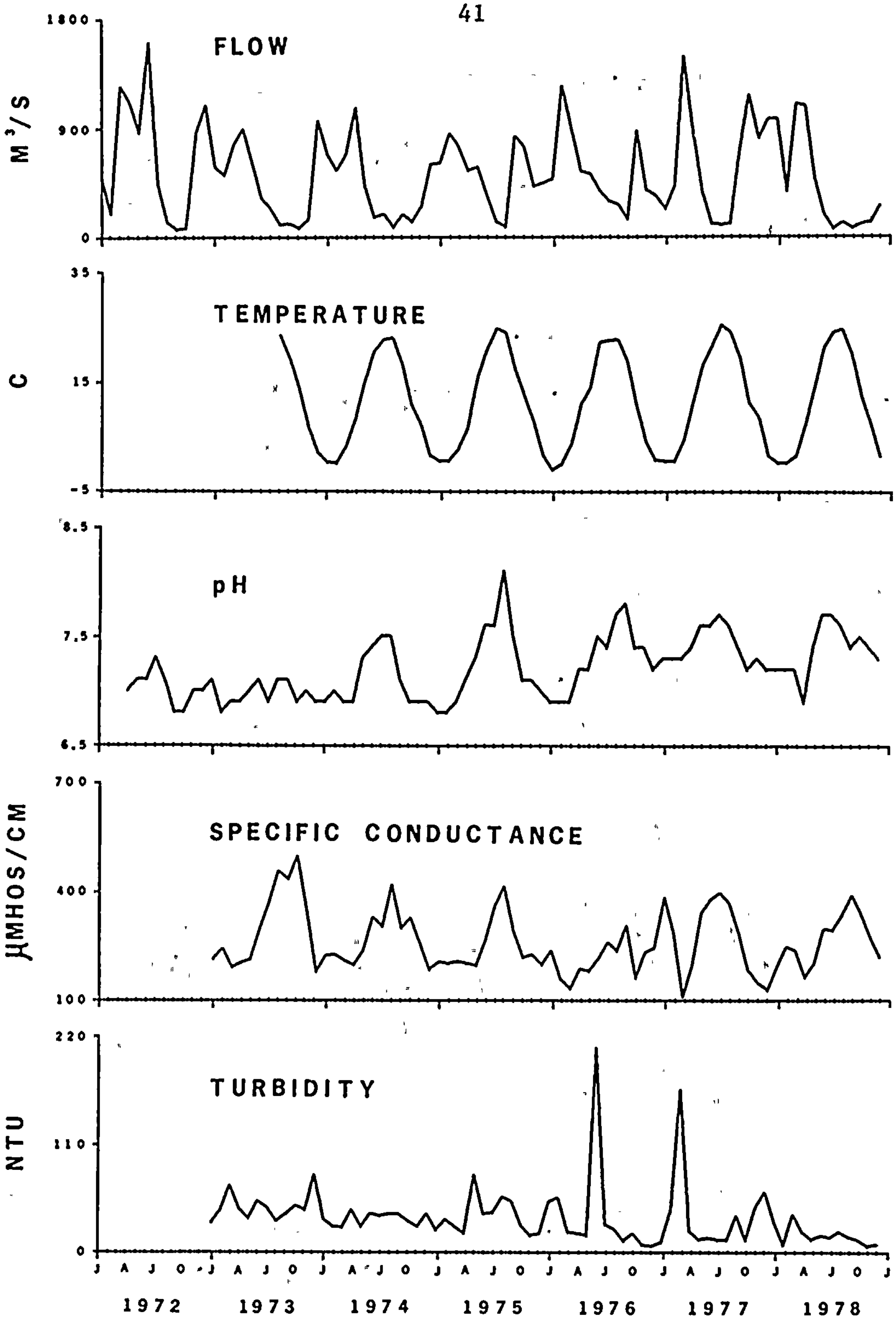

Fig. A-2. Trends in monthly mean values of flow, temperature, pH, specific conductance, and turbidity in the Susquehanna River near the Susquehanna SES from 1972 through 1978.

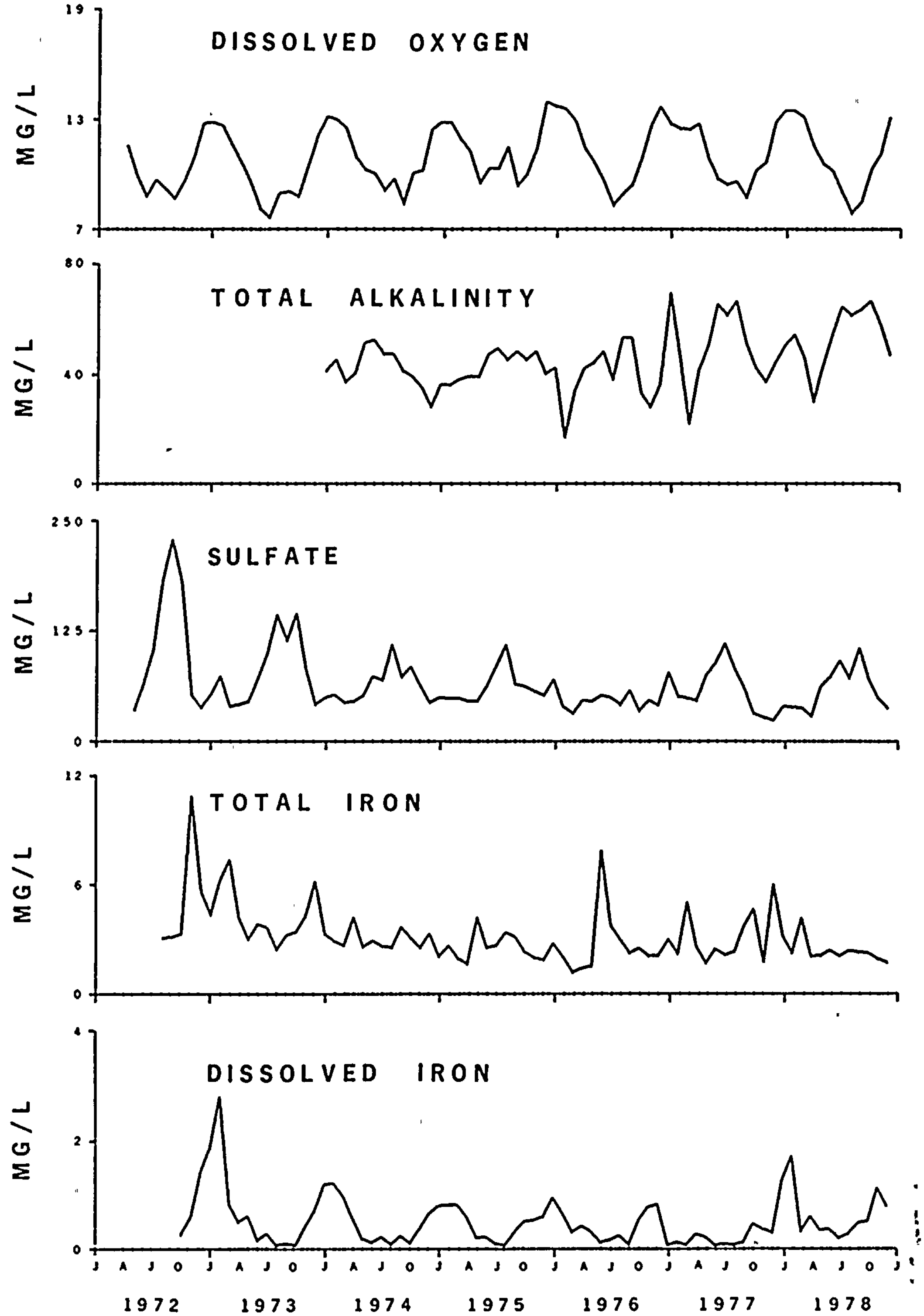

Fig. A-3. Trends in monthly mean concentrations of dissolved oxygen, total alkalinity, sulfate, total iron, and dissolved iron in the Susquehanna River near the Susquehanna SES from 1972 through 1978.

ALGAE

by

Andrew J. Gurzynski and William F. Gale

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ABSTRACT

Periphyton and phytoplankton samples were collected upriver from the Susquehanna SES intake structure (SSES) and downriver from the discharge diffuser (Bell Bend) throughout 1977 and 1978. Diatoms composed 84.5% of the periphyton collected on cumulative and bimonthly plates in 1978. Green algae were second in abundance (14.2%). Standing crops of periphyton were usually higher at Bell Bend than at SSES. Standing crops of periphyton peaked in October at Bell Bend (5,400 units/mm^2 on the bimonthly plate) and in December at SSES (4,500 units/mm^2 on the cumulative plate). Colonization rates of periphyton on bimonthly plates averaged only 62 and 96 units/mm^2 per sampling period in February and December, respectively. Standing crops of phytoplankton peaked at both stations in June when there was an average of 27,400 units/ml. Diatoms composed 66.3% of the phytoplankton collected. Green algae was second in abundance (32.8%).

INTRODUCTION

Algal density in periphyton samples from Susquehanna River stones varied widely in 1973 (Ichthyological Associates 1974) and subsequently, artificial substrates were used to reduce sample variability. Artificial substrates provided a more homogeneous surface for algae to colonize than did river stones. Of five substrates tested in 1974, frosted (sandblasted) acrylic was the most desirable (Gale and Gurzynski 1976).

The primary objective in the 1977-78 study was to describe seasonal changes in the periphyton community colonizing frosted acrylic plates at two stations near the Susquehanna SES (Fig. A-1). One station (SSES) was 463 m upriver from the Susquehanna SES intake structure, 135 m from the west bank; the other (Bell Bend) was 397 m downriver from the discharge diffuser, 30 m from the west bank.

PROCEDURES

Brass pins fastened acrylic plates (22 x 30 cm) to an acrylic holder (Fig. B-1) on the river bottom. Projections that would catch drifting detritus were eliminated from the holder. Plates faced upstream at 5^{o} from horizontal and offered little resistance to the current. The holders were placed near the channel where minimum and maximum water depths ranged from about 2.5 to 6.0 m, respectively. The concrete-filled holder was too bulky for a scuba diver to manipulate in strong currents and was lowered to the river bottom on a submersible raft (Gale and Thompson 1974). Steel stakes driven into the substrate held the holder in place. The upriver edge of the holder and the stakes were covered with small stones to prevent fouling by detritus.

Eight plates were placed in the holders at each station on 16 December 1976. Three plates were randomly selected for sampling at two-month intervals at each station from February 1977 through December 1978 (Gurzynski and Gale 1978). One of the three plates was a spare that could be sampled if a plate was lost. Three replicate samples were taken from each plate. Slots where plates were removed were filled with clean plates that would be sampled the following period. The remaining five plates provided cumulative samples of 2 to 12 months duration in 1977. In 1978, the cumulative plates were submerged for 10-month intervals. Plates removed for cumulative samples were replaced by clean ones to maintain a constant current pattern.

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

Samples were cleaned by vibration (Gale 1975) with an ultrasonic dental cleaning probe that loosened almost all cells within a few minutes vibration. Dislodged cells were flushed into a collecting jar with water sprayed inside the collecting cup through the cleaning probe. Vibration lasted 10 minutes to reduce the chances of missing any cells. After vibration, the surface of the plate had a "fresh" appearance where the sample was taken. Vibration may have damaged some cells, but tests in which samples were cleaned by: 1) scraping and brushing, and 2) scraping and vibration, more cells per unit area were obtained by the second method. (Gale 1975). Samples were then preserved with formalin and, after settling 10 days, were concentrated to 50 ml by 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. The remainder was placed in our reference collection for a 12-month period.

A 1-liter phytoplankton sample was collected near the river surface at each periphyton sampling station on the same day periphyton samples were collected. The samples were concentrated in the same manner in which the periphyton samples were, except that they were siphoned three times because of their greater initial volume.

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

RESULTS AND DISCUSSION

Periphyton

In 1978, a total of 51 genera of algae was collected in 36 samples from acrylic plates above the intake; 59 genera were collected in samples taken below the discharge. A summary of these data appear in Tables B-1 through B-4; raw data are in Tables B-5 through B-28.

Thirty species of algae were identified that composed 5% or more of the total units counted in samples from the two sampling stations (Table B-29). Diatoms occurred in about the same proportions at Bell Bend (84.6%

of the total) and at SSES (84.3% of the total). Overall, diatoms composed 84.5% of the total periphyton at both stations combined. Five species of diatoms that composed over 5% of the total units counted at SSES composed less than 5% of the total at Bell Bend (Table B-29); the reverse was true for three species at Bell Bend. Blue green algae were relatively scarce at both stations, but in December composed over 5% of the total units counted at Bell Bend. One species of blue green, *Schizothrix calcicola*, was identified at Bell Bend.

Most of the algae found were "clean water" forms and only 3 of the abundant species in our samples were among the top 10 species of those tolerating much organic pollution listed by Palmer (1969). These were *Nitzschia palea*, *Scenedesmus quadricauda*, and *Ankistrodesmus falcatus*. Only 3 of 24 species of abundant diatoms (Table B-29) were rated as "acidophilous" by Lowe (1974). Some of the others were rated "indifferent" but most were "alkaliphilous."

It is obvious from Fig. B-2 that algal colonization of clean substrates (bimonthly plates) at both stations was extremely slow in winter 1978, as it was in 1977, and averaged only 62 and 96 units/mm^2 per sampling period in February and December, respectively. Diatoms rapidly colonized substrates between April and June as the river warmed. The colonization rate remained high from June through October, 1978. In 1977, colonization had slowed by the October sampling date. The high colonization rate in October 1978 may have resulted from the low river levels (Fig. B-3). Currents associated with high river levels scour much of the periphyton from the substrate (Gale et al. 1976).

In 1978, as in 1977, algal density at Bell Bend was usually higher than at SSES. In 1978, there was an average of 350 algal units/mm^2 on bimonthly acrylic plates and 1,240 units/mm^2 on cumulative acrylic plates at SSES. Densities at Bell Bend were somewhat higher with an average of 1,450 algal units/mm^2 on bimonthly plates and 1,230 units/mm^2 on cumulative plates.

In 1978, the overall standing crop of algae at both stations were higher than those encountered at the same sites in 1977. There was a major difference in when peak densities occurred (Fig. B-2). In 1977, very high algal densities occurred in June and August samples, whereas in 1978, the standing crop did not peak until October at Bell Bend (5,400 units/mm^2 on the bimonthly plate) and December at SSES (4,500 units/mm^2 on the cumulative plate). The high standing crop on cumulative plates in December was unusual and probably occurred because of the unusually low river flow in autumn (Fig. B-3). High river flows usually occur sometime in October or November (Fig. A-2) and scour most of the algae from the substrate before the December sampling date.

Phytoplankton

Phytoplankton in samples collected at SSES was nearly identical to that in samples taken at Bell Bend (Fig. B-4). There was a total of 49 genera of algae in 6 samples at SSES and 48 genera in 6 samples from Bell Bend (Tables B-30 and B-31).

Nineteen species of algae were identified that composed 5% or more of the total units counted in samples from the two sampling stations (Table B-32). Overall, diatoms were the most abundant type of algae at both stations and composed 66.3% of the total algal units counted. Two species of diatoms (*Cyclotella stelligera* and *Cymbella minuta*) that composed over 5% of the total units at SSES composed less than 5% of the total at Bell Bend (Table B-32); the reverse was true for two species (*Melosira distans* and *Navicula cryptocephala* var. *veneta*) at Bell Bend.

In June and August, green algae was abundant at both sites (Fig. B-4) and composed 43.2% of the total standing crop. Similar trends were observed in summer, 1972-73 (Ichthyological Associates 1974). Overall, green algae composed 32.8% of the total algal units counted in 1978.

Most of the algae found were "clean water" forms and only 2 of the abundant species were listed by Palmer (1969) in the top 10 species of those tolerating much organic pollution. These were *Nitzschia palea* and *Scenedesmus quadricauda*. Only one of the species of abundant diatoms were rated as "acidophilous" by Lowe (1974). Some were rated "indifferent" but most were "alkaliphilous."

Standing crops of phytoplankton were low in February and April but increased by about 26-fold to the season's high in June when there was an average of 27,400 phytoplankton units/ml at the two sites. The standing crop at SSES in June was 28,400 units/ml; at Bell Bend it was 26,500 units/ml. Such small differences probably reflect normal sampling variability. The standing crop at both stations remained fairly high throughout the summer and did not decline sharply until December.

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Table B-1. Mean densities (units/mm^2) of periphytic algae in three replicates from bimonthly (submerged for 2 months) plates at SSES on the Susquehanna River, 1978.

TAXON	14 FEB	13 APR	15 JUN	15 AUG	16 OCT	14 DEC	% TOTAL
CHLOROPHYTA							
ACTINASTRUM	0.0	0.0	2.4	3.5	0.0	0.0	0.3
ANKISTRODESMUS	0.0	0.0	12.6	42.1	31.5	0.0	4.1
CHLAMYDOMONAS	0.0	0.0	155.8	1.2	1.6	0.0	7.6
CHODATELLA	0.0	0.0	1.6	0.0	0.8	0.0	0.1
CLOSTERIUM	0.0	0.0	0.0	0.0	2.4	0.0	0.1
COELASTRUM	0.0	0.0	0.0	0.8	0.0	0.0	0.0
COSMARIUM	0.0	0.0	0.0	0.0	3.9	0.0	0.2
CRUCIGENIA	0.0	0.0	3.1	1.6	2.4	0.0	0.3
DICTYOSPHAERIUM	0.0	0.0	5.5	1.2	0.8	0.0	0.4
GOLENKINIA	0.0	0.0	1.6	0.0	0.0	0.0	0.1
KIRCHNERIELLA	0.0	0.0	3.1	0.4	10.2	0.0	0.7
MICRACTINIUM	0.0	0.0	5.5	0.0	0.8	0.0	0.3
PEDIASTRUM	0.0	0.0	0.0	4.3	2.4	0.0	0.3
SCENEDESMUS	0.0	0.0	15.7	50.3	62.9	0.1	6.2
SCHROEDERIA	0.0	0.0	3.1	0.8	0.8	0.0	0.2
SELENASTRUM	0.0	0.0	0.8	0.0	0.0	0.0	0.0
TETRAEDRON	0.0	0.0	0.0	0.8	0.0	0.0	0.0
TETRASTRUM	0.0	0.0	0.0	4.7	1.6	0.0	0.3
TREUBARIA	0.0	0.0	0.0	0.4	0.0	0.0	0.0
UNIDENTIFIED CHLOROPHYTA	0.0	0.0	11.0	10.6	29.9	0.0	2.5
BACILLARIOPHYTA							
ACHNANTHES	0.0	0.0	0.8	0.4	3.9	8.8	0.7
AMPHORA	0.0	0.0	0.0	0.0	2.4	0.0	0.1
ASTERIONELLA	0.0	0.0	0.0	0.0	0.0	0.8	0.0
COCCONEIS	0.0	0.0	0.8	10.6	6.3	0.0	0.8
CYCLOTELLA	0.0	0.0	43.3	114.9	152.6	0.0	14.8
CYMBELLA	0.0	0.0	0.8	2.0	1.6	6.7	0.5
DIATOMA	0.0	0.0	1.6	0.0	0.0	5.6	0.3
FRAGILARIA	0.0	0.0	0.0	0.0	1.6	2.4	0.2
GOMPHONEMA	0.0	2.4	2.4	5.9	9.4	5.9	1.2
GYROSIGMA	0.0	0.0	0.0	0.4	3.9	0.0	0.2
HANTZSCHIA	0.0	0.4	0.0	0.0	0.0	0.0	0.0
MELOSIRA	0.0	0.0	0.0	31.1	114.9	1.7	7.0
MERIDION	0.0	5.5	0.0	0.4	0.0	0.0	0.3
NAVICULA	0.4	2.8	36.2	29.1	284.0	16.9	17.6
NITZSCHIA	0.4	2.4	100.7	64.9	51.9	48.5	12.8
PINNULARIA	0.0	0.0	0.0	0.0	0.8	0.0	0.0
RHOICOSPHENIA	0.0	0.0	0.0	0.4	0.0	0.0	0.0
STEPHANODISCUS	0.4	0.0	138.5	17.7	184.9	0.8	16.3
SURIRELLA	0.0	0.4	0.0	0.0	0.0	0.0	0.0
SYNEDRA	0.0	0.4	30.7	2.0	6.3	3.2	2.0
CYANOPHYTA							
CHROOCOCCUS	0.0	0.0	0.8	0.0	0.0	0.0	0.0
MICROCYSTIS	0.0	0.0	0.0	0.0	2.4	0.0	0.1
OSCILLATORIA	0.0	0.8	0.0	0.0	14.9	0.0	0.8
SCHIZOTHRIX	0.0	0.4	0.0	0.0	1.6	1.3	0.2
EUGLENOPHYTA							
EUGLENA	0.0	0.0	0.8	0.0	0.0	0.0	0.0
TRACHELOMONAS	0.0	0.0	0.0	0.4	0.0	0.0	0.0

Table B-2. Mean densities (units/mm^2) of periphytic algae in three replicates from bimonthly (submerged for 2 months) plates at Bell Bend on the Susquehanna River, 1978.

TAXON	13 FEB	14 APR	14 JUN	16 AUG	16 OCT	14 DEC	% TOTAL
CHLOROPHYTA							
ACTINASTRUM	0.0	0.0	7.2	3.3	3.0	0.0	0.2
ANKISTRODESMUS	0.0	0.0	65.7	45.1	84.7	0.0	2.3
CERASTERIAS	0.0	0.0	0.8	0.0	0.0	0.0	0.0
CHLAMYDOMONAS	0.0	0.0	221.4	7.3	0.0	0.0	2.6
CHODATELLA	0.0	0.0	19.5	0.4	0.0	0.0	0.2
CLOSTERIUM	0.0	0.0	0.0	0.0	0.0	0.3	0.0
COELASTRUM	0.0	0.0	0.0	2.0	15.3	0.0	0.2
COSMARIUM	0.0	0.0	0.0	0.7	1.5	0.3	0.0
CRUCIGENIA	0.0	0.0	0.0	23.7	0.0	0.0	0.3
DICTYOSPHAERIUM	0.0	0.0	19.2	17.4	3.0	0.0	0.5
FRANCEIA	0.0	0.0	0.8	0.0	0.0	0.0	0.0
KIRCHNERIELLA	0.0	0.0	7.5	1.3	32.2	0.0	0.5
MICRACTINIUM	0.0	0.0	10.1	0.0	0.0	0.0	0.1
PEDIASTRUM	0.0	0.0	0.0	6.2	25.7	0.3	0.4
SCENEDESMUS	0.4	0.0	85.6	123.5	355.3	0.3	6.5
SCHROEDERIA	0.0	0.0	3.9	0.8	0.0	0.0	0.1
SELENASTRUM	0.0	0.0	0.0	0.0	1.5	0.0	0.0
STAURASTRUM	0.0	0.0	0.0	0.8	0.0	0.0	0.0
TETRAEDRON	0.0	0.0	2.4	0.8	0.0	0.0	0.0
TETRASTRUM	0.0	0.0	0.0	3.5	3.0	0.0	0.1
UNIDENTIFIED CHLOROPHYTA	0.8	0.0	10.0	33.9	72.3	0.0	1.3
BACILLARIOPHYTA							
ACHNANTHES	1.2	0.0	0.0	1.5	3.0	6.9	0.1
AMPHORA	0.0	0.0	3.7	0.8	0.0	0.7	0.1
ASTERIONELLA	3.9	0.0	0.0	0.4	8.9	0.7	0.2
COCCONEIS	2.4	0.0	0.0	55.2	87.9	2.0	1.7
CYCLOTELLA	2.4	0.0	159.8	273.3	2419.6	0.3	32.9
CYMBELLA	4.3	0.0	17.5	7.2	18.3	2.7	0.6
DIATOMA	4.3	0.0	3.1	0.8	0.0	2.7	0.1
EPITHEMIA	0.8	0.0	0.0	0.0	0.0	0.0	0.0
EUNOTIA	0.4	0.0	0.0	0.0	0.0	0.0	0.0
FRAGILARIA	2.4	0.0	0.0	0.0	5.9	5.9	0.2
GOMPHONEMA	15.3	0.4	21.8	9.7	37.6	11.5	1.1
GYROSIGMA	0.0	0.0	0.0	0.8	5.9	0.0	0.1
HANNAEA	0.0	0.0	1.2	0.0	0.0	0.0	0.0
HANTZSCHIA	0.0	0.0	0.0	1.5	0.0	0.0	0.0
MELOSIRA	1.6	0.0	5.5	123.1	510.4	4.4	7.4
MERIDION	5.1	0.0	6.3	0.8	3.0	0.0	0.2
NAVICULA	37.0	3.1	82.3	73.5	330.9	20.9	6.3
NITZSCHIA	30.3	0.0	290.4	202.1	215.8	26.3	8.8
PINNULARIA	0.4	0.0	0.0	1.2	0.0	0.0	0.0
RHOICOSPHENIA	0.4	0.0	0.0	0.9	0.0	0.0	0.0
STEPHANODISCUS	0.0	0.0	693.2	148.5	1077.5	0.4	22.1
SURIRELLA	3.5	0.0	0.8	0.0	0.0	0.0	0.0
SYNEDRA	5.1	0.4	119.8	11.2	27.5	0.7	1.9
CYANOPHYTA							
CHROOCOCCUS	0.0	0.0	0.0	0.0	1.5	0.0	0.0
MERISMOPEDIA	0.0	0.0	0.0	3.8	0.0	0.0	0.0
OSCILLATORIA	0.0	0.0	0.0	0.4	58.7	0.0	0.7
SCHIZOTHRIX	0.0	0.0	0.0	0.0	0.0	0.9	0.0
CHRYSOPHYTA							
UNIDENTIFIED CHRYSOPHYTA	0.0	0.0	1.2	0.0	0.0	0.0	0.0
EUGLENOPHYTA							
UNIDENTIFIED EUGLENOPHYTA	0.4	0.0	0.0	0.0	0.0	0.0	0.0

Table B-3. Mean densities (units/mm^2) of periphytic algae in three replicates from cumulative (submerged for 10 months) plates at SSES on the Susquehanna River, 1978.

TAXON	14 FEB	13 APR	15 JUN	15 AUG	16 OCT	14 DEC	% TOTAL
CHLOROPHYTA							
ACTINASTRUM	0.0	0.0	3.1	3.5	0.0	0.0	0.1
ANKISTRODESMUS	0.0	0.0	26.0	40.5	41.8	22.4	1.8
CHLAMYDOMONAS	0.0	0.0	258.0	4.7	1.8	0.0	3.6
CHODATELLA	0.0	0.0	5.5	0.4	0.8	0.0	0.1
CLOSTERIUM	0.0	0.0	0.0	0.0	0.0	21.5	0.3
COELASTRUM	0.0	0.0	0.0	0.4	2.5	0.0	0.0
COSMARIUM	0.0	0.0	3.1	1.2	0.9	1.5	0.1
CRUCIGENIA	0.0	0.0	0.0	10.6	0.0	0.0	0.1
DICTYOSPHAERIUM	0.0	0.0	3.9	10.6	0.0	0.0	0.2
ELAKATOTHRIX	0.0	0.0	0.0	0.4	0.0	0.0	0.0
KIRCHNERIELLA	0.0	0.0	2.4	3.5	9.1	10.5	0.3
OOCYSTIS	0.0	0.0	0.0	0.4	0.0	0.0	0.0
PEDIASTRUM	0.0	0.0	0.0	5.1	6.5	1.5	0.2
SCENEDESMUS	0.0	0.0	30.7	56.6	96.5	81.5	3.6
SCHROEDERIA	0.0	0.0	2.4	0.8	0.0	0.0	0.0
SELENASTRUM	0.0	0.0	0.0	0.4	0.0	0.0	0.0
STAURASTRUM	0.0	0.0	0.8	0.0	0.0	0.0	0.0
TETRASTRUM	0.0	0.0	0.8	0.0	1.7	2.0	0.1
ULOTHRIX	0.0	0.0	0.8	0.0	0.0	0.0	0.0
UNIDENTIFIED CHLOROPHYTA	0.0	0.0	10.2	23.6	27.6	44.0	1.4
BACILLARIOPHYTA							
ACHNANTHES	0.4	0.0	0.0	0.0	0.8	12.0	0.2
AMPHORA	0.0	0.0	1.6	0.0	0.0	0.0	0.0
COCCONEIS	0.0	0.8	2.4	15.3	5.8	46.5	1.0
CYCLOTELLA	0.0	0.4	92.8	97.5	232.0	126.4	7.4
CYMBELLA	0.0	0.4	4.7	2.4	1.7	122.8	1.8
DIATOMA	0.0	0.0	0.0	0.0	0.0	145.5	2.0
FRAGILARIA	0.0	0.0	0.0	1.2	0.0	227.8	3.1
FRUSTULIA	0.0	0.0	0.0	0.0	0.9	0.0	0.0
GOMPHONEMA	0.0	7.9	7.1	5.5	16.0	44.5	1.1
GYROSIGMA	0.0	0.0	0.0	0.0	1.6	3.0	0.1
MELOSIRA	0.0	0.0	7.9	37.8	189.9	213.7	6.1
MERIDION	0.0	0.0	0.0	0.8	0.8	0.0	0.0
NAVICULA	0.8	6.7	219.5	32.3	313.4	1646.9	29.9
NITZSCHIA	0.0	1.6	114.1	86.9	55.4	1392.0	22.3
PINNULARIA	0.0	0.0	0.0	0.8	0.0	0.0	0.0
RHOICOSPHENIA	0.0	0.0	0.0	0.4	1.7	3.5	0.1
STEPHANODISCUS	0.4	0.0	171.5	56.2	305.8	126.4	8.9
SURIRELLA	0.0	0.0	0.0	0.4	0.0	1.5	0.0
SYNEDRA	0.0	0.0	51.1	5.9	11.4	153.9	3.0
CYANOPHYTA							
CHROOCOCCUS	0.0	0.0	1.6	2.0	0.0	0.0	0.0
MERISMOPEDIA	0.0	0.0	0.0	0.8	0.0	0.0	0.0
OSCILLATORIA	0.0	0.0	0.0	0.0	20.8	7.5	0.4
SCHIZOTHRIX	0.0	0.0	0.0	0.0	0.0	54.9	0.7
EUGLENOPHYTA							
EUGLENA	0.0	0.4	0.0	0.0	0.0	0.0	0.0

Table B-4. Mean densities (unit/mm^2) of periphytic algae in three replicates from cumulative (submerged for 10 months) plates at Bell Bend on the Susquehanna River, 1978.

TAXON	13 FEB	14 APR	14 JUN	16 AUG	16 OCT	14 DEC	% TOTAL
CHLOROPHYTA							
ACTINASTRUM	0.0	0.0	3.6	2.4	2.0	0.0	0.1
ANKISTRODESMUS	0.0	0.0	58.8	57.8	41.7	6.7	2.2
CERASTERIAS	0.0	0.0	0.8	0.0	0.0	0.0	0.0
CHLAMYDOMONAS	0.0	0.0	97.7	7.5	0.0	0.0	1.4
CHODATELLA	0.0	0.0	13.1	1.6	0.0	0.0	0.2
CLOSTERIUM	0.0	0.0	0.0	0.0	0.0	4.5	0.1
COELASTRUM	0.0	0.0	0.0	2.4	13.3	0.0	0.2
COSMARIUM	0.0	0.0	1.2	0.8	0.0	0.0	0.0
CRUCIGENIA	0.0	0.0	1.6	23.6	0.0	0.0	0.3
DICTYOSPHAERIUM	0.0	0.0	2.4	16.5	3.3	0.0	0.3
KIRCHNERIELLA	0.0	0.0	7.3	2.0	4.3	1.5	0.2
MICRACTINIUM	0.0	0.0	0.8	0.0	0.0	0.0	0.0
OOCYSTIS	0.0	0.0	0.8	2.0	0.0	0.0	0.0
PANDORINA	0.0	0.0	1.2	0.0	0.0	0.0	0.0
PEDIASTRUM	0.0	0.0	0.0	9.8	15.3	0.0	0.3
QUADRIGULA	0.0	0.0	0.0	0.4	0.0	0.0	0.0
SCENEDESMUS	0.8	0.0	68.4	114.1	202.5	12.0	5.4
SELENASTRUM	0.0	0.0	0.0	0.0	0.8	0.0	0.0
STAURASTRUM	0.0	0.0	0.0	0.4	0.0	0.0	0.0
TETRAEDRON	0.0	0.0	0.8	2.4	3.9	0.0	0.1
TETRASTRUM	0.0	0.0	0.8	3.5	1.7	0.0	0.1
UNIDENTIFIED CHLOROPHYTA	0.4	0.0	13.2	35.4	35.5	14.2	1.3
BACILLARIOPHYTA							
ACHNANTHES	0.8	0.0	0.0	1.2	4.3	14.9	0.3
AMPHORA	0.0	0.0	5.2	0.4	0.0	1.5	0.1
ASTERIONELLA	1.6	0.0	0.0	0.0	1.7	0.0	0.0
COCCONEIS	1.2	0.0	2.0	12.6	41.1	27.8	1.1
CYCLOTELLA	4.3	0.4	181.8	210.0	809.9	67.9	17.2
CYMBELLA	7.1	0.4	23.2	3.1	7.6	41.4	1.1
DIATOMA	0.8	0.4	1.6	0.0	4.0	77.1	1.1
EPITHEMIA	0.0	0.0	0.0	0.0	1.0	0.0	0.0
EUNOTIA	0.4	0.0	0.0	0.4	0.0	0.0	0.0
FRAGILARIA	3.9	0.0	0.0	2.4	28.4	1.5	0.5
FRUSTULIA	0.0	0.0	0.0	0.4	2.0	0.0	0.0
GOMPHONEMA	14.9	2.0	7.3	3.1	34.6	35.2	1.3
GYROSIGMA	0.0	0.0	0.0	0.0	9.4	1.5	0.1
MELOSIRA	0.0	0.0	16.0	59.0	380.3	22.5	6.4
MERIDION	2.0	0.0	1.6	1.2	0.0	0.0	0.1
NAVICULA	39.3	9.0	170.8	34.6	194.7	748.2	16.2
NITZSCHIA	33.4	1.6	265.5	101.1	154.0	718.1	17.2
PINNULARIA	0.0	0.0	0.0	0.4	0.0	0.0	0.0
RHOICOSPHENIA	2.0	0.0	0.8	0.0	6.0	11.2	0.3
RHOPALODIA	0.4	0.0	0.0	0.0	0.0	0.0	0.0
STEPHANODISCUS	0.8	0.0	520.0	89.7	808.9	64.0	20.0
SURIRELLA	2.0	0.0	0.0	0.0	2.0	0.8	0.1
SYNEDRA	5.1	1.2	93.0	6.7	6.8	36.8	2.0
TABELLARIA	0.0	0.0	0.0	0.0	0.8	0.0	0.0
CYANOPHYTA							
ANABAENA	0.8	0.0	0.0	0.0	0.0	0.0	0.0
CHROOCOCCUS	0.0	0.0	4.7	0.8	0.0	0.0	0.1
GOMPHOSPHAERIA	0.0	0.0	0.0	0.4	0.0	0.0	0.0
MERISMOPEDIA	0.0	0.0	0.0	1.6	0.8	0.0	0.0
MICROCYSTIS	0.0	0.0	0.0	0.4	0.0	0.0	0.0
OSCILLATORIA	0.4	0.0	3.9	0.0	72.4	0.0	1.0
SCHIZOTHRIX	2.8	0.0	0.0	0.4	0.0	78.3	1.1
CHRYSOPHYTA							
DINOBYRON	0.4	0.0	0.0	0.0	0.0	0.0	0.0
EUGLENOPHYTA							
TRACHELOMONAS	0.0	0.0	1.2	0.0	1.0	0.0	0.0
RHODOPHYTA							
RHODOCHORTON	0.0	0.0	0.0	0.0	0.8	0.0	0.0

Table B-5. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at SSES on the Susquehanna River, 14 February 1978. Replicates are indicated by collection number.

TAXON	AJG-78-011	AJG-78-012	AJG-78-013	MEAN	% TOTAL
BACILLARIOPHYTA					
NAVICULA	0.0	1.2	0.0	0.4	33.3
NITZSCHIA	0.0	0.0	1.2	0.4	33.3
STEPHANODISCUS	0.0	0.0	1.2	0.4	33.3
TOTAL	0.0	1.2	2.4	1.2	

Table B-6. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at Bell Bend on the Susquehanna River, 13 February 1978. Replicates are indicated by collection number.

TAXON	AJG-78-003	AJG-78-004	AJG-78-005	MEAN	% TOTAL
CHLOROPHYTA					
SCENEDESMUS	0.0	1.2	0.0	0.4	0.3
UNIDENTIFIED CHLOROPHYTA	2.4	0.0	0.0	0.8	0.6
BACILLARIOPHYTA					
ACHNANTHES	2.4	1.2	0.0	1.2	1.0
ASTERIONELLA	2.4	4.7	4.7	3.9	3.2
COCCONEIS	4.7	1.2	1.2	2.4	1.9
CYCLOTELLA	0.0	5.9	1.2	2.4	1.9
CYMBELLA	7.1	3.5	2.4	4.3	3.5
DIATOMA	4.7	1.2	7.1	4.3	3.5
EPITHEMIA	1.2	1.2	0.0	0.8	0.6
EUNOTIA	0.0	1.2	0.0	0.4	0.3
FRAGILARIA	0.0	4.7	2.4	2.4	1.9
GOMPHONEMA	14.2	15.3	16.5	15.3	12.5
MELOSIRA	4.7	0.0	0.0	1.6	1.3
MERIDION	1.2	5.9	8.3	5.1	4.2
NAVICULA	27.1	43.7	40.1	37.0	30.2
NITZSCHIA	33.0	29.5	28.3	30.3	24.8
PINNULARIA	1.2	0.0	0.0	0.4	0.3
RHOICOSPHENIA	0.0	0.0	1.2	0.4	0.3
SURIRELLA	2.4	3.5	4.7	3.5	2.9
SYNEDRA	2.4	10.6	2.4	5.1	4.2
EUGLENOPHYTA					
UNIDENTIFIED EUGLENOPHYTA	1.2	0.0	0.0	0.4	0.3
TOTAL	112.1	134.5	120.4	122.3	

Table B-7. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at SSES on the Susquehanna River, 13 April 1978. Replicates are indicated by collection number.

TAXON	AJG-78-019	AJG-78-020	AJG-78-021	MEAN	% TOTAL
BACILLARIOPHYTA					
GOMPHONEMA	3.5	2.4	1.2	2.4	15.4
HANTZSCHIA	0.0	1.2	0.0	0.4	2.6
MERIDION	0.0	15.3	1.2	5.5	35.9
NAVICULA	4.7	1.2	2.4	2.8	17.9
NITZSCHIA	3.5	2.4	1.2	2.4	15.4
SURIRELLA	0.0	1.2	0.0	0.4	2.6
SYNEDRA	1.2	0.0	0.0	0.4	2.6
CYANOPHYTA					
OSCILLATORIA	2.4	0.0	0.0	0.8	5.1
SCHIZOTHRIX	0.0	0	1.2	0.4	2.6
TOTAL	15.3	23.6	7.1	15.3	

Table B-8. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at Bell Bend on the Susquehanna River, 14 April 1978. Replicates are indicated by collection number.

TAXON	AJG-78-027	AJG-78-028	AJG-78-029	MEAN	% TOTAL
BACILLARIOPHYTA					
GOMPHONEMA	0.0	1.2	0.0	0.4	10.0
NAVICULA	2.4	3.5	3.5	3.1	80.0
SYNEDRA	0.0	1.2	0.0	0.4	10.0
TOTAL	2.4	5.9	3.5	3.9	

Table B-9. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at SSES on the Susquehanna River, 15 June 1978. Replicates are indicated by collection number.

TAXON	AJG-78-043	AJG-78-044	AJG-78-045	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	2.4	0.0	4.7	2.4	0.4
ANKISTRODESMUS	2.4	4.7	30.7	12.6	2.2
CHLAMYDOMONAS	18.9	120.4	328.0	155.8	26.9
CHODATELLA	2.4	0.0	2.4	1.6	0.3
CRUCIGENIA	0.0	0.0	9.4	3.1	0.5
DICTYOSPHAERIUM	0.0	0.0	16.5	5.5	1.0
GOLENKINIA	0.0	0.0	4.7	1.6	0.3
KIRCHNERIELLA	2.4	2.4	4.7	3.1	0.5
MICRACTINIUM	0.0	0.0	16.5	5.5	1.0
SCENEDESMUS	4.7	4.7	37.8	15.7	2.7
SCHROEDERIA	0.0	0.0	9.4	3.1	0.5
SELENASTRUM	0.0	0.0	2.4	0.8	0.1
UNIDENTIFIED CHLOROPHYTA	2.4	2.4	28.3	11.0	1.9
BACILLARIOPHYTA					
ACHNANTHES	0.0	0.0	2.4	0.8	0.1
COCCONEIS	2.4	0.0	0.0	0.8	0.1
CYCLOTELLA	35.4	4.7	89.7	43.3	7.5
CYMBELLA	0.0	0.0	2.4	0.8	0.1
DIATOMA	0.0	4.7	0.0	1.6	0.3
GOMPHONEMA	2.4	0.0	4.7	2.4	0.4
NAVICULA	42.5	14.2	51.9	36.2	6.2
NITZSCHIA	61.4	21.2	219.5	100.7	17.4
STEPHANODISCUS	33.0	37.8	344.6	138.5	23.9
SYNEDRA	0.0	14.2	77.9	30.7	5.3
CYANOPHYTA					
CHROOCOCCUS	0.0	0.0	2.4	0.8	0.1
EUGLENOPHYTA					
EUGLENA	0.0	0.0	2.4	0.8	0.1
TOTAL	212.4	231.3	1293.3	579.0	

Table B-10. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at Bell Bend on the Susquehanna River, 14 June 1978. Replicates are indicated by collection number.

TAXON	AJG-78-035	AJG-78-036	AJG-78-037	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	7.3	2.4	11.8	7.2	0.4
ANKISTRODESMUS	84.0	70.8	42.5	65.7	3.5
CERASTERIAS	0.0	0.0	2.4	0.8	0.0
CHLAMYDOMONAS	270.1	151.0	243.1	221.4	11.9
CHODATELLA	18.3	28.3	11.8	19.5	1.0
DICTYOSPHAERIUM	36.5	0.0	21.2	19.2	1.0
FRANCEIA	0.0	0.0	2.4	0.8	0.0
KIRCHNERIELLA	3.7	0.0	18.9	7.5	0.4
MICRACTINIUM	25.6	2.4	2.4	10.1	0.5
SCENEDESMUS	105.9	66.1	85.0	85.6	4.6
SCHROEDERIA	0.0	2.4	9.4	3.9	0.2
TETRAEDRON	7.3	0.0	0.0	2.4	0.1
UNIDENTIFIED CHLOROPHYTA	18.3	2.4	9.4	10.0	0.5
BACILLARIOPHYTA					
AMPHORA	11.0	0.0	0.0	3.7	0.2
CYCLOTELLA	248.2	103.8	127.4	159.8	8.6
CYMBELLA	14.6	23.6	14.2	17.5	0.9
DIATOMA	0.0	0.0	9.4	3.1	0.2
GOMPHONEMA	18.3	28.3	18.9	21.8	1.2
HANNAEA	3.7	0.0	0.0	1.2	0.1
MELOSIRA	0.0	7.1	9.4	5.5	0.3
MERIDION	0.0	18.9	0.0	6.3	0.3
NAVICULA	131.4	103.8	11.8	82.3	4.4
NITZSCHIA	401.5	271.4	198.2	290.4	15.6
STEPHANODISCUS	989.2	587.6	502.7	693.2	37.3
SURIRELLA	0.0	2.4	0.0	0.8	0.0
SYNEDRA	142.4	115.6	101.5	119.8	6.4
CHRYSOPHYTA					
UNIDENTIFIED CHRYSOPHYTA	3.7	0.0	0.0	1.2	0.1
TOTAL	2540.4	1588.3	1453.8	1860.8	

Table B-11. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at SSES on the Susquehanna River, 15 August 1978. Replicates are indicated by collection number.

TAXON	AJG-78-051	AJG-78-052	AJG-78-053	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	2.4	4.7	3.5	3.5	0.9
ANKISTRODESMUS	48.4	36.6	41.3	42.1	10.4
CHLAMYDOMONAS	3.5	0.0	0.0	1.2	0.3
COELASTRUM	0.0	0.0	2.4	0.8	0.2
CRUCIGENIA	0.0	0.0	4.7	1.6	0.4
DICTYOSPHAERIUM	0.0	0.0	3.5	1.2	0.3
KIRCHNERIELLA	0.0	0.0	1.2	0.4	0.1
PEDIASTRUM	3.5	3.5	5.9	4.3	1.1
SCENEDESMUS	47.2	43.7	60.2	50.3	12.5
SCHROEDERIA	0.0	0.0	2.4	0.8	0.2
TETRAEDRON	1.2	0.0	1.2	0.8	0.2
TETRASTRUM	4.7	7.1	2.4	4.7	1.2
TREUBARIA	0.0	0.0	1.2	0.4	0.1
UNIDENTIFIED CHLOROPHYTA	11.8	10.6	9.4	10.6	2.6
BACILLARIOPHYTA					
ACHNANTHES	1.2	0.0	0.0	0.4	0.1
COCCONEIS	16.5	4.7	10.6	10.6	2.6
CYCLOTELLA	129.8	79.1	135.7	114.9	28.5
CYMBELLA	1.2	3.5	1.2	2.0	0.5
GOMPHONEMA	8.3	3.5	5.9	5.9	1.5
GYROSIGMA	1.2	0.0	0.0	0.4	0.1
MELOSIRA	24.8	28.3	40.1	31.1	7.7
MERIDION	0.0	0.0	1.2	0.4	0.1
NAVICULA	37.8	22.4	27.1	29.1	7.2
NITZSCHIA	69.6	55.5	69.6	64.9	16.1
RHOICOSPHENIA	0.0	1.2	0.0	0.4	0.1
STEPHANODISCUS	22.4	15.3	15.3	17.7	4.4
SYNEDRA	1.2	2.4	2.4	2.0	0.5
EUGLENOPHYTA					
TRACHELOMONAS	0.0	0.0	1.2	0.4	0.1
TOTAL	436.6	322.1	449.6	402.8	

Table B-12. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at Bell Bend on the Susquehanna River, 16 August 1978. Replicates are indicated by collection number.

TAXON	AJG-78-059	AJG-78-060	AJG-78-061	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	3.5	2.2	4.0	3.3	0.3
ANKISTRODESMUS	29.5	46.8	59.0	45.1	3.8
CHLAMYDOMONAS	3.5	8.9	9.4	7.3	0.6
CHODATELLA	1.2	0.0	0.0	0.4	0.0
COELASTRUM	1.2	2.2	2.7	2.0	0.2
COSMARIUM	0.0	2.2	0.0	0.7	0.1
CRUCIGENIA	53.1	11.2	6.7	23.7	2.0
DICTYOSPHAERIUM	13.0	24.5	14.7	17.4	1.5
KIRCHNERIELLA	1.2	0.0	2.7	1.3	0.1
PEDIASTRUM	8.3	2.2	8.0	6.2	0.5
SCENEDESMUS	85.0	131.6	154.1	123.5	10.4
SCHROEDERIA	2.4	0.0	0.0	0.8	0.1
STAURASTRUM	1.2	0.0	1.3	0.8	0.1
TETRAEDRON	1.2	0.0	1.3	0.8	0.1
TETRASTRUM	2.4	6.7	1.3	3.5	0.3
UNIDENTIFIED CHLOROPHYTA	30.7	40.1	30.8	33.9	2.9
BACILLARIOPHYTA					
ACHNANTHES	0.0	4.5	0.0	1.5	0.1
AMPHORA	1.2	0.0	1.3	0.8	0.1
ASTERIONELLA	1.2	0.0	0.0	0.4	0.0
COCCONEIS	62.5	53.5	49.6	55.2	4.6
CYCLOTELLA	305.6	260.9	253.3	273.3	23.0
CYMBELLA	8.3	6.7	6.7	7.2	0.6
DIATOMA	1.2	0.0	1.3	0.8	0.1
GOMPHONEMA	11.8	13.4	4.0	9.7	0.8
GYROSIGMA	2.4	0.0	0.0	0.8	0.1
HANTZSCHIA	0.0	4.5	0.0	1.5	0.1
MELOSIRA	108.6	129.3	131.3	123.1	10.4
MERIDION	1.2	0.0	1.3	0.8	0.1
NAVICULA	72.0	73.6	75.0	73.5	6.2
NITZSCHIA	160.5	267.6	178.2	202.1	17.0
PINNULARIA	2.4	0.0	1.3	1.2	0.1
RHOICOSPHENIA	0.0	0.0	2.7	0.9	0.1
STEPHANODISCUS	102.7	173.9	168.8	148.5	12.5
SYNEDRA	8.3	13.4	12.1	11.2	0.9
CYANOPHYTA					
MERISMOPEDIA	2.4	8.9	0.0	3.8	0.3
OSCILLATORIA	1.2	0.0	0.0	0.4	0.0
TOTAL	1090.3	1288.9	1183.2	1187.5	

Table B-13. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at SSES on the Susquehanna River, 16 October 1978. Replicates are indicated by collection number.

TAXON	AJG-78-075	AJG-78-076	AJG-78-077	MEAN	% TOTAL
CHLOROPHYTA					
ANKISTRODESMUS	35.4	44.8	14.2	31.5	3.2
CHLAMYDOMONAS	2.4	0.0	2.4	1.6	0.2
CHODATELLA	0.0	0.0	2.4	0.8	0.1
CLOSTERIUM	2.4	2.4	2.4	2.4	0.2
COSMARIUM	9.4	0.0	2.4	3.9	0.4
CRUCIGENIA	4.7	2.4	0.0	2.4	0.2
DICTYOSPHAERIUM	0.0	0.0	2.4	0.8	0.1
KIRCHNERIELLA	9.4	21.2	0.0	10.2	1.0
MICRACTINIUM	0.0	2.4	0.0	0.8	0.1
PEDIASTRUM	2.4	2.4	2.4	2.4	0.2
SCENEDESMUS	73.2	66.1	49.6	62.9	6.3
SCHROEDERIA	0.0	0.0	2.4	0.8	0.1
TETRASTRUM	0.0	4.7	0.0	1.6	0.2
UNIDENTIFIED CHLOROPHYTA	11.8	47.2	30.7	29.9	3.0
BACILLARIOPHYTA					
ACHNANTHES	2.4	4.7	4.7	3.9	0.4
AMPHORA	0.0	4.7	2.4	2.4	0.2
COCCONEIS	4.7	7.1	7.1	6.3	0.6
CYCLOTELLA	184.1	118.0	155.8	152.6	15.3
CYMBELLA	2.4	2.4	0.0	1.6	0.2
FRAGILARIA	0.0	4.7	0.0	1.6	0.2
GOMPHONEMA	9.4	9.4	9.4	9.4	0.9
GYROSIGMA	7.1	2.4	2.4	3.9	0.4
MELOSIRA	103.8	158.1	82.6	114.9	11.5
NAVICULA	311.5	245.4	295.0	284.0	28.5
NITZSCHIA	61.4	42.5	51.9	51.9	5.2
PINNULARIA	2.4	0.0	0.0	0.8	0.1
STEPHANODISCUS	144.0	273.8	136.9	184.9	18.6
SYNEDRA	4.7	7.1	7.1	6.3	0.6
CYANOPHYTA					
MICROCYSTIS	2.4	4.7	0.0	2.4	0.2
OSCILLATORIA	9.4	21.2	14.2	14.9	1.5
SCHIZOTHRIX	4.7	0.0	0.0	1.6	0.2
TOTAL	1005.4	1099.8	880.3	995.1	

Table B-14. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at Bell Bend on the Susquehanna River, 16 October 1978. Replicates are indicated by collection number.

TAXON	AJG-78-067	AJG-78-068	AJG-78-069	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	4.5	4.5	0.0	3.0	0.1
ANKISTRODESMUS	89.2	53.5	111.2	84.7	1.6
COELASTRUM	0.0	8.9	37.1	15.3	0.3
COSMARIUM	0.0	4.5	0.0	1.5	0.0
DICTYOSPHAERIUM	0.0	8.9	0.0	3.0	0.1
KIRCHNERIELLA	17.8	4.5	74.2	32.2	0.6
PEDIASTRUM	17.8	22.3	37.1	25.7	0.5
SCENEDESMUS	214.1	258.7	593.3	355.3	6.6
SELENASTRUM	4.5	0.0	0.0	1.5	0.0
TETRASTRUM	4.5	4.5	0.0	3.0	0.1
UNIDENTIFIED CHLOROPHYTA	80.3	62.4	74.2	72.3	1.3
BACILLARIOPHYTA					
ACHNANTHES	4.5	4.5	0.0	3.0	0.1
ASTERIONELLA	26.8	0.0	0.0	8.9	0.2
COCCONEIS	31.2	102.6	129.8	87.9	1.6
CYCLOTELLA	874.2	767.1	5617.6	2419.6	44.7
CYMBELLA	8.9	8.9	37.1	18.3	0.3
FRAGILARIA	4.5	13.4	0.0	5.9	0.1
GOMPHONEMA	40.1	35.7	37.1	37.6	0.7
GYROSIGMA	13.4	4.5	0.0	5.9	0.1
MELOSIRA	289.9	258.7	982.6	510.4	9.4
MERIDION	0.0	8.9	0.0	3.0	0.1
NAVICULA	281.0	173.9	537.7	330.9	6.1
NITZSCHIA	187.3	89.2	370.8	215.8	4.0
STEPHANODISCUS	1070.4	771.6	1390.5	1077.5	19.9
SYNEDRA	4.5	22.3	55.6	27.5	0.5
CYANOPHYTA					
CHROOCOCCUS	0.0	4.5	0.0	1.5	0.0
OSCILLATORIA	53.5	66.9	55.6	58.7	1.1
TOTAL	3322.7	2765.2	10141.3	5409.6	

Table B-15. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at SSES on the Susquehanna River, 14 December 1978. Replicates are indicated by collection number.

TAXON	AJG-78-091	AJG-78-092	AJG-78-093	MEAN	% TOTAL
CHLOROPHYTA					
SCENEDESMUS	0.4	0.0	0.0	0.1	0.1
BACILLARIOPHYTA					
ACHNANTHES	2.4	14.4	9.6	8.8	8.6
ASTERIONELLA	2.4	0.0	0.0	0.8	0.8
CYMBELLA	11.2	4.0	4.8	6.7	6.5
DIATOMA	0.0	7.2	9.6	5.6	5.4
FRAGILARIA	7.2	0.0	0.0	2.4	2.3
GOMPHONEMA	8.8	4.0	4.8	5.9	5.7
MELOSIRA	1.2	4.0	0.0	1.7	1.7
NAVICULA	15.6	4.0	31.2	16.9	16.5
NITZSCHIA	48.0	60.0	37.6	48.5	47.2
STEPHANODISCUS	1.6	0.8	0.0	0.8	0.8
SYNEDRA	0.0	0.0	9.6	3.2	3.1
CYANOPHYTA					
SCHIZOTHRIX	0.0	1.6	2.4	1.3	1.3
TOTAL	98.8	100.0	109.6	102.8	

Table B-16. Percent total and density (units/mm^2) of periphytic algae in bimonthly (submerged 2 months) samples at Bell Bend on the Susquehanna River, 14 December 1978. Replicates are indicated by collection number.

TAXON	AJG-78-083	AJG-78-084	AJG-78-085	MEAN	% TOTAL
CHLOROPHYTA					
CLOSTERIUM	0.0	0.8	0.0	0.3	0.3
COSMARIUM	0.0	0.0	0.8	0.3	0.3
PEDIASTRUM	0.8	0.0	0.0	0.3	0.3
SCENEDESMUS	0.8	0.0	0.0	0.3	0.3
BACILLARIOPHYTA					
ACHNANTHES	4.8	12.0	4.0	6.9	7.9
AMPHORA	0.0	2.0	0.0	0.7	0.8
ASTERIONELLA	0.0	2.0	0.0	0.7	0.8
COCCONEIS	0.0	2.0	4.0	2.0	2.3
CYCLOTELLA	0.0	0.0	0.8	0.3	0.3
CYMBELLA	0.0	0.0	8.0	2.7	3.0
DIATOMA	0.0	0.0	8.0	2.7	3.0
FRAGILARIA	4.8	0.0	12.8	5.9	6.7
GOMPHONEMA	27.2	3.2	4.0	11.5	13.1
MELOSIRA	6.4	2.0	4.8	4.4	5.0
NAVICULA	21.6	9.2	32.0	20.9	23.8
NITZSCHIA	43.2	4.4	31.2	26.3	29.9
STEPHANODISCUS	0.0	0.4	0.8	0.4	0.5
SYNEDRA	0.0	2.0	0.0	0.7	0.8
CYANOPHYTA					
SCHIZOTHRIX	1.6	0.4	0.8	0.9	1.1
TOTAL	111.2	40.4	112.0	87.9	

Table B-17. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at SSES on the Susquehanna River, 14 February 1978. Replicates are indicated by collection number.

TAXON	AJG-78-014	AJG-78-015	AJG-78-016	MEAN	% TOTAL
BACILLARIOPHYTA					
ACHNANTHES	0.0	0.0	1.2	0.4	25.0
NAVICULA	2.4	0.0	0.0	0.8	50.0
STEPHANODISCUS	0.0	0.0	1.2	0.4	25.0
TOTAL	2.4	0.0	2.4	1.6	

Table B-18. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at Bell Bend on the Susquehanna River, 15 February 1978. Replicates are indicated by collection number.

TAXON	AJG-78-006	AJG-78-007	AJG-78-008	MEAN	% TOTAL
CHLOROPHYTA					
SCENEDESMUS	2.4	0.0	0.0	0.8	0.6
UNIDENTIFIED CHLOROPHYTA	0.0	1.2	0.0	0.4	0.3
BACILLARIOPHYTA					
ACHNANTHES	1.2	1.2	0.0	0.8	0.6
ASTERIONELLA	0.0	1.2	3.5	1.6	1.3
COCCONEIS	3.5	0.0	0.0	1.2	0.9
CYCLOTELLA	4.7	4.7	3.5	4.3	3.4
CYMBELLA	9.4	4.7	7.1	7.1	5.6
DIATOMA	0.0	1.2	1.2	0.8	0.6
EUNOTIA	0.0	1.2	0.0	0.4	0.3
FRAGILARIA	2.4	4.7	4.7	3.9	3.1
GOMPHONEMA	14.2	20.1	10.6	14.9	11.9
MERIDION	3.5	2.4	0.0	2.0	1.6
NAVICULA	30.7	54.3	33.0	39.3	31.3
NITZSCHIA	36.6	34.2	29.5	33.4	26.6
RHOICOSPHENIA	2.4	0.0	3.5	2.0	1.6
RHOPALODIA	0.0	1.2	0.0	0.4	0.3
STEPHANODISCUS	0.0	2.4	0.0	0.8	0.6
SURIRELLA	2.4	2.4	1.2	2.0	1.6
SYNEDRA	3.5	4.7	7.1	5.1	4.1
CYANOPHYTA					
ANABAENA	2.4	0.0	0.0	0.8	0.6
OSCILLATORIA	0.0	1.2	0.0	0.4	0.3
SCHIZOTHRIX	1.2	4.7	2.4	2.8	2.2
CHRYSOPHYTA					
DINOBYRON	0.0	1.2	0.0	0.4	0.3
TOTAL	120.4	148.7	107.4	125.5	

Table B-19. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at SSES on the Susquehanna River, 13 April 1978. Replicates are indicated by collection number.

TAXON	AJG-78-022	AJG-78-023	AJG-78-024	MEAN	% TOTAL
BACILLARIOPHYTA					
COCCONEIS	0.0	0.0	2.4	0.8	4.3
CYCLOTELLA	0.0	1.2	0.0	0.4	2.2
CYMBELLA	0.0	0.0	1.2	0.4	2.2
GOMPHONEMA	2.4	21.2	0.0	7.9	43.5
NAVICULA	2.4	15.3	2.4	6.7	37.0
NITZSCHIA	1.2	2.4	1.2	1.6	8.7
EUGLENOPHYTA					
EUGLENA	0.0	1.2	0.0	0.4	2.2
TOTAL	5.9	41.3	7.1	18.1	

Table B-20. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at Bell Bend on the Susquehanna River, 14 April 1978. Replicates are indicated by collection number.

TAXON	AJG-78-030	AJG-78-031	AJG-78-032	MEAN	% TOTAL
BACILLARIOPHYTA					
CYCLOTELLA	1.2	0.0	0.0	0.4	2.6
CYMBELLA	1.2	0.0	0.0	0.4	2.6
DIATOMA	0.0	1.2	0.0	0.4	2.6
GOMPHONEMA	5.9	0.0	0.0	2.0	13.2
NAVICULA	11.8	11.8	3.5	9.0	60.5
NITZSCHIA	3.5	1.2	0.0	1.6	10.5
SYNEDRA	3.5	0.0	0.0	1.2	7.9
TOTAL	27.1	14.2	3.5	14.9	

Table B-21. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at SSES on the Susquehanna River, 15 June 1978. Replicates are indicated by collection number.

TAXON	AJG-78-046	AJG-78-047	AJG-78-048	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	9.4	0.0	0.0	3.1	0.3
ANKISTRODESMUS	37.8	23.6	16.5	26.0	2.5
CHLAMYDOMONAS	217.1	285.6	271.4	258.0	25.3
CHODATELLA	7.1	7.1	2.4	5.5	0.5
COSMARIUM	0.0	0.0	9.4	3.1	0.3
DICTYOSPHAERIUM	2.4	4.7	4.7	3.9	0.4
KIRCHNERIELLA	2.4	0.0	4.7	2.4	0.2
SCENEDESMUS	35.4	44.8	11.8	30.7	3.0
SCHROEDERIA	0.0	2.4	4.7	2.4	0.2
STAURASTRUM	0.0	0.0	2.4	0.8	0.1
TETRASTRUM	0.0	2.4	0.0	0.8	0.1
ULOTHRIX	0.0	2.4	0.0	0.8	0.1
UNIDENTIFIED CHLOROPHYTA	9.4	16.5	4.7	10.2	1.0
BACILLARIOPHYTA					
AMPHORA	0.0	2.4	2.4	1.6	0.2
COCCONEIS	0.0	0.0	7.1	2.4	0.2
CYCLOTELLA	118.0	70.8	89.7	92.8	9.1
CYMBELLA	0.0	7.1	7.1	4.7	0.5
GOMPHONEMA	2.4	4.7	14.2	7.1	0.7
MELOSIRA	11.8	9.4	2.4	7.9	0.8
NAVICULA	214.8	257.2	186.4	219.5	21.5
NITZSCHIA	167.6	113.3	61.4	114.1	11.2
STEPHANODISCUS	179.4	205.3	129.8	171.5	16.8
SYNEDRA	70.8	28.3	54.3	51.1	5.0
CYANOPHYTA					
CHROOCOCCUS	4.7	0.0	0.0	1.6	0.2
TOTAL	1090.3	1088.0	887.4	1021.9	

Table B-22. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at Bell Bend on the Susquehanna River, 14 June 1978. Replicates are indicated by collection number.

TAXON	AJG-78-038	AJG-78-039	AJG-78-040	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	2.4	4.7	3.7	3.6	0.2
ANKISTRODESMUS	28.3	89.7	58.4	58.8	3.7
CERASTERIAS	0.0	2.4	0.0	0.8	0.1
CHLAMYDOMONAS	56.6	108.6	127.8	97.7	6.2
CHODATELLA	16.5	11.8	11.0	13.1	0.8
COSMARIUM	0.0	0.0	3.7	1.2	0.1
CRUCIGENIA	4.7	0.0	0.0	1.6	0.1
DICTYOSPHAERIUM	0.0	0.0	7.3	2.4	0.2
KIRCHNERIELLA	0.0	0.0	21.9	7.3	0.5
MICRACTINIUM	2.4	0.0	0.0	0.8	0.1
OOCYSTIS	0.0	2.4	0.0	0.8	0.1
PANDORINA	0.0	0.0	3.7	1.2	0.1
SCENEDESMUS	54.3	37.8	113.2	68.4	4.4
TETRAEDRON	0.0	2.4	0.0	0.8	0.1
TETRASTRUM	0.0	2.4	0.0	0.8	0.1
UNIDENTIFIED CHLOROPHYTA	14.2	7.1	18.3	13.2	0.8
BACILLARIOPHYTA					
AMPHORA	2.4	9.4	3.7	5.2	0.3
COCCONEIS	0.0	2.4	3.7	2.0	0.1
CYCLOTELLA	184.1	153.4	208.1	181.8	11.6
CYMBELLA	11.8	21.2	36.5	23.2	1.5
DIATOMA	0.0	4.7	0.0	1.6	0.1
GOMPHONEMA	0.0	0.0	21.9	7.3	0.5
MELOSIRA	4.7	21.2	21.9	16.0	1.0
MERIDION	0.0	4.7	0.0	1.6	0.1
NAVICULA	96.8	167.6	248.2	170.8	10.9
NITZSCHIA	177.0	269.0	350.4	265.5	16.9
RHOICOSPHENIA	2.4	0.0	0.0	0.8	0.1
STEPHANODISCUS	276.1	462.6	821.3	520.0	33.1
SYNEDRA	70.8	73.2	135.1	93.0	5.9
CYANOPHYTA					
CHROOCOCCUS	11.8	2.4	0.0	4.7	0.3
OSCILLATORIA	11.8	0.0	0.0	3.9	0.3
EUGLENOPHYTA					
TRACHELOMONAS	0.0	0.0	3.7	1.2	0.1
TOTAL	1029.0	1460.8	2222.9	1570.9	

Table B-23. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at SSES on the Susquehanna River, 15 August 1978. Replicates are indicated by collection number.

TAXON	AJG-78-054	AJG-78-055	AJG-78-056	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	2.4	5.9	2.4	3.5	0.7
ANKISTRODESMUS	28.3	56.6	36.6	40.5	8.0
CHLAMYDOMONAS	2.4	3.5	8.3	4.7	0.9
CHODATELLA	0.0	0.0	1.2	0.4	0.1
COELASTRUM	0.0	0.0	1.2	0.4	0.1
COSMARIUM	1.2	0.0	2.4	1.2	0.2
CRUCIGENIA	4.7	2.4	24.8	10.6	2.1
DICTYOSPHAERIUM	17.7	7.1	7.1	10.6	2.1
ELAKATOTHRIX	0.0	0.0	1.2	0.4	0.1
KIRCHNERIELLA	3.5	1.2	5.9	3.5	0.7
OOCYSTIS	1.2	0.0	0.0	0.4	0.1
PEDIASTRUM	4.7	5.9	4.7	5.1	1.0
SCENEDESMUS	50.7	63.7	55.5	56.6	11.1
SCHROEDERIA	0.0	2.4	0.0	0.8	0.2
SELENASTRUM	0.0	1.2	0.0	0.4	0.1
UNIDENTIFIED CHLOROPHYTA	26.0	20.1	24.8	23.6	4.6
BACILLARIOPHYTA					
COCCONEIS	14.2	16.5	15.3	15.3	3.0
CYCLOTELLA	99.1	121.5	72.0	97.5	19.2
CYMBELLA	1.2	4.7	1.2	2.4	0.5
FRAGILARIA	0.0	0.0	3.5	1.2	0.2
GOMPHONEMA	1.2	7.1	8.3	5.5	1.1
MELOSIRA	43.7	29.5	40.1	37.8	7.4
MERIDION	2.4	0.0	0.0	0.8	0.2
NAVICULA	33.0	27.1	36.6	32.3	6.3
NITZSCHIA	88.5	74.3	97.9	86.9	17.1
PINNULARIA	1.2	0.0	1.2	0.8	0.2
RHOICOSPHENIA	0.0	0.0	1.2	0.4	0.1
STEPHANODISCUS	67.3	30.7	70.8	56.2	11.1
SURIRELLA	0.0	0.0	1.2	0.4	0.1
SYNEDRA	10.6	5.9	1.2	5.9	1.2
CYANOPHYTA					
CHROOCOCCUS	0.0	3.5	2.4	2.0	0.4
MERISMOPEDIA	1.2	1.2	0.0	0.8	0.2
TOTAL	506.2	492.1	528.6	509.0	

Table B-24. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at Bell Bend on the Susquehanna River, 16 August 1978. Replicates are indicated by collection number.

TAXON	AJG-78-062	AJG-78-063	AJG-78-064	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	3.5	1.2	2.4	2.4	0.3
ANKISTRODESMUS	24.8	33.0	115.6	57.8	7.1
CHLAMYDOMONAS	4.7	5.9	11.8	7.5	0.9
CHODATELLA	0.0	1.2	3.5	1.6	0.2
COELASTRUM	0.0	1.2	5.9	2.4	0.3
COSMARIUM	0.0	0.0	2.4	0.8	0.1
CRUCIGENIA	21.2	23.6	26.0	23.6	2.9
DICTYOSPHAERIUM	8.3	22.4	18.9	16.5	2.0
KIRCHNERIELLA	1.2	1.2	3.5	2.0	0.2
OOCYSTIS	0.0	1.2	4.7	2.0	0.2
PEDIASTRUM	7.1	2.4	20.1	9.8	1.2
QUADRIGULA	0.0	0.0	1.2	0.4	0.0
SCENEDESMUS	69.6	94.4	178.2	114.1	14.0
STAURASTRUM	0.0	0.0	1.2	0.4	0.0
TETRAEDRON	0.0	1.2	5.9	2.4	0.3
TETRASTRUM	1.2	4.7	4.7	3.5	0.4
UNIDENTIFIED CHLOROPHYTA	27.1	18.9	60.2	35.4	4.4
BACILLARIOPHYTA					
ACHNANTHES	0.0	2.4	1.2	1.2	0.1
AMPHORA	1.2	0.0	0.0	0.4	0.0
COCCONEIS	17.7	14.2	5.9	12.6	1.5
CYCLOTELLA	182.9	212.4	234.8	210.0	25.9
CYMBELLA	3.5	5.9	0.0	3.1	0.4
EUNOTIA	1.2	0.0	0.0	0.4	0.0
FRAGILARIA	4.7	2.4	0.0	2.4	0.3
FRUSTULIA	1.2	0.0	0.0	0.4	0.0
GOMPHONEMA	5.9	2.4	1.2	3.1	0.4
MELOSIRA	62.5	72.0	42.5	59.0	7.3
MERIDION	3.5	0.0	0.0	1.2	0.1
NAVICULA	54.3	34.2	15.3	34.6	4.3
NITZSCHIA	134.5	131.0	37.8	101.1	12.4
PINNULARIA	0.0	1.2	0.0	0.4	0.0
STEPHANODISCUS	77.9	90.9	100.3	89.7	11.0
SYNEDRA	7.1	9.4	3.5	6.7	0.8
CYANOPHYTA					
CHROOCOCCUS	1.2	0.0	1.2	0.8	0.1
GOMPHOSPHAERIA	0.0	0.0	1.2	0.4	0.0
MERISMOPEDIA	1.2	2.4	1.2	1.6	0.2
MICROCYSTIS	0.0	0.0	1.2	0.4	0.0
SCHIZOTHRIX	0.0	1.2	0.0	0.4	0.0
TOTAL	729.2	794.1	913.3	812.2	

Table B-25. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at SSES on the Susquehanna River, 16 October 1978. Replicates are indicated by collection number.

TAXON	AJG-78-078	AJG-78-079	AJG-78-080	MEAN	% TOTAL
CHLOROPHYTA					
ANKISTRODESMUS	42.9	35.4	47.2	41.8	3.1
CHLAMYDOMONAS	5.4	0.0	0.0	1.8	0.1
CHODATELLA	0.0	0.0	2.4	0.8	0.1
COELASTRUM	2.7	0.0	4.7	2.5	0.2
COSMARIUM	2.7	0.0	0.0	0.9	0.1
KIRCHNERIELLA	10.7	0.0	16.5	9.1	0.7
PEDIASTRUM	5.4	7.1	7.1	6.5	0.5
SCENEDESMUS	112.6	75.5	101.5	96.5	7.2
TETRASTRUM	2.7	2.4	0.0	1.7	0.1
UNIDENTIFIED CHLOROPHYTA	40.2	16.5	26.0	27.6	2.0
BACILLARIOPHYTA					
ACHNANTHES	0.0	2.4	0.0	0.8	0.1
COCCONEIS	8.0	4.7	4.7	5.8	0.4
CYCLOTELLA	353.8	129.8	212.4	232.0	17.2
CYMBELLA	2.7	0.0	2.4	1.7	0.1
FRUSTULIA	2.7	0.0	0.0	0.9	0.1
GOMPHONEMA	26.8	11.8	9.4	16.0	1.2
GYROSIGMA	0.0	2.4	2.4	1.6	0.1
MELOSIRA	305.5	125.1	139.2	189.9	14.1
MERIDION	0.0	0.0	2.4	0.8	0.1
NAVICULA	324.3	299.7	316.2	313.4	23.3
NITZSCHIA	67.0	51.9	47.2	55.4	4.1
RHOICOSPHENIA	2.7	2.4	0.0	1.7	0.1
STEPHANODISCUS	528.0	177.0	212.4	305.8	22.7
SYNEDRA	10.7	2.4	21.2	11.4	0.8
CYANOPHYTA					
OSCILLATORIA	29.5	9.4	23.6	20.8	1.5
TOTAL	1886.7	955.8	1198.9	1347.1	

Table B-26. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at Bell Bend on the Susquehanna River, 16 October 1978. Replicates are indicated by collection number.

TAXON	AJG-78-070	AJG-78-071	AJG-78-072	MEAN	% TOTAL
CHLOROPHYTA					
ACTINASTRUM	0.0	0.0	6.0	2.0	0.1
ANKISTRODESMUS	48.8	40.1	36.1	41.7	1.4
COELASTRUM	8.6	7.1	24.1	13.3	0.5
DICTYOSPHAERIUM	2.9	7.1	0.0	3.3	0.1
KIRCHNERIELLA	5.7	7.1	0.0	4.3	0.1
PEDIASTRUM	8.6	7.1	30.1	15.3	0.5
SCENEDESMUS	175.1	113.3	319.1	202.5	7.0
SELENASTRUM	0.0	2.4	0.0	0.8	0.0
TETRAEDRON	5.7	0.0	6.0	3.9	0.1
TETRASTRUM	2.9	2.4	0.0	1.7	0.1
UNIDENTIFIED CHLOROPHYTA	43.1	21.2	42.1	35.5	1.2
BACILLARIOPHYTA					
ACHNANTHES	5.7	7.1	0.0	4.3	0.1
ASTERIONELLA	2.9	2.4	0.0	1.7	0.1
COCCONEIS	48.8	14.2	60.2	41.1	1.4
CYCLOTELLA	642.9	408.3	1378.6	809.9	28.0
CYMBELLA	8.6	14.2	0.0	7.6	0.3
DIATOMA	0.0	0.0	12.0	4.0	0.1
EPITHEMIA	2.9	0.0	0.0	1.0	0.0
FRAGILARIA	0.0	18.9	66.2	28.4	1.0
FRUSTULIA	0.0	0.0	6.0	2.0	0.1
GOMPHONEMA	20.1	23.6	60.2	34.6	1.2
GYROSIGMA	11.5	4.7	12.0	9.4	0.3
MELOSIRA	163.6	200.6	776.6	380.3	13.1
NAVICULA	160.7	134.5	289.0	194.7	6.7
NITZSCHIA	109.1	106.2	246.8	154.0	5.3
RHOICOSPHENIA	0.0	0.0	18.1	6.0	0.2
STEPHANODISCUS	645.8	408.3	1372.6	808.9	27.9
SURIRELLA	0.0	0.0	6.0	2.0	0.1
SYNEDRA	8.6	11.8	0.0	6.8	0.2
TABELLARIA	0.0	2.4	0.0	0.8	0.0
CYANOPHYTA					
MERISMOPEDIA	0.0	2.4	0.0	0.8	0.0
OSCILLATORIA	63.1	9.4	144.5	72.4	2.5
EUGLENOPHYTA					
TRACHELOMONAS	2.9	0.0	0.0	1.0	0.0
RHODOPHYTA					
RHODOCHORTON	0.0	2.4	0.0	0.8	0.0
TOTAL	2198.4	1578.8	4912.3	2896.5	

Table B-27. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at SSES on the Susquehanna River, 14 December 1978. Replicates are indicated by collection number.

TAXON	AJG-78-094	AJG-78-095	AJG-78-096	MEAN	% TOTAL
CHLOROPHYTA					
ANKISTRODESMUS	31.2	24.1	12.0	22.4	0.5
CLOSTERIUM	22.3	30.1	12.0	21.5	0.5
COSMARIUM	4.5	0.0	0.0	1.5	0.0
KIRCHNERIELLA	13.4	6.0	12.0	10.5	0.2
PEDIASTRUM	4.5	0.0	0.0	1.5	0.0
SCENEDESMUS	75.8	120.4	48.2	81.5	1.8
TETRASTRUM	0.0	6.0	0.0	2.0	0.0
UNIDENTIFIED CHLOROPHYTA	35.7	42.1	54.2	44.0	1.0
BACILLARIOPHYTA					
ACHNANTHES	0.0	30.1	6.0	12.0	0.3
COCCONEIS	31.2	66.2	42.1	46.5	1.0
CYCLOTELLA	120.4	144.5	114.4	126.4	2.8
CYMBELLA	151.6	96.3	120.4	122.8	2.7
DIATOMA	129.3	162.5	144.5	145.5	3.2
FRAGILARIA	231.9	30.1	421.4	227.8	5.0
GOMPHONEMA	31.2	60.2	42.1	44.5	1.0
GYROSIGMA	8.9	0.0	0.0	3.0	0.1
MELOSIRA	249.8	150.5	240.8	213.7	4.7
NAVICULA	1364.8	2064.9	1511.0	1646.9	36.5
NITZSCHIA	1123.9	1438.8	1613.4	1392.0	30.8
RHOICOSPHENIA	4.5	6.0	0.0	3.5	0.1
STEPHANODISCUS	120.4	144.5	114.4	126.4	2.8
SURIRELLA	4.5	0.0	0.0	1.5	0.0
SYNEDRA	160.6	144.5	156.5	153.9	3.4
CYANOPHYTA					
OSCILLATORIA	4.5	18.1	0.0	7.5	0.2
SCHIZOTHRIX	62.4	60.2	42.1	54.9	1.2
TOTAL	3987.2	4846.1	4707.6	4513.5	

Table B-28. Percent total and density (units/mm^2) of periphytic algae in cumulative (submerged 10 months) samples at Bell Bend on the Susquehanna River, 14 December 1978. Replicates are indicated by collection number.

TAXON	AJG-78-086	AJG-78-087	AJG-78-088	MEAN	% TOTAL
CHLOROPHYTA					
ANKISTRODESMUS	2.4	8.9	8.9	6.7	0.3
CLOSTERIUM	0.0	4.5	8.9	4.5	0.2
KIRCHNERIELLA	0.0	0.0	4.5	1.5	0.1
SCENEDESMUS	4.7	13.4	17.8	12.0	0.6
UNIDENTIFIED CHLOROPHYTA	2.4	22.3	17.8	14.2	0.7
BACILLARIOPHYTA					
ACHNANTHES	0.0	22.3	22.3	14.9	0.7
AMPHORA	0.0	0.0	4.5	1.5	0.1
COCCONEIS	16.5	22.3	44.6	27.8	1.4
CYCLOTELLA	16.5	26.8	160.6	67.9	3.4
CYMBELLA	26.0	58.0	40.1	41.4	2.1
DIATOMA	70.8	111.5	49.1	77.1	3.9
FRAGILARIA	0.0	4.5	0.0	1.5	0.1
GOMPHONEMA	16.5	58.0	31.2	35.2	1.8
GYROSIGMA	0.0	0.0	4.5	1.5	0.1
MELOSIRA	9.4	8.9	49.1	22.5	1.1
NAVICULA	344.6	1097.2	802.8	748.2	37.6
NITZSCHIA	325.7	945.5	883.1	718.1	36.1
RHOICOSPHENIA	2.4	17.8	13.4	11.2	0.6
STEPHANODISCUS	4.7	138.3	49.1	64.0	3.2
SURIRELLA	2.4	0.0	0.0	0.8	0.0
SYNEDRA	21.2	44.6	44.6	36.8	1.9
CYANOPHYTA					
SCHIZOTHRIX	51.9	116.0	66.9	78.3	3.9
TOTAL	918.0	2720.6	2323.7	1987.4	

Table B-29. Periphyton species composing at least 5% of the total units counted in samples at two stations on the Susquehanna River, 1978. Numbers following diatoms indicate the species affinity for pH as rated by Lowe (1974): 1 = alkaliphilous; 2 = acidophilous; 3 = indifferent to pH; and 4 = unknown.

Species		SSES	Bell Bend
CHLOROPHYTA			
Ankistrodesmus falcatus		Aug	Aug
Chlamydomonas globosa		Jun	Jun
Scenedesmus abundans		Aug	Aug
S. falcatus		Aug	
S. quadricauda		Aug, Oct	Aug, Oct
BACILLARIOPHYTA			
Achnanthes minutissima	(1,3)	Dec	Dec
Cocconeis placentula	(1)		Aug
Cyclotella atomus	(4)	Aug, Oct	Jun, Aug, Oct
C. meneghiniana	(1)	Aug, Oct	Aug, Oct
C. pseudostelligera	(1,3)	Jun, Aug	Jun, Aug, Oct
C. stelligera	(1,3)	Aug	Aug, Oct
Cymbella sp.		Dec	
Diatoma vulgare	(1)	Dec	Feb
Fragilaria capucina	(1,2)	Dec	
F. vaucheriae	(1,2)		Dec
Gomphonema olivaceum	(1)	Apr	Feb
G. parvulum	(1,3)		Feb, Dec
Melosira distans	(2,3)	Aug, Oct	Aug, Oct
M. granulata	(1)	Oct	Oct
Meridion circulare	(1)	Apr	
Navicula cryptocephala	(1)	Oct, Dec	Feb
N. cryptocephala var. veneta	(1)	Dec	Dec
N. salinarum var. intermedia	(4)	Oct, Dec	Feb, Oct, Dec
N. symmetrica	(4)	Oct	
N. tripunctata	(1)	Dec	
N. viridula	(1,3)	Apr, Jun	Feb, Apr, Jun
Nitzschia acicularis	(1)	Jun, Aug	Jun, Aug
N. dissipata	(1)	Dec	Feb, Dec
N. palea	(1,3)	Aug, Dec	Feb, Aug, Dec
Stephanodiscus invisitatus	(4)	Jun, Aug, Oct	Jun, Aug, Oct
CYANOPHYTA			
Schizothrix calcicola			Dec

Table B-30. Percent total and density (units/ml) of phytoplankton in bimonthly samples (indicated by date and collection number) at SSES on the Susquehanna River, 1978.

TAXON	14 FEB AJG-78-009	13 APR AJG-78-017	15 JUN AJG-78-041	15 AUG AJG-78-049	16 OCT AJG-78-073	14 DEC AJG-78-089	MEAN	% TOTAL
CHLOROPHYTA								
ACTINASTRUM	0	0	107	464	0	0	95.2	0.77
ANKISTRODESMUS	0	0	929	1286	784	8	501.0	4.03
CHLAMYDOMONAS	0	0	8857	429	108	0	1565.6	12.58
CHODATELLA	0	0	214	36	0	0	41.7	0.33
CLOSTERIOPSIS	0	0	0	36	0	0	6.0	0.05
CLOSTERIUM	0	0	0	0	0	8	1.3	0.01
COELASTRUM	0	0	0	107	81	0	31.4	0.25
CRUCIGENIA	0	0	143	321	81	0	90.9	0.73
DICTYOSPHAERIUM	0	0	357	1714	270	0	390.3	3.14
GOLENKINIA	0	0	143	71	0	0	35.7	0.29
KIRCHNERIELLA	0	0	214	464	324	0	167.1	1.34
MICRACTINIUM	0	0	179	0	54	0	38.8	0.31
OOCYSTIS	0	0	0	71	0	0	11.9	0.10
PEDIASTRUM	0	0	36	250	0	0	47.6	0.38
SCENEDESMUS	0	0	1036	1750	649	18	575.5	4.62
SCHROEDERIA	0	0	143	36	0	0	29.8	0.24
SELENASTRUM	0	0	0	0	27	0	4.5	0.04
STAURASTRUM	0	0	0	36	54	0	15.0	0.12
TETRAEDRON	0	0	0	250	27	0	46.2	0.37
TETRASTRUM	0	0	0	321	27	0	58.1	0.47
TREUBARIA	0	0	0	36	0	0	6.0	0.05
UNIDENTIFIED CHLOROPHYTA	1	12	679	1464	811	13	496.6	3.99
BACILLARIOPHYTA								
ACHNANTHES	1	6	0	71	0	68	24.5	0.20
AMPHORA	0	6	0	0	0	0	1.0	0.01
ASTERIONELLA	2	8	0	214	0	11	39.1	0.31
COCCONEIS	0	14	0	0	0	32	7.6	0.06
CYCLOTELLA	0	2	7429	6571	892	50	2490.6	20.01
CYMBELLA	1	63	143	0	0	142	58.1	0.47
DENTICULA	0	2	0	0	0	0	0.3	0.00
DIATOMA	3	12	0	0	0	197	35.4	0.28
EUNOTIA	0	2	0	0	0	0	0.3	0.00
FRAGILARIA	0	18	0	0	0	39	9.5	0.08
GOMPHONEMA	5	163	0	0	0	47	35.8	0.29
GYROSIGMA	0	0	0	0	0	5	0.9	0.01
HANNAEA	0	0	0	0	0	3	0.4	0.00
MELOSIRA	0	33	107	1107	108	132	247.9	1.99
MERIDION	0	57	0	0	0	24	13.4	0.11
NAVICULA	9	247	107	36	162	363	154.0	1.24
NITZSCHIA	11	186	2643	1893	378	445	926.0	7.44
PINNULARIA	0	0	0	0	0	5	0.9	0.01
RHOICOSPHENIA	0	6	0	0	0	3	1.4	0.01
STEPHANODISCUS	1	18	4107	1643	17513	53	3889.1	31.25
SURIRELLA	0	18	0	0	0	5	3.8	0.03
SYNEDRA	1	20	714	286	0	55	179.3	1.44
TABELLARIA	0	6	0	0	0	0	1.0	0.01
CYANOPHYTA								
CHROOCOCCUS	0	0	0	0	0	5	0.9	0.01
MERISMOPEDIA	0	0	0	286	0	0	47.6	0.38
MICROCYSTIS	0	0	36	36	0	0	11.9	0.10
OSCILLATORIA	6	0	0	0	0	3	1.4	0.01
CHRYSOPHYTA								
DINOBYRON	0	0	36	0	0	3	6.4	0.05
TOTAL	40	896	28357	21286	22351	1737	12444.5	

Table B-31. Percent total and density (units/ml) of phytoplankton in bimonthly samples (indicated by date and collection number) at Bell Bend on the Susquehanna River, 1978.

TAXON	13 FEB AJG-78-001	14 APR AJG-78-025	14 JUN AJG-78-033	16 AUG AJG-78-057	16 OCT AJG-78-065	14 DEC AJG-78-081	MEAN	% TOTAL
CHLOROPHYTA								
ACTINASTRUM	0	0	0	179	0	0	29.8	0.25
ANKISTRODESMUS	0	2	607	821	270	11	285.2	2.40
CHLAMYDOMONAS	0	8	5929	571	108	0	1102.7	9.27
CHODATELLA	0	0	321	143	0	0	77.4	0.65
CLOSTERIUM	0	0	0	0	0	5	0.9	0.01
COELASTRUM	0	0	0	179	0	3	30.2	0.25
CRUCIGENIA	0	0	0	250	0	0	41.7	0.35
DICTYOSPHAERIUM	0	0	357	2857	270	16	583.4	4.90
GOLENKINIA	0	0	36	250	27	0	52.1	0.44
KIRCHNERIELLA	0	0	214	250	189	0	108.9	0.92
MICRACTINIUM	0	0	286	0	27	0	52.1	0.44
OOCYSTIS	0	0	0	71	27	0	16.4	0.14
PEDIASTRUM	0	0	0	36	0	0	6.0	0.05
SCENEDESMUS	0	0	1250	2071	541	32	648.9	5.45
SCHROEDERIA	0	0	71	143	0	0	35.7	0.30
SELENASTRUM	0	0	0	0	27	0	4.5	0.04
STAURASTRUM	0	0	0	107	0	0	17.9	0.15
TETRAEDRON	0	0	143	143	27	0	52.1	0.44
TETRASTRUM	0	0	71	286	27	0	64.0	0.54
TREUBARIA	0	0	0	36	0	0	6.0	0.05
ULOTHRIX	0	0	0	0	0	8	1.3	0.01
UNIDENTIFIED CHLOROPHYTA	0	12	214	2143	730	13	518.6	4.36
BACILLARIOPHYTA								
ACHNANTHES	0	10	0	0	27	45	13.6	0.11
AMPHORA	0	6	0	0	0	0	1.0	0.01
ASTERIONELLA	0	4	0	0	0	3	1.1	0.01
COCCONEIS	0	6	0	0	0	45	8.4	0.07
CYCLOTELLA	0	2	8286	3643	1676	21	2271.2	19.09
CYMBELLA	2	29	0	0	0	124	25.8	0.22
DIATOMA	3	8	0	0	0	237	41.3	0.35
EUNOTIA	0	2	0	0	0	0	0.3	0.00
FRAGILARIA	0	29	0	0	0	5	5.8	0.05
GOMPHONEMA	0	165	0	0	27	74	44.2	0.37
HANNAEA	0	6	0	0	0	0	1.0	0.01
MELOSIRA	0	25	36	2143	703	63	495.0	4.16
MERIDION	0	73	0	0	0	0	12.1	0.10
NAVICULA	6	253	214	36	135	382	170.9	1.44
NITZSCHIA	6	218	2964	2000	378	463	1004.9	8.45
PINNULARIA	0	0	0	0	0	8	1.3	0.01
RHOICOSPHENIA	0	0	0	0	0	16	2.6	0.02
STEPHANODISCUS	0	6	4429	2429	15486	0	3724.9	31.31
SURIRELLA	0	8	0	0	0	8	2.6	0.02
SYNEDRA	2	29	893	143	0	45	185.3	1.56
TABELLARIA	0	0	71	0	0	0	11.9	0.10
CYANOPHYTA								
CHROOCOCCUS	0	0	0	143	0	0	23.8	0.20
MERISMOPEDIA	0	0	0	500	27	0	87.8	0.74
MICROCYSTIS	0	0	0	0	27	0	4.5	0.04
OSCILLATORIA	0	14	36	0	0	16	10.9	0.09
SCHIZOTHRIX	0	0	0	0	0	11	1.8	0.01
EUGLENOPHYTA								
EUGLENA	0	0	36	0	0	3	6.4	0.05
TOTAL	19	914	26464	21571	20757	1653	11896.2	

Table B-32. Phytoplankton species composing at least 5% of the total units counted in samples at two stations on the Susquehanna River, 1978. Numbers following diatoms indicate the species affinity for pH as rated by Lowe (1974): 1 = alkaliphilous; 2 = acidophilous; 3 = indifferent to pH; and 4 = unknown.

Species		SSES	Bell Bend
CHLOROPHYTA			
Chlamydomonas globosa		Jun	Jun
Dictyosphaerium pulchellum		Aug	Aug
Scenedesmus quadricauda		Aug	Aug
BACILLARIOPHYTA			
Cyclotella atomus	(4)	Aug	Aug
C. pseudostelligera	(1,3)	Jun, Aug	Jun, Aug
C. stelligera	(1,3)	Aug	
Cymbella minuta[a]	(1,3)	Apr, Dec	
Diatoma vulgare	(1)	Dec	Feb, Dec
Gomphonema olivaceum	(1)	Feb, Apr	Apr
Melosira distans	(2,3)		Aug
Meridion circulare	(1)	Apr	Apr
Navicula cryptocephala	(1)	Apr	Apr
N. cryptocephala var. veneta	(1)		Dec
N. salinarum var. intermedia	(4)	Dec	Dec
N. viridula	(1,3)	Feb, Apr	Feb, Apr
Nitzschia acicularis	(1)	Jun	Jun
N. dissipata	(1)	Feb, Apr, Dec	Apr, Dec
N. palea	(1,3)	Feb, Dec	Feb, Dec
Stephanodiscus invisitatus	(4)	Jun, Aug, Oct	Jun, Aug, Oct
CYANOPHYTA			
Oscillatoria sp.		Feb	

[a]Referred to as *Cymbella ventricosa* on page 49 in Gurzynski and Gale (1978); reclassified as *Cymbella minuta* by Patrick and Reimer (1975).

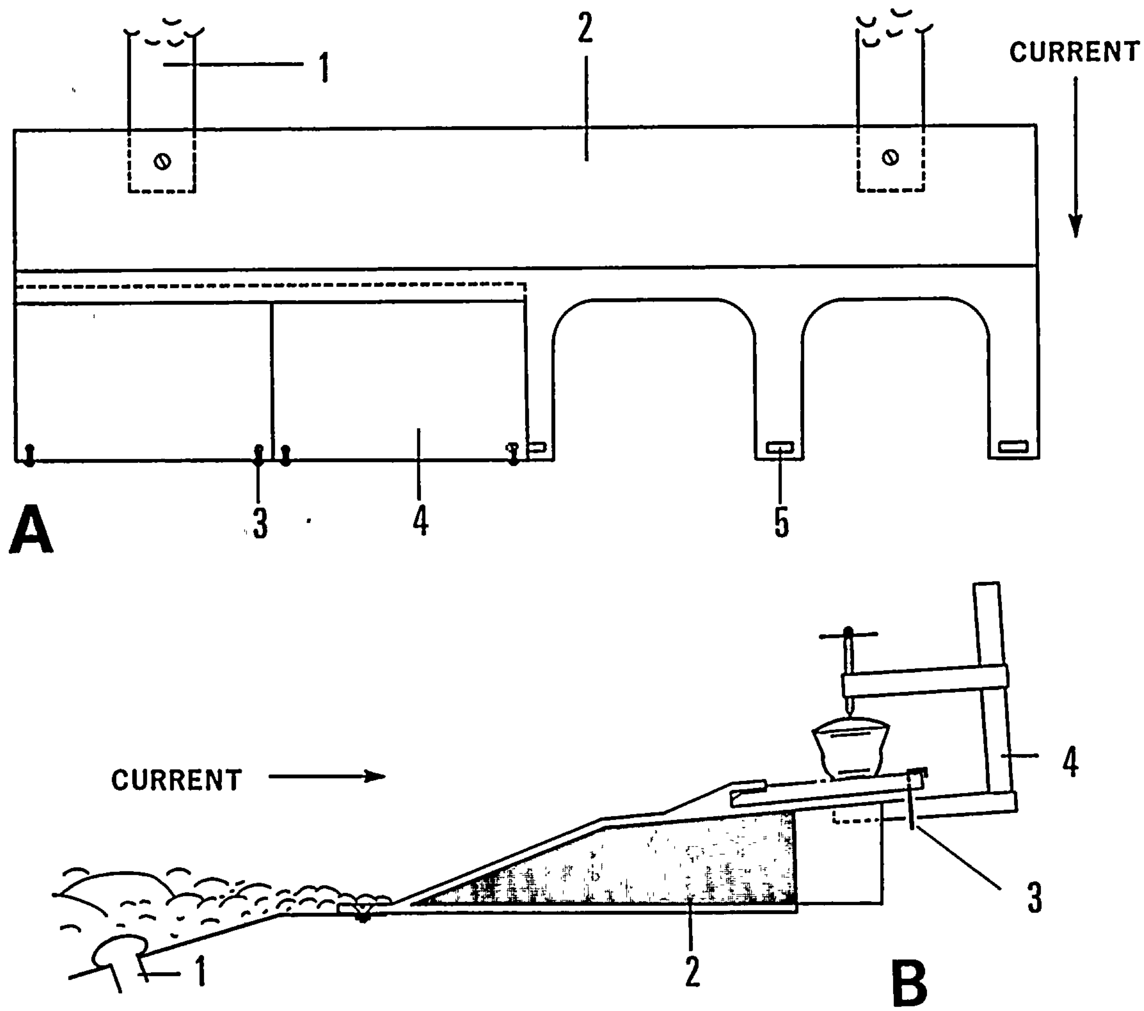

Fig. B-1. Detritus-free apparatus for periphytic algae studies. A. Acrylic holder with two plates removed (top view): 1) metal retaining strap; 2) deflecting shield, acrylic; 3) brass pin; 4) acrylic plate; 5) pin retaining slot. B. Acrylic holder (end view) with sampler in place: 1) steel stake (buried);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

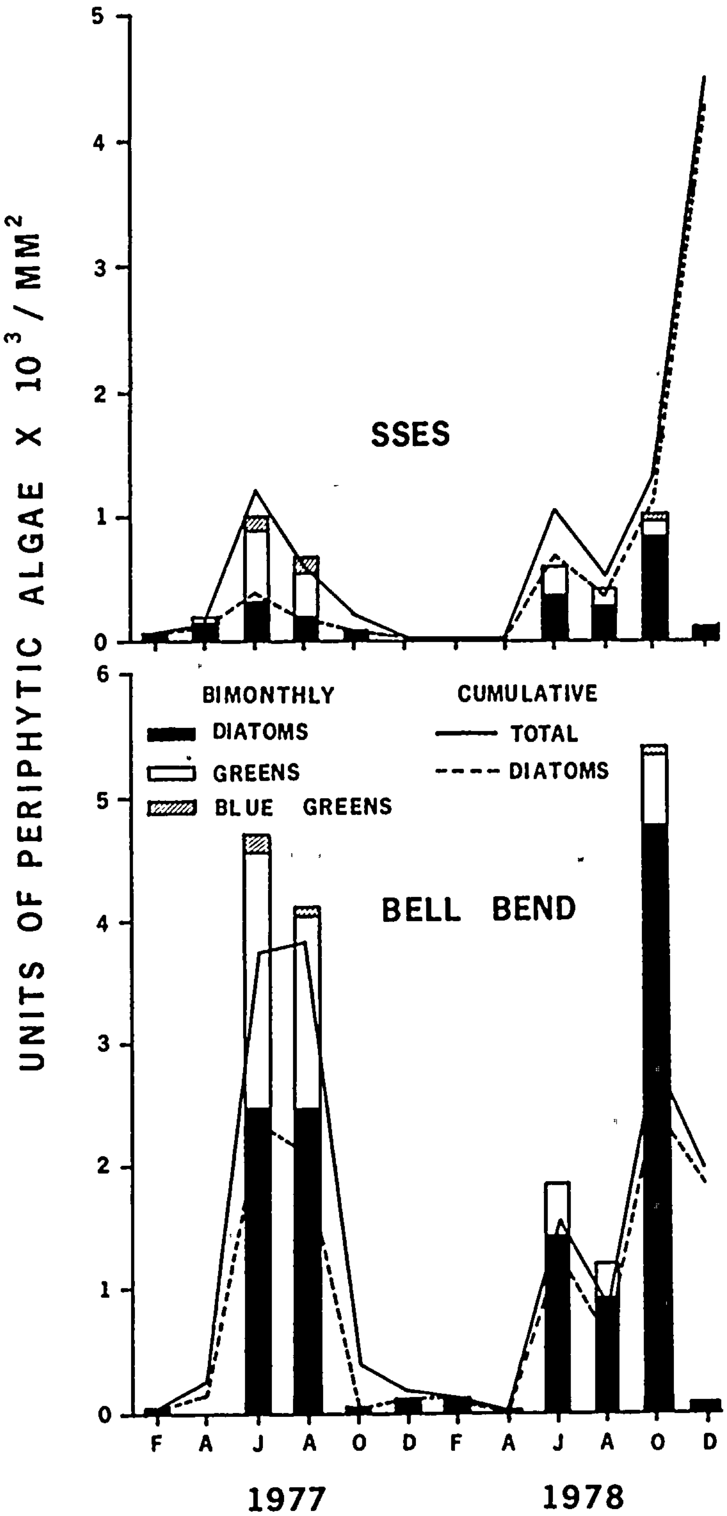

Fig. B-2. Standing crop of algae (units/mm^2) on bimonthly and cumulative acrylic plates at SSES and Bell Bend in 1977-78.

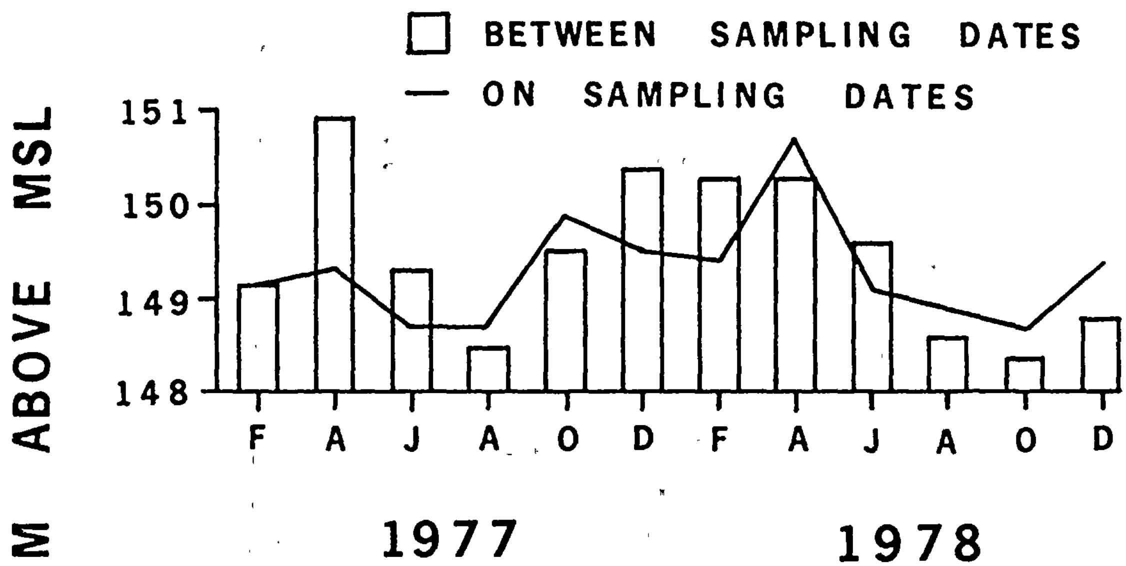

Fig. B-3. River level (meters above mean sea level) at SSES in 1977-78.

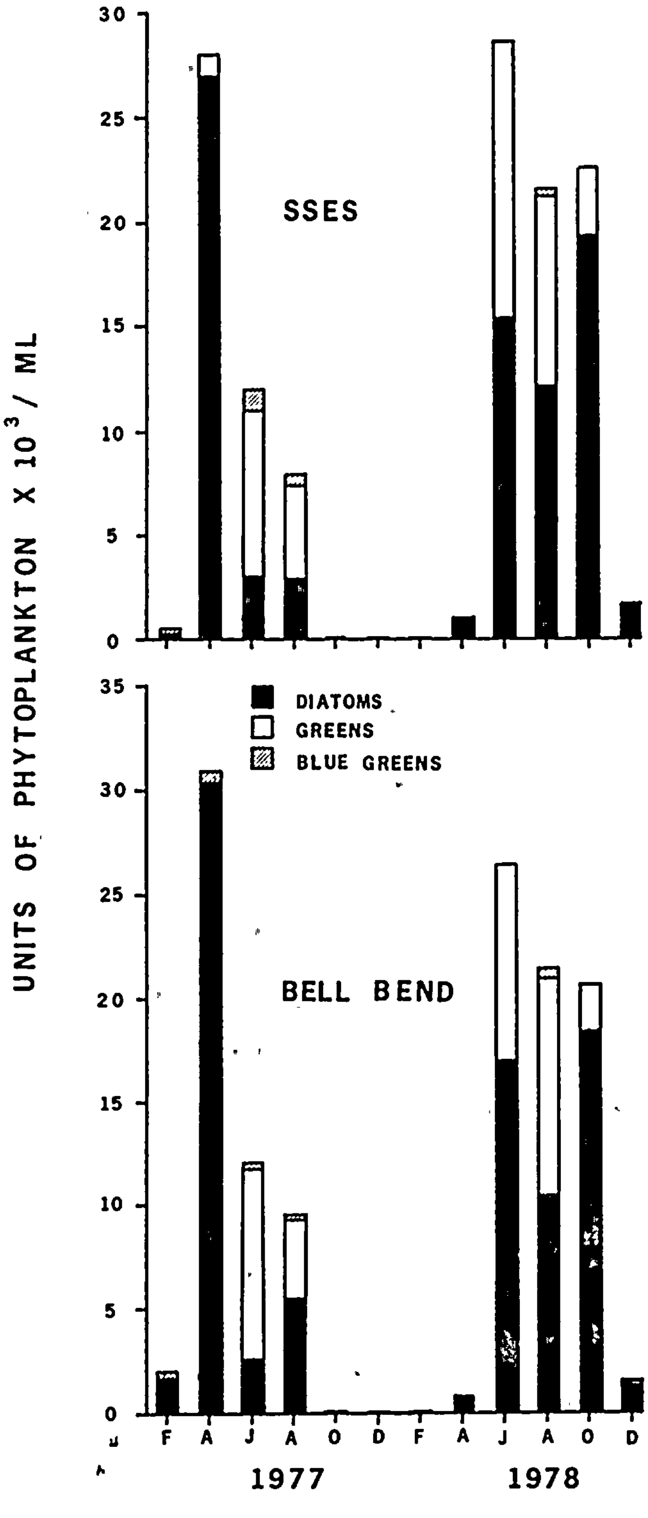

Fig. B-4. Standing crop of algae (units/ml) from bimonthly samples taken at SSES and Bell Bend in 1977-78.

BENTHIC MACROINVERTEBRATES

by

Lynn Sabin, William G. Deutsch, and William F. Gale

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ABSTRACT

The benthic macroinvertebrate community was sampled at four sites (two stations) in April, June, and October 1978. Two sites were upriver from the intake structure (SSES I and II) and two were below the discharge diffuser (Bell Bend I and III). Overall mean density of macroinvertebrates at SSES was 19,200 organisms/m^2 and at Bell Bend it was 8,600 org/m^2. Oligochaetes (Naididae and Tubificidae), mayflies (Caenidae and Heptageniidae), caddisflies (Hydropsychidae), and dipterans (Chironomidae) composed more than 90% of the total macroinvertebrates at each site. In 1978, total mean density and biomass were 3-fold and nearly 2-fold greater than in 1977, respectively; increases were primarily due to the much greater standing crop present at both stations in October 1978.

INTRODUCTION

Because benthic macroinvertebrates are relatively sessile and occur in large numbers, they are useful organisms to monitor water quality. Some species are highly selective in their choice of habitat and are, therefore, important indicators of both environmental quality and change (Paine and Gaufin 1956).

General environmental evaluations can be made when macroinvertebrates are identified to order or family (Mackenthum and Ingram 1967), but species within these groups have wide ranges of physicochemical tolerances (Resh and Unzicker 1975). For the latter reason, it is desirable to identify organisms to species for interpretation of macroinvertebrate data. The problem of insufficient taxonomic keys (especially for immature insect stages) has been ameliorated by recent literature (Lewis 1974; McCafferty 1974; Beck 1976; Edmunds et al. 1976; Resh 1976; Saether 1976, 1977a, b; Surdick and Kim 1976; Wiggins 1977; and Merritt and Cummins 1978).

The objective of this study was to monitor seasonal changes in the benthic community of the Susquehanna River near the Susquehanna SES throughout 1978.

PROCEDURES

Benthic macroinvertebrates were collected at four sites (two stations) near the Susquehanna SES (Fig. A-1). Two sites (SSES I and II) were upriver from the intake structure, and the other two (Bell Bend I and III) were downriver from the discharge diffuser; the Bell Bend III site was added in 1978. Locations of the other sites were unchanged from 1977 (Table C-1).

Three replicate dome suction samples (Gale and Thompson 1975) were collected at each site on 17, 18 April; 13-16 June; and 10, 12 October 1978. After the dome sampler was lowered from a boat to the river bottom, a scuba diver moved it upriver or laterally to the first undisturbed area encountered where an adequate seal between the sampler band and the substrate could be established. The area (0.163 m^2) enclosed by the sampler was vacuumed for five minutes with a hose leading to a bilge pump mounted on the sampler. Sand, gravel, and organisms were pumped into a nylon net (216-μ mesh); larger stones were carefully vacuumed and discarded.

When all three replicates were collected, they were returned to the boat by the diver.

One of three replicate samples was used for biomass estimates. It was important to keep organisms alive since Howmiller (1972) found that a considerable weight loss occurred due to the effects of preservatives. Therefore, organisms were sorted and identified as quickly as possible after collection (decomposition occurred quickly after death), and they were usually identified to family. Mollusc shells were dissolved in 1% HCL (decalcification). Organisms were then counted, placed in aluminum foil containers, and dried in a Precision Scientific Thelco Model 17 oven at 100 C for at least 12 hours. After drying, they were cooled to room temperature in a glass dessicator and weighed using a Mettler H10W balance.

The other two replicates were washed, sieved (U.S. Standard No. 60 sieve), and preserved in 10% buffered formalin. After a sample was macroscopically sorted, 1/4 of the residue was randomly selected in an acrylic subsampler (Ichthyological Associates 1973). Subsamples were examined with a dissecting microscope (30 X) and macroinvertebrates removed. The number of organisms in each subsample was multiplied by 4 and added to the number found in the initial sorting. Total number of organisms per sample was multiplied by 6.135 to convert the data to numbers/m^2. Invertebrates were identified (usually to genus or species) with the keys of Pennak (1953), Allen and Edmunds (1962, 1963a, b, 1965), Parrish (1968), and others noted above.

Data were analyzed using a series of BASIC computer programs written for a Hewlett-Packard 9830-A computer. These programs first calculated a between-sample similarity matrix using the Bray-Curtis (1957) index:

$$1 - \frac{\sum_{j=1}^{n} |X1_j - X2_j|}{\sum_{j=1}^{n} (X1_j + X2_j)}$$

where $X1_j$ and $X2_j$ represent the abundance of taxon j for samples 1 and 2, respectively, and n represents the number of taxa captured. The similarity matrix was then clustered by the group-average sorting technique (Clifford and Stephenson 1975). In this way samples could be classified according to similarity in taxonomic composition and abundance.

RESULTS AND DISCUSSION

Standing Crop

Overall mean density of macroinvertebrates in 1978 was much higher at SSES (19,200 organisms/m^2) than at Bell Bend (8,600 org/m^2) (Table C-2). Oligochaetes (Naididae and Tubificidae), mayflies (Caenidae and Heptageniidae), caddisflies (Hydropsychidae) and dipterans (Chironomidae) composed more than 90% of the total number of macroinvertebrates at each site. Three genera of chironomids (*Rheotanytarsus* sp., *Polypedilum* spp., and *Conchapelopia* spp.) were especially numerous and composed 28.1% of the standing crop. On the average, there were 3-fold more macroinvertebrates collected in 1978 than in 1977.

The lowest standing crop of macroinvertebrates was found in April (Fig. C-1) at all sites (Tables C-3 through C-6). Overall mean density was 1,000 org/m^2. Nematodes (28.1% of the standing crop) were abundant in April; at Bell Bend III there were 900 individuals/m^2. Oligochaetes (21.0%), chironomids (15.5%), and hydropsychids (13.6%) also predominated at both stations.

By June, the standing crop of macroinvertebrates had increased markedly at all sites with the largest gains being made at SSES I and II (Tables C-7 through C-10). Much of the increase at all sites was due to the oligochaete population which composed 45.9% of the total standing crop. At SSES II there were 8,800 naidids/m^2. Also, the density of mayflies (Caenidae and Heptageniidae), caddisflies (Hydropsychidae), and dipterans (Chironomidae) increased; each of these groups composed about 17% of the standing crop.

Numbers of macroinvertebrates peaked at all sites in October (Tables C-11 through C-14; Fig. C-1). Density at SSES I ($\bar{x}$ = 53,000 org/m^2) was much higher than had been found at any time in the previous three sampling years at either station. The greater densities were probably due to low river flow in September and the first half of October 1978 (Fig. A-2). High river flows in late September 1975 (Hurricane Eloise) and in October 1977, seemed to have reduced macroinvertebrate standing crops (Deutsch 1976, 1978).

In October, chironomids ($\bar{x}$ = 12,100 org/m^2) and caddisflies ($\bar{x}$ = 9,600 org/m^2) composed 77.5% of the standing crop. Three genera of chironomids (*Rheotanytarsus* sp., *Conchapelopia* spp., and *Polypedilum* spp.) and two genera of hydropsychid caddisflies (*Cheumatopsyche* spp. and *Hydropsyche* spp.) were especially numerous. At Bell Bend I, leptocerid and psychomyiid caddisflies composed over 10% of the standing crop.

Cluster analysis showed marked seasonal differences in taxonomic composition and abundance at all sites (Fig. C-2). Analysis of four years of data (1975-78) revealed that all months but one (April 1977) formed distinct clusters. As a whole, the analysis gave strong evidence that seasonal changes were more important in characterizing the macrobenthic community than station or site differences.

Individual sites, often difficult to categorize without multivariate techniques, generally represented distinct entities. The only misclassifications (fusion of two samples from different sites) occurred in early spring (1975-78) when high water may have disrupted the distribution of macroinvertebrates.

Between-site similarity patterns were inconsistent. For example, the SSES sites exhibited no more affinity to each other than to either of the Bell Bend sites (Fig. C-2). Based on these analyses, SSES is similar enough to Bell Bend to serve as a control.

A list of species found in dome samples from 1975 through 1978 is presented in Table C-15. Members of the *Interpunctatum* group in the genus *Stenonema* (Ephemeroptera: Heptageniidae) were placed in the genus *Stenacron* as recommended by Lewis (1974). In 1978, there were six additions to the more comprehensive species list of 1977 (Deutsch 1978). These identifications are in the process of being verified. Included were the mayflies, *Ephemerella sordida, Heterocloeon* sp., and *Stenacron gildersleevei;* the caddisflies, *Ceraclea neffi* and *Ptilostomis* sp.; and an aquatic noctuid (Lepidoptera) larva.

Biomass

Biomass (dry weight) in 1978 (11.0 kg/ha) was 79.0% greater than it was in 1977 (6.2 kg/ha). Total mean biomass was greater at SSES (16.7 kg/ha) than at Bell Bend (5.4 kg/ha) in 1978 (Tables C-16 and C-17). Hydropsychid caddisflies composed most of the biomass at SSES (63.7%) and Bell Bend (29.3%). Other major groups at Bell Bend were heptageniids (16.5%), oligochaetes (9.8%), and potamanthids (9.2%). Biomass was lowest in April and highest in October. In April, 58.0% of the biomass at the four sites was composed of hydropsychids ($\bar{x}$ = 1.1 kg/ha). In June, oligochaetes ($\bar{x}$ = 0.9 kg/ha) and mayflies ($\bar{x}$ = 3.2 kg/ha) composed 60.8% of the biomass. In October, hydropsychids ($\bar{x}$ = 16.9 kg/ha) composed 69.2% of the biomass.

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Table C-1. Description and location of benthic macroinvertebrate sampling sites on the Susquehanna River, 1978.

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	gravel-pebble
Location	817 m upriver from the center of the intake structure; 32 m from the west bank	817 m upriver from the center of the intake structure; 103 m from the west bank	791 m downriver from the center of the discharge diffuser; 37 m from the west bank	791 m downriver from the center of the discharge diffuser; 66 m from the west bank

[a]Station depths (m) when river surface elevation is 148.6 m above mean sea level at the Susquehanna SES Biological Laboratory.

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

Table C-2. Mean density (no./m^2) and percent total of benthic macroinvertebrates in six dome samples at each site on the Susquehanna River, 1978.

STATION	SSES		PERCENT	BELL BEND		PERCENT
SITE	I	II	TOTAL	I	III	TOTAL
TAXON						
HYDRA SP.	0	0	<0.1	4	2	<0.1
ALLOEOCOELA	4	1	<0.1	3	3	<0.1
TRICLADIDA	213	148	0.9	31	160	1.1
PROSTOMA SP.	80	128	0.5	196	359	3.2
NEMATODA	76	71	0.4	106	362	2.7
NAIDIDAE	4278	3395	20.0	1446	2112	20.6
TUBIFICIDAE	581	224	2.1	425	444	5.0
ASELLUS SP.	1	0	<0.1	0	0	<0.1
GAMMARUS SP.	1	0	<0.1	2	1	<0.1
ASTACIDAE	0	0	<0.1	0	1	<0.1
ISOTOMIDAE	1	0	<0.1	0	0	<0.1
PLECOPTERA	14	1	<0.1	0	7	<0.1
PERLIDAE	17	0	<0.1	0	1	<0.1
ACRONEURIA SPP.	0	2	<0.1	1	0	<0.1
ACRONEURIA ABNORMIS	1	0	<0.1	0	0	<0.1
ACRONEURIA LYCORIAS	0	1	<0.1	0	0	<0.1
NEOPERLA CLYMENE	18	1	<0.1	5	10	<0.1
PHASGANOPHORA SP.	2	1	<0.1	0	0	<0.1
EPHEMEROPTERA	3	0	<0.1	0	0	<0.1
EPHORON SP.	27	20	0.1	19	15	0.2
POTAMANTHUS SPP.	45	45	0.2	60	60	0.7
CAENIS SP.	441	196	1.7	118	426	3.1
TRICORYTHODES SP.	0	0	<0.1	0	1	<0.1
EPHEMERELLA SPP.	12	9	<0.1	1	3	<0.1
EPHEMERELLA DEFICIENS	3	8	<0.1	0	0	<0.1
EPHEMERELLA SORDIDA	0	2	<0.1	0	0	<0.1
PARALEPTOPHLEBIA ADOPTIVA	0	0	<0.1	0	1	<0.1
BAETIDAE	6	0	<0.1	0	0	<0.1
BAETIS SP.	4	7	<0.1	3	14	0.1
HETEROCLOEON SP.	0	1	<0.1	0	0	<0.1
SIPHLONURIDAE	2	0	<0.1	0	0	<0.1
ISONYCHIA SP.	37	181	0.6	10	25	0.2
HEPTAGENIIDAE	303	173	1.2	171	579	4.3
HEPTAGENIA SPP.	72	27	0.3	67	174	1.4
RHITHROGENA SP.	7	0	<0.1	0	1	<0.1
STENONEMA SPP.	113	134	0.6	75	122	1.1
STENONEMA FUSCUM	0	6	<0.1	0	2	<0.1
STENONEMA GILDERSLEEVEI	0	0	<0.1	4	0	<0.1
STENONEMA INTERPUNCTATUM	0	3	<0.1	11	1	<0.1
STENONEMA ITHACA	6	5	<0.1	0	4	<0.1
STENONEMA NEPOTELLUM	0	2	<0.1	2	2	<0.1
COENAGRIONIDAE	2	0	<0.1	1	0	<0.1
SIALIS SP.	10	7	<0.1	32	29	0.3
CORYDALUS CORNUTUS	0	1	<0.1	0	0	<0.1
TRICHOPTERA (PUPAE)	6	7	<0.1	1	1	<0.1
TRICHOPTERA (ADULTS)	0	0	<0.1	0	2	<0.1
POLYCENTROPODIDAE	0	0	<0.1	0	16	<0.1
NEURECLIPSIS SP.	84	73	0.4	59	70	0.7
HYDROPSYCHIDAE	693	481	3.1	43	376	2.4
CHEUMATOPSYCHE SPP.	6055	3248	24.2	483	2186	15.5
HYDROPSYCHE SPP.	2	1	<0.1	0	4	<0.1
HYDROPSYCHE BIFIDA GRP	49	34	0.2	0	5	<0.1
HYDROPSYCHE PHALERATA	405	314	1.9	17	97	0.7
MACRONEMA SPP.	1	7	<0.1	0	0	<0.1
MACRONEMA ZABRATA	0	1	<0.1	0	0	<0.1
HYDROPTILIDAE	30	25	0.1	0	12	<0.1
AGRAYLEA SP.	1	0	<0.1	0	0	<0.1
PTISLOSTOMIS SP.	1	0	<0.1	0	0	<0.1
LEPTOCERIDAE	135	110	0.6	90	75	1.0
CERACLEA SPP.	7	36	0.1	8	21	0.2
CERACLEA MACULATA	1	47	0.1	0	0	<0.1
CERACLEA NEFFI	0	5	<0.1	1	0	<0.1
OECETIS SPP.	95	44	0.4	110	81	1.1
OECETIS CINERACENS	113	80	0.5	10	103	0.7
NOCTUIDAE	1	0	<0.1	0	0	<0.1
DINEUTES SP.	0	0	<0.1	1	0	<0.1
BEROSUS SP.	2	0	<0.1	1	0	<0.1

Table C-2 (cont.)

STATION	SSES		PERCENT	BELL BEND		PERCENT
SITE	I	II	TOTAL	I	III	TOTAL
TAXON						
ELMIDAE (ADULTS)	4	1	<0.1	0	0	<0.1
DUBIRAPHIA SP.	0	1	<0.1	0	4	<0.1
OPTIOSERVUS SP.	19	2	<0.1	0	7	<0.1
STENELMIS SP.	120	89	0.5	19	35	0.3
STENELMIS SP.(ADULTS)	1	0	<0.1	0	0	<0.1
STENELMIS BICARINATA(ADULTS)	15	3	<0.1	0	1	<0.1
SIMULIIDAE	14	2	<0.1	1	5	<0.1
EMPIDIDAE	506	103	1.6	31	139	1.0
EMPIDIDAE (PUPAE)	1	0	<0.1	0	0	<0.1
CERATOPOGONIDAE	3	0	<0.1	13	8	0.1
CHIRONOMIDAE	72	8	0.2	5	43	0.3
CHIRONOMIDAE (PUPAE)	57	60	0.3	21	46	0.4
CHIRONOMIDAE (ADULTS)	10	3	<0.1	2	26	0.2
ABLABESMYIA SPP.	14	0	<0.1	20	32	0.3
ABLABESMYIA MALLOCHI	16	13	<0.1	24	52	0.4
CONCHAPELOPIA SPP.	2103	1189	8.6	150	1474	9.4
MACROPELOPIA SP.	0	1	<0.1	0	0	<0.1
PSECTROTANYPUS SP.	8	0	<0.1	0	0	<0.1
TANYPODINAE SP#1	36	15	0.1	1	27	0.2
CHIRONOMINAE	5	29	<0.1	0	0	<0.1
CHIRONOMUS SPP.	1	1	<0.1	0	1	<0.1
CRYPTOCHIRONOMUS SPP.	1	0	<0.1	2	1	<0.1
CRYPTOCHIRONOMUS BLARINA	0	2	<0.1	1	0	<0.1
CRYPTOCHIRONOMUS FULVUS	11	1	<0.1	26	30	0.3
DICROTENDIPES SPP.	208	74	0.7	83	176	1.5
DICROTENDIPES MODESTUS	24	9	<0.1	6	7	<0.1
ENDOCHIRONOMUS SPP.	1	1	<0.1	10	8	0.1
GLYPTOTENDIPES SP.	156	66	0.6	76	171	1.4
MICROPSECTRA SP.	0	1	<0.1	0	0	<0.1
MICROTENDIPES SP.	11	11	<0.1	22	36	0.3
PARACHIRONOMUS SPP.	17	0	<0.1	0	0	<0.1
PARACHIRONOMUS PECTINATELLAE	1	4	<0.1	0	0	<0.1
POLYPEDILUM SPP.	2272	1692	10.3	193	875	6.2
POLYPEDILUM FALLAX	3	5	<0.1	1	5	<0.1
RHEOTANYTARSUS SP.	3200	1542	12.3	134	797	5.4
TANYTARSUS SP.	77	18	0.2	57	53	0.6
TRIBELOS FUSICORNIS	0	0	<0.1	0	1	<0.1
TRIBELOS JUCUNDUS	0	0	<0.1	0	2	<0.1
ZAVRELIA SP.	131	26	0.4	41	178	1.3
ORTHOCLADIINAE	25	0	<0.1	0	0	<0.1
CARDIOCLADIUS SP.	0	1	<0.1	0	0	<0.1
CORYNONEURA TARIS	2	0	<0.1	0	4	<0.1
CRICOTOPUS SPP.	65	99	0.4	17	44	0.4
CRICOTOPUS BICINCTUS	210	51	0.7	4	11	<0.1
EUKIEFFERIELLA SP#1	47	39	0.2	0	6	<0.1
NANOCLADIUS SP.	52	132	0.5	95	122	1.3
PARAMETRIOCNEMUS SP.	0	1	<0.1	0	0	<0.1
SYNORTHOCLADIUS SP.	0	0	<0.1	1	0	<0.1
THIENEMANNIELLA SPP.	3	1	<0.1	0	14	<0.1
UNIDENTIFIED TERRESTRIAL	2	1	<0.1	0	5	<0.1
PISIDIUM SP.	6	6	<0.1	34	37	0.4
SPHAERIUM SPP.	28	185	0.6	13	93	0.6

Table C-3. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 18 April 1978. Replicates are indicated by collection number.

TAXON	LYS-78-002	LYS-78-003	MEAN	PERCENT TOTAL
NEMATODA	55.2	55.2	55.2	12.7
NAIDIDAE	42.9	12.3	27.6	6.3
TUBIFICIDAE	6.1	110.4	58.3	13.4
ISOTOMIDAE	0.0	6.1	3.1	0.7
PLECOPTERA	18.4	18.4	18.4	4.2
ACRONEURIA ABNORMIS	0.0	6.1	3.1	0.7
EPHEMEROPTERA	12.3	6.1	9.2	2.1
POTAMANTHUS SPP.	18.4	30.7	24.5	5.6
EPHEMERELLA SPP.	0.0	6.1	3.1	0.7
EPHEMERELLA DEFICIENS	0.0	6.1	3.1	0.7
ISONYCHIA SP.	0.0	12.3	6.1	1.4
HEPTAGENIIDAE	0.0	6.1	3.1	0.7
STENONEMA SPP.	6.1	24.5	15.3	3.5
HYDROPSYCHIDAE	6.1	0.0	3.1	0.7
CHEUMATOPSYCHE SPP.	0.0	24.5	12.3	2.8
HYDROPSYCHE BIFIDA GRP	0.0	12.3	6.1	1.4
HYDROPSYCHE PHALERATA	0.0	18.4	9.2	2.1
NOCTUIDAE	0.0	6.1	3.1	0.7
STENELMIS SP.	61.3	36.8	49.1	11.3
STENELMIS SP.(ADULTS)	0.0	6.1	3.1	0.7
EMPIDIDAE	18.4	24.5	21.5	4.9
CHIRONOMIDAE (PUPAE)	0.0	6.1	3.1	0.7
CHIRONOMIDAE (ADULTS)	18.4	18.4	18.4	4.2
CONCHAPELOPIA SPP.	30.7	49.1	39.9	9.2
CHIRONOMINAE	6.1	0.0	3.1	0.7
CRYPTOCHIRONOMUS FULVUS	6.1	0.0	3.1	0.7
POLYPEDILUM SPP.	6.1	18.4	12.3	2.8
RHEOTANYTARSUS SP.	6.1	0.0	3.1	0.7
ZAVRELIA SP.	6.1	6.1	6.1	1.4
ORTHOCLADIINAE	0.0	12.3	6.1	1.4
SPHAERIUM SPP.	0.0	6.1	3.1	0.7
TOTAL	325.1	546.0	435.6	

Table C-4. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 18 April 1978. Replicates are indicated by collection number.

TAXON	LYS-78-005	LYS-78-006	MEAN	PERCENT TOTAL
TRICLADIDA	6.1	18.4	12.3	0.8
PROSTOMA SP.	36.8	42.9	39.9	2.6
NEMATODA	36.8	184.0	110.4	7.1
NAIDIDAE	257.7	128.8	193.3	12.4
TUBIFICIDAE	79.8	67.5	73.6	4.7
ACRONEURIA LYCORIAS	6.1	0.0	3.1	0.2
POTAMANTHUS SPP.	104.3	42.9	73.6	4.7
EPHEMERELLA SPP.	6.1	6.1	6.1	0.4
EPHEMERELLA DEFICIENS	6.1	0.0	3.1	0.2
HEPTAGENIIDAE	12.3	12.3	12.3	0.8
STENONEMA SPP.	24.5	6.1	15.3	1.0
HYDROPSYCHIDAE	0.0	6.1	3.1	0.2
CHEUMATOPSYCHE SPP.	343.6	263.8	303.7	19.5
HYDROPSYCHE SPP.	0.0	6.1	3.1	0.2
HYDROPSYCHE BIFIDA GRP	24.5	18.4	21.5	1.4
HYDROPSYCHE PHALERATA	55.2	30.7	42.9	2.8
HYDROPTILIDAE	12.3	6.1	9.2	0.6
CERACLEA MACULATA	6.1	0.0	3.1	0.2
OECETIS SPP.	141.1	18.4	79.8	5.1
OECETIS CINERACENS	24.5	6.1	15.3	1.0
DUBIRAPHIA SP.	6.1	0.0	3.1	0.2
OPTIOSERVUS SP.	12.3	0.0	6.1	0.4
STENELMIS SP.	85.9	79.8	82.8	5.3
STENELMIS BICARINATA(ADULTS)	6.1	6.1	6.1	0.4
EMPIDIDAE	147.2	73.6	110.4	7.1
CHIRONOMIDAE (PUPAE)	6.1	0.0	3.1	0.2
CONCHAPELOPIA SPP.	147.2	42.9	95.1	6.1
MACROPELOPIA SP.	6.1	0.0	3.1	0.2
CHIRONOMINAE	0.0	12.3	6.1	0.4
CRYPTOCHIRONOMUS BLARINA	12.3	0.0	6.1	0.4
GLYPTOTENDIPES SP.	30.7	6.1	18.4	1.2
MICROPSECTRA SP.	6.1	0.0	3.1	0.2
POLYPEDILUM SPP.	30.7	36.8	33.7	2.2
POLYPEDILUM FALLAX	12.3	0.0	6.1	0.4
RHEOTANYTARSUS SP.	177.9	42.9	110.4	7.1
ZAVRELIA SP.	6.1	6.1	6.1	0.4
CRICOTOPUS SPP.	6.1	18.4	12.3	0.8
EUKIEFFERIELLA SP#1	12.3	6.1	9.2	0.6
PARAMETRIOCNEMUS SP.	6.1	0.0	3.1	0.2
SPHAERIUM SPP.	12.3	0.0	6.1	0.4
TOTAL	1914.0	1196.3	1555.1	

Table C-5. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 17 April 1978. Replicates are indicated by collection number.

TAXON	LYS-78-008	LYS-78-009	MEAN	PERCENT TOTAL
NEMATODA	73.6	6.1	39.9	5.5
NAIDIDAE	49.1	6.1	27.6	3.8
TUBIFICIDAE	460.1	374.2	417.2	57.6
POTAMANTHUS SPP.	30.7	6.1	18.4	2.5
EPHEMERELLA SPP.	6.1	0.0	3.1	0.4
ISONYCHIA SP.	12.3	0.0	6.1	0.8
HEPTAGENIIDAE	6.1	6.1	6.1	0.8
STENONEMA SPP.	36.8	12.3	24.5	3.4
CHEUMATOPSYCHE SPP.	67.5	42.9	55.2	7.6
HYDROPSYCHE PHALERATA	6.1	18.4	12.3	1.7
OECETIS SPP.	6.1	0.0	3.1	0.4
STENELMIS SP.	18.4	6.1	12.3	1.7
EMPIDIDAE	6.1	12.3	9.2	1.3
CONCHAPELOPIA SPP.	12.3	0.0	6.1	0.8
CRYPTOCHIRONOMUS BLARINA	6.1	0.0	3.1	0.4
CRYPTOCHIRONOMUS FULVUS	12.3	6.1	9.2	1.3
DICROTENDIPES MODESTUS	6.1	0.0	3.1	0.4
ENDOCHIRONOMUS SPP.	12.3	0.0	6.1	0.8
POLYPEDILUM SPP.	30.7	18.4	24.5	3.4
POLYPEDILUM FALLAX	6.1	0.0	3.1	0.4
RHEOTANYTARSUS SP.	0.0	6.1	3.1	0.4
ZAVRELIA SP.	6.1	18.4	12.3	1.7
CRICOTOPUS SPP.	12.3	0.0	6.1	0.8
SYNORTHOCLADIUS SP.	0.0	6.1	3.1	0.4
SPHAERIUM SPP.	18.4	0.0	9.2	1.3
TOTAL	901.8	546.0	723.9	

Table C-6. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend III on the Susquehanna River, 17 April 1978. Replicates are indicated by collection number.

TAXON	LYS-78-011	LYS-78-012	MEAN	PERCENT TOTAL
TRICLADIDA	0.0	6.1	3.1	0.2
PROSTOMA SP.	0.0	12.3	6.1	0.5
NEMATODA	1607.4	208.6	908.0	73.3
NAIDIDAE	6.1	30.7	18.4	1.5
TUBIFICIDAE	18.4	6.1	12.3	1.0
PLECOPTERA	0.0	12.3	6.1	0.5
POTAMANTHUS SPP.	18.4	30.7	24.5	2.0
EPHEMERELLA SPP.	0.0	12.3	6.1	0.5
PARALEPTOPHLEBIA ADOPTIVA	0.0	6.1	3.1	0.2
ISONYCHIA SP.	0.0	12.3	6.1	0.5
HEPTAGENIIDAE	0.0	12.3	6.1	0.5
STENONEMA SPP.	0.0	24.5	12.3	1.0
STENONEMA FUSCUM	6.1	6.1	6.1	0.5
STENONEMA INTERPUNCTATUM	6.1	0.0	3.1	0.2
CHEUMATOPSYCHE SPP.	36.8	49.1	42.9	3.5
HYDROPSYCHE BIFIDA GRP	6.1	6.1	6.1	0.5
HYDROPSYCHE PHALERATA	12.3	18.4	15.3	1.2
CERACLEA SPP.	6.1	0.0	3.1	0.2
OECETIS SPP.	6.1	6.1	6.1	0.5
STENELMIS SP.	18.4	12.3	15.3	1.2
STENELMIS BICARINATA(ADULTS)	0.0	6.1	3.1	0.2
EMPIDIDAE	6.1	0.0	3.1	0.2
CHIRONOMIDAE (PUPAE)	6.1	0.0	3.1	0.2
CHIRONOMIDAE (ADULTS)	0.0	6.1	3.1	0.2
CONCHAPELOPIA SPP.	0.0	42.9	21.5	1.7
DICROTENDIPES MODESTUS	0.0	6.1	3.1	0.2
MICROTENDIPES SP.	6.1	0.0	3.1	0.2
POLYPEDILUM SPP.	6.1	18.4	12.3	1.0
POLYPEDILUM FALLAX	6.1	0.0	3.1	0.2
RHEOTANYTARSUS SP.	18.4	18.4	18.4	1.5
TANYTARSUS SP.	12.3	6.1	9.2	0.7
TRIBELOS FUSICORNIS	0.0	6.1	3.1	0.2
ZAVRELIA SP.	18.4	12.3	15.3	1.2
CRICOTOPUS SPP.	18.4	18.4	18.4	1.5
NANOCLADIUS SP.	6.1	6.1	6.1	0.5
UNIDENTIFIED TERRESTRIAL	6.1	0.0	3.1	0.2
TOTAL	1858.8	619.6	1239.1	

Table C-7. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 14 June 1978. Replicates are indicated by collection number.

TAXON	LYS-78-017	LYS-78-018	MEAN	PERCENT TOTAL
PROSTOMA SP.	6.1	36.8	21.5	0.1
NEMATODA	104.3	135.0	119.6	0.7
NAIDIDAE	5116.6	7079.8	6098.2	35.0
TUBIFICIDAE	822.1	858.9	840.5	4.8
ASELLUS SP.	0.0	6.1	3.1	0.0
PLECOPTERA	24.5	24.5	24.5	0.1
NEOPERLA CLYMENE	49.1	61.3	55.2	0.3
PHASGANOPHORA SP.	0.0	12.3	6.1	0.0
EPHORON SP.	110.4	49.1	79.8	0.5
POTAMANTHUS SPP.	55.2	122.7	89.0	0.5
CAENIS SP.	1276.1	1343.6	1309.8	7.5
EPHEMERELLA SPP.	12.3	49.1	30.7	0.2
EPHEMERELLA DEFICIENS	12.3	0.0	6.1	0.0
BAETIDAE	36.8	0.0	18.4	0.1
BAETIS SP.	6.1	18.4	12.3	0.1
SIPHLONURIDAE	12.3	0.0	6.1	0.0
ISONYCHIA SP.	128.8	18.4	73.6	0.4
HEPTAGENIIDAE	644.2	441.7	542.9	3.1
HEPTAGENIA SPP.	147.2	141.1	144.2	0.8
RHITHROGENA SP.	6.1	36.8	21.5	0.1
STENONEMA SPP.	67.5	42.9	55.2	0.3
SIALIS SP.	18.4	18.4	18.4	0.1
TRICHOPTERA (PUPAE)	6.1	30.7	18.4	0.1
HYDROPSYCHIDAE	374.2	558.3	466.3	2.7
CHEUMATOPSYCHE SPP.	4865.0	2871.2	3868.1	22.2
HYDROPSYCHE SPP.	6.1	0.0	3.1	0.0
HYDROPSYCHE PHALERATA	24.5	6.1	15.3	0.1
CERACLEA SPP.	18.4	0.0	9.2	0.1
OECETIS SPP.	12.3	0.0	6.1	0.0
OPTIOSERVUS SP.	18.4	30.7	24.5	0.1
STENELMIS SP.	92.0	147.2	119.6	0.7
SIMULIIDAE	61.3	12.3	36.8	0.2
EMPIDIDAE	0.0	6.1	3.1	0.0
EMPIDIDAE (PUPAE)	6.1	0.0	3.1	0.0
CERATOPOGONIDAE	12.3	6.1	9.2	0.1
CHIRONOMIDAE	49.1	0.0	24.5	0.1
CHIRONOMIDAE (PUPAE)	67.5	98.2	82.8	0.5
CHIRONOMIDAE (ADULTS)	6.1	18.4	12.3	0.1
ABLABESMYIA SPP.	12.3	24.5	18.4	0.1
ABLABESMYIA MALLOCHI	61.3	36.8	49.1	0.3
CONCHAPELOPIA SPP.	490.8	466.3	478.5	2.7
TANYPODINAE SP#1	98.2	116.6	107.4	0.6
CHIRONOMINAE	12.3	0.0	6.1	0.0
CRYPTOCHIRONOMUS SPP.	0.0	6.1	3.1	0.0
CRYPTOCHIRONOMUS FULVUS	6.1	36.8	21.5	0.1
DICROTENDIPES MODESTUS	6.1	0.0	3.1	0.0
GLYPTOTENDIPES SP.	85.9	92.0	89.0	0.5
MICROTENDIPES SP.	24.5	18.4	21.5	0.1
PARACHIRONOMUS SPP.	6.1	0.0	3.1	0.0
PARACHIRONOMUS PECTINATELLAE	0.0	6.1	3.1	0.0
POLYPEDILUM SPP.	619.6	773.0	696.3	4.0
POLYPEDILUM FALLAX	6.1	12.3	9.2	0.1
RHEOTANYTARSUS SP.	957.1	1110.4	1033.7	5.9
TANYTARSUS SP.	104.3	110.4	107.4	0.6
ZAVRELIA SP.	300.6	374.2	337.4	1.9
ORTHOCLADIINAE	36.8	98.2	67.5	0.4
CORYNONEURA TARIS	12.3	0.0	6.1	0.0
CRICOTOPUS SPP.	30.7	12.3	21.5	0.1
CRICOTOPUS BICINCTUS	6.1	0.0	3.1	0.0
EUKIEFFERIELLA SP#1	30.7	6.1	18.4	0.1
NANOCLADIUS SP.	6.1	6.1	6.1	0.0
THIENEMANNIELLA SPP.	18.4	0.0	9.2	0.1
UNIDENTIFIED TERRESTRIAL	12.3	0.0	6.1	0.0
TOTAL	17219.0	17587.5	17403.0	

Table C-8. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 16 June 1978. Replicates are indicated by collection number.

TAXON	LYS-78-020	LYS-78-021	MEAN	PERCENT TOTAL
TRICLADIDA	12.3	0.0	6.1	0.0
PROSTOMA SP.	184.0	67.5	125.8	0.8
NEMATODA	55.2	30.7	42.9	0.3
NAIDIDAE	13588.9	3950.9	8769.9	59.0
TUBIFICIDAE	245.4	147.2	196.3	1.3
PLECOPTERA	6.1	0.0	3.1	0.0
ACRONEURIA SPP.	12.3	0.0	6.1	0.0
NEOPERLA CLYMENE	6.1	0.0	3.1	0.0
EPHORON SP.	110.4	12.3	61.3	0.4
POTAMANTHUS SPP.	36.8	42.9	39.9	0.3
CAENIS SP.	944.8	147.2	546.0	3.7
EPHEMERELLA SPP.	0.0	24.5	12.3	0.1
EPHEMERELLA DEFICIENS	42.9	0.0	21.5	0.1
EPHEMERELLA SORDIDA	0.0	12.3	6.1	0.0
BAETIS SP.	24.5	18.4	21.5	0.1
HETEROCLOEON SP.	0.0	6.1	3.1	0.0
ISONYCHIA SP.	834.4	92.0	463.2	3.1
HEPTAGENIIDAE	325.2	104.3	214.7	1.4
HEPTAGENIA SPP.	85.9	73.6	79.8	0.5
STENONEMA SPP.	6.1	30.7	18.4	0.1
STENONEMA INTERPUNCTATUM	6.1	0.0	3.1	0.0
STENONEMA NEPOTELLUM	12.3	0.0	6.1	0.0
SIALIS SP.	42.9	0.0	21.5	0.1
CORYDALUS CORNUTUS	6.1	0.0	3.1	0.0
TRICHOPTERA (PUPAE)	18.4	24.5	21.5	0.1
HYDROPSYCHIDAE	42.9	24.5	33.7	0.2
CHEUMATOPSYCHE SPP.	1638.0	582.8	1110.4	7.5
HYDROPSYCHE PHALERATA	49.1	24.5	36.8	0.2
MACRONEMA ZABRATA	6.1	0.0	3.1	0.0
LEPTOCERIDAE	98.2	24.5	61.3	0.4
CERACLEA SPP.	0.0	159.5	79.8	0.5
CERACLEA MACULATA	245.4	30.7	138.0	0.9
CERACLEA NEFFI	30.7	0.0	15.3	0.1
OECETIS SPP.	12.3	12.3	12.3	0.1
STENELMIS SP.	147.2	85.9	116.6	0.8
STENELMIS BICARINATA(ADULTS)	6.1	0.0	3.1	0.0
SIMULIIDAE	12.3	0.0	6.1	0.0
EMPIDIDAE	30.7	0.0	15.3	0.1
CHIRONOMIDAE (PUPAE)	135.0	73.6	104.3	0.7
CHIRONOMIDAE (ADULTS)	12.3	6.1	9.2	0.1
ABLABESMYIA MALLOCHI	55.2	24.5	39.9	0.3
CONCHAPELOPIA SPP.	190.2	42.9	116.6	0.8
TANYPODINAE SP#1	67.5	24.5	46.0	0.3
CHIRONOMINAE	55.2	104.3	79.8	0.5
CHIRONOMUS SPP.	6.1	0.0	3.1	0.0
GLYPTOTENDIPES SP.	98.2	24.5	61.3	0.4
MICROTENDIPES SP.	49.1	0.0	24.5	0.2
POLYPEDILUM SPP.	926.4	343.6	635.0	4.3
POLYPEDILUM FALLAX	6.1	12.3	9.2	0.1
RHEOTANYTARSUS SP.	1282.2	306.7	794.5	5.3
TANYTARSUS SP.	49.1	30.7	39.9	0.3
ZAVRELIA SP.	67.5	73.6	70.6	0.5
CARDIOCLADIUS SP.	6.1	0.0	3.1	0.0
CRICOTOPUS SPP.	116.6	282.2	199.4	1.3
CRICOTOPUS BICINCTUS	18.4	6.1	12.3	0.1
EUKIEFFERIELLA SP#1	98.2	12.3	55.2	0.4
NANOCLADIUS SP.	116.6	104.3	110.4	0.7
THIENEMANNIELLA SPP.	6.1	0.0	3.1	0.0
UNIDENTIFIED TERRESTRIAL	6.1	0.0	3.1	0.0
SPHAERIUM SPP.	141.1	85.9	113.5	0.8
TOTAL	22432.8	7288.0	14859.5	

Table C-9. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 13 June 1978. Replicates are indicated by collection number.

TAXON	LYS-78-023	LYS-78-024	MEAN	PERCENT TOTAL
PROSTOMA SP.	30.7	73.6	52.1	0.9
NEMATODA	294.5	135.0	214.7	3.6
NAIDIDAE	2325.2	3435.6	2880.4	47.8
TUBIFICIDAE	208.6	687.1	447.9	7.4
GAMMARUS SP.	6.1	6.1	6.1	0.1
ACRONEURIA SPP.	6.1	0.0	3.1	0.1
NEOPERLA CLYMENE	6.1	24.5	15.3	0.3
EPHORON SP.	61.3	55.2	58.3	1.0
POTAMANTHUS SPP.	128.8	92.0	110.4	1.8
CAENIS SP.	380.4	312.9	346.6	5.8
BAETIS SP.	0.0	18.4	9.2	0.2
ISONYCHIA SP.	6.1	42.9	24.5	0.4
HEPTAGENIIDAE	331.3	404.9	368.1	6.1
HEPTAGENIA SPP.	196.3	208.6	202.5	3.4
STENONEMA SPP.	0.0	6.1	3.1	0.1
STENONEMA GILDERSLEEVEI	0.0	24.5	12.3	0.2
STENONEMA NEPOTELLUM	6.1	6.1	6.1	0.1
SIALIS SP.	24.5	147.2	85.9	1.4
TRICHOPTERA (PUPAE)	0.0	6.1	3.1	0.1
HYDROPSYCHIDAE	6.1	251.5	128.8	2.1
CHEUMATOPSYCHE SPP.	227.0	202.5	214.7	3.6
CERACLEA SPP.	0.0	18.4	9.2	0.2
CERACLEA NEFFI	0.0	6.1	3.1	0.1
OECETIS SPP.	18.4	30.7	24.5	0.4
DINEUTES SP.	0.0	6.1	3.1	0.1
STENELMIS SP.	61.3	12.3	36.8	0.6
SIMULIIDAE	6.1	0.0	3.1	0.1
EMPIDIDAE	6.1	6.1	6.1	0.1
CERATOPOGONIDAE	0.0	30.7	15.3	0.3
CHIRONOMIDAE	0.0	24.5	12.3	0.2
CHIRONOMIDAE (PUPAE)	0.0	24.5	12.3	0.2
CHIRONOMIDAE (ADULTS)	0.0	12.3	6.1	0.1
ABLABESMYIA MALLOCHI	92.0	49.1	70.6	1.2
CONCHAPELOPIA SPP.	85.9	110.4	98.2	1.6
TANYPODINAE SP#1	6.1	0.0	3.1	0.1
CRYPTOCHIRONOMUS SPP.	6.1	0.0	3.1	0.1
CRYPTOCHIRONOMUS FULVUS	24.5	55.2	39.9	0.7
DICROTENDIPES SPP.	0.0	6.1	3.1	0.1
GLYPTOTENDIPES SP.	12.3	42.9	27.6	0.5
MICROTENDIPES SP.	67.5	67.5	67.5	1.1
POLYPEDILUM SPP.	67.5	104.3	85.9	1.4
RHEOTANYTARSUS SP.	6.1	42.9	24.5	0.4
TANYTARSUS SP.	104.3	42.9	73.6	1.2
ZAVRELIA SP.	42.9	55.2	49.1	0.8
CRICOTOPUS SPP.	36.8	55.2	46.0	0.8
NANOCLADIUS SP.	18.4	177.9	98.2	1.6
SPHAERIUM SPP.	24.5	0.0	12.3	0.2
TOTAL	4932.3	7122.5	6027.3	

Table C-10. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend III on the Susquehanna River, 15 June 1978. Replicates are indicated by collection number.

TAXON	LYS-78-026	LYS-78-027	MEAN	PERCENT TOTAL
HYDRA SP.	0.0	12.3	6.1	0.0
TRICLADIDA	6.1	6.1	6.1	0.0
PROSTOMA SP.	61.3	61.3	61.3	0.5
NEMATODA	92.0	30.7	61.3	0.5
NAIDIDAE	3865.0	3441.7	3653.4	28.3
TUBIFICIDAE	877.3	343.6	610.4	4.7
GAMMARUS SP.	0.0	6.1	3.1	0.0
ASTACIDAE	6.1	0.0	3.1	0.0
PLECOPTERA	6.1	24.5	15.3	0.1
PERLIDAE	6.1	0.0	3.1	0.0
NEOPERLA CLYMENE	18.4	42.9	30.7	0.2
EPHORON SP.	55.2	36.8	46.0	0.4
POTAMANTHUS SPP.	98.2	104.3	101.2	0.8
CAENIS SP.	1331.3	1214.7	1273.0	9.9
EPHEMERELLA SPP.	0.0	6.1	3.1	0.0
BAETIS SP.	42.9	42.9	42.9	0.3
ISONYCHIA SP.	36.8	98.2	67.5	0.5
HEPTAGENIIDAE	1245.4	957.1	1101.2	8.5
HEPTAGENIA SPP.	496.9	546.0	521.5	4.0
RHITHROGENA SP.	6.1	0.0	3.1	0.0
STENONEMA SPP.	24.5	12.3	18.4	0.1
SIALIS SP.	55.2	79.8	67.5	0.5
TRICHOPTERA (PUPAE)	0.0	6.1	3.1	0.0
TRICHOPTERA (ADULTS)	0.0	12.3	6.1	0.0
HYDROPSYCHIDAE	552.1	582.8	567.5	4.4
CHEUMATOPSYCHE SPP.	2362.0	2055.2	2208.6	17.1
HYDROPSYCHE PHALERATA	42.9	24.5	33.7	0.3
LEPTOCERIDAE	6.1	0.0	3.1	0.0
OECETIS SPP.	12.3	67.5	39.9	0.3
OPTIOSERVUS SP.	18.4	18.4	18.4	0.1
STENELMIS SP.	24.5	12.3	18.4	0.1
SIMULIIDAE	12.3	18.4	15.3	0.1
EMPIDIDAE	6.1	0.0	3.1	0.0
CERATOPOGONIDAE	0.0	24.5	12.3	0.1
CHIRONOMIDAE	24.5	0.0	12.3	0.1
CHIRONOMIDAE (PUPAE)	49.1	36.8	42.9	0.3
CHIRONOMIDAE (ADULTS)	79.8	67.5	73.6	0.6
ABLABESMYIA SPP.	0.0	18.4	9.2	0.1
ABLABESMYIA MALLOCHI	122.7	190.2	156.4	1.2
CONCHAPELOPIA SPP.	300.6	177.9	239.3	1.9
TANYPODINAE SP#1	67.5	92.0	79.8	0.6
CRYPTOCHIRONOMUS SPP.	6.1	0.0	3.1	0.0
CRYPTOCHIRONOMUS FULVUS	42.9	12.3	27.6	0.2
GLYPTOTENDIPES SP.	30.7	49.1	39.9	0.3
MICROTENDIPES SP.	79.8	98.2	89.0	0.7
POLYPEDILUM SPP.	362.0	509.2	435.6	3.4
POLYPEDILUM FALLAX	24.5	0.0	12.3	0.1
RHEOTANYTARSUS SP.	202.5	441.7	322.1	2.5
TANYTARSUS SP.	67.5	36.8	52.1	0.4
ZAVRELIA SP.	441.7	374.2	408.0	3.2
CORYNONEURA TARIS	24.5	0.0	12.3	0.1
CRICOTOPUS SPP.	36.8	141.1	89.0	0.7
EUKIEFFERIELLA SP#1	0.0	12.3	6.1	0.0
NANOCLADIUS SP.	55.2	104.3	79.8	0.6
THIENEMANNIELLA SPP.	61.3	24.5	42.9	0.3
SPHAERIUM SPP.	36.8	24.5	30.7	0.2
TOTAL	13483.2	12299.7	12890.9	

Table C-11. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES I on the Susquehanna River, 10 October 1978. Replicates are indicated by collection number.

TAXON	LYS-78-039	LYS-78-040	MEAN	PERCENT TOTAL
ALLOEOCOELA	12.3	12.3	12.3	0.0
TRICLADIDA	625.8	650.3	638.0	1.2
PROSTOMA SP.	263.8	171.8	217.8	0.4
NEMATODA	55.2	49.1	52.1	0.1
NAIDIDAE	5877.3	7539.9	6708.6	12.7
TUBIFICIDAE	717.8	969.3	843.6	1.6
GAMMARUS SP.	6.1	0.0	3.1	0.0
PERLIDAE	30.7	73.6	52.1	0.1
POTAMANTHUS SPP.	12.3	30.7	21.5	0.0
CAENIS SP.	6.1	18.4	12.3	0.0
EPHEMERELLA SPP.	0.0	6.1	3.1	0.0
ISONYCHIA SP.	0.0	61.3	30.7	0.1
HEPTAGENIIDAE	257.7	466.3	362.0	0.7
STENONEMA SPP.	141.1	398.8	269.9	0.5
STENONEMA ITHACA	12.3	24.5	18.4	0.0
COENAGRIONIDAE	12.3	0.0	6.1	0.0
SIALIS SP.	0.0	24.5	12.3	0.0
NEURECLIPSIS SP.	110.4	392.6	251.5	0.5
HYDROPSYCHIDAE	1773.0	1447.9	1610.4	3.0
CHEUMATOPSYCHE SPP.	12380.3	16190.1	14285.2	27.0
HYDROPSYCHE SPP.	6.1	0.0	3.1	0.0
HYDROPSYCHE BIFIDA GRP	67.5	214.7	141.1	0.3
HYDROPSYCHE PHALERATA	1159.5	1220.9	1190.2	2.2
MACRONEMA SPP.	0.0	6.1	3.1	0.0
HYDROPTILIDAE	73.6	104.3	89.0	0.2
AGRAYLEA SP.	6.1	0.0	3.1	0.0
PTISLOSTOMIS SP.	6.1	0.0	3.1	0.0
LEPTOCERIDAE	171.8	638.0	404.9	0.8
CERACLEA SPP.	0.0	24.5	12.3	0.0
CERACLEA MACULATA	6.1	0.0	3.1	0.0
OECETIS SPP.	98.2	460.1	279.1	0.5
OECETIS CINERACENS	214.7	466.3	340.5	0.6
BEROSUS SP.	0.0	12.3	6.1	0.0
ELMIDAE (ADULTS)	24.5	0.0	12.3	0.0
OPTIOSERVUS SP.	6.1	61.3	33.7	0.1
STENELMIS SP.	79.8	300.6	190.2	0.4
STENELMIS BICARINATA(ADULTS)	36.8	55.2	46.0	0.1
SIMULIIDAE	0.0	12.3	6.1	0.0
EMPIDIDAE	1049.1	1938.7	1493.9	2.8
CHIRONOMIDAE	355.8	24.5	190.2	0.4
CHIRONOMIDAE (PUPAE)	110.4	61.3	85.9	0.2
ABLABESMYIA SPP.	0.0	49.1	24.5	0.0
CONCHAPELOPIA SPP.	4104.3	7478.5	5791.4	10.9
PSECTROTANYPUS SP.	0.0	49.1	24.5	0.0
CHIRONOMINAE	12.3	0.0	6.1	0.0
CHIRONOMUS SPP.	6.1	0.0	3.1	0.0
CRYPTOCHIRONOMUS FULVUS	6.1	12.3	9.2	0.0
DICROTENDIPES SPP.	466.3	779.1	622.7	1.2
DICROTENDIPES MODESTUS	85.9	49.1	67.5	0.1
ENDOCHIRONOMUS SPP.	6.1	0.0	3.1	0.0
GLYPTOTENDIPES SP.	269.9	490.8	380.4	0.7
MICROTENDIPES SP.	0.0	24.5	12.3	0.0
PARACHIRONOMUS SPP.	0.0	98.2	49.1	0.1
POLYPEDILUM SPP.	4717.8	7496.9	6107.4	11.5
RHEOTANYTARSUS SP.	7631.9	9496.9	8564.4	16.2
TANYTARSUS SP.	73.6	171.8	122.7	0.2
ZAVRELIA SP.	49.1	49.1	49.1	0.1
CRICOTOPUS SPP.	153.4	196.3	174.8	0.3
CRICOTOPUS BICINCTUS	411.0	840.5	625.8	1.2
EUKIEFFERIELLA SP#1	85.9	159.5	122.7	0.2
NANOCLADIUS SP.	104.3	196.3	150.3	0.3
PISIDIUM SP.	18.4	18.4	18.4	0.0
SPHAERIUM SPP.	49.1	110.4	79.8	0.2
TOTAL	44016.5	61893.6	52954.4	

Table C-12. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at SSES II on the Susquehanna River, 10 October 1978. Replicates are indicated by collection number.

TAXON	LYS-78-042	LYS-78-043	MEAN	PERCENT TOTAL
ALLOEOCOELA	0.0	6.1	3.1	0.0
TRICLADIDA	674.8	177.9	426.4	1.5
PROSTOMA SP.	349.7	85.9	217.8	0.8
NEMATODA	116.6	0.0	58.3	0.2
NAIDIDAE	1858.9	582.8	1220.9	4.4
TUBIFICIDAE	742.3	61.3	401.8	1.4
PHASGANOPHORA SP.	6.1	0.0	3.1	0.0
POTAMANTHUS SPP.	36.8	6.1	21.5	0.1
CAENIS SP.	85.9	0.0	42.9	0.2
EPHEMERELLA SPP.	18.4	0.0	9.2	0.0
ISONYCHIA SP.	122.7	36.8	79.8	0.3
HEPTAGENIIDAE	484.7	98.2	291.4	1.0
STENONEMA SPP.	509.2	227.0	368.1	1.3
STENONEMA FUSCUM	36.8	0.0	18.4	0.1
STENONEMA INTERPUNCTATUM	12.3	0.0	6.1	0.0
STENONEMA ITHACA	24.5	6.1	15.3	0.1
NEURECLIPSIS SP.	362.0	73.6	217.8	0.8
HYDROPSYCHIDAE	2159.5	650.3	1404.9	5.0
CHEUMATOPSYCHE SPP.	12374.2	4288.3	8331.3	29.8
HYDROPSYCHE BIFIDA GRP	141.1	18.4	79.8	0.3
HYDROPSYCHE PHALERATA	1374.2	349.7	862.0	3.1
MACRONEMA SPP.	42.9	0.0	21.5	0.1
HYDROPTILIDAE	79.8	49.1	64.4	0.2
LEPTOCERIDAE	423.3	116.6	269.9	1.0
CERACLEA SPP.	55.2	0.0	27.6	0.1
OECETIS SPP.	73.6	6.1	39.9	0.1
OECETIS CINERACENS	349.7	98.2	223.9	0.8
ELMIDAE (ADULTS)	0.0	6.1	3.1	0.0
STENELMIS SP.	67.5	67.5	67.5	0.2
EMPIDIDAE	245.4	122.7	184.0	0.7
CHIRONOMIDAE	12.3	36.8	24.5	0.1
CHIRONOMIDAE (PUPAE)	98.2	49.1	73.6	0.3
CONCHAPELOPIA SPP.	5073.6	1638.0	3355.8	12.0
CRYPTOCHIRONOMUS FULVUS	0.0	6.1	3.1	0.0
DICROTENDIPES SPP.	349.7	92.0	220.9	0.8
DICROTENDIPES MODESTUS	24.5	30.7	27.6	0.1
ENDOCHIRONOMUS SPP.	0.0	6.1	3.1	0.0
GLYPTOTENDIPES SP.	190.2	49.1	119.6	0.4
MICROTENDIPES SP.	18.4	0.0	9.2	0.0
PARACHIRONOMUS PECTINATELLAE	24.5	0.0	12.3	0.0
POLYPEDILUM SPP.	5950.9	2865.0	4408.0	15.7
RHEOTANYTARSUS SP.	5865.0	1576.7	3720.9	13.3
TANYTARSUS SP.	24.5	6.1	15.3	0.1
CRICOTOPUS SPP.	135.0	36.8	85.9	0.3
CRICOTOPUS BICINCTUS	171.8	110.4	141.1	0.5
EUKIEFFERIELLA SP#1	79.8	24.5	52.1	0.2
NANOCLADIUS SP.	466.3	104.3	285.3	1.0
PISIDIUM SP.	6.1	30.7	18.4	0.1
SPHAERIUM SPP.	785.3	85.9	435.6	1.6
TOTAL	42102.8	13882.8	27992.3	

Table C-13. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend I on the Susquehanna River, 12 October 1978. Replicates are indicated by collection number.

TAXON	LYS-78-045	LYS-78-046	MEAN	PERCENT TOTAL
HYDRA SP.	0.0	24.5	12.3	0.2
ALLOEOCOELA	18.4	0.0	9.2	0.1
TRICLADIDA	104.3	79.8	92.0	1.2
PROSTOMA SP.	208.6	865.0	536.8	7.2
NEMATODA	122.7	6.1	64.4	0.9
NAIDIDAE	779.1	2079.8	1429.4	19.3
TUBIFICIDAE	337.4	484.7	411.0	5.5
POTAMANTHUS SPP.	49.1	55.2	52.1	0.7
CAENIS SP.	12.3	0.0	6.1	0.1
HEPTAGENIIDAE	42.9	233.1	138.0	1.9
STENONEMA SPP.	251.5	141.1	196.3	2.6
STENONEMA INTERPUNCTATUM	0.0	67.5	33.7	0.5
COENAGRIONIDAE	0.0	6.1	3.1	0.0
SIALIS SP.	6.1	12.3	9.2	0.1
NEURECLIPSIS SP.	141.1	214.7	177.9	2.4
CHEUMATOPSYCHE SPP.	1533.7	822.1	1177.9	15.9
HYDROPSYCHE PHALERATA	61.3	18.4	39.9	0.5
LEPTOCERIDAE	0.0	539.9	269.9	3.6
CERACLEA SPP.	6.1	24.5	15.3	0.2
OECETIS SPP.	36.8	570.6	303.7	4.1
OECETIS CINERACENS	42.9	18.4	30.7	0.4
BEROSUS SP.	0.0	6.1	3.1	0.0
STENELMIS SP.	12.3	6.1	9.2	0.1
EMPIDIDAE	24.5	128.8	76.7	1.0
CERATOPOGONIDAE	0.0	49.1	24.5	0.3
CHIRONOMIDAE	0.0	6.1	3.1	0.0
CHIRONOMIDAE (PUPAE)	24.5	79.8	52.1	0.7
ABLABESMYIA SPP.	0.0	122.7	61.3	0.8
CONCHAPELOPIA SPP.	288.3	404.9	346.6	4.7
CRYPTOCHIRONOMUS SPP.	6.1	0.0	3.1	0.0
CRYPTOCHIRONOMUS FULVUS	30.7	24.5	27.6	0.4
DICROTENDIPES SPP.	171.8	319.0	245.4	3.3
DICROTENDIPES MODESTUS	30.7	0.0	15.3	0.2
ENDOCHIRONOMUS SPP.	24.5	24.5	24.5	0.3
GLYPTOTENDIPES SP.	110.4	288.3	199.4	2.7
POLYPEDILUM SPP.	447.9	490.8	469.3	6.3
RHEOTANYTARSUS SP.	398.8	349.7	374.2	5.0
TANYTARSUS SP.	24.5	171.8	98.2	1.3
ZAVRELIA SP.	24.5	98.2	61.3	0.8
CRICOTOPUS BICINCTUS	0.0	24.5	12.3	0.2
NANOCLADIUS SP.	110.4	263.8	187.1	2.5
PISIDIUM SP.	24.5	177.9	101.2	1.4
SPHAERIUM SPP.	24.5	12.3	18.4	0.2
TOTAL	5533.5	9312.7	7423.1	

Table C-14. Density (no./m^2) and percent total of benthic macroinvertebrates collected with a dome sampler at Bell Bend III on the Susquehanna River, 12 October 1978. Replicates are indicated by collection number.

TAXON	LYS-78-048	LYS-78-049	MEAN	PERCENT TOTAL
ALLOEOCOELA	6.1	12.3	9.2	0.0
TRICLADIDA	447.9	490.8	469.3	2.0
PROSTOMA SP.	1607.4	411.0	1009.2	4.3
NEMATODA	177.9	55.2	116.6	0.5
NAIDIDAE	2533.7	2797.5	2665.6	11.3
TUBIFICIDAE	901.8	515.3	708.6	3.0
POTAMANTHUS SPP.	73.6	36.8	55.2	0.2
CAENIS SP.	12.3	0.0	6.1	0.0
TRICORYTHODES SP.	0.0	6.1	3.1	0.0
HEPTAGENIIDAE	754.6	503.1	628.8	2.7
STENONEMA SPP.	349.7	319.0	334.4	1.4
STENONEMA ITHACA	18.4	6.1	12.3	0.1
STENONEMA NEPOTELLUM	0.0	12.3	6.1	0.0
SIALIS SP.	6.1	30.7	18.4	0.1
POLYCENTROPODIDAE	49.1	49.1	49.1	0.2
NEURECLIPSIS SP.	165.6	251.5	208.6	0.9
HYDROPSYCHIDAE	742.3	380.4	561.3	2.4
CHEUMATOPSYCHE SPP.	4693.3	3920.2	4306.7	18.3
HYDROPSYCHE SPP.	0.0	24.5	12.3	0.1
HYDROPSYCHE BIFIDA GRP	0.0	18.4	9.2	0.0
HYDROPSYCHE PHALERATA	331.3	153.4	242.3	1.0
HYDROPTILIDAE	24.5	49.1	36.8	0.2
LEPTOCERIDAE	319.0	122.7	220.9	0.9
CERACLEA SPP.	49.1	73.6	61.3	0.3
OECETIS SPP.	257.7	135.0	196.3	0.8
OECETIS CINERACENS	349.7	269.9	309.8	1.3
DUBIRAPHIA SP.	24.5	0.0	12.3	0.1
OPTIOSERVUS SP.	0.0	6.1	3.1	0.0
STENELMIS SP.	61.3	79.8	70.6	0.3
EMPIDIDAE	674.8	147.2	411.0	1.7
CERATOPOGONIDAE	24.5	0.0	12.3	0.1
CHIRONOMIDAE	128.8	104.3	116.6	0.5
CHIRONOMIDAE (PUPAE)	30.7	153.4	92.0	0.4
ABLABESMYIA SPP.	147.2	24.5	85.9	0.4
CONCHAPELOPIA SPP.	3908.0	4417.2	4162.6	17.7
CHIRONOMUS SPP.	0.0	6.1	3.1	0.0
CRYPTOCHIRONOMUS FULVUS	42.9	79.8	61.3	0.3
DICROTENDIPES SPP.	343.6	711.7	527.6	2.2
DICROTENDIPES MODESTUS	6.1	30.7	18.4	0.1
ENDOCHIRONOMUS SPP.	24.5	24.5	24.5	0.1
GLYPTOTENDIPES SP.	435.6	509.2	472.4	2.0
MICROTENDIPES SP.	0.0	30.7	15.3	0.1
POLYPEDILUM SPP.	2024.5	2331.3	2177.9	9.3
RHEOTANYTARSUS SP.	1834.4	2263.8	2049.1	8.7
TANYTARSUS SP.	122.7	73.6	98.2	0.4
TRIBELOS JUCUNDUS	12.3	0.0	6.1	0.0
ZAVRELIA SP.	147.2	73.6	110.4	0.5
CRICOTOPUS SPP.	24.5	24.5	24.5	0.1
CRICOTOPUS BICINCTUS	0.0	67.5	33.7	0.1
EUKIEFFERIELLA SP#1	24.5	0.0	12.3	0.1
NANOCLADIUS SP.	276.1	282.2	279.1	1.2
UNIDENTIFIED TERRESTRIAL	0.0	24.5	12.3	0.1
PISIDIUM SP.	104.3	116.6	110.4	0.5
SPHAERIUM SPP.	300.6	196.3	248.5	1.1
TOTAL	24593.4	22421.8	23507.4	

Table C-15. Benthic macroinvertebrates collected in dome samples at SSES and Bell Bend on the Susquehanna River, 1975-78. An asterisk denotes macroinvertebrates collected for the first time in dome samples in 1978.

	SSES	BELL BEND
Coelenterata		
Hydroida		
Hydra sp.	X	X
Platyhelminthes		
Turbellaria		
Alloeocoela	X	X
Tricladida	X	X
Nemertea		
Tetrastemmatidae		
Prostoma sp.	X	X
Nematoda	X	X
Endoprocta		
Urnatella gracilis		X
Annelida		
Oligochaeta		
Naididae	X	X
Tubificidae	X	X
Arthropoda		
Crustacea		
Isopoda		
Asellus sp.	X*	X
Amphipoda		
Gammarus sp.	X	X
Decapoda		
Astacidae		X*
Insecta		
Collembola		
Isotomidae		
Isotomurus palustris	X	X
Plecoptera		
Taeniopterygidae		
Taeniopteryx sp.	X	X
Leuctridae		
Leuctra sp.	X	
Perlidae		
Acroneuria abnormis	X*	
A. lycorias	X*	
Acroneuria spp.	X	X
Neoperla clymene	X	X
Phasganophora capitata	X	
Phasganophora sp.	X	X
Perlesta sp.	X	
Ephemeroptera		
Ephemeridae		
Ephemera sp.		X
Polymitarcidae		
Ephoron sp.	X	X
Potamanthidae		
Potamanthus spp.	X	X
Caenidae		
Caenis sp.	X	X
Tricorythidae		
Tricorythodes sp.		X*
Ephemerellidae		
Ephemerella bicolor	X	
E. coxalis		X
E. deficiens	X	X
E. invaria	X	X
E. sordida	X*	
E. walkeri	X	
Ephemerella spp.	X	X
Leptophlebiidae		
Paraleptophlebia adoptiva		X*
Baetidae		
Baetis sp.	X	X
Heterocloeon sp.	X*	
Psuedocloeon sp.	X	X
Ephemeroptera (cont.)		
Siphlonuridae		
Isonychia sp.	X	X
Heptageniidae		
Epeorus sp.	X	X
Heptagenia spp.	X	X
Rhithrogena sp.	X	X*
Stenacron gildersleevei		X*
S. interpunctatum	X	X
Stenonema fuscum	X	X
S. ithaca	X	X
S. nepotellum	X	X
S. rubrum	X	
Stenonema spp.	X	X
Odonata		
Coenagrionidae	X	X
Megaloptera		
Sialidae		
Sialis sp.	X	X
Corydalidae		
Chauliodes sp.	X	
Corydalus cornutus	X*	
Trichoptera		
Glossosomatidae		
Protoptila sp.	X	
Philopotamidae		
Chimarra obscura	X	X
Polycentropodidae		
Neureclipsis sp.	X	X
Polycentropus sp.	X	X
Hydropsychidae		
Cheumatopsyche spp.	X	X
Hydropsyche bifida grp.	X	X
H. phalerata	X	X
Hydropsyche spp.	X	X
Macronema carolina	X	
M. zebratum	X	X
Macronema spp.	X	
Hydroptilidae	X	X
Agraylea sp.	X*	
Phryganeidae		
Ptilostomis sp.	X*	
Leptoceridae	X	X
Ceraclea ancylus	X	
C. maculata	X	
C. neffi	X*	X*
C. nepha	X	X
C. tarsipunctata	X	X
Ceraclea spp.	X	X
Nectopsyche sp.		X
Oecetis cinerascens	X	X
O. inconspicua	X	
Oecetis spp.	X	X
Lepidoptera		
Noctuidae	X*	
Coleoptera		
Gyrinidae		
Dineutes sp.		X*
Hydrophilidae		
Berosus sp.	X	X*
Psephenidae		
Psephenus herricki	X	
Elmidae		
Dubiraphia sp.	X	X
Optioservus sp.	X	X
Stenelmis bicarinata	X*	X*
Stenelmis sp.	X	X

Table C-15 (cont.)

	SSES	BELL BEND
Diptera		
Tipulidae		
Antocha saxicola	X	X
Simuliidae	X	X
Empididae	X	X
Ceratopogonidae	X	X
Chironomidae		
Tanypodinae		
Ablabesmia mallochi	X	X
A. ornata	X	
A. peleensis	X	
A. rhamphe	X	
Ablabesmyia spp.	X	X
Conchapelopia spp.	X	X
Macropelopia sp.	X*	X
Procladius sp.		X
Psectrotanypus sp.	X*	
Tanypodinae sp. #1	X	X
Chironominae		
Chironomus decorus		X
Chironomus spp.	X	X
Cryptochironomus blarina	X	X
C. fulvus	X	X
Cryptochironomus spp.	X	X
Demicryptochironomus sp.		X
Dicrotendipes modestus	X	X
Dicrotendipes spp.	X	X
Endochironomus spp.	X	X
Glyptotendipes sp.	X	X
Micropsectra sp.	X*	X
Microtendipes sp.	X	X
Parachironomus carinatus	X	
P. monochromus	X	X
P. pectinatellae	X	X
Parachironomus spp.	X	
Polypedilum fallax	X*	X*
Polypedilum spp.	X	X
Rheotanytarsus sp.	X	X
Stenochironomus sp.	X	
Stictochironomus sp.		X
Tanytarsus sp.	X	X
Tribelos fusicornis		X*
T. jucundus		X*
Zavrelia sp.	X	X
Diamesinae		
Diamesa sp. #4	X	X
Diamesa spp.		X
Pseudodiamesa sp.	X	
Orthocladiinae		
Brillia sp.	X	
Cardiocladius sp.	X*	
Corynoneura taris	X	X
Cricotopus bicinctus	X	X
Cricotopus spp.	X	X
Eukiefferiella sp. #1	X	X
E. coerulescens grp. sp. #1	X	X
Heterotrissocladius sp.	X	X
Nanocladius sp.	X	X
Orthocladius sp.		X
Parametriocnemus sp.	X*	
Rheocricotopus spp.	X	X
Synorthocladius sp.	X	X
Thienemanniella spp.	X	X

	SSES	BELL BEND
Mollusca		
Gastropoda		
Physidae		
Physa sp.	X	
Lymnaeidae		
Lymnaea sp.	X	
Ancylidae		
Ferrissia sp.	X	
Pelecypodae		
Sphaeriidae		
Pisidium sp.	X	X
Sphaerium spp.	X	X

Table 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 April, June, and October 1978.

SITE	SSES I			PERCENT	SSES II			PERCENT
MONTH	APR	JUN	OCT	TOTAL	APR	JUN	OCT	TOTAL
TAXON								
TRICLADIDA	0.0	0.0	98.2	1.9	<0.1	0.0	6.1	0.1
TETRASTEMMATIDAE	0.0	0.0	12.3	0.2	0.0	0.0	<0.1	<0.1
NEMATODA	<0.1	<0.1	<0.1	<0.1	6.1	0.0	<0.1	0.1
OLIGOCHAETA	6.1	141.1	135.0	5.4	18.4	12.3	67.5	2.1
PTERONARCIDAE	0.0	0.0	0.0	<0.1	0.0	0.0	122.7	2.6
PERLIDAE	0.0	6.1	135.0	2.7	0.0	<0.1	92.0	1.9
POLYMITARCIDAE	0.0	6.1	0.0	0.1	0.0	<0.1	0.0	<0.1
POTAMANTHIDAE	12.3	98.2	12.3	2.3	12.3	79.8	6.1	2.1
CAENIDAE	0.0	6.1	<0.1	0.1	<0.1	6.1	<0.1	0.1
EPHEMERELLIDAE	0.0	30.7	<0.1	0.6	0.0	6.1	0.0	0.1
BAETIDAE	0.0	12.3	0.0	0.2	0.0	0.0	0.0	<0.1
SIPHLONURIDAE	<0.1	196.3	12.3	4.0	6.1	6.1	24.5	0.8
HEPTAGENIIDAE	6.1	177.9	122.7	5.8	6.1	49.1	104.3	3.4
COENAGRIONIDAE	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	<0.1
SIALIDAE	0.0	<0.1	0.0	<0.1	0.0	0.0	49.1	1.0
TRICHOPTERA (PUPAE)	0.0	36.8	0.0	0.7	0.0	30.7	0.0	0.6
PHILOPOTAMIDAE	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	<0.1
POLYCENTROPODIDAE	0.0	0.0	85.9	1.6	0.0	0.0	30.7	0.6
HYDROPSYCHIDAE	12.3	61.3	3184.0	61.9	404.9	6.1	2699.4	65.8
HYDROPTILIDAE	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	<0.1
LEPTOCERIDAE	0.0	<0.1	42.9	0.8	<0.1	12.3	18.4	0.6
ELMIDAE	36.8	24.5	55.2	2.2	42.9	12.3	18.4	1.6
ELMIDAE (ADULTS)	0.0	6.1	24.5	0.6	6.1	0.0	6.1	0.3
DIPTERA (ADULTS)	0.0	0.0	0.0	<0.1	0.0	<0.1	0.0	<0.1
TIPULIDAE	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1
SIMULIIDAE	0.0	6.1	<0.1	0.1	0.0	<0.1	0.0	<0.1
SIMULIIDAE (PUPAE)	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1
EMPIDIDAE	<0.1	<0.1	12.3	0.2	6.1	6.1	6.1	0.4
EMPIDIDAE (PUPAE)	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1
CERATOPOGONIDAE	0.0	0.0	0.0	<0.1	0.0	0.0	<0.1	<0.1
CHIRONOMIDAE	6.1	92.0	208.6	5.8	18.4	24.5	208.6	5.3
CHIRONOMIDAE (PUPAE)	0.0	12.3	<0.1	0.2	0.0	6.1	<0.1	0.1
CHIRONOMIDAE (ADULTS)	0.0	<0.1	0.0	<0.1	0.0	<0.1	0.0	<0.1
UNIDENTIFIED TERRESTRIAL	0.0	6.1	0.0	0.1	0.0	0.0	0.0	<0.1
SPHAERIIDAE	0.0	0.0	122.7	2.3	6.1	429.4	49.1	10.2
TOTAL	79.8	920.2	4263.8		533.7	687.1	3509.2	

Table C-17. Dry weight of benthic macroinvertebrates (mg/m^2) collected with a dome sampler at Bell Bend I and III on the Susquehanna River in April, June, and October 1978.

SITE	BELL BEND I			PERCENT	BELL BEND III			PERCENT
MONTH	APR	JUN	OCT	TOTAL	APR	JUN	OCT	TOTAL
TAXON								
HYDRIDAE	0.0	0.0	0.0	<0.1	0.0	<0.1	0.0	<0.1
TRICLADIDA	0.0	0.0	6.1	0.6	0.0	<0.1	116.6	5.3
TETRASTEMMATIDAE	0.0	0.0	36.8	3.6	0.0	0.0	42.9	1.9
NEMATODA	<0.1	<0.1	0.0	<0.1	12.3	<0.1	0.0	0.6
OLIGOCHAETA	61.3	116.6	30.7	20.1	<0.1	98.2	12.3	5.0
ASELLIDAE	0.0	0.0	0.0	<0.1	0.0	<0.1	0.0	<0.1
ASTACIDAE	0.0	55.2	0.0	5.3	0.0	0.0	0.0	<0.1
ISOTOMIDAE	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0	<0.1
PERLIDAE	0.0	<0.1	<0.1	<0.1	0.0	6.1	0.0	0.3
EPHEMERIDAE	0.0	0.0	0.0	<0.1	0.0	0.0	30.7	1.4
POLYMITARCIDAE	0.0	6.1	0.0	0.6	0.0	6.1	0.0	0.3
POTAMANTHIDAE	6.1	110.4	0.0	11.2	<0.1	104.3	73.6	8.1
CAENIDAE	0.0	6.1	0.0	0.6	0.0	6.1	0.0	0.3
EPHEMERELLIDAE	0.0	0.0	0.0	<0.1	0.0	6.1	6.1	0.6
BAETIDAE	0.0	0.0	0.0	<0.1	0.0	6.1	0.0	0.3
SIPHLONURIDAE	6.1	6.1	0.0	1.2	6.1	<0.1	0.0	0.3
HEPTAGENIIDAE	12.3	98.2	49.1	15.4	<0.1	257.7	116.6	17.0
COENAGRIONIDAE	0.0	0.0	6.1	0.6	0.0	0.0	0.0	<0.1
CORIXIDAE	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1
SIALIDAE	0.0	<0.1	61.3	5.9	0.0	6.1	92.0	4.5
TRICHOPTERA (PUPAE)	0.0	24.5	0.0	2.4	0.0	0.0	0.0	<0.1
POLYCENTROPODIDAE	0.0	0.0	42.9	4.1	0.0	0.0	24.5	1.1
HYDROPSYCHIDAE	18.4	30.7	79.8	12.4	12.3	18.4	791.4	37.3
LEPTOCERIDAE	<0.1	<0.1	12.3	1.2	0.0	6.1	6.1	0.6
HYDROPHILIDAE	0.0	0.0	<0.1	<0.1	0.0	0.0	6.1	0.3
ELMIDAE	<0.1	6.1	0.0	0.6	<0.1	6.1	18.4	1.1
ELMIDAE (ADULTS)	0.0	6.1	<0.1	0.6	0.0	0.0	<0.1	<0.1
SIMULIIDAE	0.0	0.0	0.0	<0.1	0.0	<0.1	0.0	<0.1
EMPIDIDAE	0.0	0.0	<0.1	<0.1	<0.1	0.0	<0.1	<0.1
EMPIDIDAE (PUPAE)	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1
CHIRONOMIDAE	6.1	30.7	61.3	9.5	12.3	36.8	42.9	4.2
CHIRONOMIDAE (PUPAE)	0.0	6.1	0.0	0.6	0.0	12.3	0.0	0.6
CHIRONOMIDAE (ADULTS)	0.0	0.0	0.0	<0.1	0.0	<0.1	0.0	<0.1
UNIDENTIFIED TERRESTRIAL	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	<0.1
SPHAERIIDAE	0.0	0.0	36.8	3.6	0.0	18.4	184.0	9.2
TOTAL	110.4	503.1	423.3		42.9	595.1	1564.4	

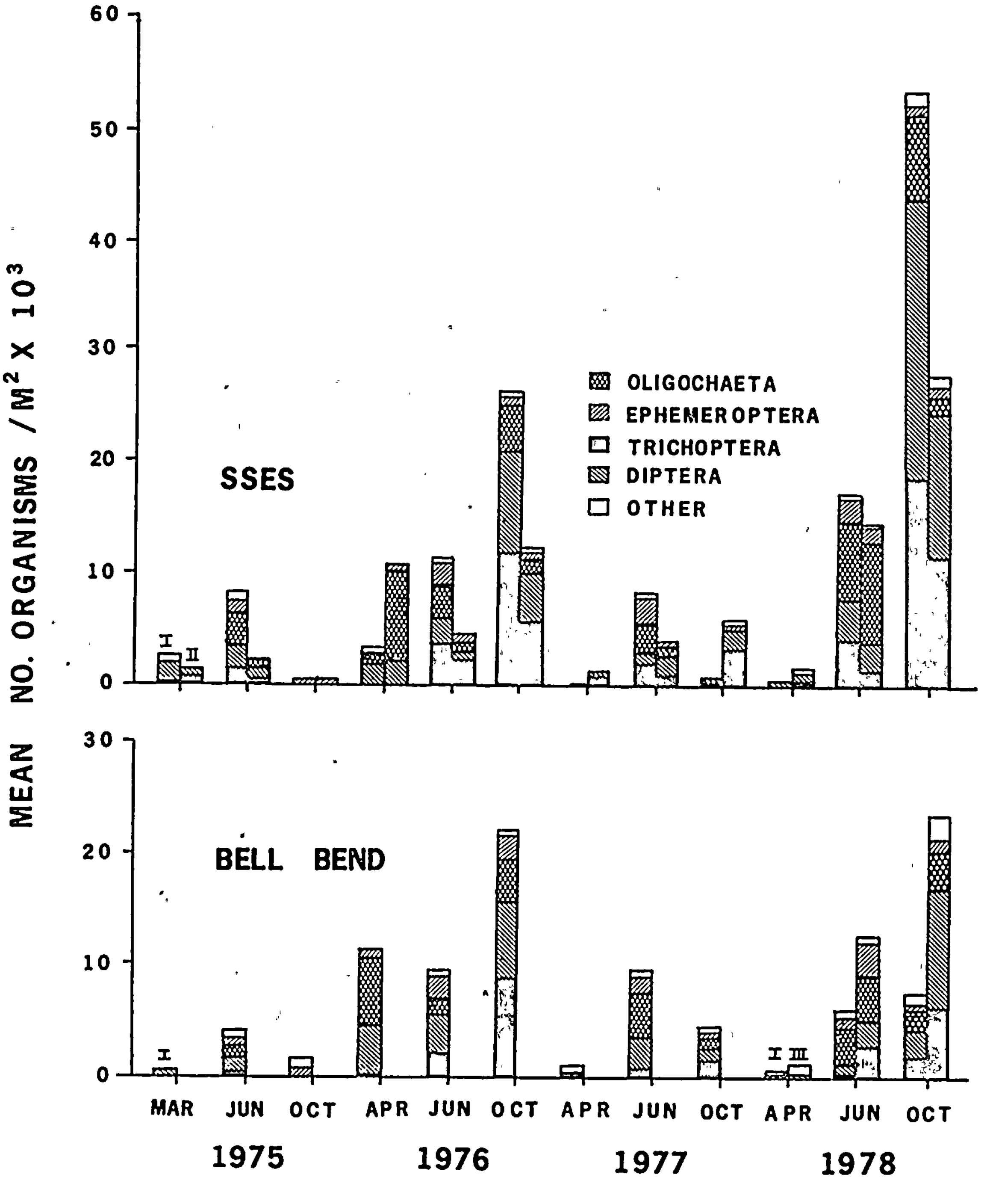
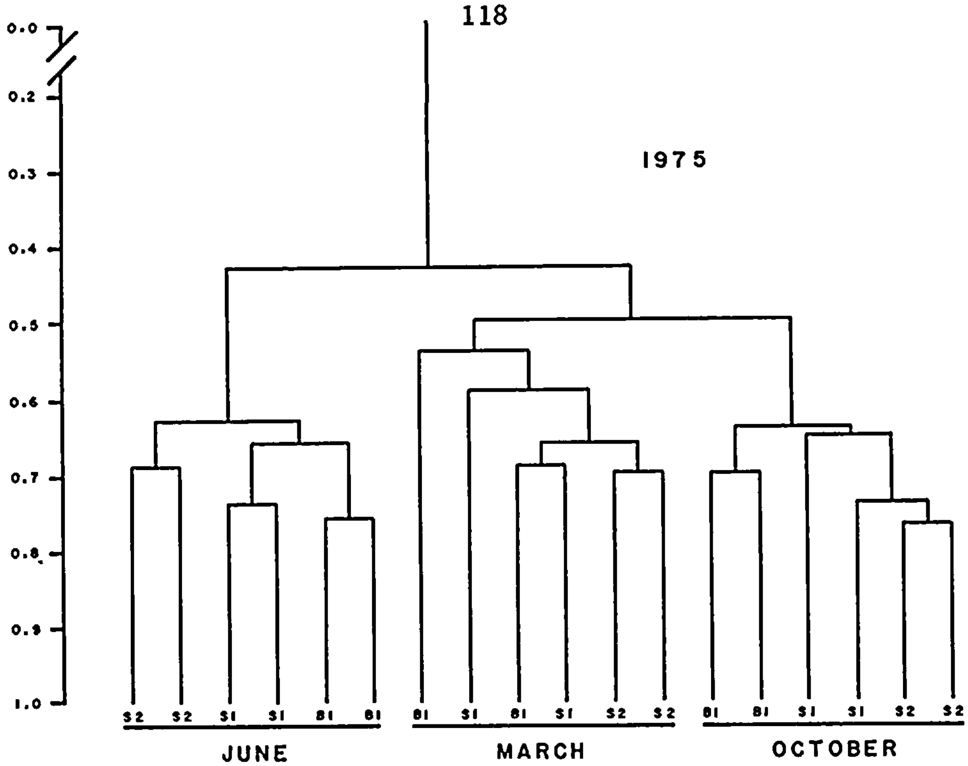


Fig. C-1. Mean density (no./m^2) of benthic macroinvertebrates in replicate dome samples (2/sampling period) at SSES I and II and at Bell Bend I and III on the Susquehanna River, 1975-78. Sampling at Bell Bend III was initiated in 1978.



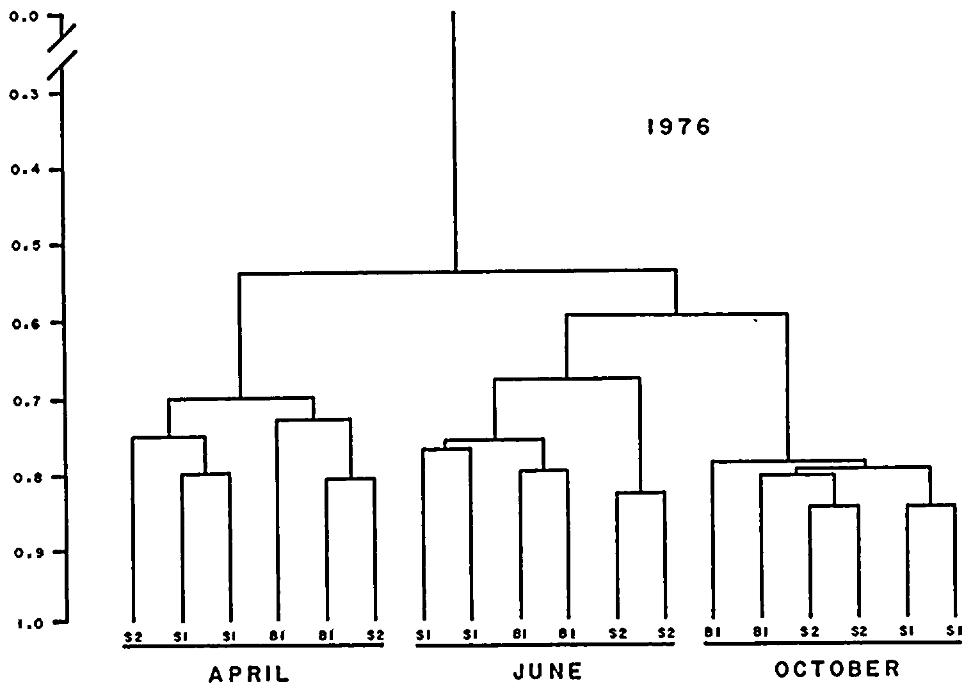


Fig. C-2. Dendrogram of the cluster analysis of Bray-Curtis similarity matrices for the 1975 through 1978 benthic macroinvertebrate data at SSES I (S1) and II (S2) and at Bell Bend I (B1) and III (B3). The scale ranges from complete similarity (1.0) to complete dissimilarity (0.0).

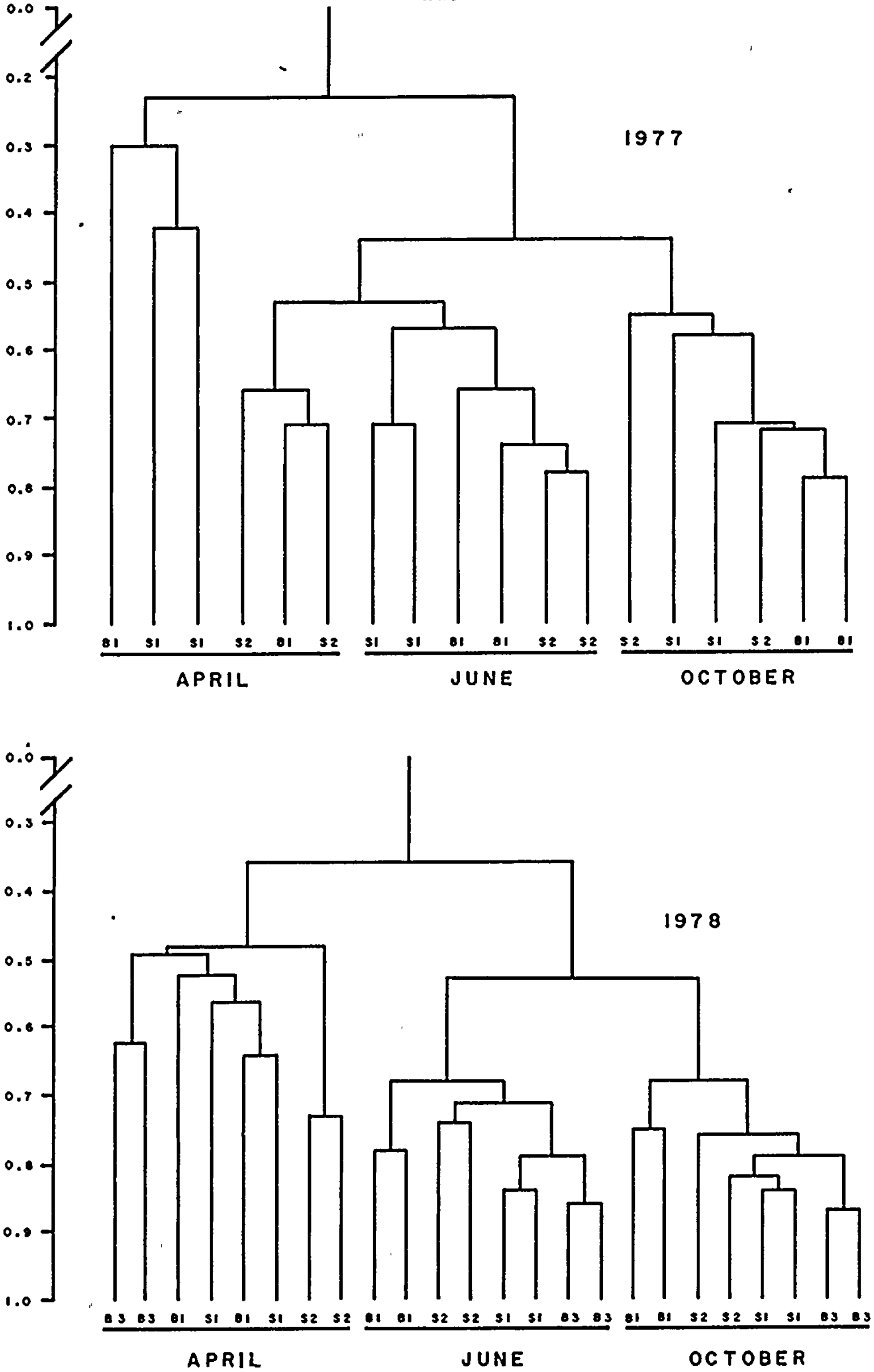

1977
0.0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
B1 S1 S1 S2 B1 S2
APRIL
S1 S1 B1 B1 S2 S2
JUNE
S2 S1 S1 S2 B1 B1
OCTOBER
1978
0.0
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
B3 B3 B1 S1 B1 S1 S2 S2
APRIL
B1 B1 S2 S2 S1 S1 B3 B3
JUNE
B1 B1 S2 S2 S1 S1 B3 B3
OCTOBER

Fig. C-2 (cont.)

LARVAL FISHES

by

Harold W. Mohr, Jr., Gerard L. Buynak, and Theodore V. Jacobsen

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ABSTRACT

In 1978, the relative abundance and density of larval fish was monitored at SSES and Bell Bend near the Susquehanna SES. A total of 1,636 larvae (about 90% prolarvae) of at least 14 species was collected from 4 May through 17 August. Over 90% of the total number captured at both sites was composed of quillback, minnow spp., tessellated darter, and carp. Maximum densities at SSES and Bell Bend occurred on 31 May when 26.2 and 29.5 fish/10 m^3 were collected, respectively. No significant differences were observed between the combined catches at both sites. Significantly more larvae ($P<0.001$) were taken at night than during the day, and more were captured near the surface than near the bottom.

INTRODUCTION

Seasonal fluctuations in the relative abundance and density of drifting larval fish near the Susquehanna SES intake structure has been monitored since 1974 (Buynak and Mohr 1976, 1977, 1978a; Gale and Mohr 1978). In 1978, monitoring was conducted upriver from the intake and downriver from the station's discharge diffuser. Simultaneous monitoring was conducted at these sites to establish a baseline of preoperational conditions.

PROCEDURES

Larval fish were sampled at SSES and Bell Bend pumping sites (Fig. D-1). The site at SSES was located 190 m upriver from the Susquehanna SES intake structure. The Bell Bend site was 920 m downriver from the discharge diffuser. Both sites were within 50 m of the west bank. Depth was 3.3 m at SSES and 2.3 m at Bell Bend when the surface elevation of the river at the Susquehanna SES Biological Laboratory was 148.6 m above mean sea level.

Samples were collected simultaneously at both sites with similarly equipped pontoon boats on 4, 9, 23, and 31 May; 7, 14, 21, and 28 June; 5 and 20 July; and 2 and 17 August. At each site, river water was pumped through a 216-μ mesh net with a high-capacity, gasoline-powered trash pump (Gale and Mohr 1978). Three replicate surface and bottom samples (5 min each) were taken at 0900 and 2100 h. Surface replicates were taken before bottom replicates.

The volume sampled in each replicate was determined by multiplying pumping duration (5 min) by pumping rate. The pumping rate was checked on each sampling date with a hand-held tachometer (Stewart-Warner, Model 757-W). The pumping rate of each pump was tested monthly by timing the filling of a 1,280-liter trough. Tachometer readings taken during these tests were compared with those taken on each sampling date to assure that each pump was functioning at near maximum capacity. The volume of each replicate ranged from 11.3 to 12.8 m^3 in May. After adjusting the pump engines, constant volumes of 12.0 m^3 per replicate were obtained from June through August.

Each sample was preserved in the field with 10% formalin containing rose bengal stain, and transported to the laboratory where larvae were sorted. After sorting, identifications and life stages (prolarva or postlarva) of all larvae were determined using a dissecting microscope

(10-70 X). Prolarvae were defined as fish with yolk and postlarvae were those without yolk (Hubbs 1943). Once scalation began, fish were considered juveniles and not reported.

Where necessary, identifications were made by comparing larvae to our reference series of 31 species of laboratory-reared specimens and with developmental information given in Buynak and Mohr (1978b-d; 1979a-d). We also used keys and descriptions in Fish (1932), Norden (1961), Mansueti (1964), Mansueti and Hardy (1967), May and Gasaway (1967), Siefert (1969), Taber (1969), Meyer (1970), Gerlach (1973), Lippson and Moran (1974), Hogue et al. (1976), Snyder et al. (1977), and Taubert (1977). In a few instances, positive identification to species could not be made, either because of damaged specimens or a lack of adequate keys. These fish were identified to the lowest taxon possible. Severely damaged fish which could not be identified were tabulated as fragments. Names and order of listing (Table D-1) conform to Bailey et al. (1970). All specimens were stored in 10% buffered formalin.

Data were processed with a Hewlett-Packard 9830-A computer and stored on permanent magnetic disc files. An impact printer was used to print out raw data and density tables.

Densities were analyzed using a 4-way analysis of variance (Hewlett-Packard 1974). Data from the first two sampling dates were excluded because only one larva was captured. The factors tested were stations, dates, day-night, surface-bottom, and their first order interactions. Results of the second and third order interactions were ambiguous and are not presented. Because replicate means were positively correlated with their variances, data were given a log (x+1) transformation prior to analyses. Upon completion of the analysis of variance, Bartlett's test for homogeneity of variance was applied. The nonsignificant results in Bartlett's test indicated that variances were suitably homogeneous for significance testing. The 5% probability level was used to determine significance in each test.

RESULTS AND DISCUSSION

A total of 1,636 larvae of at least 14 species was collected from 4 May through 17 August at the SSES and Bell Bend sampling sites (Tables D-1 through D-13). At SSES, 851 larvae were captured, and at Bell Bend 785 were taken. About 90% of the larvae collected at both sites were prolarvae.

Fishes in three of five families composed about 98% of the total number of larvae captured at both sites (Tables D-14 and D-15). Suckers were the most abundant (SSES, 58.0% and Bell Bend, 56.5%) followed by minnows and carp (SSES, 27.2% and Bell Bend, 22.5%) and perches (SSES, 12.3% and Bell Bend, 18.7%). Fishes in these three families have composed similar percentages of the total catch at SSES each year since 1974 (Buynak and Mohr 1976, 1977, 1978a; Gale and Mohr 1978).

Over 90% of the total number at each site was composed of quillback, minnow spp., tessellated darter, and carp (Tables D-14 and D-15). Quillback was the most abundant; it composed about 54% of the total catch at each site.

At SSES, minnow spp. were second in abundance (17.2%) followed by tessellated darter (11.5%) and carp (9.1%). At Bell Bend, tessellated darter was second in abundance (17.0%) followed by minnow spp. (13.3%) and carp (8.7%).

On 23 May, prolarval quillback, white sucker, tessellated darter, walleye, and perch spp. were captured at SSES, and the same fishes were taken at Bell Bend, except for tessellated darter (Tables D-14 and D-15). By 31 May, carp, minnow spp., shorthead redhorse, crappie spp., and tessellated darter were taken at both sites. One or more of the three sucker species (quillback, white sucker, and shorthead redhorse) were found at both sites from 23 May to 28 June. Although walleye was not taken after 31 May, other perches, mostly tessellated darter, were captured at each site through 20 July. At both sites, carp was taken through 28 June and minnow spp. were found through 17 August.

Sunfishes (rock bass, bluegill, sunfish spp., and crappie spp.) and catfishes (white catfish, channel catfish, and margined madtom) composed only about 2% of the total number of larvae at both sites (Tables D-14 and D-15). Some of these fishes, which exhibit parental care (Scott and Crossman 1973), may not have been drifting when they were drawn into the intake. Sunfishes were found at either SSES or Bell Bend from 31 May to 20 July, excluding 5 July. Catfishes were taken at either SSES or Bell Bend on 28 June, 5 and 20 July, and 2 August. Fishes in these families have always composed a small percentage of the total catch at SSES since 1974 (Buynak and Mohr 1976, 1977, 1978a; Gale and Mohr 1978).

Fluctuations in larval fish densities were similar at SSES and Bell Bend throughout the 1978 sampling season (Tables D-14 and D-15; Fig. D-2). At both sites, the greatest increase in density occurred from 23 to 31 May. At SSES, the density increased from 4.7 to a maximum of 26.2 fish/10 m^3, and at Bell Bend, it increased from 1.9 to a maximum of 29.5 fish/10 m^3. One week later, densities at both sites decreased to less than 10.0 fish/10 m^3. By 28 June, an overall mean of 2.7 fish/10 m^3 was found at the two sites, and on most sampling dates from 5 July to 17 August, less than 1.0 fish/10 m^3 was taken.

Highly significant differences ($P<0.001$) were found in the densities of drifting larvae relative to sampling dates at SSES and Bell Bend (Table D-16). Such differences were expected because of fluctuations in the density of larval fish throughout the sampling season (Fig. D-2).

There were no significant differences between the combined catches of larval fish at SSES and Bell Bend (Table D-16). Except for quillback, the catches of each species were not significantly different. Quillback densities were significantly greater ($P<0.001$) at SSES. Closer examination of data revealed that this difference was confined to higher densities at SSES on the bottom (Tables D-16 through D-24). Although statistically significant, the biological importance of this occurrence is not known.

Significantly more larvae ($P<0.001$) were taken at night than during the day at SSES and Bell Bend (Table D-16). This was also true in 1977 when similar results were obtained at SSES (Buynak and Mohr 1978a). In 1978 at SSES, mean density at night (7.0 fish/10 m^3) was over 2-fold greater than during the day (2.9 fish/10 m^3) (Tables D-17 through D-20). At Bell Bend, mean density at night (6.9 fish/10 m^3) was nearly 3-fold greater than during the day (2.4 fish/10 m^3) (Tables D-21 through D-24). At both sites, significantly more ($P<0.001$) quillback, white sucker, shorthead redhorse, and tessellated darter were captured at night. Significant day-night differences were not obtained for minnow spp. and carp.

At SSES and Bell Bend, significantly more larvae ($P<0.01$) were taken near the surface of the river than near the bottom (Table D-16). This also occurred at SSES in 1977 (Buynak and Mohr 1978a). In 1978, the mean density at SSES was about 2-fold greater near the surface (6.2 fish/10 m^3) compared with the bottom (3.7 fish/10 m^3) (Tables D-17 through D-20). At Bell Bend, it was nearly 3-fold greater near the surface (6.8 fish/10 m^3) as compared to the bottom (2.4 fish/10 m^3) (Tables D-21 through D-24). Significantly more ($P<0.001$) carp, minnow spp., and quillback were captured near the surface at both sites. No surface-bottom differences were found for tessellated darter, white sucker, and shorthead redhorse. The collection of so few white sucker (26) and shorthead redhorse (27), made differences, if present, difficult to detect. In 1975 at SSES, when more larvae of both species were captured, distinct changes in their diel surface-bottom distributions were clearly demonstrated (Gale and Mohr 1978).

As stated previously, the densities of minnow spp. did not exhibit significant day-night differences at SSES and Bell Bend, but they did show significant surface-bottom differences. Although densities of minnow spp. were greater on the bottom in both day and night samples, the day-night vs. surface-bottom interaction effect showed that a significantly higher proportion of the larvae were captured near the surface at night. These day-night differences were expected because they did occur when diel studies were conducted at SSES in 1974-76 (Buynak and Mohr 1978a, Gale and Mohr 1978). However, since samples were collected less frequently while monitoring in 1978, day-night differences were not detectable. Furthermore, differences in the drifting behavior of individual minnow species could have confounded the analysis.

Surface-bottom differences could not be detected in densities of tessellated darter, but a significant interaction between day-night and surface-bottom suggested a diel drift pattern. Larvae were never captured near the surface in day samples and their mean densities were relatively low near the bottom. However, in night samples, mean bottom densities increased nearly 5-fold to about 1.0 fish/10 m^3, while near the surface they increased from 0.0 to 1.5 fish/10 m^3 (Tables D-17 through D-24). Diel studies at SSES in 1974-76 (Buynak and Mohr 1978a, Gale and Mohr 1978) showed a distinct pattern of diel drift for tessellated darter.

Significant day-night differences could not be found for carp, even though their densities were greater at the surface. In addition, the non-significance of the day-night vs. surface-bottom interaction indicated that a diel drift pattern had not occurred. These results were in agreement with some of the previous diel studies. Buynak and Mohr (1978a) showed that the vertical distribution of carp at SSES was similar at the surface and bottom in 1976 when abundance was low. However, they conducted another diel study in the same year when carp were more abundant and documented significantly higher densities at night near the surface.

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Table D-1. Larval fishes collected in pump samples at SSES (1974-78) and Bell Bend (1978) on the Susquehanna River. An asterisk denotes fishes taken in 1978.

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

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

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

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

Percidae - Perches
- *Etheostoma olmstedi* - tessellated darter*
- *Perca flavescens* - yellow perch
- *Stizostedion vitreum* - walleye*
- Unidentified Percidae - perch spp.*

Table D-2. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 4 May 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0935						2059-2136						0900-0941						2100-2135					
M^3/REPLICATE	11.3						11.3						12.8						12.8					
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. HWM-78-	001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024
SPECIES																								
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0857-0931						2059-2133						0900-0934						2100-2134					
M^3/REPLICATE	11.3						12.0						11.6						12.8					
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. HWM-78-	025	026	027	028	029	030	031	032	033	034	035	036	037	038	039	040	041	042	043	044	045	046	047	048
SPECIES																								
FISH (UNIDENTIFIED) PROLARVA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table D-4. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 23 May 1978.

STATION	SSES											
SAMPLING PERIOD	DAY						NIGHT					
SAMPLING TIME	0857-0937						2100-2135					
M^3/REPLICATE	12.0						12.0					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. HWM-78-	049	050	051	052	053	054	055	056	057	058	059	060
SPECIES												
QUILLBACK PROLARVA	1	2	2	0	0	1	15	16	14	2	0	1
WHITE SUCKER PROLARVA	0	0	0	0	0	0	1	3	3	1	0	1
TESSELLATED DARTER PROLARVA	0	0	0	0	0	0	0	1	0	0	1	0
WALLEYE PROLARVA	0	0	0	0	1	0	0	0	0	0	0	0
PERCH SPP. PROLARVA	0	0	0	0	0	0	0	0	1	0	0	0
FISH (FRAGMENTS)	0	0	0	0	0	0	0	0	0	0	1	0
TOTAL	1	2	2	0	1	1	16	20	18	3	2	2

STATION	BELL BEND											
SAMPLING PERIOD	DAY						NIGHT					
SAMPLING TIME	0900-0934						2100-2133					
M^3/REPLICATE	11.6						11.6					
LOCATION	SURFACE			BOTTOM			SURFACE			BOTTOM		
REPLICATE	1	2	3	1	2	3	1	2	3	1	2	3
COLLECTION NO. HWM-78-	061	062	063	064	065	066	067	068	069	070	071	072
SPECIES												
QUILLBACK PROLARVA	2	3	1	1	0	0	4	6	4	0	0	0
WHITE SUCKER PROLARVA	0	0	0	1	0	0	1	1	0	0	0	1
TESSELLATED DARTER PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0
WALLEYE PROLARVA	0	0	0	0	0	0	0	0	1	0	0	0
PERCH SPP. PROLARVA	0	0	0	0	0	0	1	0	0	0	0	0
FISH (FRAGMENTS)	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	3	1	2	0	0	6	7	5	0	0	1

Table D-5. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 31 May 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0857-0935						2058-2136						0900-0935						2059-2134					
M^3/REPLICATE	12.0						12.0						11.6						11.6					
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. HWM-78-	073	074	075	076	077	078	079	080	081	082	083	084	085	086	087	088	089	090	091	092	093	094	095	096
SPECIES																								
CARP																								
PROLARVA	7	4	2	2	5	0	11	6	16	0	1	0	7	6	8	2	2	0	15	4	6	1	0	1
MINNOW SPP.																								
PROLARVA	4	1	1	5	13	7	3	5	3	8	12	7	0	1	1	9	4	13	2	2	3	2	2	0
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
QUILLBACK																								
PROLARVA	1	5	1	17	29	16	26	54	55	0	3	0	3	5	7	10	9	6	66	68	51	0	1	0
POSTLARVA	0	0	0	0	0	0	3	2	6	0	0	0	0	0	0	0	0	0	19	10	6	0	0	0
WHITE SUCKER																								
POSTLARVA	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	1	0	3	0	0	2
SHORTHEAD REDHORSE																								
PROLARVA	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0
SUCKER SPP.																								
PROLARVA	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUNFISH SPP.																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
CRAPPIE SPP.																								
POSTLARVA	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
TESSELLATED DARTER																								
PROLARVA	0	0	0	1	0	1	3	9	3	1	2	3	0	0	0	0	0	1	12	12	10	4	3	0
WALLEYE																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PERCH SPP.																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
POSTLARVA	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
FISH (FRAGMENTS)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	12	10	4	27	47	24	50	76	86	10	21	10	10	13	16	23	17	20	115	97	81	7	7	4

Table D-6. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 7 June 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0858-0934						2100-2135						0900-0933						2059-2132					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	097	098	099	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SPECIES																								
CARP																								
PROLARVA	0	1	0	1	0	2	2	0	1	0	1	0	0	2	1	0	1	0	0	0	3	0	1	0
POSTLARVA	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
MINNOW SPP.																								
PROLARVA	0	3	2	5	8	2	2	1	1	6	3	6	0	0	0	4	6	1	1	2	0	0	0	0
POSTLARVA	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
QUILLBACK																								
PROLARVA	0	0	1	6	3	3	13	24	16	0	2	3	0	0	0	0	2	0	6	12	14	0	0	0
POSTLARVA	0	0	0	0	0	0	0	4	3	0	0	0	0	0	0	1	0	2	0	5	8	0	0	0
WHITE SUCKER																								
POSTLARVA	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
SHORTHEAD REDHORSE																								
POSTLARVA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ROCK BASS																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
POSTLARVA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUNFISH SPP.																								
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
TESSELLATED DARTER																								
PROLARVA	0	0	0	0	0	0	1	0	0	3	2	0	0	0	0	0	0	1	3	3	0	3	3	1
PERCH SPP.																								
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
POSTLARVA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FISH (FRAGMENTS)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	4	4	13	12	8	19	29	22	10	8	11	0	2	2	5	9	4	10	23	27	3	4	1

Table D-7. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 14 June 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0859-0936						2059-2134						0859-0934						2100-2135					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
SPECIES																								
CARP																								
PROLARVA	2	1	0	1	0	0	2	0	2	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0
SPOTTAIL SHINER																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
MINNOW SPP.																								
PROLARVA	0	2	2	3	2	5	0	0	0	0	0	0	1	0	3	3	4	3	0	0	1	0	1	0
QUILLBACK																								
PROLARVA	1	1	0	5	10	4	18	13	29	2	0	0	1	3	3	1	1	0	13	21	26	0	0	0
POSTLARVA	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	2	0	0	0
SHORTHEAD REDHORSE																								
POSTLARVA	0	0	1	1	0	0	1	1	3	2	0	1	0	0	0	0	0	0	2	5	1	1	0	0
ROCK BASS																								
POSTLARVA	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
CRAPPIE SPP.																								
POSTLARVA	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TESSELLATED DARTER																								
PROLARVA	0	0	0	1	1	0	2	5	6	2	5	1	0	0	0	4	2	2	3	1	6	2	4	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
PERCH SPP.																								
POSTLARVA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
FISH (FRAGMENTS)	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	5	5	4	12	14	9	23	20	41	6	6	2	3	4	7	8	7	7	19	30	36	3	6	1

Table D-8. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 21 June 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0934						2100-2134						0900-0933						2059-2132					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168
SPECIES																								
CARP																								
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
SPOTTAIL SHINER																								
POSTLARVA	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
MINNOW SPP.																								
PROLARVA	1	0	0	3	3	0	2	1	0	0	0	0	0	0	0	7	1	3	0	1	0	0	0	0
QUILLBACK																								
PROLARVA	1	0	0	1	1	2	4	4	6	0	0	1	0	3	0	2	2	0	0	4	3	0	0	0
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
CRAPPIE SPP.																								
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
TESSELLATED DARTER																								
PROLARVA	0	0	0	0	0	0	4	3	3	4	2	1	0	0	0	3	0	0	2	4	3	1	1	1
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
PERCH SPP.																								
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
TOTAL	2	1	1	4	4	2	10	8	9	5	5	2	0	3	0	13	3	3	2	9	8	3	1	1

Table D-9. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 28 June 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0901-0935						2059-2132						0859-0934						2100-2140					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192
SPECIES																								
CARP																								
PROLARVA	1	0	0	1	0	0	1	2	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0
SPOTTAIL SHINER																								
POSTLARVA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPOTFIN SHINER																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0
MINNOW SPP.																								
PROLARVA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	1	0	1	0	2	1	0
POSTLARVA	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
QUILLBACK																								
PROLARVA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
SHORTHEAD REDHORSE																								
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
WHITE CATFISH																								
POSTLARVA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHANNEL CATFISH																								
POSTLARVA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARGINED MADTOM																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	2	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	0	0	0	0	0	0	0	0	0	0	1	0	0	0
BLUEGILL																								
POSTLARVA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
TESSELLATED DARTER																								
PROLARVA	0	0	0	0	0	0	1	1	7	3	2	3	0	0	0	0	0	1	0	4	9	5	3	0
POSTLARVA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PERCH 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
FISH (FRAGMENTS)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	0	1	2	1	0	2	6	9	5	6	4	2	2	2	2	1	2	0	6	12	7	4	1

Table D-10. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 5 July 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0900-0933						2100-2134						0900-0937						2100-2133					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216
SPECIES																								
SPOTFIN SHINER																								
POSTLARVA	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MINNOW SPP.																								
PROLARVA	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
WHITE 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
CHANNEL CATFISH																								
POSTLARVA	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0
TESSELLATED DARTER																								
PROLARVA	0	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	2	2	2	0	1	3
POSTLARVA	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1
PERCH SPP.																								
POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
TOTAL	0	0	0	1	0	0	0	1	3	3	1	4	0	0	0	0	0	1	2	2	2	2	4	4

Table D-11. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 20 July 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0859-0932						2100-2133						0900-0933						2059-2131					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SPECIES																								
SPOTFIN SHINER POSTLARVA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MINNOW SPP. PROLARVA	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	1	0	0	0	0	1	0	2
WHITE CATFISH POSTLARVA	0	0	0	0	0	0	0	0	1	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	0	0	0	0	2	1	1
BLUEGILL POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
CRAPPIE SPP. POSTLARVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
TESSELLATED DARTER POSTLARVA	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PERCH SPP. 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	1	0	0	0	0	0	1	0	1	2	2	2	0	1	0	0	1	0	1	0	0	3	2	3

Table D-12. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 2 August 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0902-0935						2059-2133						0900-0932						2100-2133					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264
SPECIES																								
MINNOW SPP.																								
PROLARVA	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	3	0	1	0
CHANNEL CATFISH																								
POSTLARVA	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	1	0	0	0	1	0	0	0	1	3	0	1	0

Table D-13. Number of larval fish captured with a pump sampler at SSES and Bell Bend on the Susquehanna River, 17 August 1978.

STATION	SSES												BELL BEND											
SAMPLING PERIOD	DAY						NIGHT						DAY						NIGHT					
SAMPLING TIME	0859-0931						2059-2132						0900-0932						2101-2133					
M^3/REPLICATE	12.0						12.0						12.0						12.0					
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. HWM-78-	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288
SPECIES																								
MINNOW SPP.																								
PROLARVA	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	2	1
POSTLARVA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTAL	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	1	0	1	0	0	1	0	2	1

Table D-14. Mean density of larval fish/10 m^3 captured at SSES on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	3.75	0.56	0.56	0.07	0.35	0.00	0.00	0.00	0.00	0.44	8.9
POSTLARVA	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.2
SPOTTAIL SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.07	0.00	0.00	0.00	0.00	0.02	0.5
SPOTFIN SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.02	0.4
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	4.79	2.71	0.97	0.69	0.07	0.14	0.28	0.07	0.14	0.82	16.7
POSTLARVA	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.14	0.00	0.00	0.00	0.07	0.02	0.5
QUILLBACK														
PROLARVA	0.00	0.00	3.75	14.37	4.93	5.76	1.39	0.07	0.00	0.00	0.00	0.00	2.52	51.2
POSTLARVA	0.00	0.00	0.00	0.76	0.49	0.35	0.07	0.00	0.00	0.00	0.00	0.00	0.14	2.8
WHITE SUCKER														
PROLARVA	0.00	0.00	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.1
POSTLARVA	0.00	0.00	0.00	0.28	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.8
SHORTHEAD REDHORSE														
PROLARVA	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.5
POSTLARVA	0.00	0.00	0.00	0.00	0.07	0.69	0.00	0.07	0.00	0.00	0.00	0.00	0.07	1.4
SUCKER SPP.														
PROLARVA	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.2
WHITE CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.02	0.4
CHANNEL CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.00	0.00	0.00	0.02	0.4
MARGINED MADTOM														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.01	0.2
ROCK BASS														
POSTLARVA	0.00	0.00	0.00	0.00	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.2
BLUEGILL														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.01	0.1
SUNFISH SPP.														
PROLARVA	0.00	0.00	0.00	0.00	0.07	0.00	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	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.01	0.1
POSTLARVA	0.00	0.00	0.00	0.07	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.4
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.14	1.60	0.42	1.60	1.18	1.18	0.28	0.00	0.00	0.00	0.53	10.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.21	0.00	0.00	0.03	0.7
WALLEYE														
PROLARVA	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
PERCH SPP.														
PROLARVA	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.01	0.2
POSTLARVA	0.00	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.07	0.00	0.00	0.00	0.02	0.5
FISH (UNIDENTIFIED)														
PROLARVA	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
FISH (FRAGMENTS)	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.02	0.5
TOTAL	0.00	0.07	4.72	26.18	9.86	10.21	3.68	2.57	0.90	0.62	0.07	0.21	4.93	

Table D-15. Mean density of larval fish/10 m^3 captured at Bell Bend on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	3.74	0.56	0.28	0.00	0.21	0.00	0.00	0.00	0.00	0.40	8.6
POSTLARVA	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
SPOTTAIL SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
SPOTFIN SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.02	0.4
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	2.80	0.97	1.11	0.83	0.49	0.07	0.28	0.35	0.35	0.60	13.0
POSTLARVA	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.01	0.3
QUILLBACK														
PROLARVA	0.00	0.00	1.51	16.24	2.36	4.79	0.97	0.21	0.00	0.00	0.00	0.00	2.17	46.9
POSTLARVA	0.00	0.00	0.00	2.51	1.11	0.21	0.07	0.00	0.00	0.00	0.00	0.00	0.33	7.0
WHITE SUCKER														
PROLARVA	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.5
POSTLARVA	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.8
SHORTHEAD REDHORSE														
PROLARVA	0.00	0.00	0.00	0.07	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	0.07	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.06	1.2
CHANNEL CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.28	0.07	0.00	0.04	0.9
ROCK BASS														
PROLARVA	0.00	0.00	0.00	0.00	0.07	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	0.07	0.00	0.07	0.00	0.00	0.00	0.00	0.01	0.2
BLUEGILL														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.07	0.00	0.00	0.01	0.2
SUNFISH SPP.														
PROLARVA	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
CRAPPIE SPP.														
POSTLARVA	0.00	0.00	0.00	0.14	0.00	0.07	0.00	0.00	0.00	0.07	0.00	0.00	0.02	0.5
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.00	3.02	0.97	1.67	1.04	1.53	0.69	0.00	0.00	0.00	0.74	16.1
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.07	0.21	0.00	0.00	0.00	0.04	0.9
WALLEYE														
PROLARVA	0.00	0.00	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.3
PERCH SPP.														
PROLARVA	0.00	0.00	0.07	0.22	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.6
POSTLARVA	0.00	0.00	0.00	0.07	0.00	0.07	0.14	0.00	0.07	0.07	0.00	0.00	0.03	0.8
FISH (FRAGMENTS)	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
TOTAL	0.00	0.00	1.94	29.45	6.25	9.10	3.19	2.85	1.18	0.76	0.42	0.42	4.63	

Table D-16. Results (F values) of seven analysis of variance tests comparing larval fish densities among replicates, dates (1), stations (2), times (3), and depths (4) on the Susquehanna River, 1978 (N.S. = not significant, * = P<0.05, ** = P<0.01, and *** = P<0.001).

	Main Effects					Interaction Effects						Bartlett's Test
	Replicates	1	2	3	4	1X2	1X3	2X3	1X4	2X4	3X4	
DF	(2, 158)	(9, 158)	(1, 158)	(1, 158)	(1, 158)	(9, 158)	(9, 158)	(1, 158)	(9, 158)	(1, 158)	(1, 158)	
Species												
Combined	1.14	137.21***	3.71	131.46***	9.92**	3.19**	2.97**	3.74	9.38***	1.98	100.31***	N.S.
Carp	0.67	51.17***	0.99	1.08	49.78***	0.33	0.26	0.17	15.80***	0.01	1.95	N.S.
Minnow spp.	0.30	35.17***	3.09	3.26	43.66***	4.72***	5.88***	2.84	3.25**	0.36	24.75***	N.S.
Quillback	4.50*	143.00***	11.93***	56.43***	165.92***	2.97**	7.57***	1.75	21.36***	13.92***	360.34***	N.S.
White sucker	2.48	10.60***	1.42	20.73***	0.24	0.95	8.49***	1.45	1.23	0.06	2.19	N.S.
Shorthead redhorse	0.07	13.72***	2.18	21.43***	1.05	0.67	7.73***	0.23	2.26*	1.23	1.05	N.S.
Tessellated darter	0.45	22.35***	1.67	178.38***	0.18	0.89	12.61***	0.24	1.62	0.32	10.53**	N.S.

Table D-17. Mean density of larval fish/10 m^3 captured near the surface during the day at SSES on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	3.61	0.28	0.83	0.28	0.28	0.00	0.00	0.00	0.00	0.44	30.6
POSTLARVA	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	3.2
SPOTFIN SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.02	1.6
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	1.67	1.39	1.11	0.28	0.00	0.00	0.00	0.00	0.00	0.37	25.8
QUILLBACK														
PROLARVA	0.00	0.00	1.39	1.94	0.28	0.56	0.28	0.00	0.00	0.00	0.00	0.00	0.37	25.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.6
SHORTHEAD REDHORSE														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.6
CHANNEL CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	1.6
ROCK BASS														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.6
SUNFISH SPP.														
PROLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.6
CRAPPIE SPP.														
PROLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.02	1.6
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.6
PERCH SPP.														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.6
TOTAL	0.00	0.00	1.39	7.22	2.78	3.89	1.11	0.56	0.00	0.28	0.00	0.00	1.44	

Table D-18. Mean density of larval fish/10 m^3 captured near the bottom during the day at SSES on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	1.94	0.83	0.28	0.00	0.28	0.00	0.00	0.00	0.00	0.28	6.5
SPOTTAIL SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	0.5
SPOTFIN SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.02	0.5
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	6.94	4.17	2.78	1.67	0.00	0.00	0.00	0.00	0.28	1.32	31.0
POSTLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.05	1.1
QUILLBACK														
PROLARVA	0.00	0.00	0.28	17.22	3.33	5.28	1.11	0.00	0.00	0.00	0.00	0.00	2.27	53.2
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.1
WHITE SUCKER														
POSTLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.5
SHORTHEAD REDHORSE														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.5
SUCKER SPP.														
PROLARVA	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.1
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.00	0.56	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.09	2.2
WALLEYE														
PROLARVA	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.5
PERCH SPP.														
POSTLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.5
FISH (UNIDENTIFIED)														
PROLARVA	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.6
TOTAL	0.00	0.29	0.56	27.22	9.17	9.72	2.78	0.83	0.28	0.00	0.00	0.28	4.26	

Table D-19. Mean density of larval fish/10 m^3 captured near the surface at night at SSES on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	9.17	0.83	1.11	0.00	0.83	0.00	0.00	0.00	0.00	1.00	9.1
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	3.06	1.11	0.00	0.83	0.28	0.28	0.28	0.00	0.00	0.49	4.5
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.02	0.2
QUILLBACK														
PROLARVA	0.00	0.00	12.50	37.50	14.72	16.67	3.89	0.28	0.00	0.00	0.00	0.00	7.13	65.4
POSTLARVA	0.00	0.00	0.00	3.06	1.94	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.44	4.0
WHITE SUCKER														
PROLARVA	0.00	0.00	1.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	1.5
POSTLARVA	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.4
SHORTHEAD REDHORSE														
PROLARVA	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.1
WHITE CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.02	0.2
ROCK BASS														
POSTLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.2
BLUEGILL														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	0.2
CRAPPIE SPP.														
POSTLARVA	0.00	0.00	0.00	0.28	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.4
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.28	4.17	0.28	3.61	2.78	2.50	0.56	0.00	0.00	0.00	1.18	10.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.02	0.2
PERCH SPP.														
PROLARVA	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.05	0.4
POSTLARVA	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.2
FISH (FRAGMENTS)	0.00	0.00	0.00	0.28	0.28	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.07	0.6
TOTAL	0.00	0.00	15.00	58.89	19.44	23.33	7.50	4.72	1.11	0.56	0.00	0.28	10.90	

Table D-20. Mean density of larval fish/10 m^3 captured near the bottom at night at SSES on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.5
SPOTTAIL SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.07	2.2
SPOTFIN SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	0.7
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	7.50	4.17	0.00	0.00	0.00	0.28	0.83	0.28	0.28	1.11	35.8
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	0.7
QUILLBACK														
PROLARVA	0.00	0.00	0.83	0.83	1.39	0.56	0.28	0.00	0.00	0.00	0.00	0.00	0.32	10.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.05	1.5
WHITE SUCKER														
PROLARVA	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.5
POSTLARVA	0.00	0.00	0.00	0.56	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	3.0
SHORTHEAD REDHORSE														
PROLARVA	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.5
POSTLARVA	0.00	0.00	0.00	0.00	0.28	0.83	0.00	0.28	0.00	0.00	0.00	0.00	0.12	3.7
WHITE CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.28	0.00	0.00	0.00	0.05	1.5
CHANNEL CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.05	1.5
MARGINED MADTOM														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.05	1.5
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.28	1.67	1.39	2.22	1.94	2.22	0.56	0.00	0.00	0.00	0.86	27.6
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.28	0.83	0.00	0.00	0.12	3.7
PERCH SPP.														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.02	0.7
FISH (FRAGMENTS)	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.7
TOTAL	0.00	0.00	1.94	11.39	8.06	3.89	3.33	4.17	2.22	1.67	0.28	0.28	3.10	

Table D-21. Mean density of larval fish/10 m^3 captured near the surface during the day at Bell Bend on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	6.03	0.83	0.56	0.00	0.83	0.00	0.00	0.00	0.00	0.69	39.9
POSTLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
SPOTFIN SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.07	4.0
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	0.57	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.14	8.1
QUILLBACK														
PROLARVA	0.00	0.00	1.72	4.31	0.00	1.94	0.83	0.00	0.00	0.00	0.00	0.00	0.73	42.6
ROCK BASS														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
BLUEGILL														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.02	1.3
CRAPPIE SPP.														
POSTLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.4
TOTAL	0.00	0.00	1.72	11.21	1.11	3.89	0.83	1.67	0.00	0.28	0.00	0.00	1.73	

Table D-22. Mean density of larval fish/10 m^3 captured near the bottom during the day at Bell Bend on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	1.15	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	3.9
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	7.47	3.06	2.78	3.06	0.83	0.28	0.28	0.28	0.28	1.53	49.5
POSTLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.05	1.5
QUILLBACK														
PROLARVA	0.00	0.00	0.29	7.18	0.56	0.56	1.11	0.00	0.00	0.00	0.00	0.00	0.81	26.2
POSTLARVA	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	2.3
WHITE SUCKER														
PROLARVA	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.8
BLUEGILL														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	0.8
SUNFISH SPP.														
PROLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.8
CRAPPIE SPP.														
POSTLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.8
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.00	0.29	0.28	2.22	0.83	0.28	0.00	0.00	0.00	0.00	0.32	10.5
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.05	1.5
WALLEYE														
PROLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.8
FISH (FRAGMENTS)	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.8
TOTAL	0.00	0.00	0.57	17.24	5.00	6.11	5.28	1.39	0.28	0.28	0.28	0.56	3.08	

Table D-23. Mean density of larval fish/10 m^3 captured near the surface at night at Bell Bend on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	7.18	0.83	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.71	6.0
SPOTTAIL SHINER														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.2
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	2.01	0.83	0.28	0.28	0.28	0.00	0.00	0.83	0.28	0.40	3.3
QUILLBACK														
PROLARVA	0.00	0.00	4.02	53.16	8.89	16.67	1.94	0.83	0.00	0.00	0.00	0.00	7.13	59.7
POSTLARVA	0.00	0.00	0.00	10.06	3.61	0.83	0.28	0.00	0.00	0.00	0.00	0.00	1.23	10.3
WHITE SUCKER														
PROLARVA	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.4
POSTLARVA	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.8
SHORTHEAD REDHORSE														
POSTLARVA	0.00	0.00	0.00	0.00	0.28	2.22	0.00	0.00	0.00	0.00	0.00	0.00	0.21	1.7
CHANNEL CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.02	0.2
ROCK BASS														
PROLARVA	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.2
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.02	0.2
CRAPPIE SPP.														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.02	0.2
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.00	9.77	1.67	2.78	2.50	3.61	1.67	0.00	0.00	0.00	1.83	15.4
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.02	0.2
WALLEYE														
PROLARVA	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.2
PERCH SPP.														
PROLARVA	0.00	0.00	0.29	0.86	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.0
TOTAL	0.00	0.00	5.17	84.19	16.67	23.61	5.28	5.00	1.67	0.28	1.11	0.28	11.94	

Table D-24. Mean density of larval fish/10 m^3 captured near the bottom at night at Bell Bend on the Susquehanna River, 1978.

SPECIES	4 MAY	9 MAY	23 MAY	31 MAY	7 JUN	14 JUN	21 JUN	28 JUN	5 JUL	20 JUL	2 AUG.	17 AUG	MEAN	% TOTAL
CARP														
PROLARVA	0.00	0.00	0.00	0.57	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	4.0
MINNOW SPP.														
PROLARVA	0.00	0.00	0.00	1.15	0.00	0.28	0.00	0.83	0.00	0.83	0.28	0.83	0.35	19.7
QUILLBACK														
PROLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
WHITE SUCKER														
PROLARVA	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
POSTLARVA	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	2.7
SHORTHEAD REDHORSE														
PROLARVA	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
CHANNEL CATFISH														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	1.11	0.00	0.00	0.14	7.8
CRAPPIE SPP.														
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.3
TESSELLATED DARTER														
PROLARVA	0.00	0.00	0.00	2.01	1.94	1.67	0.83	2.22	1.11	0.00	0.00	0.00	0.82	46.0
POSTLARVA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.83	0.00	0.00	0.00	0.09	5.2
PERCH SPP.														
POSTLARVA	0.00	0.00	0.00	0.29	0.00	0.28	0.56	0.00	0.28	0.28	0.00	0.00	0.14	7.9
TOTAL	0.00	0.00	0.29	5.17	2.22	2.78	1.39	3.33	2.78	2.22	0.28	0.83	1.77	

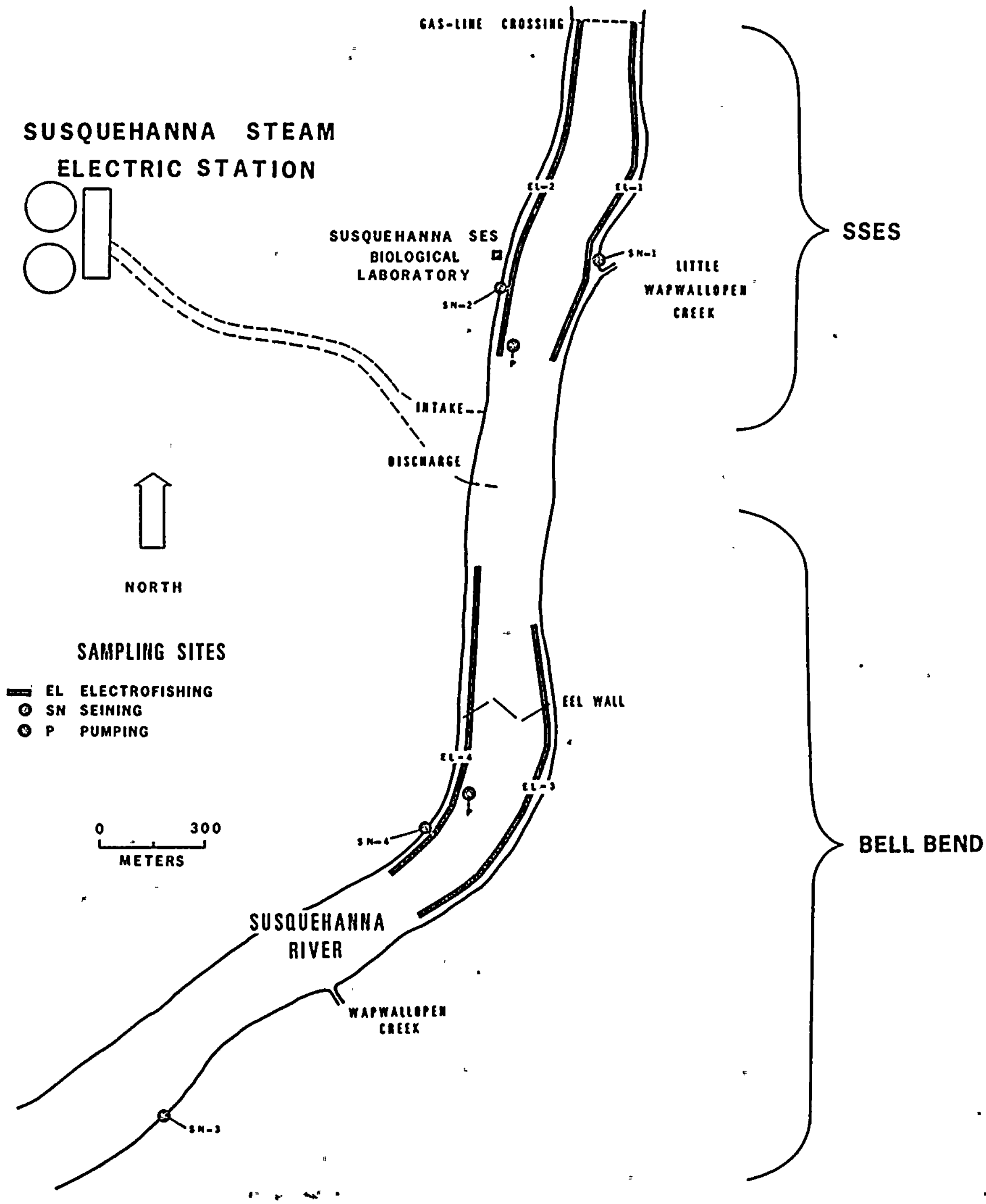

Fig. D-1. Sampling sites for pumping (P), electrofishing (EL), and seining (SN) at SSES and Bell Bend on the Susquehanna River, 1978.

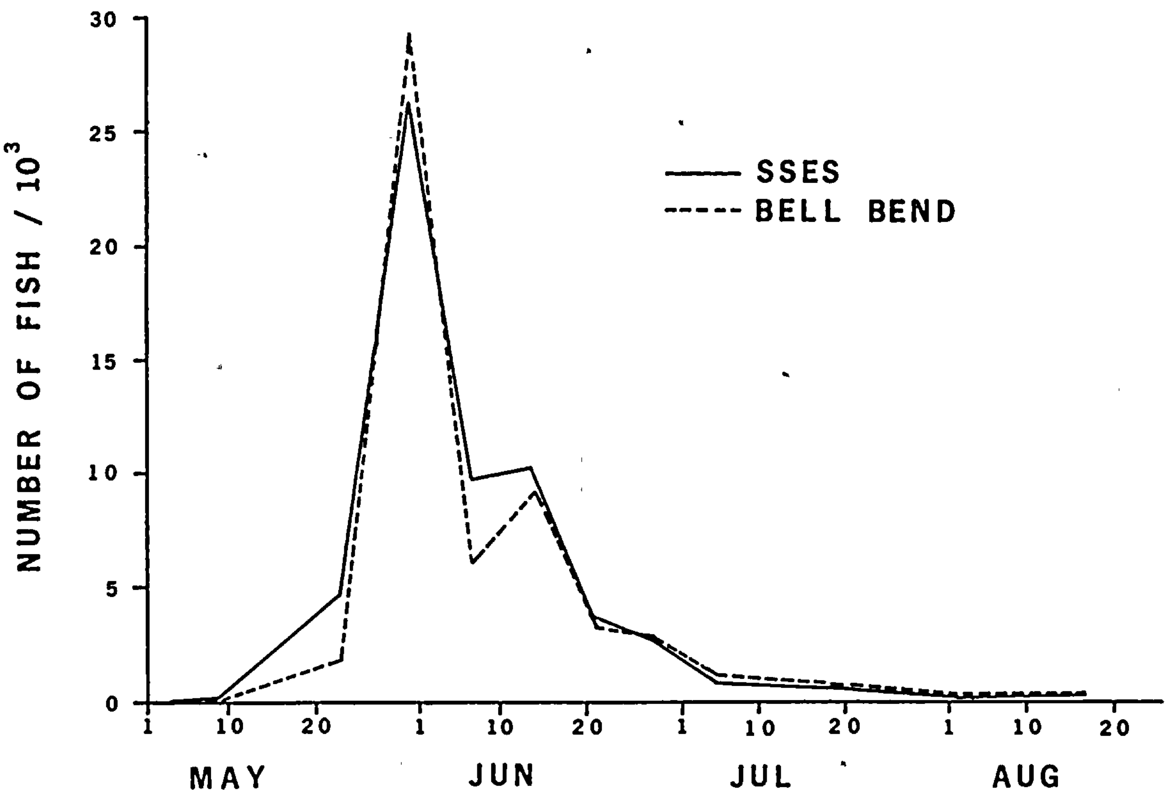

Fig. D-2. Mean density of larval fish captured at SSES and Bell Bend on the Susquehanna River, 1978.

FISHES

by

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

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ABSTRACT

Fish were sampled at two stations (SSES and Bell Bend) with an electrofisher and seine. A total of 4,639 specimens of at least 24 fishes was observed while electrofishing and 1,977 specimens of 21 fishes was captured by seine. Walleye, white sucker, smallmouth bass, shorthead redhorse, quillback, and northern hog sucker composed 75% of the total observed while electrofishing. Nearly 90% of the seine catch at both stations was composed of spotfin shiner, spottail shiner, bluntnose minnow, comely shiner, and white sucker. Occurrence of the more abundant fishes was similar at both stations. No significant differences were found in either the total number of fishes or their species composition at the electrofisher and seine sites. No significant differences were found in the total number of specimens at either station or at the east and west bank sites within each station. Significantly more fish were observed while electrofishing at night than during the day at both stations. A relatively large year class of walleye was produced in 1978.

INTRODUCTION

Seasonal fluctuations in species composition and relative abundance of fishes near the Susquehanna SES has been monitored since 1971 (Ichthyological Associates 1972, 1973, 1974; Buynak and Gurzynski 1976a, b, 1977a-d, 1978; and Buynak et al. 1978a, b). Beginning in 1976, emphasis was placed on a comparison of fisheries data collected at two sampling stations, one was located upriver from the intake of the Susquehanna SES and the other downriver from the discharge diffuser. Throughout 1978, comparative sampling at both stations was conducted to establish a baseline of preoperational conditions.

PROCEDURES

Fish populations were sampled by electrofisher and seine, upriver from the Susquehanna SES intake (SSES) and downriver from the discharge diffuser (Bell Bend). Stations were electrofished with a pulsed direct-current electrofisher similar to that described by Novotny and Priegel (1974). It consisted of a 4-kw generator and a variable voltage pulsator mounted in a 6-m flat-bottomed boat powered by an outboard motor. Seine samples were collected with a 7.6-m bag seine with 0.64-cm mesh.

Electrofishing was conducted at two 1,000-m sites, one near each river bank, at SSES and Bell Bend (Table E-1; Fig. D-1). The sites were shocked monthly from March through December during ice-free periods when river level at the Susquehanna SES Biological Laboratory was between 148.5 and 150.3 m above mean sea level (msl). All sites were sampled once during the day and once at night by slowly driving the electrofisher downriver parallel to the current from 1 to 50 m from the river bank. Each 1,000-m run was considered one unit of effort. Day sampling began about 3 hours after sunrise and night sampling began about 1 hour after sunset. All species of stunned fish larger than about 10 cm (excluding cyprinids, except carp, river chub, and fallfish) were identified and counted by two observers on the bow of the boat. Fish that surfaced behind the observers were identified and enumerated by the boat operator. Data were recorded on a cassette tape recorder (Craig No. 8108). Fish which could not be positively identified in the water were captured, identified, and released; those that escaped were recorded as unidentified.

Seine samples were collected at two sites, one on each bank, at SSES and Bell Bend (Table E-1; Fig. D-1). Sites were selected in areas free of underwater obstructions to increase sampling efficiency. Samples were collected monthly from April through October during ice-free periods when river level at the laboratory was less than 149.4 m above msl. Seining was conducted at night beginning about 1 hour after sunset. Two replicate hauls were made at each site. During the first haul, one seine brail was held on the river bank and the other was taken into the river to a depth of about 1.3 m or a distance of about 6 m. The brail on the river bank was held stationary while the other was pulled slowly upriver and then to shore. Fish were removed from the net and preserved with 10% formalin. The seine was then returned to the initial starting point and a second haul taken. The two hauls were combined and considered one unit of effort. In the laboratory, all specimens were identified, separated by species, and stored in 40% isopropyl alcohol. Identifications were based on characteristics given in keys by Pflieger (1968), Eddy (1969), and Scott and Crossman (1973).

Air and surface water temperatures and a surface grab sample of water were obtained at the downriver end of each electrofishing run and at each seining site during the collection of fish samples. Each sample was analyzed in the laboratory for dissolved oxygen, pH, turbidity, and specific conductance (electrofishing only) according to methods in Table A-1.

Both the fisheries and physicochemical data were processed with a Hewlett-Packard 9830-A computer and stored on permanent magnetic disc files. A thermal printout of these data was checked for accuracy before final data tables were printed with an impact printer. Names of fishes and the order of listing conform to Bailey et al. (1970).

The data were analyzed with three statistical tests. A nonparametric sign test (Siegel 1956) was used to determine if there were any differences in the number of fish captured between stations and at sites within stations. Day-night differences were also tested for electrofishing data. Two significance tests (Hendrickson 1978) were used to determine if patterns of species occurrence were present in the data. The first, the mathematical equivalent of Cochran's Q-statistic, tested whether sites differed in the number of species present. Because sites might have similar numbers of species, but different species composition, a second test called an M-statistic, was used to compute the number of species in common at each site. Both the Q and M statistics have an approximately chi-squared distribution. The 5% probability level was used to determine significance for all tests.

RESULTS AND DISCUSSION

Electrofishing

A total of 4,639 specimens of at least 24 fishes was observed using the electrofisher at SSES and Bell Bend (Tables E-2 through E-12). Of the 23 fishes recorded at SSES (Table E-13), six composed 75.9% of the total. Walleye was the most abundant (18.7%) followed by white sucker (17.9%), smallmouth bass (12.0%), shorthead redhorse (11.9%), quillback (7.8%), and northern hog sucker (7.5%). At Bell Bend, 21 fishes were observed (Table E-14), six of these composed 74.8% of the total. Walleye was the most abundant (23.2%) followed by white sucker (16.4%), smallmouth bass (14.0%), shorthead redhorse (11.6%), rock bass (5.2%), and northern hog sucker (4.4%). At both stations combined, walleye, white sucker, smallmouth bass, shorthead redhorse, quillback, and northern hog sucker were the most abundant fishes observed and composed 74.9% of the total. These fishes were also the most abundant in 1977 (Buynak et al. 1978a) and 1976 (Buynak and Gurzynski 1977a) when they composed 70% and 77% of the total, respectively.

Occurrence of the more abundant fishes at each station was similar throughout the 10 months sampled. At SSES (sites EL-1 and EL-2), carp and white sucker were the only fishes observed in all months (Table E-13). Quillback and shorthead redhorse were observed each month except December, and walleye in all months except April. Fewest fishes were observed in April and December (4 each) and most in November (19). At Bell Bend (sites EL-3 and EL-4), quillback and white sucker were the only fishes observed in all months (Table E-14). Walleye, northern hog sucker, and fallfish were observed each month except April; carp, shorthead redhorse, and rock bass in all months except December. The number of fishes at Bell Bend ranged from 5 in April to 18 in September. Monthly differences at both stations were influenced by seasonal changes in river level and turbidity.

At the four sites, no significant differences were found either in the total number of fishes observed (Q = 2.71; DF = 3) or in species composition (M = 3.67; DF = 3) (Tables E-3 through E-12). The number of fishes ranged from 19 to 22 at the four sites. White sucker, shorthead redhorse, smallmouth bass, and walleye composed 57.9, 63.6, 65.1, and 65.3% of the total observed at EL-1, EL-2, EL-3, and EL-4, respectively.

Between SSES and Bell Bend, no significant difference was found in the total number of specimens observed per unit effort. At SSES, 2,402 specimens were observed and at Bell Bend, 2,237 specimens were recorded (Tables E-3 through E-12). In 1977, Buynak et al. (1978a) also found no significant difference in the number of specimens observed per unit effort between SSES and Bell Bend. In 1976, however, significantly more specimens were observed per unit effort at Bell Bend than at SSES (Buynak and Gurzynski 1977a).

No significant differences were found in the number of specimens observed per unit effort between the east and west bank sites (Tables E-3 through E-12) at either SSES or Bell Bend. Totals of 1,244 and 1,158 specimens were observed at the SSES east bank site (EL-1) and the west bank site (EL-2), respectively. At the Bell Bend east bank site (EL-3), 1,209 specimens were observed compared to 1,028 at the west bank site (EL-4). In 1977, however, significantly more specimens were observed at the east bank sites at both stations (Buynak et al. 1978a). In 1976, no difference was found at SSES, but significantly more specimens were observed at the Bell Bend east bank site (Buynak and Gurzynski 1977a).

At both SSES and Bell Bend, significantly more ($P<0.01$; $n = 40$) fish per unit effort were observed at night than during the day. Totals of 1,835 (day) and 2,804 (night) specimens were observed (Tables E-3 through E-12). In 1977, the number observed per unit effort was also significantly greater at night (Buynak et al. 1978a). In 1976, however, significantly more fish were observed at night at Bell Bend, but no differences were found at SSES (Buynak and Gurzynski 1977a).

Walleye, an important game fish, showed a marked increase at both stations in relative abundance and number observed per unit effort in 1978 compared to 1976 and 1977 (Buynak and Gurzynski 1977a, Buynak et al. 1978a). Its relative abundance increased from an average of 6.0% at SSES and Bell Bend in 1976-77 to 20.9% in 1978. The number observed per unit effort increased from an average of 2.5 walleye in 1976-77 to 12.1 in 1978. More than 50% of the walleye observed in 1978 were young, and most were seen from September through November (Tables E-13 and E-14). A sample of 13 young, collected on 17 October, ranged in length from 144 to 196 mm and weighed from 24 to 60 gms. These data indicate that a relatively large year class of walleye was produced in 1978. Based on previous age and growth studies (Ichthyological Associates 1974), most of the surviving individuals of the 1978 year class should enter the sport fishery by 1981.

Seining

A total of 1,977 specimens of 21 fishes was captured by seine at SSES and Bell Bend (Tables E-2 and E-15 through E-21). Of the 20 fishes captured at SSES (Table E-22), five composed 90.2% of the total catch. Spotfin shiner was the most abundant (57.3%) followed by spottail shiner (12.0%), bluntnose minnow (7.9%), comely shiner (7.0%), and white sucker (6.0%). At Bell Bend, 16 fishes were captured (Table E-23). The same five fishes, in the identical order of relative abundance as at SSES, composed 86.9% of the total catch. Spotfin shiner was the most abundant (35.4%) followed by spottail shiner (19.3%), bluntnose minnow (12.7%), comely shiner (11.1%), and white sucker (8.4%).

Occurrence of the more abundant fishes at both stations was similar throughout the seven months sampled. At SSES (sites SN-1 and SN-2), spottail shiner, spotfin shiner, and bluntnose minnow were captured each month (Table E-22). Fewest fishes were taken in October (6); most were captured in June (15). At Bell Bend (sites SN-3 and SN-4), spotfin shiner was the only species taken each month. Spottail shiner and bluntnose minnow were captured in all months except July (Table E-23).

The number of fishes captured at Bell Bend ranged from 4 in July to 11 in August. As with data collected by electrofishing, monthly differences at both stations were influenced by seasonal changes in river level and turbidity.

At the four sites, no significant differences were found either in the total number of fishes captured (Q = 1.67; DF = 3) or in their species composition (M = 0.82; DF = 3) (Tables E-15 through E-21). The number of fishes ranged from 13 to 16 at the four sites. Comely shiner, spottail shiner, spotfin shiner, bluntnose minnow, and white sucker composed 88.2, 94.5, 87.8, and 86.0% of the total catch at SN-1, SN-2, SN-3, and SN-4, respectively.

Between SSES and Bell Bend, no significant difference was found in the total number of specimens captured per unit effort. At SSES, 1,465 specimens were captured and at Bell Bend, 512 specimens were taken (Tables E-15 through E-21). Significant differences were not detected in the number of specimens captured per unit effort between SSES and Bell Bend in 1976-77 (Buynak and Gurzynski 1977b, Buynak et al. 1978b).

No significant differences were found in the number of specimens captured per unit effort between the east and west bank sites (Tables E-15 through E-21) at either SSES or Bell Bend. At the SSES east bank site (SN-1), 1,008 specimens were captured compared to 457 at the west bank site (SN-2). At Bell Bend, 254 specimens were taken at the east bank site (SN-3) and 258 were captured at the west bank site (SN-4).

In 1976-77 (Buynak and Gurzynski 1977b, Buynak et al. 1978b), significant differences were not found between the east and west bank sites at both stations.

In 1978, the SN-1 site was moved because seining could not be conducted at the original location due to erosion of the river bank. Water at the original location was relatively clear because it was diluted with water from Little Wapwallopen Creek. The river water at the new location, 15 m upriver from the creek mouth, is undiluted and more turbid. Nearly 7-fold more fish were taken at the new location in 1978 compared with the mean catch at the original location in 1976-77 (Buynak and Gurzynski 1977b, Buynak et al. 1978b). The larger catch in 1978 probably occurred as a result of decreased net avoidance because of increased turbidity.

A total of four young walleye was captured at SSES and Bell Bend in 1978. Only three young walleye were taken from 1971 through 1977, a period when overall seining effort was several fold greater than in 1978. These data support the conclusion in the electrofishing section, that a relatively large year class of walleye was produced in 1978.

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Table E-1. Descriptions of electrofishing (EL) and seining (SN) sites at SSES and Bell Bend on the Susquehanna River, 1978.

Site	Location
	SSES
EL-1	East bank from gas-line crossing to 213 m upriver from a point opposite the center of the Susquehanna SES intake structure
EL-2	West bank from gas-line crossing to 213 m upriver from the center of the Susquehanna SES intake structure
SN-1	East bank 540 m upriver from a point opposite the center of the Susquehanna SES intake structure (15 m upriver from the mouth of Little Wapwallopen Creek)
SN-2	West bank 350 m upriver from the center of the Susquehanna SES intake structure (75 m downriver from the boat dock at the Susquehanna SES Biological Laboratory)
	BELL BEND
EL-3	East bank from 230 m downriver from a point opposite the Susquehanna SES discharge diffuser to 200 m upriver from the mouth of Wapwallopen Creek
EL-4	West bank from 165 m downriver from the Susquehanna SES discharge diffuser to 175 m upriver from the mouth of the small stream opposite the mouth of Wapwallopen Creek
SN-3	East bank 2,235 m downriver from a point opposite the Susquehanna SES discharge diffuser (at the launching ramp of the Berwick Boat Club)
SN-4	West bank 1,175 m downriver from the Susquehanna SES discharge diffuser (300 m upriver from the mouth of the small stream opposite Wapwallopen Creek)

Table E-2. Fishes found at SSES and Bell Bend on the Susquehanna River, 1971-78. An asterisk denotes fishes taken in 1978.

Anguillidae - Freshwater Eels
Anguilla rostrata - American eel

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

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

Cyprinidae - Minnows and Carps
Campostoma anomalum - stoneroller
Cyprinus carpio - 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*
Notropis spp. - shiner spp.
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*
Unidentified catostomidae - sucker spp.*

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

Cyprinodontidae - Banded Killifishes
Fundulus diaphanus - banded killifish

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

Percidae - Perches
Etheostoma olmstedi - tessellated darter*
Perca flavescens - yellow perch*
Percina peltata - shield darter[a]
Stizostedion vitreum - walleye*

Cottidae - Sculpins
Cottus bairdi - mottled sculpin*

[a]Adult captured at the SSES pump site with a high-capacity trash pump on 21 June 1978.

Table E-3. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 9 March 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-001	GLB-78-007	GLB-78-002	GLB-78-008	GLB-78-004	GLB-78-006	GLB-78-003	GLB-78-005
TIME	0929-0951	2005-2020	0958-1014	2035-2055	1050-1115	1940-2000	1025-1045	1909-1931
AIR TEMPERATURE (C)	0.0	-1.0	0.0	-1.0	0.5	0.0	0.5	0.0
WATER TEMPERATURE (C)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TURBIDITY (NTU)	5.8	5.4	6.7	7.3	7.3	7.3	6.4	6.9
DISSOLVED OXYGEN (MG/L)	13.40	13.60	13.35	13.50	13.40	13.40	13.45	13.40
PH	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
SPECIFIC CONDUCTANCE AT 25 C(μMHOS/CM)	300	265	321	333	--	325	328	340
SPECIES								
MUSKELLUNGE	0	0	0	0	0	0	1	0
CARP	0	2	0	0	0	1	0	0
FALLFISH	0	2	0	1	0	1	0	0
QUILLBACK	41	11	0	0	0	0	0	1
WHITE SUCKER	0	18	0	13	1	14	0	28
NORTHERN HOG SUCKER	6	4	4	0	2	3	0	2
SHORTHEAD REDHORSE	7	8	0	2	0	8	0	0
ROCK BASS	1	2	0	0	0	0	0	2
SMALLMOUTH BASS	0	1	0	0	0	2	1	0
WALLEYE	0	21	1	43	0	5	0	5
FISH (UNIDENTIFIED)	2	3	0	3	0	2	2	3
TOTAL	57	72	5	62	3	36	4	41

Table E-4. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 13 April 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-011	GLB-78-014	GLB-78-012	GLB-78-013	GLB-78-010	GLB-78-015	GLB-78-009	GLB-78-016
TIME	0933-0948	2020-2035	0955-1008	2001-2013	0907-0923	2045-2100	0845-0901	2111-2125
AIR TEMPERATURE (C)	14.0	7.5	14.0	7.5	14.0	8.5	14.0	8.5
WATER TEMPERATURE (C)	8.5	9.0	8.5	9.0	8.5	7.0	8.5	7.0
TURBIDITY (NTU)	13	15	15	14	13	16	13	15
DISSOLVED OXYGEN (MG/L)	11.00	11.00	11.10	11.00	11.10	11.00	11.20	11.10
PH	7.2	7.3	7.3	7.3	7.3	7.2	7.3	7.4
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	151	--	150	150	158	155	150	--
SPECIES								
CARP	1	0	0	1	1	1	0	2
QUILLBACK	6	6	0	1	3	2	0	1
WHITE SUCKER	14	5	0	5	6	4	22	12
SHORTHEAD REDHORSE	0	2	0	2	0	1	0	8
ROCK BASS	0	0	0	0	0	1	0	0
FISH (UNIDENTIFIED)	2	2	0	2	0	2	0	10
TOTAL	23	15	0	11	10	11	22	33

Table E-5. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 8 May 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-035	GLB-78-038	GLB-78-036	GLB-78-037	GLB-78-034	GLB-78-039	GLB-78-033	GLB-78-040
TIME	0956-1016	2140-2202	1021-1039	2113-2135	0922-0945	2207-2236	0856-0911	2245-2309
AIR TEMPERATURE (C)	11.0	10.5	12.0	10.5	11.0	10.5	11.0	10.5
WATER TEMPERATURE (C)	11.0	11.0	11.0	11.0	11.0	10.5	11.0	10.5
TURBIDITY (NTU)	5.5	3.7	4.2	4.6	6.7	5.1	6.3	4.4
DISSOLVED OXYGEN (MG/L)	11.40	10.70	11.40	10.90	11.00	10.80	11.20	11.00
PH	7.6	7.4	7.5	7.5	7.5	7.5	7.6	7.6
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	170	155	230	230	215	218	225	--
SPECIES								
BROWN TROUT	0	1	3	0	1	0	0	0
MUSKELLUNGE	0	0	0	0	1	1	0	2
CARP	4	8	1	2	2	4	2	5
FALLFISH	0	3	1	0	2	2	1	1
QUILLBACK	1	10	17	5	0	1	2	4
WHITE SUCKER	2	7	4	14	5	9	9	5
NORTHERN HOG SUCKER	1	4	4	3	0	1	1	1
SHORTHEAD REDHORSE	6	31	28	13	2	26	7	16
BROWN BULLHEAD	0	1	0	2	0	2	0	2
ROCK BASS	0	5	0	1	0	21	0	1
SMALLMOUTH BASS	3	7	0	1	0	5	2	2
SUNFISH SPP.	0	0	0	1	0	1	0	0
WALLEYE	3	34	1	9	0	49	1	24
FISH (UNIDENTIFIED)	1	19	9	11	6	8	3	8
TOTAL	21	130	68	62	19	130	28	71

Table E-6. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 5 June 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-050	GLB-78-056	GLB-78-049	GLB-78-055	GLB-78-051	GLB-78-054	GLB-78-052	GLB-78-053
TIME	0920-0943	2307-2306	0854-0907	2237-2300	0949-1010	2158-2220	1016-1037	2128-2150
AIR TEMPERATURE (C)	16.0	15.0	16.0	15.0	16.0	15.0	16.0	15.0
WATER TEMPERATURE (C)	20.0	21.0	20.5	21.0	20.5	21.0	20.5	21.0
TURBIDITY (NTU)	12	14	14	15	11	12	13	15
DISSOLVED OXYGEN (MG/L)	8.80	9.90	8.80	9.60	8.80	10.60	8.80	10.00
PH	7.3	7.5	7.3	7.5	7.3	7.6	7.4	7.5
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	288	298	295	308	295	298	299	310
SPECIES								
CARP	0	0	1	1	2	1	4	1
FALLFISH	5	0	3	0	1	2	1	2
QUILLBACK	1	0	2	7	0	1	0	2
WHITE SUCKER	11	0	5	12	11	5	0	3
NORTHERN HOG SUCKER	2	0	1	1	0	0	0	1
SHORTHEAD REDHORSE	0	0	11	3	4	4	3	2
BROWN BULLHEAD	1	0	1	3	1	3	0	0
CHANNEL CATFISH	0	0	0	0	0	1	0	1
CATFISH SPP.	0	0	0	0	0	0	0	1
ROCK BASS	1	0	0	8	1	5	0	9
PUMPKINSEED	0	0	0	0	0	1	0	0
BLUEGILL	2	2	0	12	0	1	0	3
SMALLMOUTH BASS	4	1	6	29	5	23	7	9
SUNFISH SPP.	0	0	1	1	0	2	1	2
WHITE CRAPPIE	0	1	0	0	0	0	0	0
WALLEYE	1	1	1	11	7	15	2	8
FISH (UNIDENTIFIED)	0	1	4	3	4	5	1	4
TOTAL	28	6	36	91	36	69	19	48

Table E-7. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 6 July 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-068	GLB-78-069	GLB-78-067	GLB-78-070	GLB-78-066	GLB-78-071	GLB-78-065	GLB-78-072
TIME	1023-1043	2123-2144	1001-1018	2150-2207	0922-0950	2212-2237	0849-0915	2250-2308
AIR TEMPERATURE (C)	22.0	19.5	22.0	19.5	20.5	18.5	20.5	18.5
WATER TEMPERATURE (C)	21.0	23.0	21.0	23.0	20.0	23.0	20.5	23.0
TURBIDITY (NTU)	18	17	24	17	18	17	17	17
DISSOLVED OXYGEN (MG/L)	10.70	12.60	10.50	11.40	9.90	12.50	9.90	11.40
PH	7.6	8.2	7.5	7.8	7.5	8.0	7.5	7.8
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	--	349	382	370	380	386	389	379
SPECIES								
CHAIN PICKEREL	0	1	0	0	0	0	0	0
PIKE SPP.	1	0	0	0	0	0	0	0
CARP	0	4	1	0	0	0	1	1
FALLFISH	1	0	6	3	0	0	1	0
QUILLBACK	2	8	1	2	1	2	1	5
WHITE SUCKER	10	6	17	8	3	11	2	4
NORTHERN HOG SUCKER	1	5	26	1	0	0	1	1
SHORTHEAD REDHORSE	9	5	7	3	0	0	1	0
SUCKER SPP.	0	0	0	0	0	1	0	0
BROWN BULLHEAD	0	0	0	1	0	0	0	0
CHANNEL CATFISH	0	1	0	3	0	2	0	0
ROCK BASS	0	4	2	4	0	7	0	9
REDBREAST SUNFISH	2	3	0	0	0	0	0	0
PUMPKINSEED	2	0	0	0	1	0	0	0
BLUEGILL	0	2	0	0	0	2	0	0
SMALLMOUTH BASS	7	15	16	18	1	11	6	18
LARGEMOUTH BASS	1	0	1	0	0	0	0	0
SUNFISH SPP.	1	1	0	0	2	0	0	0
BLACK CRAPPIE	0	1	0	0	0	1	0	1
YELLOW PERCH	0	1	0	0	0	0	1	0
WALLEYE	1	10	0	6	1	18	3	11
FISH (UNIDENTIFIED)	6	11	5	1	2	4	2	4
TOTAL	44	78	82	50	11	59	19	54

Table E-8. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 7 August 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-083	GLB-78-086	GLB-78-084	GLB-78-085	GLB-78-081	GLB-78-088	GLB-78-082	GLB-78-087
TIME	0944-1002	2144-2205	1010-1025	2116-2134	0840-0904	2245-2308	0913-0932	2215-2235
AIR TEMPERATURE (C)	24.0	--	24.0	--	24.0	--	24.0	--
WATER TEMPERATURE (C)	25.0	25.5	25.0	25.5	25.0	25.5	25.0	25.5
TURBIDITY (NTU)	12	15	11	29	11	33	11	27
DISSOLVED OXYGEN (MG/L)	7.40	7.90	7.20	7.50	7.80	7.20	7.85	7.70
PH	7.5	7.5	7.5	7.5	7.4	7.5	7.5	7.5
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	327	331	330	320	320	331	325	332
SPECIES								
MUSKELLUNGE	1	0	0	0	0	2	0	0
CHAIN PICKEREL	0	1	0	0	1	0	0	0
PIKE SPP.	0	0	0	0	0	0	0	1
CARP	1	13	2	2	2	10	3	7
FALLFISH	0	0	7	0	1	0	0	0
QUILLBACK	5	3	5	2	8	4	1	4
WHITE SUCKER	6	4	26	7	12	8	4	3
NORTHERN HOG SUCKER	0	0	20	0	9	0	1	0
SHORTHEAD REDHORSE	5	7	12	18	13	12	5	9
CHANNEL CATFISH	1	0	0	0	1	0	0	2
ROCK BASS	0	2	0	0	1	0	0	2
REDBREAST SUNFISH	0	0	0	0	1	0	0	0
PUMPKINSEED	2	0	0	1	2	0	2	0
BLUEGILL	0	0	7	0	2	1	0	0
SMALLMOUTH BASS	9	28	25	4	31	9	20	13
LARGEMOUTH BASS	0	1	0	0	0	0	0	0
SUNFISH SPP.	1	0	1	7	4	0	2	4
BLACK CRAPPIE	0	2	0	1	3	0	0	0
WALLEYE	2	6	2	3	3	9	0	4
FISH (UNIDENTIFIED)	4	18	4	11	7	15	13	13
TOTAL	37	85	111	56	101	70	51	62

Table E-9. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 20 September 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-106	GLB-78-111	GLB-78-105	GLB-78-112	GLB-78-108	GLB-78-109	GLB-78-107	GLB-78-110
TIME	0955-1020	2150-2212	0920-0945	2230-2250	1100-1120	2031-2100	1028-1052	2114-2135
AIR TEMPERATURE (C)	17.5	17.0	17.5	17.0	18.0	18.0	18.0	18.0
WATER TEMPERATURE (C)	19.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0
TURBIDITY (NTU)	15	22	20	17	16	17	21	22
DISSOLVED OXYGEN (MG/L)	7.40	6.90	6.20	6.50	7.00	7.35	6.30	6.55
PH	7.2	7.1	7.1	7.2	7.2	7.2	7.1	7.1
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	379	351	371	358	371	347	378	360
SPECIES								
MUSKELLUNGE	0	0	0	0	0	0	1	0
CHAIN PICKEREL	0	0	0	0	0	0	1	0
CARP	3	0	2	0	3	0	3	1
RIVER CHUB	0	0	1	0	0	0	0	0
FALLFISH	0	0	0	0	0	0	1	0
QUILLBACK	2	15	1	1	6	5	3	1
WHITE SUCKER	5	7	18	9	8	18	9	8
NORTHERN HOG SUCKER	2	12	30	12	7	5	5	4
SHORTHEAD REDHORSE	33	13	3	8	19	7	12	3
BROWN BULLHEAD	1	0	0	2	0	0	1	1
CHANNEL CATFISH	4	0	0	3	0	0	0	0
ROCK BASS	2	7	0	1	1	12	1	9
REDBREAST SUNFISH	0	0	0	0	0	0	3	0
PUMPKINSEED	1	0	2	0	0	0	1	0
BLUEGILL	1	1	1	1	1	2	4	3
SMALLMOUTH BASS	15	14	30	3	23	14	26	14
LARGEMOUTH BASS	0	1	0	0	1	0	2	0
SUNFISH SPP.	2	1	0	1	0	1	0	0
BLACK CRAPPIE	1	3	0	0	0	1	0	0
CRAPPIE SPP.	0	0	0	0	0	0	1	1
YELLOW PERCH	4	0	4	0	0	0	4	0
WALLEYE	19	22	9	8	4	42	10	32
FISH (UNIDENTIFIED)	11	11	6	5	13	13	6	7
TOTAL	106	107	107	54	86	120	94	84

Table E-10. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 17 October 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-124	GLB-78-125	GLB-78-123	GLB-78-126	GLB-78-122	GLB-78-127	GLB-78-121	GLB-78-128
TIME	1100-1121	2000-2016	1036-1056	2021-2041	0952-1015	2047-2109	0920-0942	2120-2145
AIR TEMPERATURE (C)	7.5	8.0	7.0	8.0	7.0	8.0	7.0	8.0
WATER TEMPERATURE (C)	12.0	11.5	11.5	12.0	11.0	12.0	12.0	12.0
TURBIDITY(NTU)	10	9.9	10	13	9.8	13	13	15
DISSOLVED OXYGEN(MG/L)	9.75	9.70	9.80	9.60	9.55	9.75	9.50	9.60
PH	7.4	7.5	7.5	7.5	7.4	7.5	7.4	7.6
SPECIFIC CONDUCTANCE AT 25 C(μMHOS/CM)	280	280	297	288	290	287	299	288
SPECIES								
MUSKELLUNGE	0	0	0	0	2	0	1	0
CHAIN PICKEREL	0	0	0	0	2	0	2	0
CARP	2	5	4	2	3	3	2	2
FALLFISH	0	0	3	0	1	0	0	1
QUILLBACK	5	11	0	3	1	6	1	5
WHITE SUCKER	13	16	28	28	14	14	8	4
NORTHERN HOG SUCKER	4	1	3	1	2	1	3	2
SHORTHEAD REDHORSE	13	16	7	10	22	21	12	16
BROWN BULLHEAD	0	1	0	0	0	1	0	1
CHANNEL CATFISH	0	5	0	2	0	0	0	0
ROCK BASS	0	4	0	2	1	6	2	3
PUMPKINSEED	0	1	2	0	0	0	0	0
BLUEGILL	0	1	3	1	5	1	1	1
SMALLMOUTH BASS	3	10	10	4	8	11	13	7
LARGEMOUTH BASS	0	1	0	1	0	0	4	2
SUNFISH SPP.	0	1	0	1	0	1	0	1
BLACK CRAPPIE	0	0	1	1	0	0	0	1
CRAPPIE SPP.	0	1	0	2	0	0	0	0
YELLOW PERCH	1	1	1	0	2	0	2	0
WALLEYE	2	50	20	9	7	25	17	54
FISH (UNIDENTIFIED)	2	22	10	6	8	19	6	12
TOTAL	45	147	92	73	78	109	74	112

Table E-11. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 6 November 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-129	GLB-78-136	GLB-78-130	GLB-78-135	GLB-78-132	GLB-78-133	GLB-78-131	GLB-78-134
TIME	0842-0902	1952-2016	0906-0925	1930-1943	0958-1019	1822-1847	0927-0952	1856-1913
AIR TEMPERATURE (C)	8.0	7.0	8.0	7.0	10.0	8.5	10.0	8.5
WATER TEMPERATURE (C)	9.0	9.5	9.0	9.5	9.0	10.0	9.0	10.0
TURBIDITY (NTU)	6.5	5.3	5.5	5.3	5.7	5.8	5.2	6.9
DISSOLVED OXYGEN (MG/L)	10.30	11.25	10.60	11.15	10.40	10.90	10.60	11.25
PH	7.4	7.6	7.4	7.6	7.4	7.6	7.4	7.6
SPECIFIC CONDUCTANCE AT 25 C (μ MHOS/CM)	240	245	250	251	245	250	252	258
SPECIES								
NORTHERN PIKE	0	1	0	0	0	0	0	0
MUSKELLUNGE	0	3	0	0	0	2	0	0
CHAIN PICKEREL	0	0	2	0	1	0	2	2
PIKE SPP.	0	1	0	0	1	0	0	1
CARP	3	7	0	1	1	1	0	1
FALLFISH	0	0	1	1	0	0	0	2
QUILLBACK	0	9	0	4	0	8	0	15
WHITE SUCKER	22	15	42	14	55	20	8	3
NORTHERN HOG SUCKER	9	10	11	3	36	1	3	5
SHORTHEAD REDHORSE	0	2	0	2	9	10	1	7
YELLOW BULLHEAD	0	0	0	0	0	0	0	1
BROWN BULLHEAD	0	1	1	0	1	0	0	0
CHANNEL CATFISH	0	1	0	0	0	0	0	6
ROCK BASS	0	10	3	11	0	14	3	0
PUMPKINSEED	0	0	1	0	0	0	0	1
BLUEGILL	0	0	0	2	0	0	0	5
SMALLMOUTH BASS	4	8	10	4	12	6	10	0
LARGEMOUTH BASS	3	1	0	0	0	0	3	2
SUNFISH SPP.	0	1	0	0	0	0	0	0
BLACK CRAPPIE	0	8	0	1	0	0	0	3
YELLOW PERCH	1	3	1	0	1	0	2	99
WALLEYE	4	86	5	55	10	47	5	5
FISH (UNIDENTIFIED)	1	12	1	4	3	5	2	[illegible]
TOTAL	47	179	78	102	130	114	39	158

Table E-12. Number of fish observed at SSES and Bell Bend electrofishing sites on the Susquehanna River, 13 December 1978.

STATION	SSES				BELL BEND			
SITE	EL-1		EL-2		EL-3		EL-4	
COLLECTION NO.	GLB-78-140	GLB-78-141	GLB-78-139	GLB-78-142	GLB-78-138	GLB-78-143	GLB-78-137	GLB-78-144
TIME	1114-1129	1825-1840	1021-1034	1849-1900	0959-1012	1907-1923	0930-0948	1930-1945
AIR TEMPERATURE (C)	3.0	2.5	3.0	2.5	1.0	3.0	2.0	2.0
WATER TEMPERATURE (C)	1.5	2.0	1.5	2.0	1.5	2.0	1.5	2.0
TURBIDITY (NTU)	9.0	12	20	22	17	15	18	18
DISSOLVED OXYGEN (MG/L)	13.05	12.90	13.00	13.00	12.60	12.95	12.80	12.95
PH	7.4	7.2	7.4	7.2	7.3	7.2	7.3	7.2
SPECIFIC CONDUCTANCE AT 25 C (μMHOS/CM)	141	139	170	168	170	162	171	168
SPECIES								
BROWN TROUT	0	0	0	1	0	0	0	0
MUSKELLUNGE	0	0	0	0	0	1	2	1
CHAIN PICKEREL	0	0	0	0	0	0	1	0
CARP	0	1	1	0	0	0	0	0
FALLFISH	0	0	0	0	2	0	0	0
QUILLBACK	0	0	0	0	0	1	0	0
WHITE SUCKER	4	3	6	7	1	6	2	7
NORTHERN HOG SUCKER	0	0	0	0	0	0	1	0
BLACK CRAPPIE	0	0	0	0	1	0	0	0
WALLEYE	0	4	0	1	0	1	0	0
FISH (UNIDENTIFIED)	0	5	1	1	2	2	0	1
TOTAL	4	13	8	10	6	11	6	9

Table E-13. Mean number of fish observed in electrofishing runs at SSES on the Susquehanna River, March through December 1978.

SPECIES	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOTAL
BROWN TROUT	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.13	0.21
NORTHERN PIKE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.03	0.04
MUSKELLUNGE	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.8	0.0	0.10	0.17
CHAIN PICKEREL	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.5	0.0	0.10	0.17
PIKE SPP.	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.05	0.08
CARP	0.5	0.5	3.8	0.5	1.3	4.5	1.3	3.3	2.8	0.5	1.88	3.12
RIVER CHUB	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.03	0.04
FALLFISH	0.8	0.0	1.0	2.0	2.5	1.8	0.0	0.8	0.5	0.0	0.93	1.54
QUILLBACK	13.0	3.3	8.3	2.5	3.3	3.8	4.8	4.8	3.3	0.0	4.68	7.79
WHITE SUCKER	7.8	6.0	6.8	7.0	10.3	10.8	9.8	21.3	23.3	5.0	10.78	17.94
NORTHERN HOG SUCKER	3.5	0.0	3.0	1.0	8.3	5.0	14.0	2.3	8.3	0.0	4.53	7.54
SHORTHEAD REDHORSE	4.3	1.0	19.5	3.5	6.0	10.5	14.3	11.5	1.0	0.0	7.15	11.91
BROWN BULLHEAD	0.0	0.0	0.8	1.3	0.3	0.0	0.8	0.3	0.5	0.0	0.38	0.62
CHANNEL CATFISH	0.0	0.0	0.0	0.0	1.0	0.3	1.8	1.8	0.3	0.0	0.50	0.83
ROCK BASS	0.8	0.0	1.5	2.3	2.5	0.5	2.5	1.5	6.0	0.0	1.75	2.91
REDBREAST SUNFISH	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.13	0.21
PUMPKINSEED	0.0	0.0	0.0	0.0	0.5	0.8	0.8	0.8	0.3	0.0	0.30	0.50
BLUEGILL	0.0	0.0	0.0	4.0	0.5	1.8	1.0	1.3	0.5	0.0	0.90	1.50
SMALLMOUTH BASS	0.3	0.0	2.8	10.0	14.0	16.5	15.5	6.8	6.5	0.0	7.23	12.03
LARGEMOUTH BASS	0.0	0.0	0.0	0.0	0.5	0.3	0.3	0.5	1.0	0.0	0.25	0.42
SUNFISH SPP.	0.0	0.0	0.3	0.5	0.5	2.3	1.0	0.5	0.3	0.0	0.53	0.87
WHITE CRAPPIE	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.04
BLACK CRAPPIE	0.0	0.0	0.0	0.0	0.3	0.8	1.0	0.5	2.3	0.0	0.48	0.79
CRAPPIE SPP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.08	0.12
YELLOW PERCH	0.0	0.0	0.0	0.0	0.3	0.0	2.0	0.8	1.3	0.0	0.43	0.71
WALLEYE	16.3	0.0	11.8	3.5	4.3	3.3	14.5	20.3	37.5	1.3	11.25	18.73
FISH (UNIDENTIFIED)	2.0	1.5	10.0	2.0	5.8	9.3	8.3	10.0	4.5	1.8	5.50	9.16
TOTAL	49.0	12.3	70.3	40.3	63.5	72.3	93.5	89.3	101.5	8.8	60.05	

Table E-14. Mean number of fish observed in electrofishing runs at Bell Bend on the Susquehanna River, March through December 1978.

SPECIES	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	% TOTAL
BROWN TROUT	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.04
MUSKELLUNGE	0.3	0.0	1.0	0.0	0.0	0.5	0.3	0.8	0.5	1.0	0.43	0.76
CHAIN PICKEREL	0.0	0.0	0.0	0.0	0.0	0.3	0.3	1.0	1.3	0.3	0.30	0.54
PIKE SPP.	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.08	0.13
CARP	0.3	1.0	3.3	2.0	0.5	5.5	1.8	2.5	0.8	0.0	1.75	3.13
FALLFISH	0.3	0.0	1.5	1.5	0.3	0.3	0.3	0.5	0.5	0.5	0.55	0.98
QUILLBACK	0.3	1.5	1.8	0.8	2.3	4.3	3.8	3.3	5.8	0.3	2.38	4.25
WHITE SUCKER	10.8	11.0	7.0	4.8	5.0	6.8	10.8	10.0	21.5	4.0	9.15	16.36
NORTHERN HOG SUCKER	1.8	0.0	0.8	0.3	0.5	2.5	5.3	2.0	11.3	0.3	2.45	4.38
SHORTHEAD REDHORSE	2.0	2.3	12.8	3.3	0.3	9.8	10.3	17.8	6.8	0.0	6.50	11.62
SUCKER SPP.	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.03	0.04
YELLOW BULLHEAD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.03	0.04
BROWN BULLHEAD	0.0	0.0	1.0	1.0	0.0	0.0	0.5	0.5	0.3	0.0	0.33	0.58
CHANNEL CATFISH	0.0	0.0	0.0	0.5	0.5	0.8	0.0	0.0	0.0	0.0	0.18	0.31
CATFISH SPP.	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.04
ROCK BASS	0.5	0.3	5.5	3.8	4.0	0.8	5.8	3.0	5.8	0.0	2.93	5.23
REDBREAST SUNFISH	0.0	0.0	0.0	0.0	0.0	0.3	0.8	0.0	0.0	0.0	0.10	0.18
PUMPKINSEED	0.0	0.0	0.0	0.3	0.3	1.0	0.3	0.0	0.0	0.0	0.18	0.31
BLUEGILL	0.0	0.0	0.0	1.0	0.5	0.8	2.5	2.0	0.3	0.0	0.70	1.25
SMALLMOUTH BASS	0.8	0.0	2.3	11.0	9.0	18.3	19.3	9.8	8.3	0.0	7.85	14.04
LARGEMOUTH BASS	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.5	0.8	0.0	0.30	0.54
SUNFISH SPP.	0.0	0.0	0.3	1.3	0.5	2.5	0.3	0.5	0.5	0.0	0.58	1.03
BLACK CRAPPIE	0.0	0.0	0.0	0.0	0.5	0.8	0.3	0.3	0.0	0.3	0.20	0.36
CRAPPIE SPP.	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.05	0.09
YELLOW PERCH	0.0	0.0	0.0	0.0	0.3	0.0	1.0	1.0	1.5	0.0	0.38	0.67
WALLEYE	2.5	0.0	18.5	8.0	8.3	4.0	22.0	25.8	40.3	0.3	12.95	23.16
FISH (UNIDENTIFIED)	1.8	3.0	6.3	3.5	3.0	12.0	9.8	11.3	3.8	1.3	5.55	9.92
TOTAL	21.0	19.0	62.0	43.0	35.8	71.0	96.0	93.3	110.3	8.0	55.93	

Table E-15. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 27 April 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-017	GLB-78-019	GLB-78-023	GLB-78-021
TIME	2000-2012	2018-2023	2042-2054	2029-2037
AIR TEMPERATURE (C)	8.0	8.0	7.5	8.0
WATER TEMPERATURE (C)	11.0	11.5	11.0	11.5
TURBIDITY (NTU)	5.4	7.3	4.8	7.3
DISSOLVED OXYGEN (MG/L)	10.20	10.40	10.30	10.50
PH	7.2	7.3	7.3	7.3
SPECIES				
COMELY SHINER	8	1	20	3
SPOTTAIL SHINER	39	0	54	0
SWALLOWTAIL SHINER	14	0	0	0
SPOTFIN SHINER	52	0	53	0
BLUNTNOSE MINNOW	9	0	6	1
LONGNOSE DACE	0	0	3	0
FALLFISH	4	0	5	1
WHITE SUCKER	0	0	1	0
ROCK BASS	1	0	0	0
TOTAL	127	1	142	5

Table E-16. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 3 May 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-031	GLB-78-029	GLB-78-027	GLB-78-025
TIME	2152-2205	2140-2148	2125-2132	2113-2121
AIR TEMPERATURE (C)	7.0	7.0	7.5	7.5
WATER TEMPERATURE (C)	12.5	12.0	12.0	12.5
TURBIDITY (NTU)	13	13	13	13
DISSOLVED OXYGEN (MG/L)	11.70	11.50	11.20	11.60
PH	7.9	7.9	7.8	7.9
SPECIES				
COMELY SHINER	62	27	5	29
SPOTTAIL SHINER	51	5	8	20
SWALLOWTAIL SHINER	20	0	0	1
SPOTFIN SHINER	210	31	0	6
BLUNTNOSE MINNOW	43	6	1	21
FALLFISH	0	0	0	3
TESSELLATED DARTER	2	0	0	0
MOTTLED SCULPIN	1	0	0	0
TOTAL	389	69	14	80

Table E-17. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 16 June 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-057	GLB-78-059	GLB-78-063	GLB-78-061
TIME	2130-2135	2140-2155	2230-2255	2202-2216
AIR TEMPERATURE (C)	11.0	11.0	11.0	11.0
WATER TEMPERATURE (C)	20.5	20.5	20.0	20.5
TURBIDITY (NTU)	13	13	13	13
DISSOLVED OXYGEN (MG/L)	8.80	8.85	9.30	9.15
PH	7.5	7.5	7.5	7.5
SPECIES				
GOLDEN SHINER	2	0	4	1
COMELY SHINER	4	0	0	0
SPOTTAIL SHINER	32	15	3	2
SWALLOWTAIL SHINER	11	0	0	0
SPOTFIN SHINER	250	141	0	5
BLUNTNOSE MINNOW	16	6	0	2
LONGNOSE DACE	5	0	0	0
FALLFISH	25	2	0	1
WHITE SUCKER	59	29	28	13
SHORTHEAD REDHORSE	3	0	0	0
ROCK BASS	4	1	2	0
BLUEGILL	0	0	0	1
WHITE CRAPPIE	0	1	0	0
BLACK CRAPPIE	0	1	0	0
TESSELLATED DARTER	6	2	0	1
YELLOW PERCH	1	0	0	0
TOTAL	418	198	37	26

Table E-18. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 12 July 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-077	GLB-78-079	GLB-78-073	GLB-78-075
TIME	2150-2200	2205-2215	2125-2132	2137-2142
AIR TEMPERATURE (C)	16.5	16.5	17.5	17.0
WATER TEMPERATURE (C)	24.5	24.5	24.5	24.5
TURBIDITY (NTU)	13	17	13	17
DISSOLVED OXYGEN (MG/L)	9.25	9.25	10.45	9.55
PH	7.7	7.7	8.0	7.7
SPECIES				
CHAIN PICKEREL	0	0	1	0
GOLDEN SHINER	0	0	9	0
SPOTTAIL SHINER	9	4	0	0
SPOTFIN SHINER	6	7	2	0
BLUNTNOSE MINNOW	3	1	0	0
FALLFISH	3	0	0	0
WHITE SUCKER	0	0	1	0
ROCK BASS	1	0	0	0
TESSELLATED DARTER	0	4	0	0
WALLEYE	1	0	0	0
TOTAL	23	16	13	0

Table E-19. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 15 August 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-089	GLB-78-091	GLB-78-095	GLB-78-093
TIME	2102-2107	2112-2121	2143-2150	2130-2138
AIR TEMPERATURE (C)	24.5	24.5	24.5	24.5
WATER TEMPERATURE (C)	26.0	26.0	26.0	26.0
TURBIDITY (NTU)	13	13	9.0	14
DISSOLVED OXYGEN (MG/L)	8.60	9.10	9.30	9.30
PH	7.8	7.8	7.9	7.9
SPECIES				
GOLDEN SHINER	0	0	1	0
COMELY SHINER	0	1	0	0
SPOTTAIL SHINER	0	16	0	6
SWALLOWTAIL SHINER	0	0	1	1
SPOTFIN SHINER	1	114	19	62
BLUNTNOSE MINNOW	12	12	5	14
FALLFISH	0	0	0	2
ROCK BASS	2	2	0	2
PUMPKINSEED	0	1	0	0
BLUEGILL	7	1	1	0
SMALLMOUTH BASS	0	1	0	4
TESSELLATED DARTER	2	3	2	5
WALLEYE	0	1	0	1
TOTAL	24	152	29	97

Table E-20. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 6 September 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-103	GLB-78-101	GLB-78-099	GLB-78-097
TIME	2140-2147	2130-2136	2105-2112	2050-2057
AIR TEMPERATURE(C)	22.0	22.0	22.0	22.0
WATER TEMPERATURE(C)	23.0	23.0	23.0	23.0
TURBIDITY(NTU)	12	12	8.7	12
DISSOLVED OXYGEN(MG/L)	10.50	11.00	10.65	10.35
PH	7.6	7.8	8.1	7.8
SPECIES				
GOLDEN SHINER	1	0	1	0
SPOTTAIL SHINER	3	0	2	1
SWALLOWTAIL SHINER	1	1	0	0
SPOTFIN SHINER	12	3	6	15
BLUNTNOSE MINNOW	7	0	2	7
ROCK BASS	0	0	0	1
BLUEGILL	0	1	0	5
SMALLMOUTH BASS	0	0	0	3
WHITE CRAPPIE	0	1	0	0
TESSELLATED DARTER	0	0	0	1
WALLEYE	1	0	0	0
TOTAL	25	6	11	33

Table E-21. Number of fish captured at SSES and Bell Bend seining sites on the Susquehanna River, 2 October 1978.

STATION	SSES		BELL BEND	
SITE	SN-1	SN-2	SN-3	SN-4
COLLECTION NO.	GLB-78-113	GLB-78-115	GLB-78-119	GLB-78-117
TIME	1950-1956	2000-2005	2015-2020	2007-2012
AIR TEMPERATURE (C)	12.5	12.5	11.5	12.0
WATER TEMPERATURE (C)	15.0	15.5	15.0	15.5
TURBIDITY (NTU)	8.7	9.4	12	14
DISSOLVED OXYGEN (MG/L)	11.80	10.50	11.50	10.30
PH	7.4	7.7	7.7	7.5
SPECIES				
GOLDEN SHINER	1	0	0	0
SPOTTAIL SHINER	0	1	0	3
SPOTFIN SHINER	0	12	6	7
BLUNTNOSE MINNOW	1	0	1	5
ROCK BASS	0	0	0	1
SMALLMOUTH BASS	0	0	0	1
WHITE CRAPPIE	0	1	1	0
TESSELLATED DARTER	0	1	0	0
TOTAL	2	15	8	17

Table E-22. Mean number of fish captured in seining hauls at SSES on the Susquehanna River, April through October 1978.

SPECIES	APR	MAY	JUN	JUL	AUG	SEP	OCT	MEAN	% TOTAL
GOLDEN SHINER	0.0	0.0	1.0	0.0	0.0	0.5	0.5	0.29	0.27
COMELY SHINER	4.5	44.5	2.0	0.0	0.5	0.0	0.0	7.36	7.03
SPOTTAIL SHINER	19.5	28.0	23.5	6.5	8.0	1.5	0.5	12.50	11.95
SWALLOWTAIL SHINER	7.0	10.0	5.5	0.0	0.0	1.0	0.0	3.36	3.21
SPOTFIN SHINER	26.0	120.5	195.5	6.5	57.5	7.5	6.0	59.93	57.27
BLUNTNOSE MINNOW	4.5	24.5	11.0	2.0	12.0	3.5	0.5	8.29	7.92
LONGNOSE DACE	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.36	0.34
FALLFISH	2.0	0.0	13.5	1.5	0.0	0.0	0.0	2.43	2.32
WHITE SUCKER	0.0	0.0	44.0	0.0	0.0	0.0	0.0	6.29	6.01
SHORTHEAD REDHORSE	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.21	0.20
ROCK BASS	0.5	0.0	2.5	0.5	2.0	0.0	0.0	0.79	0.75
PUMPKINSEED	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.07	0.07
BLUEGILL	0.0	0.0	0.0	0.0	4.0	0.5	0.0	0.64	0.61
SMALLMOUTH BASS	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.07	0.07
WHITE CRAPPIE	0.0	0.0	0.5	0.0	0.0	0.5	0.5	0.21	0.20
BLACK CRAPPIE	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.07	0.07
TESSELLATED DARTER	0.0	1.0	4.0	2.0	2.5	0.0	0.5	1.43	1.37
YELLOW PERCH	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.07	0.07
WALLEYE	0.0	0.0	0.0	0.5	0.5	0.5	0.0	0.21	0.20
MOTTLED SCULPIN	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.07	0.07
TOTAL	64.0	229.0	308.0	19.5	88.0	15.5	8.5	104.64	

Table E-23. Mean number of fish captured in seining hauls at Bell Bend on the Susquehanna River, April through October 1978.

SPECIES	APR	MAY	JUN	JUL	AUG	SEP	OCT	MEAN	% TOTAL
CHAIN PICKEREL	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.07	0.20
GOLDEN SHINER	0.0	0.0	2.5	4.5	0.5	0.5	0.0	1.14	3.12
COMELY SHINER	11.5	17.0	0.0	0.0	0.0	0.0	0.0	4.07	11.13
SPOTTAIL SHINER	27.0	14.0	2.5	0.0	3.0	1.5	1.5	7.07	19.34
SWALLOWTAIL SHINER	0.0	0.5	0.0	0.0	1.0	0.0	0.0	0.21	0.59
SPOTFIN SHINER	26.5	3.0	2.5	1.0	40.5	10.5	6.5	12.93	35.35
BLUNTNOSE MINNOW	3.5	11.0	1.0	0.0	9.5	4.5	3.0	4.64	12.70
LONGNOSE DACE	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.21	0.59
FALLFISH	3.0	1.5	0.5	0.0	1.0	0.0	0.0	0.86	2.34
WHITE SUCKER	0.5	0.0	20.5	0.5	0.0	0.0	0.0	3.07	8.40
ROCK BASS	0.0	0.0	1.0	0.0	1.0	0.5	0.5	0.43	1.17
BLUEGILL	0.0	0.0	0.5	0.0	0.5	2.5	0.0	0.50	1.37
SMALLMOUTH BASS	0.0	0.0	0.0	0.0	2.0	1.5	0.5	0.57	1.56
WHITE CRAPPIE	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.07	0.20
TESSELLATED DARTER	0.0	0.0	0.5	0.0	3.5	0.5	0.0	0.64	1.76
WALLEYE	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.07	0.20
TOTAL	73.5	47.0	31.5	6.5	63.0	22.0	12.5	36.57	

FLORA AND VEGETATION

by

James D. Montgomery

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ABSTRACT

A total of 622 species of vascular plants was observed on the Susquehanna SES site from 1972 through 1974 and 1977 through 1978. None of the plants are proposed as threatened or endangered. Eleven salt drift transects were utilized in 1978 for observations of phenology and parasitic plant diseases. The greatest number of species flowered in August on forest and field transects, and in July on marsh transects. Twenty-four parasitic plant diseases were observed.

Three upland forest plots, two abandoned fields, and one marsh were sampled quantitatively. Data from two forest plots were compared with that collected on the same plots in 1977. Few significant changes were found. The most important species in the abandoned fields were perennial herbs, especially *Solidago* spp. and grasses. The North Field had a larger number of species present than Switchyard Field due to greater soil moisture. The marsh was dominated by more or less typical marsh species, especially *Leersia oryzoides*, *Sagittaria latifolia*, and *Sparganium eurycarpum*.

INTRODUCTION

Terrestrial ecological studies were conducted on the Susquehanna SES site from 1972 through 1974 (Ichthyological Associates 1973, 1974; Burton 1976) and in 1977 (Montgomery 1978). The studies begun in January 1977 and continued through 1978, were initiated to gather baseline information on flora and vegetation to compare with information to be collected during the operation of the Susquehanna SES.

The purpose of the flora and vegetation studies in 1978 was to establish continuing programs that can be used to monitor changes, if any, during the operation of the Susquehanna SES. Systematic information was collected on the phenology of flowering plants and ferns and parasitic plant diseases (flora), and quantitative information was obtained for selected plant communities (vegetation).

PROCEDURES

Flora

Floristic studies were conducted from March through October 1978. As in 1977 (Montgomery 1978), observations were made on both sides of the Susquehanna River throughout the Susquehanna SES site (Fig. F-1). In addition to general observations, transects for systematic observations were established. These 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. Salt drift transects were located in several plant communities at varying distances and directions from the Susquehanna SES (Table F-1). 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 relative effect of the parasitic disease (i.e. defoliation, major leaf necrosis, minor necrosis, etc.).

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

Ustilago maydis (corn smut) was observed in the cornfield north of the biological laboratory in August. A survey of the incidence of the disease was made by counting the number of plants on which the disease occurred in two randomly selected rows in the cornfield. The survey was made on 29 August.

Vegetation

Quantitative vegetation studies were conducted in three upland forests: Council Cup Forest (CC), Township Road 419 Forest (TR419), and Quarry Hillside Forest (QH); two abandoned fields: North Field (NF) and Switchyard Field (SwF); and an open marsh: US 11 Marsh (US11M) (Fig. F-1).

The three forest plots were sampled in July. The CC Forest was 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 nearly level to a gently east-facing slope, at an elevation of approximately 335 m. The TR419 Forest was 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. The QH Forest was located on a steep south-facing hillside east of an abandoned quarry above Route PA 239, in Conyngham Township, Luzerne County. Elevation ranged from 225 to 250 m.

The CC Forest and TR419 Forest were sampled in 1977, the QH Forest was sampled for the first time in 1978.

The forest areas were surveyed into transects parallel with the long direction of the plot. Points were located along these transects at distances depending on the size of the plot to be covered: 50-m intervals in CC, 75-m intervals in TR419, and 30-m intervals in QH. At each point a 10 x 10-m quadrat was permanently marked for sampling trees and saplings (Cain and Castro 1959), There were 20 quadrats in CC, 24 quadrats in TR419, and 15 quadrats in QH. Trees were defined as 10-cm diameter breast height (dbh) or greater, saplings as 1.0-9.5-cm dbh, and seedlings less than 1.0-cm dbh. All trees and saplings in the 10 x 10-m quadrat were identified, counted, and the dbh measured to the nearest cm with a diameter tape. Two 1 x 1-m quadrats were established in diagonally opposite corners of the 10 x 10-m quadrat for sampling tree seedlings, shrubs, herbs, and ground cover (litter, moss, rock, and bare soil were defined as ground cover). Plants were identified and an estimate was made of the percent cover in the quadrat for each species, 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:

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

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

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

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

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

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

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

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

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

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

Frequency and Relative Frequency = same as above

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

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

Importance Value = relative frequency + relative dominance

Comparisons of 1978 data with that collected in 1977 were made using an analysis of variance with repeated measures design (Sokal and Rohlf 1969). Quadrat by quadrat tests were made using number of stems per quadrat for each tree and sapling species, and percent cover per quadrat for shurbs, herbs, and ground cover. Tree seedlings were not counted in 1977 and 1 x 1-m quadrats were not sampled in TR419 in 1977; therefore, comparisons were not made for these data. 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).

Two abandoned fields, NF and SwF, were sampled in September and October 1978 (Fig. F-1). NF was located at the north end of a cornfield on the west side of the Susquehanna River, 2 km northeast of the Susquehanna SES, in Salem Township, Luzerne County. Elevation is 153 m. The western edge of the field was wet in spring, but dried by midsummer. This wet part of the field was not included in the sampling area; the remainder of the field was dry except during periods of extreme river flooding.

SwF was located adjacent to the Luzerne Electric Division, UGI, substation, above 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 entirely dry.

The line intercept method was used for sampling (Cain and Castro 1959, Smith 1966). A baseline was established near the parallel to one edge of the 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. The number of transects per line depended on the width of the field; 3 in NF, 5 in SwF. Fifty-one transects were established in NF. Fifty-five transects were established in SwF, but five were disturbed during construction and not sampled. 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 to the nearest cm for each taxon along the tape was recorded. Tree seedlings, shrubs, and herbs were sampled together, but the data were treated separately for each. Species area curves were drawn after sampling as a check on the adequacy of the area sampled (Mueller-Dombois and Ellenberg 1974). The following were calculated for all taxa:

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

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

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

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

Importance Value = relative frequency + relative coverage

The US 11 Marsh was sampled in August. It is located east of US 11 and the railroad, and immediately north of Lake Took-a-while (Fig. F-1), 1.2 km east of the Susquehanna SES, in Salem Township, Luzerne County. Part of the marsh contains standing water at all times; in spring or after prolonged rains much of the area is wet. The aspect is of herbaceous plants with a few clumps of shrubs in the marsh and shrubs bordering the open marsh.

Two parallel transect lines were run the length of the marsh. Points were located at 50-m intervals along these transects, and a m^2 quadrat was located at each point. There was a total of 31 quadrats. In each quadrat all taxa were identified, percent cover for each was estimated, and the average height for each was measured to the nearest cm. Ground cover was estimated as in forest plots.

Calculation of frequency, relative frequency, dominance, relative dominance, and importance value was done as described for forest quadrat data.

RESULTS AND DISCUSSION

Flora

A total of 622 species of vascular plants was observed on the Susquehanna SES site from 1972 through 1974 and 1977 through 1978. This total includes 122 woody plants (Table F-2) and 500 herbaceous plants (Table F-3). The herbaceous plants include 37 ferns and fern-allies and 463 flowering plants. Fifty-three species were observed for the first time on the site in 1978. None of the plants observed on the site has been proposed as threatened or endangered by the U. S. Department of the Interior (1975, 1976). No plants are presently listed for Pennsylvania (U.S. Department of the Interior 1979).

There was a total of 418 plants observed on the salt drift transects; 345 on forest transects (Table F-4), 175 in field transects and 112 in marsh transects (Table F-5). Of the forest transects, QSH (abbreviations are given in Table F-1) had the greatest number of species (196), followed by TR438 (158), TR419 (132), CC (108), RF (91), and GIF (88). The greatest number of species flowered in August (132), followed by July (115), and May (103). Most transects had more species in flower in July and August except CC, where more species flowered in May and June. Of the abandoned field transects, TCF had the greatest number of species (99), followed by NF (93), and SwF (81). The greatest number of species flowered in August (73), followed by July (57), and September (52). On most field transects the number of species in flower increased through the spring to late summer; there was no spring flowering peak in May comparable to that on forest transects. On the marsh transects, 81 species were observed on

US11M and 73 on SM. The greatest number of species flowered in July (30), August (29), and September (25) on US11M; and in August (28), September (20), and June (19) on SM. No species flowered on any transect except QSH in March, and none flowered in either marsh in April. With these exceptions, species were observed on all transects in each month, April through October.

A total of 24 parasitic plant diseases was observed on 46 host species (Table F-6). The powdery mildew, *Erysiphe cichoracearum*, infected 18 species and the rust, *Coleosporium solidaginis*, infected 7 species. Twenty-one diseases were observed on QSH, 15 on TR438, and 15 on CC; diseases were observed on all transects. The occurrence of diseases was related to the presence of host species rather than to any observed environmental factors. In the spring, leaf spots were the most prominent, especially on *Acer rubrum*. In the late summer and fall, rusts, especially of *Solidago* spp., and powdery mildews were most abundant.

The incidence of corn smut in the cornfield north of the biological laboratory was found to be 2.1%. Of the 2,912 plants examined in two rows, 60 were infected. Plants with corn smut tended to be clumped together in the rows.

Vegetation

Betula lenta was the most important (highest importance value) tree in the CC Forest (Table F-7). *Quercus velutina, Pinus strobus, Quercus prinus, Q. alba,* and *Pinus virginiana* were associates. Total density was 620 trees/ha. *Betula lenta* and *Acer rubrum* were the most important saplings, with *Quercus velutina, Q. borealis,* and *Q. prinus* as important associates (Table F-8). Total density was 2,345 saplings/ha. The most important seedlings were *Acer rubrum* and *Prunus serotina*, with three species of *Quercus* of secondary importance (Table F-9). Total density was 25,750 saplings/ha. *Vaccinium vacillans* was the most important and only frequent shrub, with smaller amounts of seven other species (Table F-10). *Lycopodium flabelliforme* was the most important herb, with 15 other species encountered (Table F-10). Litter was the predominant ground cover.

The same trees were the most important in 1978 as in 1977 (Montgomery 1978). Associates were the same with the addition of *Betula populifolia*. The only significant change in the tree layer was an increase in *Quercus velutina* from 1977 to 1978 (Table F-11). The same sapling species were important in 1977 and in 1978. Significant changes in the saplings were decreases in *Acer rubrum, Betula populifolia,* and *Carya glabra*; and an increase in *Carya tomentosa* (Table F-12). *Carya glabra* and *C. tomentosa* were not distinguished in the 1977 survey and both were reported as *C. tomentosa*. The decrease in *Betula populifolia* as a sapling was caused by death of some saplings, and by increase in diameter to tree size of one sapling. *Vaccinium vacillans* and *Rhus radicans* increased significantly in cover from 1977 to 1978 (Table F-13). *Lycopodium flabelliforme* also increased significantly in cover. There were no other significant changes in shrubs or herbs, and no changes in ground cover (Table F-13).

In the TR419 Forest, *Quercus velutina* was the most important tree, with *Pinus virginiana* second in importance (Table F-14). Eighteen species were encountered. Total density was 617 trees/ha. *Cornus florida* was the most important sapling, with *Quercus velutina, Acer rubrum,* and *Carya tomentosa* as associates (Table F-15). Sixteen species were encountered. Total density was 1,208 saplings/ha. *Cornus florida* was the most important seedling, with *Fraxinus americana* nearly as important (Table F-16). *Prunus serotina* and *Acer rubrum* were important associates. Fourteen species were encountered. Total density was 88,541 seedlings/ha. Vines, including *Parthenocissus quinquefolia, Vitis aestivalus,* and *Rhus radicans* were important in the shrub layer (Table F-17). *Rubus allegheniensis, Vaccinium vacillans,* and *V. stamineum* were also important. Eleven species were encountered. *Dennstaedtia punctilobula* was the most important herb (Table F-17). This species had high density in only three quadrats. *Carex swannii* and *Solidago caesia* were the most frequent herbs. More than half of the 48 herbs encountered occurred in only one or two quadrats, indicating the small numbers of herbs present in the forest. Litter was the predominant ground cover.

The same tree species were most important in 1977 as in 1978, and there were no significant changes in trees (Table F-18). Tree density increased from 576 trees/ha (Montgomery 1978) to 617 trees/ha in 1978. The same sapling species were most important in 1977 as in 1978, and there were no significant changes in saplings (Table F-19). Sapling density also increased, from 1,183 to 1,208 saplings/ha. Tree seedlings, shrubs, herbs, and ground cover were not sampled in 1977.

The QH Forest was sampled for the first time in 1978. *Quercus velutina* was the most important tree, with *Fraxinus americana, Quercus prinus, Acer rubrum,* and *Quercus borealis* as important associates (Table F-20). Seventeen species were encountered. Total density was 653 trees/ha. *Cornus florida* was the most important sapling, with *Acer rubrum, Fraxinus americana,* and *Quercus borealis* as associates (Table F-21). Seventeen species were encountered. Total density was 1,667 saplings/ha. *Fraxinus americana* was the most important seedling, with *Cornus florida* and *Acer rubrum* as associates (Table F-22). Seventeen species were encountered. *Quercus velutina* and *Q. prinus* were less important as saplings and seedlings than as trees. *Fraxinus americana, Acer rubrum,* and *Quercus borealis* were about equally important in all three size classes, and should become more important as trees as the forest matures. *Cornus florida,* important as a sapling and seedling, is an understory tree that seldom reaches canopy size (Braun 1950). *Parthenocissus quinquefolia* was the most important shrub; other species were much less important (Table F-23). *Aster divaricatus* was the most important herb. *Deschampsia flexuosa* and *Dryopteris marginalis* were also important. Thirty-six taxa were encountered. Litter was the most important ground cover.

The QH Forest was similar to CC and TR419 in the importance of oaks, especially *Quercus velutina. Pinus virginiana* was less important in the QH Forest, and *Pinus strobus* occurred only as a seedling. *Fraxinus americana* was more important in the QH Forest. Ten species of trees were common to QH and CC, and ten species were common to QH and TR419 (not the same ten, however). Vines were important in QH and in TR419. Herbs were infrequent in QH, as in CC and TR419. Of the five most important herb species in QH, two were found in CC, but were not among the most important species. A total of four species (11.1%) found in QH were found in CC. Of the five most important herb species in QH, three were found in TR419, and two (*Carex swannii* and *Solidago caesia)* were among the five most important species. Nineteen species (52.8%) found in QH were found in TR419. Thus, QH more closely resembles TR419 floristically; they are also on similar slope and exposure.

In NF, 97 taxa were encountered, of which 83 were herbs, 6 were tree seedlings, and 8 were shrubs or woody vines (Table F-24). *Muhlenbergia frondosa, Solidago canadensis, S. graminifolia, Agrostis* sp., and *Aster ericoides* were the most important herbaceous species. Seven additional species, including two species of *Solidago,* occurred with frequency greater than 50%. Although most species were typical of abandoned fields in the area, the diversity (number of species per unit area) is high. This is accounted for by the addition of elements from the river forest (e.g. *Lysimachia ciliata, Boehmeria cylinidrica, Leersia virginica, Impatiens biflora,* etc.) and from wet open habitat (e.g. *Epilobium coloratum, Verbena hastata, Lycopus americanus, Eupatorium perfoliatum,* etc.). Seedlings of six tree species were encountered (Table F-24); all were found as mature trees in the nearby river forest. Eight shrubs were found with *Rubus allegheniensis* the most important. The high dominance of *Rubus allegheniensis* (seventh among all species in the field) was due to the occurrence of large clumps of this plant in certain areas of the field.

In SwF, 74 taxa were encountered, of which 57 were herbs, 8 were tree seedlings, and 9 were shrubs (Table F-25). The most important herb taxa were *Solidago rugosa, S. canadensis,* grasses, *Potentilla simplex,* and *Rumex acetosella.* Nearby all of the herbaceous taxa were typical old field perennials or biennials. Seedlings of eight tree species were found. Most of these were typical of upland forests; all except *Acer saccharinum* and *Ulmus americana* were found in TR419. Eight shrub species were encountered, with *Cornus racemosa* the most important. The shrub species were also typical of old fields in the Susquehanna SES area.

Of the 97 taxa from NF, 41 were found in SwF (42.0%), including 34 herbaceous taxa (41.0% of the herbs). Of the 74 taxa from SwF, 55% were found in NF. The larger number of species in NF is due to greater soil moisture which allows marsh and river forest species to grow in this field.

Both fields were dominated by typical old field species, especially *Solidago* spp.; *Solidago* spp. accounted for a total cover of 42.7% in NF and 72.2% in SwF. Tree seedlings were frequent and had greater cover in SwF than NF. Shrubs were more frequent in SwF, but had greater total percent cover in NF. Total percent cover by trees and shrubs is low (less than 15.0%) in both fields.

In the US 11 Marsh, *Leersia oryzoides, Sagittaria latifolia, Sparganium eurycarpum,* and *Solidago gigantea* were the most important species (Table F-26). Fifty-seven taxa were encountered, including one tree seedling and three shrubs. Analysis of height measurements (Table

F-26) indicated that there were at least three indistinct layers of vegetation in the marsh. The four species given above, plus *Juncus effusus*, *Carex scoparia*, *Scirpus cyperinus*, and *Phalaris arundinacea* were important herbs more than 50 cm tall. Most of the plants in this layer were grass-like, with elongate narrow leaves (*Sagittaria latifolia* was an exception). Below this layer were shorter herbs, many of which have broader leaves; the most important species in this layer were *Eleocharis tenuis*, *Galium trifidum*, *Onoclea sensibilis*, *Polygonum sagittatum*, and *Boehmeria cylindrica*. Close to the ground (or water) was another layer of herbs, including *Lemna minor*, *Pilea pumila*, *Eleocharis acicularis*, and *Selaginella apoda*. Seedlings of other taxa, especially *Leersia oryzoides*, occurred in this layer also. None of the layers was distinct, but all quadrats except those in open water contained several layers of vegetation. Shrubs and tree seedlings were encountered infrequently (Table F-26). Ground cover was mostly litter (actually peat), with water second in importance. Observations indicated that the relative amount of water and exposed peat varied with the seasons. The time of sampling, in August, was a period of low water.

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Table F-1. Location of salt drift transects at the Susquehanna SES, 1978.

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 US 11 to TR 438
TR 438 (TR438)	W-SW	0.4-1.9	Upland forest, open field, marsh	2.3	Along Township Road 438, from TR 419 to the entrance to 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	2.0-2.3	Abandoned field	0.4	Field in the transmission corridor south of Susquehanna SES
South Marsh (SM)	SE	1.5-1.7	Open marsh	0.3	Marsh south of the Susquehanna SES intake
US 11 Marsh (US11M)	E	1.2-1.3	Open marsh	0.3	Marsh along US 11, west of Susquehanna SES Biological Laboratory

Table F-2. Species of woody plants observed on the Susquehanna SES site, 1972-74, and 1977-78. Taxa are arranged alphabetically within phyla. An asterisk indicates taxa observed for the first time in 1978.

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 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 glabra* - smooth sumax
- *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
- *Catalpa bignonioides* - catalpa

Caprifoliaceae
- *Diervilla lonicera* - bush-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
- *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. 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

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
- *Aronia melanocarpa* - chokecherry
- *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 F-2 (cont.)

Rosaceae (cont.)
Pyrus communis - pear
P. malus - apple
Pyrus sp. - crabapple
Rosa multiflora - multiflora rose
R. palustris - swamp rose
R. virginiana - wild rose
Rubus allegheniensis - blackberry
R. flagellaris - 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 F-3. Species of herbaceous plants observed on the Susquehanna SES site, 1972-74, and 1977-78. Taxa are arranged alphabetically within phyla. An asterisk indicates taxa observed for the first time in 1978.

EQUISETOPHYTA
Equisetaceae
Equisetum arvense - field horsetail

LYCOPODIOPHYTA
Isoetaceae
Isoetes engelmanni - Engelmann'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

Selaginellaceae
Selaginella apoda - meadow spike-moss

POLYPODIOPHYTA
Ophioglossaceae
Botrychium dissectum - grape fern
B. lanceolatum - lanceolate grape fern
B. matricariaefolium - 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
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 obtusa - blunt-lobed woodsia

MAGNOLIOPHYTA-DICOTYLEDONEAE
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

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. ericoides - heath aster
A. lateriflorus - calico aster
A. novae-angliae - New England aster
A. patens - late purple aster
A. paternus - 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. vulgare - bull thistle
Conyza canadensis - horseweed
Erechtites hieracifolia - fireweed
Erigeron annus - daisy 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
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. pratense - 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

Balsaminaceae
Impatiens biflora - jewelweed
I. pallida - pale jewelweed

Berberidaceae
Podophyllum peltatum - may apple

Boraginaceae
Hackelia virginiana - beggar's lice
Mertensia virginica - Virginia bluebells

Callitrichaceae
Callitriche heterophylla - water starwort

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

Cannabinaceae
Cannabis sativa - marijuana

Caprifoliaceae
Lonicera japonica - Japanese honeysuckle

Caryophyllaceae
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 laevigata - rock cress
A. lyrata - rock cress
A. shortii - rock cress
Barbarea vulgaris - wintercress
Brassica kaber - charlock
B. nigra - black mustard
Capsella bursa-pastoris - shepherd's purse
Cardamine bulbosa - 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 sylvestris - yellow cress
Sisymbrium altissimum - tumble mustard
S. officinale - hedge-mustard*
Thlaspi arvense - field pennycress

Cucurbitaceae
Sicyos angulatus - bur-cucumber

Ericaceae
Chimaphila maculata - spotted wintergreen
Epigaea repens - trailing arbutus
Gaultheria procumbens - wintergreen
Pyrola elliptica - shinleaf

Euphorbiaceae
Acalypha virginica - three-seeded mercury
Euphorbia maculata - spurge*
E. preslii - spurge

Fumariaceae
Dicentra cucullaria - Dutchman's breeches

Gentianaceae*
Gentiana andrewsii - bottle gentian*

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

Hydrophyllaceae
Hydrophyllum virginianum - waterleaf

Hypericaceae
Hypericum 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
Cunila origanoides - dittany
Galeopsis tetrahit - hemp-nettle
Glecoma hederacea - gill-over-the-ground
Hedeoma pulegioides - American pennyroyal
Leonurus cardiaca - motherwort
Lycopus americanus - water horehound
L. virginicus - water horehound
Monarda clinopodia - wild bergamot
Monotropa uniflora - Indian pipe
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 - wood-sage
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. 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

Table F-3 (cont.)

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

Lythraceae*
Lythrum salicaria - purple loosestrife*

Malvaceae
Abutilon theophrasti - velvet-leaf
Malva neglecta - cheeses*

Onagraceae
Circaea quadrisulcata - enchanter's nightshade
Epilobium coloratum - willow-herb
Gaura biennis - biennial gaura
Ludwigia alternifolia - seed-box
Oenothera biennis - evening-primrose

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 subulata - moss-pink

Polygalaceae
Polygala paucifolia - fringed polygala
P. verticillata - whorled milkwort

Polygonaceae
Polygonum arifolium - halberd-leaved tearthumb
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. virginianum - 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
Caulophyllum thalictroides - blue cohosh
Cimicifuga racemosa - bugbane
Clematis virginiana - virgin's bower
Coptis trifolia - goldthread
Hepatica americana - hepatica
Ranunculus abortivus - kidneyleaf buttercup
R. acris - common buttercup
R. bulbosus - buttercup*
R. pensylvanicus - buttercup
R. recurvatus - buttercup
R. repens - creeping 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. circaezans - bedstraw
G. palustre - bedstraw
G. trifidum - bedstraw
G. triflorum - bedstraw
Houstonia caerulea - bluets
Mitchella repens - partridge-berry

Santalaceae
Commandra umbellata - bastard toad-flax

Saxifragaceae
Mitella diphylla - miterwort
Saxifraga virginiensis - early saxifrage

Scrophulariaceae
Aureolaria virginica - downy false foxglove
Chelone glabra - turtle-head
Gerardia tenuifolia - slender gerardia
Linaria vulgaris - butter-and-eggs
Lindernia dubia - false pimpernel
Melampyrum lineare - cow-wheat
Mimulus ringens - monkey-flower
Myosotis laxa - forget-me-not
M. scorpioides - forget-me-not
Pedicularis canadensis - lousewort
Penstemon hirsutus - hairy beardtongue
Scrophularia lanceolata - figwort
Verbascum blattaria - moth-mullein
V. thapsus - common mullein
Veronica americana - American brooklime
V. arvensis - speedwell
V. officinalis - common speedwell
V. serpyllifolia - speedwell
Veronicastrum virginicum - culver's root*

Solanaceae
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*
Pastinaca sativa - wild parsnip
Sanicula marilandica - black snakeroot

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

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. strigosus - galingale

Cyperaceae (cont.)
Eleocharis acicularis - spike-rush*
E. ovata - spike-rush
E. tenuis - spike-rush*
Scirpus atrovirens - bulrush
S. cyperinus - wool grass
S. validus - great bulrush

Dioscoreaceae
Dioscorea villosa - wild yam

Gramineae
Agrostis perennans - autumn bent
A. stolonifera - bentgrass
Andropogon gerardi - big bluestem*
A. scoparius - little bluestem
A. virginicus - broom sedge*
Anthoxanthum odoratum - sweet vernal grass
Aristida dichotoma - three-awn
Bromus japonicus - Japanese chess
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 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 obtusa - nodding fescue
Glyceria canadensis - rattlesnake mannagrass
G. striata - fowl mannagrass
Holcus lanatus - velvet grass
Hystrix patula - bottlebrush
Leersia oryzoides - rice cutgrass
L. virginica - white grass
Lolium perenne - perennial ryegrass
Muhlenbergia frondosa - wirestem muhly
M. schreberi - nimblewill
M. sylvatica - muhly
Panicum boscii - panic-grass*
P. capillare - witchgrass
P. clandestinum - panic-grass*
P. commutatum - panic-grass
P. dichotomiflorum - panic-grass
P. dichotomum - panic-grass*
P. lanuginosum - panic-grass
P. virgatum - switchgrass
Panicum spp. - panic-grass
Phalaris arundinacea - reed canary grass
Phleum pratense - timothy
Poa compressa - Canada bluegrass
P. languida - bluegrass*
P. palustris - fowl bluegrass
P. pratensis - Kentucky bluegrass
Setaria faberii - nodding foxtail
S. glauca - foxtail grass
S. italica - foxtail millet
Sorghastrum nutans - Indian grass*
Sphenopholis intermedia - wedgegrass
Triodia flava - purpletop

Hydrocharitaceae
Anacharis canadensis - water-weed

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

Table F-3 (cont.)

Juncaceae
Juncus articulatus - 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 lily*
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
Trillium erectum - purple trillium
Uvularia perfoliata - perfoliate bellwort
U. sessilifolia - sessile-leaved bellwort
Veratrum veride - false hellebore

Najadaceae
Potamogeton spirillus - pondweed

Orchidaceae
Cypripedium acaule - pink lady's slipper
Epipactis helleborine - helleborine
Goodyera pubescens - rattlesnake plantain
Habenaria lacera - ragged fringed 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 F-4. Months when plants were observed in flower or shedding spores on woodland salt drift transects at the Susquehanna SES, 1978. Names, abbreviations, and locations of transects are given in Table F-1.

Species	RF	GIF	TR419	TR438	QSH	CC
Acalypha virginica	Aug	0	Aug	Aug	Aug	0
Acer nigrum	0	Apr	0	0	0	0
A. rubrum	0	0	0	Apr	Apr	Apr
A. saccharinum	Apr	0	0	0	Mar	0
Achillea millefolium	0	0	Jul-Sep	Jul-Oct	Jul-Oct	Jul Aug
Agrimonia grypsosepala	0	0	0	0	Aug	Aug
Agrostis perennans	0	Aug	Aug	0	Aug	Jun,Aug
A. stolonifera	0	0	0	Jul	Jul	0
Alliaria officinalis	May,Aug	May,Jul	0	0	0	0
Ambrosia artemisiifolia	0	0	Aug,Sep	Aug,Sep	Aug	Aug
A. trifida	Aug	0	0	0	0	0
Amelanchier arborea	0	0	0	0	0	May
Amphicarpa bracteata	0	0	Aug	0	Aug	Aug
Anaphalis margaritacea	0	0	0	0	Aug	0
Andropogon gerardi	0	Aug	0	0	0	0
A. scoparius	0	0	Aug,Sep	0	Sep	0
A. virginicus	0	0	0	0	Sep	0
Anemone quinquefolia	0	0	0	May	0	0
Anemonella thalictroides	0	0	0	0	Apr,May	0
Antennaria neglecta	0	0	May	May	Apr	May
A. plantaginifolia	0	0	May	May	May	0
Anthoxanthum odoratum	0	0	May,Jun	May,Jun	May,Jun	May
Apios americana	0	Aug	0	0	0	0
Apocynum cannabinum	0	0	Jul	0	Jul	0
Aquilegia canadensis	0	0	0	0	May	May
Arbidopsis thalliana	0	0	May	Apr,May	Apr	0
Arabis laevigata	0	May	0	0	May	May,Jun
Aralia nudicaulis	0	0	0	0	0	May
Arctium minus	Aug	0	Aug	0	0	0
Arisaema triphyllum	May	May	May	0	0	0
Aronia melanocarpa	0	0	0	May	0	0
Asclepias incarnata	0	Jul	0	Jul	0	0
A. quadrifolia	0	0	0	0	0	Jun
A. syriaca	0	0	Jul	Jul	0	0
A. tuberosa	0	0	Jul	0	0	0
Asplenium platyneuron	0	0	Jul	Jul	Jul	Jul
Aster cordifolius	Sep,Oct	0	Sep,Oct	Sep	Sep,Oct	0
A. divaricatus	Aug-Oct	0	Aug,Sep	0	Aug-Oct	Sep,Oct
A. dumosus	0	0	0	0	0	Sep,Oct
A. ericoides	0	0	Sep,Oct	Sep,Oct	Sep,Oct	Sep,Oct
A. lateriflorus	0	0	Sep,Oct	Sep,Oct	Sep,Oct	Oct
A. novae-angliae	0	0	0	0	Sep,Oct	0
A. patens	0	0	0	0	Sep	0
A. paternus	0	0	0	0	Jul	0
A. puniceus	0	0	0	Sep,Oct	0	0
A. simplex	Sep	Sep	Sep	Sep,Oct	Sep	0
Athyrium filix-femina	0	0	Jul	Jul	Jul,Aug	0
Aureolaria virginica	0	0	0	0	Jun	Aug
Baptisia tinctoria	0	0	0	0	Jul	0
Barbarea vulgaris	May	May,Jun	May	May	May	0
Betula lenta	0	0	May	May	Apr	May
B. populifolia	0	0	0	0	0	May
Bidens frondosa	Aug	0	Aug,Sep	Aug	0	0
Boehmeria cylindrica	Jul,Aug	Jul	0	0	0	0
Botrychium dissectum	0	0	0	0	Sep,Oct	0
B. matricariaefolium	0	0	0	0	Jun	0
Brassica kaber	0	0	May-Jul,Oct	Jul	0	0
Cardamine pensylvanica	0	0	May	0	May	Apr-Aug
Carex crinita	0	Jun	0	0	0	0
C. intumescens	0	Jun	0	0	0	0
C. pensylvanica	0	0	Apr	0	Apr	May
Carex sp.[a]	May	May	May	May	May	May
Carya ovata	0	0	0	May	0	0
Ceanothus americanus	0	0	Jun	0	0	Jun,Jul
Cerastium arvense	0	May	0	May	May,Jun	0
Chelidonium majus	May,Jun	May	May-Jul	0	0	0
Chenopodium ambrosioides	0	0	0	0	0	Aug
Chrysanthemum leucanthemum	0	0	Jun,Jul	Jun-Sep	May-Sep	0
Cicuta maculata	0	0	0	Jul	0	0
Cinna arundinacea	Aug	Aug	0	0	0	0
Circaea quadrisulcata	Jul	Jul	Jul,Aug	0	Jul	Jul,Aug
Cirsium arvense	0	0	0	Jun,Jul	0	0
C. vulgare	0	0	0	Aug	Aug	0

Table F-4 (cont.)

Species	RF	GIF	TR419	TR438	QSH	CC
Claytonia virginica	Apr,May	Apr	0	0	0	0
Clematis virginiana	0	0	Aug	0	0	0
Commandra umbellata	0	0	0	0	May,Jun	0
Commelina communis	Aug	Aug	Jul-Sep	Jul-Sep	Jul-Sep	0
Convolvulus sepium	0	0	Jul	0	0	0
Conyza canadensis	0	0	0	Aug,Sep	Aug	Aug
Cornus alternifolia	0	0	May	0	May	0
C. florida	0	0	May	0	May	May
C. racemosa	0	0	0	Jun	0	0
Coronilla varia	0	0	Jun-Oct	Jun,Jul	0	0
Corylus americana	0	0	0	Apr	0	0
Crataegus sp.	0	0	0	0	May	May
Cryptotaenia canadensis	0	0	Jun	0	0	0
Cunila oreganoides	0	0	0	0	Aug,Sep	Sep
Cyperus filiculmis	0	0	0	0	0	Aug
C. strigosus	0	Aug	0	Aug	0	0
Cyprepedium acaule	0	0	0	0	0	May
Cystopteris protrusa	0	Jul	0	0	0	0
Dactylis glomerata	0	0	May,Jun	May-Jul	0	Jun
Danthonia spicata	0	0	0	0	Jun	Jul
Daucus carota	0	0	Jul,Aug	Jul,Aug,Oct	Jul,Aug	Aug
Dennstaedtia punctilobula	0	0	Jul	Jul	Jul	Jul
Dentaria laciniata	Apr,May	Apr	0	0	0	0
Deschampsia flexuosa	0	0	0	0	Jun	May,Jun
Desmodium dillenii	0	0	0	0	Aug	0
D. nudiflorum	0	0	Aug	0	0	Aug
D. paniculatum	0	0	Aug	Aug	Aug	0
Dianthus armeria	0	0	0	Jun,Jul,Sep	Jun-Aug	0
Dicentra cucullaria	Apr,May	Apr	0	0	0	0
Diervilla lonicera	0	0	0	0	Jun	0
Digitaria sanguinalis	0	0	Aug	Aug	Aug	0
Dryopteris intermedia	0	0	Jun,Jul	0	Jul	0
D. marginalis	0	0	Jul	Jul	Jul	Jul
D. spinulosa	0	0	Jun	0	Jul	0
Echinochloa muricata	Aug	0	0	Aug	0	0
Elymus riparius	Aug	Aug	0	0	0	0
E. villosus	Jul	0	0	0	0	0
Epigaea repens	0	0	0	0	Apr	Apr
Epilobium coloratum	0	Aug	0	Aug	Aug	0
Equisetum arvense	0	0	0	Apr,May	Apr	0
Eragrostis frankii	0	0	Jul	0	0	0
E. spectabilis	0	0	Aug	0	0	0
Erechtites hieracifolia	0	0	Aug,Sep	Sep	0	Aug
Erigeron annuus	Jul,Aug	0	Jun-Aug	May-Aug	Jun-Oct	Jun-Sep
Erysimum cheiranthoides	0	0	Jul	Aug	0	0
E. albidum	Apr,May	0	0	0	0	0
E. americanum	Apr,May	Apr	0	0	0	0
Eupatorium fistulosum	0	0	0	Aug	0	0
E. maculatum	Aug	Aug	0	0	0	0
E. perfoliatum	Aug	0	0	Aug,Sep	Aug	0
E. rugosum	Aug-Oct	Aug-Oct	Aug-Oct	Sep	Jul-Oct	Sep,Oct
Euphorbia preslii	0	0	0	0	Aug	0
Festuca obtusa	0	0	Jun	Jun	0	Jun
Floerkia proserpinacoides	May	May	0	0	0	0
Fragaria virginiana	0	0	May	Apr,May	May	May
Fraxinus americana	0	Apr	0	May	Apr	0
Galinsoga ciliata	0	0	Jul-Oct	Aug-Oct	Jul,Aug	0
Galium aparine	0	Jul	May,Jul	May,Jul	May,Jul	0
G. asprellum	0	Aug	0	0	0	0
G. circaezans	0	0	0	0	Jul	Jul
G. triflorum	0	Aug	0	0	0	0
Gaura biennis	0	0	0	Sep	0	0
Geranium maculatum	0	0	0	May	May	May
Gerardia tenuifolia	0	0	0	0	Aug,Sep	0
Geum canadense	Jul,Aug	Jul	Jul,Aug	Jul	Jul	Jun
Glechoma hederacea	May	May	0	0	Apr	0
Gnaphalium obtusifolium	0	0	0	Aug,Sep	Aug	Sep
Goodyera pubescens	0	0	0	0	0	Aug
Hackelia virginiana	0	Jul	0	0	0	0
Hedeoma pulegioides	0	0	0	0	Aug	0
Helenium autumnale	Aug	Aug,Sep	Sep	0	0	0
Helianthus divaricatus	0	0	0	0	0	Aug
H. tuberosus	0	Jul-Sep	0	0	0	0
Hemerocallus fulva	0	0	Jul	Jun,Jul	Jul	0
Hepatica americana	0	0	0	0	Apr	May
Hesperis matronalis	May-Jul	May,Jun	0	0	0	0

Table F-4 (cont.)

Species	RF	GIF	TR419	TR438	QSH	CC
Hieracium aurantiacum	0	0	0	0	0	Jun
H. paniculatum	0	0	Aug	Aug	Aug,Sep	Aug
H. pratense	0	0	Jun	May-Jul	May-Jul	Jun,Jul
H. venosum	0	0	Jun	0	May,Jun	Jun
Holcus lanatus	0	0	0	0	Jun	Jun
Houstonia caerulea	May	0	0	0	Apr,Jun	May,Jun
Hydrangea arborescens	Jul	0	0	0	0	0
Hydrophyllum virginianum	May	0	0	0	0	0
Hypericum perforatum	Aug	0	0	Jul	Jul	0
H. punctatum	Aug	0	0	Jul,Aug	Jul	Jul
H. pyramidatum	0	Jul	0	0	0	0
Hypoxis hirsuta	0	0	0	0	0	Jun
Hystrix patula	0	0	0	0	0	Aug
Impatiens biflora	Jul,Aug	Jul,Aug	Jul,Aug	Jul-Sep	0	0
I. pallida	Jul,Aug	Aug	0	0	0	0
Juncus tenuis	0	0	0	0	0	Jul
Kalmia angustifolia	0	0	0	0	0	Jun
K. latifolia	0	0	0	0	Jun	Jun,Jul
Krigia virginica	0	0	0	May	May,Jun	May,Jun
Lactuca canadensis	0	0	0	Jul,Aug	Jul,Aug	Jun,Jul
Leersia virginica	Aug	Aug	Aug	Aug	Aug	0
Leonurus cardiaca	Jul	0	Jun-Aug	Jun,Jul	0	0
Lepidium campestre	0	0	0	0	May	0
Lespediza hirta	0	0	0	0	Aug	0
L. violacea	0	0	0	0	0	Sep
L. virginica	0	0	0	0	Aug	0
Ligustrum vulgare	0	Jun	0	0	0	0
Lilium canadense	0	Jul	0	0	0	0
L. superbum	Aug	0	0	0	0	0
Linaria vulgaris	0	0	Jul	Jul,Sep,Oct	Jul-Oct	0
Lindera benzoin	0	Apr	Apr	Apr	Apr	0
Lindernia dubia	0	Jul	0	0	0	0
Lobelia inflata	0	0	Jul,Aug	Aug	Jul,Aug	Aug
Lotus corniculatus	Jul	0	0	0	0	0
Ludwigia alternifolia	0	0	0	Jul	0	0
Lychnis alba	0	0	0	May,Jun,Aug	May,Jun	0
Lycopodium flabelliforme	0	0	0	Oct	0	Oct
L. obscurum	0	0	0	Oct	0	0
Lycopus virginicus	Aug	Aug	0	0	Aug	0
Lysimachia ciliata	Jul,Aug	Jul	0	0	0	0
L. quadrifolia	0	0	0	0	Jun	Jun,Jul
L. terrestris	0	0	0	Jun	0	0
L. vulgaris	0	Jul	0	0	0	0
Maianthemum canadense	0	0	May	0	0	May
Medicago lupulina	0	0	0	Jun	0	0
Melampyrum lineare	0	0	0	0	Jul	Jun-Aug
Melilotis alba	0	0	0	0	Jul,Aug,Oct	0
Mertensia virginica	May	0	0	0	0	0
Mimulus ringens	0	0	0	Aug	0	0
Mitchella repens	0	0	0	0	0	Jun
Monotropa uniflora	0	0	Jul	0	Jul	Aug
Muhlenbergia frondosa	Aug	Aug	0	0	0	0
M. sylvatica	0	0	0	0	Aug	0
Myrica asplenifolia	0	0	0	0	Apr	0
Nyssa sylvatica	0	0	0	0	May	0
Oenothera biennis	0	Aug	Aug	Aug,Sep	Aug	0
Osmorhiza longistylis	May	0	0	0	0	0
Osmunda cinnamomea	0	0	0	May	0	0
Oxalis dillenii	Aug	0	May,Jul,Aug	May,Aug	May,Jun,Aug	Jun
O. stricta	Jun	0	Jun,Sep	Jun,Aug,Sep	Jun	0
O. violacea	0	0	0	0	May	0
Panicum boscii	0	0	Jul	0	0	0
P. capillare	0	Aug	Aug	Aug	Aug	0
Panicum clandestinum	0	Jun,Jul	0	0	Jun	0
P. dichotomum	0	0	Jul	0	0	0
P. lanuginosum	0	0	0	0	Jun	0
P. virgatum	0	0	0	0	Jul	0
Parthenocissus quinquefolia	0	0	Jun	0	0	0
Penstemon hirsutus	0	0	May,Jun	0	Jun,Jul	Jun
Phalaris arundinacea	0	Jun	0	Jun	0	0
Phleum pratense	0	0	Jun,Jul	Jun,Jul	Jul	0
Phlox subulata	0	0	0	May	May	May
Physocarpus opulifolius	0	Jun	0	0	0	0
Phytolacca americana	Aug,Sep	Jul-Sep	Sep	Aug,Sep	Jul,Aug	Aug
Pilea pumila	Aug	Aug	0	0	0	0
Plantago lanceolata	0	0	Jun,Jul	Jun-Aug	May	Jun
Poa compressa	0	0	Jun	Jun	Jun	Jun
P. pratensis	May	May	May	May	May,Jun	May

Table F-4 (cont.)

Species	RF	GIF	TR419	TR438	QSH	CC
Podophyllum peltatum	May	May	May	0	May	0
Polygala paucifolia	0	0	0	0	0	May
Polygonatum biflorum	Jun	0	May	May	May	0
Polygonum cilinode	Jul,Aug	Jun-Aug	0	0	0	0
P. convolvulus	0	0	0	0	Aug	0
P. cuspidatum	Aug	Aug	0	0	0	0
P. hydropiperoides	Aug-Oct	Sep	0	0	Jul,Aug	0
P. pensylvanicum	Aug	0	Aug,Sep	Aug,Sep	Aug	0
P. persicaria	Jul,Aug,Oct	0	Jun-Oct	Aug,Sep	Jul,Aug	0
P. sagittatum	Aug,Sep	0	Sep	Aug,Sep	0	0
P. virginianum	Aug	Aug	Aug	Aug	Aug	0
Polystichum acrostichoides	0	0	Jun,Jul	Jun,Jul	Jul	0
Populus grandidentata	0	0	0	0	Apr	0
Potentilla norvegica	0	0	0	0	Aug	0
P. recta	0	0	0	0	Jun,Jul	0
P. simplex	0	0	May	May,Jun	May,Jun	May,Jun
Prenanthes alba	0	0	0	Sep	Aug	0
Prunella vulgaris	0	0	Aug,Sep	Jul-Sep	Jul-Sep	Aug
Prunus avium	0	0	0	0	May	0
P. serotina	0	0	May	May	May	May
P. virginiana	May	0	0	0	0	0
Pteridium aquilinum	0	0	0	0	Aug	0
Pycnanthemum incanum	0	0	0	0	Jul,Aug	Aug
Pycnanthemum virginianum	0	0	0	0	Jul	0
Quercus borealis	May	0	0	0	May	May
Ranunculus abortivus	May	0	Apr,May	May	Apr,May	0
R. acris	May	0	Jun,Jul	May-Jul	May-Jul	0
Rhododendron nudiflorum	0	0	0	May	0	May
Rhus glabra	0	0	0	Jul	Jul	0
R. radicans	Jun	Jun	0	0	0	0
R. typhina	0	0	0	Jun	0	0
Rorippa sylvestris	0	Jul	Jun	Jun	0	0
Rosa multiflora	0	0	Jun	Jun	0	0
R. virginiana	0	0	0	0	Jun	Jun
Rubus allegheniensis	0	Jul	May	May,Jun	May-Jul	May
R. flagellaris	0	0	0	Jun	May,Jun	0
R. occidentalis	0	0	May	0	May	May
Rudbeckia hirta	0	0	Jul	Jun-Oct	Jul,Aug	0
Rumex acetosella	0	0	0	May-Jul	May-Jul	May,Jun
R. crispus	Jun	0	Jun	Jun	0	0
R. obtusifolius	Jun	0	0	0	0	0
Salix humilis	0	0	0	Apr	0	0
S. sericea	0	0	0	Apr	0	0
Salix sp.	0	0	0	0	Apr	0
Sambucus canadensis	0	0	0	Jun	0	0
Sanguinaria canadensis	0	Apr	0	0	Apr	0
Saponaria officinalis	0	0	Jul	Jul-Sep	Jul,Aug	0
Sassafras albidum	0	0	May	May	May	0
Satureja vulgaris	0	0	0	Jul,Aug	Jul	0
Saxifraga virginiensis	0	0	Apr,May	0	Apr,May	May
Scirpus atrovirens	0	0	0	0	Jun,Jul	0
Scrophularia lanceolata	Aug	0	May	Jun,Jul	May,Jun	0
Senecio obovatus	0	0	0	0	0	May,Jun
Setaria faberii	0	0	Aug	Aug	0	0
S. glauca	0	0	Aug	Aug	Aug	0
Sicyos angulatus	Aug	0	0	0	0	0
Silene stellata	0	0	0	0	Aug	Aug
Sisyrinchium angustifolium	0	0	0	0	0	Jun
Smilacena racemosa	0	0	May	0	May	May
Solanum carolinense	0	Aug	0	Jul-Sep	0	0
S. dulcamara	0	0	0	Jul	0	0
Solidago arguta	0	0	0	0	0	Aug-Oct
S. bicolor	0	0	Sep	0	Aug-Oct	Sep,Oct
S. caesia	0	0	Sep,Oct	0	Sep,Oct	Sep,Oct
S. canadensis	Aug,Sep	Aug,Sep	Aug,Sep	Aug,Sep	Sep	0
S. flexicaulis	Sep,Oct	Sep,Oct	0	0	0	0
S. gigantea	Aug,Sep	Aug	Aug	Aug	Aug	0
S. graminifolia	0	Aug	Sep	Aug,Sep	Aug,Sep	Aug,Sep
S. juncea	0	Aug	0	Jul,Aug	Jul-Sep	Jul
S. nemoralis	0	0	0	Aug-Oct	Aug-Oct	0
S. rugosa	Sep	Sep	Sep,Oct	Sep,Oct	Sep,Oct	Sep
Sphenopholis intermedia	0	0	0	0	May,Jun	0
Spiraea latifolia	0	Jul	0	Jul-Sep	Jul	0
Spiranthes cernua	0	0	Sep	Sep	Sep	0
S. gracilis	0	0	0	Aug	0	0
Staphylea trifolia	May	May	0	0	0	0

Table F-4 (cont.)

Species	RF	GIF	TR419	TR438	QSH	CC
Stellaria aquatica	Aug,Oct	0	0	0	0	0
S. longifolia	0	Jul	0	0	Jun	0
S. media	0	0	Apr,May	May	Apr,May	0
Taraxacum officinale	May	0	Apr,May,Jul,Oct	Apr-Jul,Sep	May	Jun
Teucrium canadense	Aug	Jul,Aug	Jul	Jul	Jul	0
Thalictrum polygamum	0	Jul	0	Jul	0	0
Thelypteris noveboracensis	0	0	0	Aug	Jul	Aug
Tilia americana	Jul	0	0	0	0	0
Tragopogon dubius	0	0	0	0	Jun,Jul	0
Trichostema dichotomum	0	0	0	Aug	Aug	0
Trifolium agrarium	0	0	0	Jun,Jul,Oct	Jul,Aug	Jun,Jul
T. arvense	0	0	0	Aug,Sep	0	0
T. pratense	0	0	0	Jun,Jul,Sep	Jun	0
T. repens	0	0	Jun,Jul	Jun,Jul	Jun,Jul	Jun,Jul
Trillium erectum	Apr,May	Apr	0	0	0	0
Triodanus perfoliata	0	0	Jun	Jun	Jun	0
Triodia flava	0	Aug	Aug	Aug	Aug	0
Tussilago farfara	0	0	0	Apr,May	0	0
Ulmus americana	Apr	0	0	0	Apr	0
Urtica dioica	Jul,Aug	Jul	0	0	0	0
Uvularia perfoliata	0	0	0	0	0	May
U. sessilifolia	0	0	0	0	0	May
Vaccinium stamineum	0	0	0	0	May	May
V. vacillans	0	0	0	0	May	0
Verbascum thapsis	0	0	0	Jul	Jul	0
Verbena hastata	0	Jul,Aug	0	Aug	0	0
V. urticifolia	Aug	Jul	Jul,Aug	Jul,Aug	Jul,Aug	Aug
Vernonia noveboracensis	0	0	0	Aug,Sep	0	0
Veronica arvensis	0	0	May	May	0	May
V. officinalis	0	0	May	May-Jul	May,Jun	May,Jun
V. serpyllifolia	May	0	May	0	May	0
Viburnum dentatum	0	0	0	Jun	0	0
Vinca minor	0	0	Apr	0	0	0
Viola fimbriatula	0	0	May	0	Apr,May	0
V. palmata	0	0	0	0	0	May
V. papilionacea	May	Apr	Apr,May	Apr,May	Apr,May	May
V. pubescens	Apr,May	0	0	0	0	0
V. sororia	May	May	0	0	0	0
V. striata	May	0	0	0	0	0
Vitis aestivalis	0	0	Jun	Jun	0	Jun
V. riparia	0	0	Jun	0	0	0
Woodsia obtusa	0	0	0	0	Jul	0

[a]Most species of *Carex* cannot be identified in flower.

Table F-5. Months when plants were observed in flower or shedding spores on abandoned field and open marsh salt drift transects at the Susquehanna SES, 1978. Names, abbreviations, and locations of transects are given in Table F-1.

Species	NF	SwF	TCF	SM	US11M
Acalypha virginica	0	0	Sep	0	0
Acer rubrum	Apr	0	Apr	0	0
Achillea millefolium	0	Jul,Aug	Jul-Oct	0	0
Acorus calamus	0	0	0	0	May,Jun
Agrostis stolonifera	Aug	Jul,Aug	Jun,Jul	0	0
Alisma subcordatum	0	0	0	0	Jul
Alliaria officinalis	May	0	0	0	0
Allium vineale	0	0	Jul	0	0
Alnus rugosa	Apr	0	0	0	0
Ambrosia artemisiifolia	0	Aug,Sep	Aug,Sep	0	0
Andropogon scoparius	0	0	Aug,Sep	0	0
A. virginicus	0	0	Sep	0	0
Antennaria neglecta	0	May	May	0	0
Anthoxanthum odoratum	0	May-Jul	May,Jun	0	0
Apocynum cannabinum	Jun-Aug	0	0	0	0
Arabidopsis thalliana	0	0	May	0	0
Arisaema triphyllum	0	0	0	May	0
Asclepias incarnata	Jul	0	0	Jul	Jul,Aug
A. tuberosa	0	0	Jul	0	0
Aster ericoides	Sep,Oct	Sep,Oct	Sep,Oct	0	Oct
A. lateriflorus	Aug-Oct	Sep	0	0	0
A. novae-angliae	0	Aug-Oct	0	0	Sep
A. puniceus	0	0	0	Aug-Oct	Sep,Oct
A. simplex	Sep	Sep,Oct	0	0	Sep
A. umbellatus	0	Oct	0	0	0
Barbarea vulgaris	May	May	May	May	May
Bidens cernua	Sep	0	0	0	Sep
B. frondosa	Aug,Sep	0	0	0	Sep
Boehmeria cylindrica	Jul	0	0	Jul	Jul
Botrychium dissectum	0	0	Sep,Oct	0	0
B. matricariaefolium	0	0	Jun	0	0
Bulbostylis capillaris	0	0	Sep	0	0
Cardamine pensylvanica	0	0	0	May	0
Carex crinita	0	0	0	Jun	0
C. lacustris	0	0	0	Jun	0
C. lurida	0	0	0	Jun	Jun
Carex sp.[a]	May	May	May	May	May
Cassia nictitans	0	0	Jul	0	0
Cerastium arvense	May,Jun	May,Jun	May	May,Jun	0
Chelone glabra	0	0	0	Sep	0
Chrysanthemum leucanthemum	Jun-Sep	Jun-Aug	Jun,Jul	0	Jun
Cicuta bulbifera	0	0	0	0	Aug
C. maculata	Jul	0	0	Jul	Jul
Cinna arundinacea	0	0	0	Aug	0
Cirsium arvense	Jul	0	0	0	Jul
C. vulgare	Aug,Sep	0	Jul	Aug	Sep
Claytonia virginica	0	0	0	May	0
Convolvulus sepium	0	Jul,Aug	0	0	0
Conyza canadensis	0	0	Aug,Sep	0	0
Cornus amomum	0	Jun	Jun,Jul	0	Jul
C. racemosa	0	Jun	0	0	Jun
Cuscuta gronovii	0	0	0	Aug,Sep	Aug,Sep
Cyperus filiculmis	0	0	Oct	0	0
C. strigosus	0	Aug	0	Aug,Sep	Aug
Danthonia spicata	0	0	Jun	0	0
Daucus carota	Aug-Oct	Jul-Oct	Jul-Sep	0	0
Desmodium paniculatum	Aug	Aug	Aug	0	0
Dianthus armeria	Jul	Jun-Aug	Jul-Sep	0	0
Digitaria ischaemum	0	Aug	0	0	0
Dryopteris cristata	0	0	0	Jul	0
Echinochloa muricata	0	Aug	0	0	0
Eleagnus commutata	0	May	0	0	0
Eleocharis acicularis	0	0	0	0	Aug
E. ovata	0	0	0	Jun	Jun,Jul
E. tenuis	0	0	0	0	Aug
Elymus riparius	Aug	0	0	0	0
E. virginicus	Aug	0	0	0	0
Epilobium coloratum	Aug,Sep	0	0	Aug,Sep	Sep
Eragrostis cilianensis	0	0	Aug	0	0
E. spectabilis	0	0	Aug	0	0
Erechtites hieracifolia	0	0	Sep	0	Sep
Erigeron annuus	Jun-Aug	Jun-Aug	Jun-Aug	0	Jul
Eupatorium fistulosum	0	0	0	Aug,Sep	Aug,Sep
E. maculatum	Aug,Sep	0	0	0	0
E. perfoliatum	Aug	Aug	0	Jul-Sep	Jul,Sep
E. rugosum	Aug	0	Sep	Aug,Sep	0

Table F-5 (cont.)

Species	NF	SwF	TCF	SM	US11M
Floerkia proserpinacoides	May	0	0	0	0
Fragaria virginiana	May	May	May,Jun	May	0
Fraxinus americana	0	May	0	0	0
Galium aparine	0	0	0	Jun	0
G. asprellum	0	0	0	Jul,Aug	0
G. palustre	Jun,Jul	0	0	Sep,Oct	Jun
G. trifidum	0	0	0	Jul	Jun,Jul
Gaura biennis	Aug	0	0	0	Aug
Gentiana andrewsii	0	Oct	0	0	0
Gerardia tenuifolia	Sep	0	0	0	0
Geum canadense	Jul	0	0	0	0
G. laciniatum	Jun	0	0	0	Jun
Glyceria canadensis	0	0	0	Jun	0
G. striata	0	0	0	Jun	0
Gnaphalium obtusifolium	0	0	Aug-Oct	0	0
Helenium autumnale	Aug-Oct	0	0	0	Sep,Oct
Helianthus decapetalus	Aug,Sep	0	0	0	0
Hesperis matronalis	Jun	0	0	0	0
Hieracium paniculatum	0	0	Aug	0	0
H. pratense	May,Jun	May,Jun	Jun	0	0
Holcus lanatus	0	0	0	0	Jun
Houstonia caerulea	0	May	0	0	0
Hypericum mutilum	0	Aug	Sep	Aug	Aug,Sep
H. perforatum	Jul,Aug	Jul,Aug	Jul	0	0
H. punctatum	Jul,Aug	Jul,Aug	Jul	0	Jul
H. pyramidatum	Jul	0	0	0	0
Impatiens biflora	0	0	0	Jul-Sep	Jul-Sep
Iris versicolor	0	0	0	Jun	May
Juncus effusus	0	Jun	0	Jun	Jun
J. tenuis	Jun,Jul	0	Jul	0	0
Krigia virginica	0	0	May,Jul	0	0
Lactuca canadensis	0	0	Aug	0	0
Leersia oryzoides	0	0	0	Aug	Aug
L. virginica	0	0	0	Aug	Aug
Lepidium campestre	0	May	0	0	0
L. virginicum	0	0	May	0	0
Linaria vulgaris	0	0	Sep	0	0
Lobelia cardinalis	Aug	0	0	0	0
L. inflata	Aug	Jul,Aug	Jul,Aug	0	0
L. siphilitica	Aug,Sep	0	0	0	Sep
Ludwigia alternifolia	0	0	0	Aug	Jul,Aug
Luzula campestris	0	May	0	0	0
Lychnis alba	Jul	0	0	0	0
Lycopodium flabelliforme	0	0	Oct	0	0
L. obscurum	0	0	Sep	0	0
L. tristachyum	0	0	Sep	0	0
Lycopus americanus	Aug	0	0	0	0
L. virginicus	0	0	0	Jul	Jul,Aug
Lysimachia ciliata	Jul,Aug	0	0	0	0
L. terrestris	Jul	0	0	Jun,Jul	Jun,Jul
L. vulgaris	Jul,Aug	0	0	0	Jul
Lythrum salicaria	0	0	0	0	Aug
Malva neglecta	0	0	Jul	0	0
Melilotus alba	0	Jul	Jul	0	0
M. officinalis	0	Jun,Jul	0	0	0
Mimulus ringens	Aug	0	0	Jul,Aug	Jul,Aug
Mollugo verticellata	0	Aug	Sep	0	0
Monarda clinopodia	Aug	0	0	0	0
Myosotis scorpioides	0	0	0	0	May,Jun
Oenothera biennis	Aug,Sep	Jul, Aug	Jul	0	Aug,Sep
Osmorhiza longistylis	0	0	May	0	0
Osmunda cinnamomea	0	0	0	May	0
Oxalis dillenii	Jun	May	May,Jul	0	0
Panicum capillare	0	Aug	Sep	0	0
P. clandestinum	Jun	0	0	0	0
P. virgatum	Aug	0	0	0	0
Panicum sp.	0	0	Jun	0	0
Penstemon hirsutus	0	0	Jun	0	0
Penthorum sedioides	0	0	0	0	Jul,Aug
Phalaris arundinacea	0	Jun	0	0	Jun
Phleum pratense	0	Jun-Aug	Jul	0	0
Phytolacea americana	0	Aug	Jul,Sep	0	0
Pilea pumila	0	0	0	Aug,Sep	Aug
Plantago aristata	0	0	Jul	0	0
P. lanceolata	0	May,Jun	0	0	0
P. major	Aug	Aug	Jul	0	0

Table F-5 (cont.)

Species	NF	SwF	TCF	SM	US11M
Poa compressa	0	Jun	Jul	0	0
P. languida	0	0	0	Jun	Jun
P. palustris	Jul	0	0	0	Jul
P. pratensis	May,Jun	May	May	0	0
Polygala verticellata	0	Aug	Aug,Sep	0	0
Polygonum arifolium	0	0	0	Aug,Sep	0
P. cilinode	Jun,Jul	0	0	0	0
P. hydropiperoides	0	0	0	Aug-Oct	Jul-Sep
P. pensylvanicum	0	Aug	Sep	Sep	Sep
P. sagittatum	Sep	0	0	Aug-Oct	Aug,Sep
Populus grandidentata	0	0	Apr	0	0
P. tremuloides	Apr	0	Apr	0	0
Potentilla norvegica	Jun,Aug	Jul	0	0	0
P. simplex	May,Jun	May,Jun	May,Jun	0	0
Prunella vulgaris	Aug	Jun-Sep	Jul-Sep	0	0
Pycnanthemum virginianum	0	0	0	0	Aug
Quercus palustris	0	0	0	May	0
Ranunculus abortivus	0	0	0	May	0
R. bulbosus	May	0	0	0	0
R. pensylvanicus	Aug	0	0	0	Jul,Aug
R. repens	May,Jun	0	0	0	0
Ribes americanum	0	0	0	May	0
Rorippa sylvestris	Jun,Jul	0	0	0	0
Rosa multiflora	0	Jun	0	0	0
R. palustris	0	0	0	Jul	0
R. virginiana	0	0	Jul	0	0
Rubus allegheniensis	0	May	Jun	Jun	0
R. flagellaris	0	0	Jun	0	0
Rudbeckia hirta	Jun-Aug	Jun-Sep	Jul,Aug	0	0
Rumex acetosella	May,Jun	May-Jul	May-Jul	0	0
R. crispus	Jun	Jun	0	0	Jun
R. obtusifolius	Jun	0	0	0	0
Sagittaria latifolia	0	0	0	Aug	Jul,Aug
Sambucus canadensis	0	0	0	Jun	Jul
Sassafras albidum	0	0	May	0	0
Scirpus atrovirens	0	0	0	0	Jun,Jul
S. cyperinus	0	0	0	0	Aug
S. validus	0	0	0	Jun	Jun,Jul
Selaginella apoda	0	0	0	0	Sep
Setaria faberii	0	Aug	Aug	0	0
S. glauca	Aug	Aug	0	0	0
Sisyrinchium angustifolium	Jun	Jun	0	0	0
Solanum carolinense	Jul,Aug	Aug	Sep	0	0
Solidago canadensis	Aug,Sep	Aug-Oct	Sep	0	Sep,Oct
S. gigantea	Aug,Oct	Aug	Aug	Aug,Oct	Aug
S. graminifolia	Aug,Sep	Aug,Sep	Aug,Sep	Aug,Sep	Aug,Sep
S. juncea	Aug-Oct	Jul,Aug	Jul-Oct	0	0
S. nemoralis	0	Aug-Oct	Aug,Sep	0	0
S. rugosa	Sep,Oct	Oct	Sep	Aug-Oct	Sep,Oct
Sorghastrum nutans	Sep	0	0	0	0
Sparganium eurycarpum	0	0	0	Jun	Jun,Jul
Spiraea latifolia	Aug,Sep	Jul	Jul,Aug	0	Jul
Spiranthes cernua	0	0	0	0	Sep
Stellaria longifolia	0	May,Jun	0	Jun	0
Syringa vulgaris	0	0	May	0	0
Taraxacum officinale	May	Apr,May	May	0	0
Teucrium canadense	0	Jul,Aug	0	0	0
Thalictrum polygamum	0	0	0	Jul	0
Thelypteris palustris	0	0	0	Aug,Sep	0
Triadenium virginicum	0	0	0	Jul	0
Trichostema dichotomum	0	0	Aug,Sep	0	0
Trifolium agrarium	0	Jun,Jul	Jul	0	0
T. arvense	Sep	0	0	0	0
T. hybridum	Jun-Aug	Jun-Aug	0	0	0
T. pratense	0	May-Oct	0	0	0
T. repens	Jun-Aug	May-Jul	Jun,Jul	0	0
Triodanus perfoliata	0	0	Aug	0	0
Typha latifolia	0	0	0	Jul	0
Urtica dioica	0	0	0	Aug	Jul
Vaccinium corymbosum	0	0	May	May	0
V. vacillans	0	0	May	0	0
Verbascum thapsis	0	0	Jul	0	0
Verbena hastata	Jul,Aug	0	0	Jun-Sep	Jul,Aug
V. urticifolia	Aug	0	Sep	0	0
Vernonia noveboracensis	0	0	0	Aug,Sep	Aug,Sep
Veronica arvensis	0	0	May	0	0
V. officinalis	0	0	Jun	0	0

Table F-5 (cont.)

Species	NF	SwF	TCF	SM	US11M
Veronicastrum virginicum	0	0	0	0	Jul
Viburnum dentatum	0	0	0	Jun	Jun
Viola conspersa	0	0	0	May	0
V. fimbriatula	0	0	May	0	0
V. papilionacea	May	May	0	May	0
V. sororia	May	May	0	0	0
Vitis aestivalis	0	0	0	Jun	0

[a]Most species of *Carex* cannot be identified in flower.

Table F-6. Parasitic plant diseases observed on salt drift transects at the Susquehanna SES, 1978. Names, abbreviations, and locations of transects are given in Table F-1.

Host Species	Disease	Location
Acer rubrum	*Phyllosticta minima* (leaf spot)	RF, GIF, TR419, TR438, QSH, CC, TCF
A. saccharinum	*P. minima* (leaf spot)	RF
Achillea millefolium	*Erysiphe cichoracearum* (powdery mildew)	TR438, CC
Agrimonia grypsosepala	*E. polygoni* (powdery mildew)	CC
Ambrosia artemisiifolia	*E. cichoracearum* (powdery mildew)	TR419, TR438, QSH, CC, NF
Amphicarpa bracteata	*E. polygoni* (powdery mildew)	TR438
Arisaema triphyllum	*Uromyces aritriphylli* (rust)	TR419
Aster divaricatus	*Erysiphe cichoracearum* (powdery mildew)	QSH
A. divaricatus	*Coleosporium solidaginis* (rust)	QSH
A. novae-angliae	*Erysiphe cichoracearum* (powdery mildew)	QSH, SwF
A. puniceus	*E. cichoracearum* (powdery mildew)	TR438
A. simplex	*E. cichoracearum* (powdery mildew)	TR419, TR438, QSH
Betula lenta	*Nectria galligena* (nectria canker)	CC
Castanea dentata	*Endothia parasitica* (chestnut blight)	CC
Catalpa bignonioides	*Phyllosticta catalpae* (leaf spot)	GIF
Celtis occidentalis	unidentified anthracnose	QSH
Chrysanthemum leucanthemum	*Erysiphe cichoracearum* (powdery mildew)	QSH
Cornus amomum	*Septoria cornicola* (leaf spot)	US11M
Desmodium paniculatum	*Uromyces hedysari-paniculati* (rust)	TCF
Eupatorium fistulosum	*Erysiphe cichoracearum* (powdery mildew)	RF, TCF, US11M
E. rugosum	*E. cichoracearum* (powdery mildew)	QSH
Fraxinus americana	*Gloeosporium aridum* (anthracnose)	RF, GIF, TR438, QSH, CC
Helenium autumnale	*Erysiphe cichoracearum* (powdery mildew)	NF
Helianthus decapetalus	*Coleosporium helianthi* (leaf rust)	NF
Liriodendron tulipifera	*Mycosphaerella liriodendri* (leaf spot)	SwF
Panicum sp.	*Balansia strangulans* (black-ring)	QSH

Table F-6 (cont.)

Host Species	Disease	Location
Podophyllum peltatum	*Puccina podophylli* (rust)	GIF, TR419
Potentilla simplex	*Frommea obtusa* (rust)	QSH
Prunus virginiana	*Coccomyces lutescens* (leaf spot)	CC
Pycnanthemum incanum	*Erysiphe cichoracearum* (powdery mildew)	CC
Quercus alba	*Gnomonia quercina* (anthracnose)	TR438
Q. borealis	*Microsphaera alni* (powdery mildew)	CC
Q. borealis	*Gnomonia quercina* (anthracnose)	CC
Rubus allegheniensis	*Gymnoconia peckiana* (rust)	QSH
R. occidentalis	*G. peckiana* (rust)	TR419, TR438, QSH
Salix sericea	*Melampsora bigelowii* (rust)	TR438
Solidago arguta	*Erysiphe cichoracearum* (powdery mildew)	CC
S. caesia	*Coleosporium solidaginis* (pine needle rust)	QSH
S. caesia	*Erysiphe cichoracearum* (powdery mildew)	QSH, CC
S. canadensis	*Coleosporium solidaginis* (pine needle rust)	TR419, TR438, NF, TCF
S. canadensis	*Erysiphe cichoracearum* (powdery mildew)	RF, GIF, TR438, QSH, SwF, TCF, US11M
S. flexicaulis	*Coleosporium solidaginis* (pine needle rust)	RF, GIF
S. gigantea	*C. solidaginis* (pine needle rust)	TCF
S. gigantea	*Erysiphe cichoracearum* (powdery mildew)	RF, TCF, US11M
S. graminifolia	*Placosphaera haydeni* (tar spot)	GIF, TR438, QSH, NF, SwF, TCF, US11M
S. graminifolia	*Coleosporium delicatulum* (rust)	TR438, NF, US11M
S. juncea	*C. solidaginis* (pine needle rust)	TCF
S. rugosa	*C. solidaginis* (pine needle rust)	GIF, QSH, SwF, TCF, SM
S. rugosa	*Erysiphe cichoracearum* (powdery mildew)	QSH, CC, SwF, US11M
Trifolium pratense	*E. polygoni* (powdery mildew)	TR438, SwF
Verbena hastata	*E. cichoracearum* (powdery mildew)	US11M
V. urticifolia	*E. cichoracearum* (powdery mildew)	QSH, CC
Vitis riparia	*Phyllosticta* sp. (leaf spot)	TR419

Table F-7. Vegetation analysis for trees in the Council Cup Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
BETULA LENTA	SWEET BIRCH	0.65	22.4	205	33.1	43502	25.9	81.3
QUERCUS VELUTINA	BLACK OAK	0.45	15.5	105	16.9	22540	13.4	45.9
PINUS STROBUS	WHITE PINE	0.30	10.3	50	8.1	19474	11.6	30.0
QUERCUS PRINUS	CHESTNUT OAK	0.25	8.6	65	10.5	17373	10.3	29.4
QUERCUS ALBA	WHITE OAK	0.20	6.9	25	4.0	29020	17.3	28.2
PINUS VIRGINIANA	VIRGINIA PINE	0.20	6.9	55	8.9	18009	10.7	26.5
QUERCUS BOREALIS	RED OAK	0.25	8.6	30	4.8	4779	2.8	16.3
ACER RUBRUM	RED MAPLE	0.20	6.9	35	5.6	4006	2.4	14.9
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.10	3.4	15	2.4	2721	1.6	7.5
CORNUS FLORIDA	FLOWERING DOGWOOD	0.05	1.7	10	1.6	2553	1.5	4.9
PYRUS MALUS	APPLE	0.05	1.7	5	0.8	1135	0.7	3.2
CARYA GLABRA	PIGNUT HICKORY	0.05	1.7	5	0.8	1135	0.7	3.2
BETULA POPULIFOLIA	GRAY BIRCH	0.05	1.7	5	0.8	884	0.5	3.1
SASSAFRAS ALBIDUM	SASSAFRAS	0.05	1.7	5	0.8	565	0.3	2.9
TSUGA CANADENSIS	EASTERN HEMLOCK	0.05	1.7	5	0.8	475	0.3	2.8
TOTAL		-	100.0	620	100.0	168165	100.0	300.0

Table F-8. Vegetation analysis for saplings in the Council Cup Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
BETULA LENTA	SWEET BIRCH	0.75	12.9	655	27.9	10848	29.4	70.2
ACER RUBRUM	RED MAPLE	0.75	12.9	570	24.3	7142	19.3	56.6
QUERCUS VELUTINA	BLACK OAK	0.65	11.2	190	8.1	3974	10.8	30.1
QUERCUS BOREALIS	RED OAK	0.65	11.2	190	8.1	3196	8.7	28.0
QUERCUS PRINUS	CHESTNUT OAK	0.45	7.8	225	9.6	3581	9.7	27.1
PINUS STROBUS	WHITE PINE	0.45	7.8	110	4.7	1720	4.7	17.1
BETULA POPULIFOLIA	GRAY BIRCH	0.25	4.3	80	3.4	2050	5.6	13.3
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.35	6.0	60	2.6	491	1.3	9.9
QUERCUS ALBA	WHITE OAK	0.30	5.2	55	2.3	581	1.6	9.1
CARYA GLABRA	PIGNUT HICKORY	0.25	4.3	30	1.3	683	1.9	7.4
CORNUS FLORIDA	FLOWERING DOGWOOD	0.20	3.4	50	2.1	397	1.1	6.7
PRUNUS SEROTINA	BLACK CHERRY	0.15	2.6	35	1.5	302	0.8	4.9
SASSAFRAS ALBIDUM	SASSAFRAS	0.15	2.6	20	0.9	365	1.0	4.4
AMELANCHIER ARBOREA	SHAD-BUSH	0.15	2.6	20	0.9	149	0.4	3.8
PRUNUS PENSYLVANICA	PIN CHERRY	0.10	1.7	10	0.4	569	1.5	3.7
TSUGA CANADENSIS	EASTERN HEMLOCK	0.05	0.9	20	0.9	620	1.7	3.4
CASTANEA DENTATA	AMERICAN CHESTNUT	0.10	1.7	20	0.9	59	0.2	2.7
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.05	0.9	5	0.2	192	0.5	1.6
TOTAL		-	100.0	2345	100.0	36921	100.0	300.0

Table F-9. Vegetation analysis for tree seedlings in the Council Cup Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
ACER RUBRUM	RED MAPLE	0.48	27.1	9250	35.9	1.75	23.3	86.3
PRUNUS SEROTINA	BLACK CHERRY	0.35	20.0	6000	23.3	1.18	15.6	58.9
QUERCUS BOREALIS	RED OAK	0.23	12.9	1500	5.8	1.08	14.3	33.0
QUERCUS VELUTINA	BLACK OAK	0.20	11.4	2000	7.8	0.68	9.0	28.2
QUERCUS PRINUS	CHESTNUT OAK	0.15	8.6	2000	7.8	0.45	6.0	22.3
CASTANEA DENTATA	AMERICAN CHESTNUT	0.05	2.9	750	2.9	0.65	8.6	14.4
BETULA LENTA	SWEET BIRCH	0.05	2.9	1250	4.9	0.40	5.8	13.0
FRAXINUS AMERICANA	WHITE ASH	0.05	2.9	500	1.9	0.48	6.3	11.1
SASSAFRAS ALBIDUM	SASSAFRAS	0.05	2.9	1000	3.9	0.20	2.7	9.4
PINUS STROBUS	WHITE PINE	0.03	1.4	250	1.0	0.30	4.0	6.4
QUERCUS ALBA	WHITE OAK	0.05	2.9	0	0.0	0.20	2.7	5.5
POPULUS TREMULOIDES	QUAKING ASPEN	0.03	1.4	750	2.9	0.03	0.3	4.7
CARYA GLABRA	PIGNUT HICKORY	0.03	1.4	250	1.0	0.13	1.7	4.1
CRATAEGUS SP.	HAWTHORNE	0.03	1.4	250	1.0	0.03	0.3	2.7
TOTAL		-	100.0	25750	100.0	7.53	100.0	300.0

Table F-10. Vegetation analysis for shrubs, herbs, and ground cover in the Council Cup Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.58	48.9	10.28	54.1	103.0
KALMIA LATIFOLIA	MOUNTAIN LAUREL	0.20	17.0	4.28	22.5	39.5
RHODODENDRON NUDIFLORUM	PINXTER-FLOWER	0.13	10.6	2.00	10.5	21.2
RHUS RADICANS	POISON IVY	0.13	10.6	1.08	5.7	16.3
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.05	4.3	0.45	2.4	6.6
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.05	4.3	0.18	0.9	5.2
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.03	2.1	0.40	2.1	4.2
KALMIA ANGUSTIFOLIA	SHEEP LAUREL	0.03	2.1	0.35	1.8	4.0
HERBS						
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.33	29.5	6.75	43.7	73.2
ARALIA NUDICAULIS	WILD SARSAPARILLA	0.15	13.6	3.90	25.2	38.9
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	0.08	6.8	2.48	16.0	22.8
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.10	9.1	0.53	3.4	12.5
POLYGALA PAUCIFOLIA	FRINGED POLYGALA	0.08	6.8	0.55	3.6	10.4
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.08	6.8	0.50	3.2	10.1
GAULTHERIA PROCUMBENS	WINTERGREEN	0.05	4.5	0.10	0.6	5.2
MONOTROPA UNIFLORA	INDIAN PIPE	0.05	4.5	0.08	0.5	5.0
DESCHAMPSIA FLEXUOSA	HAIRGRASS	0.03	2.3	0.15	1.0	3.2
GRASS(UNIDENTIFIED)	-	0.03	2.3	0.15	1.0	3.2
PYROLA ELLIPTICA	SHINLEAF	0.03	2.3	0.10	0.6	2.9
MELAMPYRUM LINEARE	COW-WHEAT	0.03	2.3	0.05	0.3	2.6
MITCHELLA REPENS	PARTRIDGE-BERRY	0.03	2.3	0.05	0.3	2.6
MEDEOLA VIRGINIANA	INDIAN CUCUMBER	0.03	2.3	0.03	0.2	2.4
DRYOPTERIS MARGINALIS	MARGINAL WOOD FERN	0.03	2.3	0.03	0.2	2.4
PRENANTHES ALBA	TALL WHITE LETTUCE	0.03	2.3	0.03	0.2	2.4
GROUND COVER						
LITTER	-	1.00	69.0	97.35	98.0	167.0
ROCK	-	0.23	15.5	1.18	1.2	16.7
MOSS	-	0.15	10.3	0.63	0.6	11.0
BARE SOIL	-	0.08	5.2	0.20	0.2	5.4

Table F-11. Comparison of trees (number of stems) in the Council Cup Forest, 1977-78.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	F VALUE
BETULA LENTA	SWEET BIRCH	45	41	1.19
QUERCUS VELUTINA	BLACK OAK	11	21	5.76*
QUERCUS PRINUS	CHESTNUT OAK	13	13	0.00
PINUS VIRGINIANA	VIRGINIA PINE	8	11	2.46
PINUS STROBUS	WHITE PINE	10	10	0.28
ACER RUBRUM	RED MAPLE	8	7	1.00
QUERCUS BOREALIS	RED OAK	9	6	0.11
QUERCUS ALBA	WHITE OAK	3	5	2.11
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	3	3	0.00
CORNUS FLORIDA	FLOWERING DOGWOOD	3	2	1.00
BETULA POPULIFOLIA	GRAY BIRCH	0	1	1.00
PYRUS MALUS	APPLE	1	1	0.00
SASSAFRAS ALBIDUM	SASSAFRAS	1	1	0.00
CARYA GLABRA	PIGNUT HICKORY	1	1	0.00
TSUGA CANADENSIS	EASTERN HEMLOCK	1	1	0.00

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

Table F-12. Comparison of saplings (number of stems) in the Council Cup Forest, 1977-78.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	F VALUE
BETULA LENTA	SWEET BIRCH	131	131	0.04
ACER RUBRUM	RED MAPLE	133	114	8.92**
QUERCUS PRINUS	CHESTNUT OAK	55	45	2.23
QUERCUS VELUTINA	BLACK OAK	36	38	1.07
QUERCUS BOREALIS	RED OAK	57	38	3.35
PINUS STROBUS	WHITE PINE	24	22	0.81
BETULA POPULIFOLIA	GRAY BIRCH	27	16	5.91*
CARYA TOMENTOSA	MOCKERNUT HICKORY	0	12	9.71**
QUERCUS ALBA	WHITE OAK	20	11	0.68
CORNUS FLORIDA	FLOWERING DOGWOOD	10	10	0.00
PRUNUS SEROTINA	BLACK CHERRY	9	7	0.25
CARYA GLABRA	PIGNUT HICKORY	15	6	4.98*
TSUGA CANADENSIS	EASTERN HEMLOCK	4	4	0.00
CASTANEA DENTATA	AMERICAN CHESTNUT	2	4	0.34
AMELANCHIER ARBOREA	SHAD-BUSH	3	4	1.00
SASSAFRAS ALBIDUM	SASSAFRAS	6	4	1.96
PRUNUS PENSYLVANICA	PIN CHERRY	3	2	1.00
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0	1	1.00
PINUS VIRGINIANA	VIRGINIA PINE	3	0	2.00
FRAXINUS AMERICANA	WHITE ASH	3	0	3.35

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

Table F-13. Comparison of shrubs, herbs, and ground cover (% cover) in the Council Cup Forest, 1977-78.

SPECIES	COMMON NAME	% COVER 1977	1978	F VALUE
SHRUBS				
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	8.15	10.28	9.22**
KALMIA LATIFOLIA	MOUNTAIN LAUREL	3.33	4.28	2.83
RHODODENDRON NUDIFLORUM	PINXTER-FLOWER	1.33	2.00	1.96
RHUS RADICANS	POISON IVY	0.38	1.08	4.59*
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.13	0.45	1.58
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.38	0.40	0.00
KALMIA ANGUSTIFOLIA	SHEEP LAUREL	0.00	0.35	1.00
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.03	0.18	1.59
HERBS				
LYCOPODIUM FLABELLIFORME	GROUND PINE	4.58	6.75	5.43*
ARALIA NUDICAULIS	WILD SARSAPARILLA	2.80	3.90	3.09
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	1.28	2.48	1.30
POLYGALA PAUCIFOLIA	FRINGED POLYGALA	0.18	0.55	1.85
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.08	0.53	2.68
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.25	0.50	3.01
GRASS (UNIDENTIFIED)	-	0.03	0.15	1.00
DESCHAMPSIA FLEXUOSA	HAIRGRASS	0.08	0.15	1.00
GAULTHERIA PROCUMBENS	WINTERGREEN	0.03	0.10	1.00
PYROLA ELLIPTICA	SHINLEAF	0.05	0.10	0.28
MONOTROPA UNIFLORA	INDIAN PIPE	0.00	0.08	2.11
MITCHELLA REPENS	PARTRIDGE-BERRY	0.03	0.05	0.00
MELAMPYRUM LINEARE	COW-WHEAT	0.00	0.05	1.00
DRYOPTERIS MARGINALIS	MARGINAL WOOD FERN	0.00	0.03	1.00
MEDEOLA VIRGINIANA	INDIAN CUCUMBER	0.03	0.03	0.00
PRENANTHES ALBA	TALL WHITE LETTUCE	0.03	0.03	0.00
GALIUM CIRCAEZANS	BEDSTRAW	0.03	0.00	1.00
CHIMAPHILIA MACULATA	SPOTTED WINTERGREEN	0.05	0.00	2.11
CAREX SWANNII	SEDGE	0.03	0.00	1.00
GROUND COVER				
LITTER	-	97.80	97.35	0.60
ROCK	-	0.88	1.18	1.45
MOSS	-	0.55	0.63	1.87
BARE SOIL	-	0.33	0.20	0.09

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

Table F-14. Vegetation analysis for trees in the TR419 Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
QUERCUS VELUTINA	BLACK OAK	0.58	17.3	129	20.9	81380	35.9	74.1
PINUS VIRGINIANA	VIRGINIA PINE	0.38	11.1	104	16.9	44908	19.8	47.8
CORNUS FLORIDA	FLOWERING DOGWOOD	0.50	14.8	96	15.5	10661	4.7	35.1
PINUS STROBUS	WHITE PINE	0.25	7.4	63	10.1	16834	7.4	25.0
ACER RUBRUM	RED MAPLE	0.29	8.6	50	8.1	15004	6.6	23.4
QUERCUS PRINUS	CHESTNUT OAK	0.33	9.9	38	6.1	11202	4.9	20.9
PRUNUS SEROTINA	BLACK CHERRY	0.21	6.2	38	6.1	12000	5.3	17.5
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.21	6.2	25	4.1	4866	2.1	12.4
FRAXINUS AMERICANA	WHITE ASH	0.17	4.9	17	2.7	5524	2.4	10.1
QUERCUS ALBA	WHITE OAK	0.08	2.5	8	1.4	9248	4.1	7.9
PRUNUS AVIUM	SWEET CHERRY	0.08	2.5	8	1.4	3943	1.7	5.6
TSUGA CANADENSIS	EASTERN HEMLOCK	0.04	1.2	8	1.4	3943	1.7	4.3
PYRUS MALUS	APPLE	0.04	1.2	8	1.4	2137	0.9	3.5
BETULA POPULIFOLIA	GRAY BIRCH	0.04	1.2	8	1.4	1289	0.6	3.2
LIRIODENDRON TULIPIFERA	TULIP-TREE	0.04	1.2	4	0.7	2212	1.0	2.9
SASSAFRAS ALBIDUM	SASSAFRAS	0.04	1.2	4	0.7	641	0.3	2.2
CRATAEGUS SP.	HAWTHORNE	0.04	1.2	4	0.7	553	0.2	2.2
CARYA GLABRA	PIGNUT HICKORY	0.04	1.2	4	0.7	327	0.1	2.1
TOTAL		-	100.0	617	100.0	226667	100.0	300.0

Table F-15. Vegetation analysis for saplings in the TR419 Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
CORNUS FLORIDA	FLOWERING DOGWOOD	0.83	23.8	533	44.1	14227	54.1	122.1
QUERCUS VELUTINA	BLACK OAK	0.38	10.7	196	16.2	3397	12.9	39.8
ACER RUBRUM	RED MAPLE	0.58	16.7	104	8.6	1947	7.4	32.7
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.33	9.5	83	6.9	2206	8.4	24.8
BETULA POPULIFOLIA	GRAY BIRCH	0.13	3.6	67	5.5	841	3.2	12.3
CARYA GLABRA	PIGNUT HICKORY	0.17	4.8	38	3.1	1057	4.0	11.9
CRATAEGUS SP.	HAWTHORNE	0.21	6.0	42	3.4	383	1.5	10.9
PRUNUS SEROTINA	BLACK CHERRY	0.13	3.6	21	1.7	429	1.6	6.9
QUERCUS ALBA	WHITE OAK	0.13	3.6	21	1.7	259	1.0	6.3
FRAXINUS AMERICANA	WHITE ASH	0.13	3.6	21	1.7	144	0.5	5.8
PINUS VIRGINIANA	VIRGINIA PINE	0.08	2.4	17	1.4	527	2.0	5.8
QUERCUS PRINUS	CHESTNUT OAK	0.13	3.6	21	1.7	88	0.3	5.6
AMELANCHIER ARBOREA	SHAD-BUSH	0.08	2.4	21	1.7	219	0.8	4.9
QUERCUS BOREALIS	RED OAK	0.08	2.4	8	0.7	173	0.7	3.7
FAGUS GRANDIFOLIA	AMERICAN BEECH	0.08	2.4	8	0.7	43	0.2	3.2
PINUS STROBUS	WHITE PINE	0.04	1.2	8	0.7	347	1.3	3.2
TOTAL		-	100.0	1208	100.0	26285	100.0	300.0

Table F-16. Vegetation analysis for tree seedlings in the TR419 Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
CORNUS FLORIDA	FLOWERING DOGWOOD	0.54	18.4	16250	18.4	4.52	31.3	68.1
FRAXINUS AMERICANA	WHITE ASH	0.48	16.3	32708	36.9	1.52	10.5	63.8
PRUNUS SEROTINA	BLACK CHERRY	0.54	18.4	13750	15.5	2.04	14.1	48.1
ACER RUBRUM	RED MAPLE	0.48	16.3	9375	10.6	2.08	14.4	41.3
SASSAFRAS ALBIDUM	SASSAFRAS	0.25	8.5	6042	6.8	1.04	7.2	22.5
QUERCUS VELUTINA	BLACK OAK	0.15	5.0	1250	1.4	1.25	8.6	15.0
QUERCUS PRINUS	CHESTNUT OAK	0.10	3.5	833	0.9	0.90	6.2	10.7
PRUNUS AVIUM	SWEET CHERRY	0.15	5.0	3125	3.5	0.23	1.6	10.1
BETULA LENTA	SWEET BIRCH	0.02	0.7	2292	2.6	0.46	3.2	6.5
AMELANCHIER ARBOREA	SHAD-BUSH	0.10	3.5	1250	1.4	0.15	1.0	6.0
BETULA POPULIFOLIA	GRAY BIRCH	0.04	1.4	833	0.9	0.13	0.9	3.2
CRATAEGUS SP.	HAWTHORNE	0.04	1.4	417	0.5	0.06	0.4	2.3
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.02	0.7	208	0.2	0.06	0.4	1.4
PINUS VIRGINIANA	VIRGINIA PINE	0.02	0.7	208	0.2	0.02	0.1	1.1
TOTAL		-	100.0	88541	100.0	14.46	100.0	300.0

Table F-17. Vegetation analysis for shrubs, herbs, and ground cover in the TR419 Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.42	25.3	2.27	16.8	42.1
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.29	17.7	3.06	22.6	40.3
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.19	11.4	2.83	20.9	32.3
VITIS AESTIVALIS	SUMMER GRAPE	0.25	15.2	0.71	5.2	20.4
VACCINIUM STAMINEUM	DEERBERRY	0.08	5.1	1.90	14.0	19.1
LINDERA BENZOIN	SPICEBUSH	0.17	10.1	1.17	8.6	18.7
RHUS RADICANS	POISON IVY	0.13	7.6	0.94	6.9	14.5
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.06	3.8	0.58	4.3	8.1
VIBURNUM DENTATUM	ARROWWOOD	0.02	1.3	0.04	0.3	1.6
RHUS TYPHINA	STAGHORN SUMAC	0.02	1.3	0.02	0.2	1.4
BERBERIS THUNBERGII	JAPANESE BARBERRY	0.02	1.3	0.02	0.2	1.4
HERBS						
DENNSTAEDTIA PUNCTILOBULA	HAY-SCENTED FERN	0.06	2.6	3.60	23.8	26.4
CAREX SWANNII	SEDGE	0.38	15.4	0.92	6.1	21.4
PILEA PUMILA	CLEARWEED	0.08	3.4	1.25	8.3	11.7
POTENTILLA SIMPLEX	CINQUEFOIL	0.06	2.6	1.19	7.9	10.4
SOLIDAGO CAESIA	BLUE-STEMMED GOLDENROD	0.15	6.0	0.33	2.2	8.2
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.13	5.1	0.35	2.3	7.5
DANTHONIA SPICATA	POVERTY OATGRASS	0.06	2.6	0.60	4.0	6.6
LYCOPODIUM FLABELLIFORME	GROUND PINE	0.06	2.6	0.56	3.7	6.3
PANICUM SPP.	PANIC-GRASS	0.08	3.4	0.33	2.2	5.6
GEUM CANADENSE	AVENS	0.06	2.6	0.44	2.9	5.5
ASTER DIVARICATUS	WHITE WOOD ASTER	0.06	2.6	0.40	2.6	5.2
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.02	0.9	0.63	4.1	5.0
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.04	1.7	0.44	2.9	4.6
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.06	2.6	0.27	1.8	4.4
GALIUM APARINE	CLEAVERS	0.04	1.7	0.40	2.6	4.3
POLYSTICHUM ACROSTICHOIDES	CHRISTMAS FERN	0.04	1.7	0.27	1.8	3.5
MAIANTHEMUM CANADENSE	WILD LILY-OF-THE-VALLEY	0.06	2.6	0.13	0.8	3.4
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.04	1.7	0.25	1.7	3.4
LYSIMACHIA QUADRIFOLIA	WHORLED LOOSESTRIFE	0.02	0.9	0.38	2.5	3.3
PHYTOLACCA AMERICANA	POKEWEED	0.06	2.6	0.10	0.7	3.3
MONOTROPA UNIFLORA	INDIAN PIPE	0.06	2.6	0.10	0.7	3.3
DESMODIUM NUDIFLORUM	TICK-TREFOIL	0.06	2.6	0.08	0.6	3.1
IMPATIENS BIFLORA	JEWELWEED	0.04	1.7	0.21	1.4	3.1
GALIUM CIRCAEZANS	BEDSTRAW	0.04	1.7	0.19	1.2	2.9
RUMEX ACETOSELLA	SHEEP SORREL	0.02	0.9	0.31	2.1	2.9
UVULARIA PERFOLIATA	PERFOLIATE BELLWORT	0.04	1.7	0.13	0.8	2.5
JUNCUS TENUIS	PATH RUSH	0.04	1.7	0.13	0.8	2.5
VIOLA CONSPERSA	AMERICAN DOG-VIOLET	0.02	0.9	0.25	1.7	2.5
CUNILA ORIGANOIDES	DITTANY	0.04	1.7	0.06	0.4	2.1
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.04	1.7	0.04	0.3	2.0
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.04	1.7	0.04	0.3	2.0
CHIMAPHILIA MACULATA	SPOTTED WINTERGREEN	0.04	1.7	0.04	0.3	2.0
TARAXACUM OFFICINALE	DANDELION	0.04	1.7	0.04	0.3	2.0
POLYGONUM PERSICARIA	SMARTWEED	0.02	0.9	0.15	1.0	1.8
SMILACINA RACEMOSA	FALSE SOLOMAN'S SEAL	0.02	0.9	0.08	0.6	1.4
POLYGONUM SCANDENS	FALSE BUCKWHEAT	0.02	0.9	0.06	0.4	1.3
HIERACIUM PRATENSE	HAWKWEED	0.02	0.9	0.06	0.4	1.3
CAREX ROSEA	SEDGE	0.02	0.9	0.04	0.3	1.1
RANUNCULUS ABORTIVUS	KIDNEYLEAF BUTTERCUP	0.02	0.9	0.04	0.3	1.1
OXALIS DILLENII	YELLOW WOOD SORREL	0.02	0.9	0.04	0.3	1.1
ATHYRIUM FILIX-FEMINA	LADY FERN	0.02	0.9	0.04	0.3	1.1
ARISAEMA TRIPHYLLUM	JACK-IN-THE-PULPIT	0.02	0.9	0.02	0.1	1.0
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.02	0.9	0.02	0.1	1.0
KRIGIA VIRGINICA	DWARF DANDELION	0.02	0.9	0.02	0.1	1.0
GRASS (UNIDENTIFIED)	-	0.02	0.9	0.02	0.1	1.0
DRYOPTERIS SPINULOSA	SPINULOSE WOOD FERN	0.02	0.9	0.02	0.1	1.0
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.02	0.9	0.02	0.1	1.0
CAREX PENSYLVANICA	SEDGE	0.02	0.9	0.02	0.1	1.0
GROUND COVER						
LITTER	-	1.00	53.9	91.96	93.6	147.6
ROCK	-	0.31	16.9	1.40	1.4	18.3
MOSS	-	0.27	14.6	2.65	2.7	17.3
BARE SOIL	-	0.27	14.6	2.21	2.2	16.9

Table F-18. Comparison of trees (number of stems) in the TR419 Forest, 1977-78.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	F VALUE
QUERCUS VELUTINA	BLACK OAK	27	31	4.25
PINUS VIRGINIANA	VIRGINIA PINE	28	25	1.91
CORNUS FLORIDA	FLOWERING DOGWOOD	18	23	0.90
PINUS STROBUS	WHITE PINE	13	15	1.90
ACER RUBRUM	RED MAPLE	12	12	0.05
QUERCUS PRINUS	CHESTNUT OAK	10	9	0.00
PRUNUS SEROTINA	BLACK CHERRY	8	9	1.00
CARYA TOMENTOSA	MOCKERNUT HICKORY	6	6	0.00
FRAXINUS AMERICANA	WHITE ASH	3	4	1.00
BETULA POPULIFOLIA	GRAY BIRCH	2	2	0.00
PYRUS MALUS	APPLE	3	2	1.00
PRUNUS AVIUM	SWEET CHERRY	2	2	0.00
TSUGA CANADENSIS	EASTERN HEMLOCK	2	2	0.00
QUERCUS ALBA	WHITE OAK	2	2	0.00
CRATAEGUS SP.	HAWTHORNE	0	1	1.00
LIRIODENDRON TULIPIFERA	TULIP-TREE	1	1	0.00
CARYA GLABRA	PIGNUT HICKORY	1	1	0.00
SASSAFRAS ALBIDUM	SASSAFRAS	1	1	0.00

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

Table F-19. Comparison of saplings (number of stems) in the TR419 Forest, 1977-78.

SPECIES	COMMON NAME	NUMBER OF STEMS 1977	1978	F VALUE
CORNUS FLORIDA	FLOWERING DOGWOOD	136	128	0.08
QUERCUS VELUTINA	BLACK OAK	50	47	0.14
ACER RUBRUM	RED MAPLE	16	25	4.23
CARYA TOMENTOSA	MOCKERNUT HICKORY	19	20	0.05
BETULA POPULIFOLIA	GRAY BIRCH	11	16	1.96
CRATAEGUS SP.	HAWTHORNE	6	10	3.10
CARYA GLABRA	PIGNUT HICKORY	9	9	0.03
PRUNUS SEROTINA	BLACK CHERRY	8	5	1.22
FRAXINUS AMERICANA	WHITE ASH	1	5	1.86
AMELANCHIER ARBOREA	SHAD-BUSH	4	5	0.05
QUERCUS PRINUS	CHESTNUT OAK	6	5	1.00
QUERCUS ALBA	WHITE OAK	5	5	0.28
PINUS VIRGINIANA	VIRGINIA PINE	7	4	2.66
QUERCUS BOREALIS	RED OAK	2	2	0.00
FAGUS GRANDIFOLIA	AMERICAN BEECH	2	2	0.00
PINUS STROBUS	WHITE PINE	1	2	1.00
SASSAFRAS ALBIDUM	SASSAFRAS	1	0	1.00

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

Table F-20. Vegetation analysis for trees in the Quarry Hillside Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
QUERCUS VELUTINA	BLACK OAK	0.67	20.0	167	25.5	49296	27.6	73.1
FRAXINUS AMERICANA	WHITE ASH	0.53	16.0	100	15.3	21284	11.9	43.2
QUERCUS PRINUS	CHESTNUT OAK	0.47	14.0	80	12.2	22174	12.4	38.6
ACER RUBRUM	RED MAPLE	0.33	10.0	73	11.2	13713	7.7	28.9
QUERCUS BOREALIS	RED OAK	0.33	10.0	53	8.2	11948	6.7	24.8
TILIA AMERICANA	BASSWOOD	0.13	4.0	33	5.1	17127	9.6	18.7
PINUS VIRGINIANA	VIRGINIA PINE	0.13	4.0	33	5.1	10362	5.8	14.9
ULMUS AMERICANA	AMERICAN ELM	0.07	2.0	20	3.1	11477	6.4	11.5
CORNUS FLORIDA	FLOWERING DOGWOOD	0.13	4.0	27	4.1	2314	1.3	9.4
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.07	2.0	13	2.0	2204	1.2	5.3
BETULA LENTA	SWEET BIRCH	0.07	2.0	13	2.0	1932	1.1	5.1
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.07	2.0	7	1.0	3540	2.0	5.0
PRUNUS AVIUM	SWEET CHERRY	0.07	2.0	7	1.0	3272	1.8	4.8
PRUNUS SEROTINA	BLACK CHERRY	0.07	2.0	7	1.0	2770	1.5	4.6
CELTIS OCCIDENTALIS	HACKBERRY	0.07	2.0	7	1.0	2094	1.2	4.2
SASSAFRAS ALBIDUM	SASSAFRAS	0.07	2.0	7	1.0	1696	0.9	4.0
CARYA OVATA	SHAGBARK HICKORY	0.07	2.0	7	1.0	1696	0.9	4.0
TOTAL		-	100.0	653	100.0	178895	100.0	300.0

Table F-21. Vegetation analysis for saplings in the Quarry Hillside Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (BA/HA)	RELATIVE DOMINANCE	IMPORTANCE VALUE
CORNUS FLORIDA	FLOWERING DOGWOOD	0.73	16.4	707	42.4	9570	27.2	86.0
ACER RUBRUM	RED MAPLE	0.47	10.4	200	12.0	5403	15.4	37.8
FRAXINUS AMERICANA	WHITE ASH	0.47	10.4	160	9.6	6000	17.1	37.1
QUERCUS BOREALIS	RED OAK	0.47	10.4	180	10.8	3964	11.3	32.5
QUERCUS PRINUS	CHESTNUT OAK	0.33	7.5	100	6.0	3477	9.9	23.3
QUERCUS VELUTINA	BLACK OAK	0.40	9.0	80	4.8	2450	7.0	20.7
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.33	7.5	73	4.4	1340	3.8	15.7
PINUS VIRGINIANA	VIRGINIA PINE	0.20	4.5	27	1.6	429	1.2	7.3
ULMUS AMERICANA	AMERICAN ELM	0.13	3.0	27	1.6	953	2.7	7.3
SASSAFRAS ALBIDUM	SASSAFRAS	0.13	3.0	20	1.2	723	2.1	6.2
TILIA AMERICANA	BASSWOOD	0.13	3.0	20	1.2	188	0.5	4.7
CELTIS OCCIDENTALIS	HACKBERRY	0.13	3.0	20	1.2	126	0.4	4.5
AMELANCHIER ARBOREA	SHAD-BUSH	0.13	3.0	13	0.8	105	0.3	4.1
PRUNUS VIRGINIANA	CHOKE CHERRY	0.13	3.0	13	0.8	52	0.1	3.9
PRUNUS SEROTINA	BLACK CHERRY	0.13	3.0	13	0.8	10	0.0	3.8
POPULUS GRANDIDENTATA	BIG-TOOTHED ASPEN	0.07	1.5	7	0.4	335	1.0	2.8
CARYA OVATA	SHAGBARK HICKORY	0.07	1.5	7	0.4	47	0.1	2.0
TOTAL		-	100.0	1667	100.0	35173	100.0	300.0

Table F-22. Vegetation analysis for tree seedlings in the Quarry Hillside Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DENSITY (NO./HA)	RELATIVE DENSITY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
FRAXINUS AMERICANA	WHITE ASH	0.37	17.5	37000	49.3	1.80	19.9	86.7
CORNUS FLORIDA	FLOWERING DOGWOOD	0.20	9.5	10000	13.3	2.47	27.3	50.2
ACER RUBRUM	RED MAPLE	0.33	15.9	8000	10.7	0.67	7.4	33.9
PRUNUS SEROTINA	BLACK CHERRY	0.20	9.5	3667	4.9	0.47	5.2	19.6
SASSAFRAS ALBIDUM	SASSAFRAS	0.20	9.5	4667	6.2	0.33	3.7	19.4
QUERCUS BOREALIS	RED OAK	0.17	7.9	2667	3.6	0.37	4.1	15.6
ULMUS AMERICANA	AMERICAN ELM	0.03	1.6	2333	3.1	0.83	9.2	13.9
PRUNUS VIRGINIANA	CHOKE CHERRY	0.10	4.8	2000	2.7	0.53	5.9	13.3
QUERCUS PRINUS	CHESTNUT OAK	0.13	6.3	1000	1.3	0.30	3.3	11.0
AMELANCHIER ARBOREA	SHAD-BUSH	0.10	4.8	1000	1.3	0.27	3.0	9.0
QUERCUS VELUTINA	BLACK OAK	0.07	3.2	0	0.0	0.50	5.5	8.7
TILIA AMERICANA	BASSWOOD	0.03	1.6	1333	1.8	0.07	0.7	4.1
PINUS VIRGINIANA	VIRGINIA PINE	0.03	1.6	333	0.4	0.13	1.5	3.5
CRATAEGUS SP.	HAWTHORNE	0.03	1.6	333	0.4	0.07	0.7	2.8
CELTIS OCCIDENTALIS	HACKBERRY	0.03	1.6	333	0.4	0.07	0.7	2.8
PINUS STROBUS	WHITE PINE	0.03	1.6	333	0.4	0.07	0.7	2.8
CARYA TOMENTOSA	MOCKERNUT HICKORY	0.03	1.6	0	0.0	0.10	1.1	2.7
TOTAL		-	100.0	75000	100.0	9.03	100.0	300.0

Table F-23. Vegetation analysis for shrubs, herbs, and ground cover in the Quarry Hillside Forest, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
SHRUBS						
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.37	36.7	6.27	46.0	82.6
LINDERA BENZOIN	SPICEBUSH	0.10	10.0	2.43	17.8	27.8
HAMAMELIS VIRGINIANA	WITCH HAZEL	0.10	10.0	2.03	14.9	24.9
VACCINIUM VACILLANS	LOW-BUSH BLUEBERRY	0.07	6.7	1.67	12.2	18.9
VITIS AESTIVALIS	SUMMER GRAPE	0.17	16.7	0.27	2.0	18.6
VACCINIUM STAMINEUM	DEERBERRY	0.03	3.3	0.47	3.4	6.8
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.03	3.3	0.17	1.2	4.6
CELASTRUS SCANDENS	BITTERSWEET	0.03	3.3	0.13	1.0	4.3
RUBUS FLAGELLARIS	DEWBERRY	0.03	3.3	0.10	0.7	4.1
VIBURNUM ACERIFOLIUM	MAPLE-LEAF VIBURNUM	0.03	3.3	0.07	0.5	3.8
RHUS RADICANS	POISON IVY	0.03	3.3	0.03	0.2	3.6
HERBS						
ASTER DIVARICATUS	WHITE WOOD ASTER	0.40	13.0	7.50	26.6	39.6
DESCHAMPSIA FLEXUOSA	HAIRGRASS	0.23	7.6	4.33	15.4	23.0
DRYOPTERIS MARGINALIS	MARGINAL WOOD FERN	0.23	7.6	3.63	12.9	20.5
CAREX SWANNII	SEDGE	0.13	4.3	1.80	6.4	10.7
SOLIDAGO CAESIA	BLUE-STEMMED GOLDENROD	0.17	5.4	0.90	3.2	8.6
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.13	4.3	0.77	2.7	7.1
CAREX SP.	SEDGE	0.13	4.3	0.73	2.6	6.9
CAREX ROSEA	SEDGE	0.13	4.3	0.60	2.1	6.5
ARALIA NUDICAULIS	WILD SARSAPARILLA	0.07	2.2	1.07	3.8	6.0
POTENTILLA SIMPLEX	CINQUEFOIL	0.07	2.2	0.73	2.6	4.8
POLYSTICHUM ACROSTICHOIDES	CHRISTMAS FERN	0.03	1.1	1.00	3.5	4.6
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.07	2.2	0.63	2.2	4.4
UVULARIA SESSILIFOLIA	SESSILE-LEAVED BELLWORT	0.10	3.3	0.27	0.9	4.2
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.07	2.2	0.47	1.7	3.8
CAREX PENSYLVANICA	SEDGE	0.07	2.2	0.47	1.7	3.8
GALIUM APARINE	CLEAVERS	0.07	2.2	0.47	1.7	3.8
ASPLENIUM PLATYNEURON	EBONY SPLEENWORT	0.10	3.3	0.13	0.5	3.7
GEUM CANADENSE	AVENS	0.07	2.2	0.43	1.5	3.7
POA COMPRESSA	CANADA BLUEGRASS	0.07	2.2	0.33	1.2	3.4
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.07	2.2	0.20	0.7	2.9
WOODSIA OBTUSA	BLUNT-LOBED WOODSIA	0.07	2.2	0.13	0.5	2.6
SMILACINA RACEMOSA	FALSE SOLOMAN'S SEAL	0.07	2.2	0.10	0.4	2.5
PANICUM SPP.	PANIC-GRASS	0.07	2.2	0.10	0.4	2.5
AMBROSIA ARTEMISIIFOLIA	RAGWEED	0.07	2.2	0.07	0.2	2.4
LUZULA CAMPESTRIS	WOOD RUSH	0.03	1.1	0.27	0.9	2.0
RANUNCULUS ACRIS	COMMON BUTTERCUP	0.03	1.1	0.20	0.7	1.8
DANTHONIA SPICATA	POVERTY OATGRASS	0.03	1.1	0.20	0.7	1.8
DESMODIUM NUDIFLORUM	TICK-TREFOIL	0.03	1.1	0.13	0.5	1.6
SCROPHULARIA LANCEOLATA	FIGWORT	0.03	1.1	0.10	0.4	1.4
MELAMPYRUM LINEARE	COW-WHEAT	0.03	1.1	0.10	0.4	1.4
SOLIDAGO BICOLOR	SILVERROD	0.03	1.1	0.10	0.4	1.4
GRASS (UNIDENTIFIED)	-	0.03	1.1	0.07	0.2	1.3
DIOSCOREA VILLOSA	WILD YAM	0.03	1.1	0.07	0.2	1.3
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.03	1.1	0.03	0.1	1.2
SATUREJA VULGARIS	WILD BASIL	0.03	1.1	0.03	0.1	1.2
OXALIS DILLENII	YELLOW WOOD SORREL	0.03	1.1	0.03	0.1	1.2
GROUND COVER						
LITTER	-	1.00	34.5	75.97	74.6	109.1
ROCK	-	0.97	33.3	19.33	19.0	52.3
BARE SOIL	-	0.53	18.4	5.20	5.1	23.5
MOSS	-	0.40	13.8	1.33	1.3	15.1

Table F-24. Vegetation analysis for tree seedlings, shrubs, and herbs in the North Field, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
TREE SEEDLINGS						
BETULA NIGRA	RIVER BIRCH	0.20	38.5	1.63	64.6	103.1
ULMUS AMERICANA	AMERICAN ELM	0.12	23.1	0.48	19.2	42.2
ACER SACCHARINUM	SILVER MAPLE	0.10	19.2	0.25	9.8	29.0
ACER RUBRUM	RED MAPLE	0.06	11.5	0.09	3.6	15.1
CARYA CORDIFORMIS	BITTERNUT HICKORY	0.02	3.8	0.05	1.9	5.7
TILIA AMERICANA	BASSWOOD	0.02	3.8	0.02	0.9	4.8
SHRUBS						
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.31	43.2	8.60	73.7	116.9
PARTHENOCISSUS QUINQUEFOLIA	VIRGINIA CREEPER	0.16	21.6	0.57	4.9	26.5
ALNUS RUGOSA	SPECKLED ALDER	0.08	10.8	1.56	13.4	24.2
RUBUS OCCIDENTALIS	BLACK RASBERRY	0.06	8.1	0.21	1.8	9.9
VITIS RIPARIA	RIVERBANK GRAPE	0.04	5.4	0.41	3.5	8.9
VITIS AESTIVALIS	SUMMER GRAPE	0.04	5.4	0.19	1.6	7.0
CORNUS RACEMOSA	GRAY DOGWOOD	0.02	2.7	0.10	0.8	3.5
CORNUS AMOMUM	SILKY DOGWOOD	0.02	2.7	0.04	0.3	3.0
HERBS						
MUHLENBERGIA FRONDOSA	WIRESTEM MUHLY	0.94	4.9	28.71	16.2	21.1
SOLIDAGO CANADENSIS	CANADA GOLDENROD	0.96	5.0	17.82	10.0	15.1
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	0.96	5.0	15.06	8.5	13.5
AGROSTIS SP.	BENTGRASS	0.76	4.0	12.23	6.9	10.9
ASTER ERICOIDES	HEATH ASTER	0.84	4.4	10.76	6.1	10.5
SOLIDAGO GIGANTEA	LATE GOLDENROD	0.78	4.1	8.43	4.7	8.9
LYSIMACHIA CILIATA	FRINGED LOOSESTRIFE	0.73	3.8	8.95	5.0	8.8
DESMODIUM PANICULATUM	TICK-TREFOIL	0.57	3.0	7.66	4.3	7.3
POTENTILLA SIMPLEX	CINQUEFOIL	0.39	2.1	8.42	4.7	6.8
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.61	3.2	4.35	2.5	5.6
LYSIMACHIA VULGARIS	GARDEN LOOSESTRIFE	0.45	2.4	3.98	2.2	4.6
PANICUM VIRGATUM	SWITCHGRASS	0.27	1.4	5.04	2.8	4.3
EPILOBIUM COLORATUM	WILLOW-HERB	0.59	3.1	2.05	1.2	4.2
POA PRATENSIS	KENTUCKY BLUEGRASS	0.31	1.6	4.46	2.5	4.2
BOEHMERIA CYLINDRICA	FALSE NETTLE	0.47	2.5	2.82	1.6	4.1
CAREX SP.	SEDGE	0.49	2.6	2.55	1.4	4.0
GEUM CANADENSE	AVENS	0.59	3.1	1.57	0.9	4.0
HYPERICUM PUNCTATUM	SPOTTED ST. JOHN'S WORT	0.51	2.7	1.43	0.8	3.5
DAUCUS CAROTA	QUEEN ANNE'S LACE	0.45	2.4	1.77	1.0	3.4
JUNCUS TENUIS	PATH RUSH	0.31	1.6	3.03	1.7	3.4
LEERSIA VIRGINICA	WHITE GRASS	0.39	2.1	1.89	1.1	3.1
HELENIUM AUTUMNALE	SNEEZEWEED	0.41	2.2	1.50	0.8	3.0
OXALIS STRICTA	YELLOW WOOD SORREL	0.49	2.6	0.62	0.3	2.9
ASTER SIMPLEX	ASTER	0.33	1.7	1.87	1.1	2.8
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.29	1.5	1.51	0.9	2.4
ASTER LATERIFLORUS	CALICO ASTER	0.22	1.1	2.06	1.2	2.3
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.31	1.6	0.94	0.5	2.2
RUMEX OBTUSIFOLIUS	BITTER DOCK	0.27	1.4	0.93	0.5	2.0
RUMEX CRISPUS	CURLY DOCK	0.27	1.4	0.75	0.4	1.9
VERBENA HASTATA	BLUE VERVAIN	0.25	1.3	0.70	0.4	1.7
IMPATIENS BIFLORA	JEWELWEED	0.24	1.2	0.58	0.3	1.6
OENOTHERA BIENNIS	EVENING-PRIMROSE	0.25	1.3	0.37	0.2	1.5
HELIANTHUS DECAPETALUS	THIN-LEAF SUNFLOWER	0.06	0.3	2.15	1.2	1.5
LYCOPUS AMERICANUS	WATER HOREHOUND	0.20	1.0	0.87	0.5	1.5
EUPATORIUM PERFOLIATUM	BONESET	0.20	1.0	0.66	0.4	1.4
GRASS(UNIDENTIFIED)	-	0.18	0.9	0.77	0.4	1.4
HYPERICUM PERFORATUM	COMMON ST. JOHN'S WORT	0.20	1.0	0.42	0.2	1.3
CIRSIUM VULGARE	BULL THISTLE	0.18	0.9	0.59	0.3	1.3
ELYMUS VIRGINICUS	WILD RYE	0.16	0.8	0.47	0.3	1.1
UNIDENTIFIED HERB#1	-	0.16	0.8	0.35	0.2	1.0
RUMEX ACETOSELLA	SHEEP SORREL	0.16	0.8	0.30	0.2	1.0
PANICUM CLANDESTINUM	PANIC-GRASS	0.12	0.6	0.62	0.4	1.0
POLYGONUM SCANDENS	FALSE BUCKWHEAT	0.12	0.6	0.36	0.2	0.8
LYCOPUS VIRGINICUS	WATER HOREHOUND	0.12	0.6	0.33	0.2	0.8
POLYGONUM SAGITTATUM	ARROW-LEAVED TEARTHUMB	0.12	0.6	0.24	0.1	0.8
TEUCRIUM CANADENSE	WOOD-SAGE	0.10	0.5	0.25	0.1	0.7
FRAGARIA VIRGINIANA	WILD STRAWBERRY	0.08	0.4	0.23	0.1	0.5
POTENTILLA RECTA	ROUGH-FRUITED CINQUEFOIL	0.08	0.4	0.18	0.1	0.5
APOCYNUM CANNABINUM	INDIAN HEMP	0.08	0.4	0.18	0.1	0.5
CONVOLVULUS SEPIUM	HEDGE BINDWEED	0.06	0.3	0.33	0.2	0.5
SOLANUM CAROLINENSE	HORSE-NETTLE	0.08	0.4	0.15	0.1	0.5
EUPATORIUM RUGOSUM	WHITE SNAKEROOT	0.06	0.3	0.24	0.1	0.4
POA COMPRESSA	CANADA BLUEGRASS	0.04	0.2	0.41	0.2	0.4
EUPATORIUM MACULATUM	SPOTTED JOE-PYE-WEED	0.04	0.2	0.35	0.2	0.4
ERIGERON ANNUS	DAISY FLEABANE	0.06	0.3	0.16	0.1	0.4
AMPHICARPA BRACTEATA	HOG-PEANUT	0.04	0.2	0.33	0.2	0.4
PLANTAGO MAJOR	COMMON PLANTAIN	0.06	0.3	0.07	0.0	0.3
GAURA BIENNIS	BIENNIAL GAURA	0.02	0.1	0.40	0.2	0.3
URTICA DIOICA	STINGING NETTLE	0.04	0.2	0.18	0.1	0.3
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.04	0.2	0.11	0.1	0.3
POTENTILLA NORVEGICA	ROUGH CINQUEFOIL	0.04	0.2	0.06	0.0	0.2
RUDBECKIA HIRTA	BLACK-EYED SUSAN	0.04	0.2	0.05	0.0	0.2
HYPERICUM MUTILUM	ST. JOHN'S WORT	0.04	0.2	0.03	0.0	0.2
LOBELIA INFLATA	INDIAN-TOBACCO	0.04	0.2	0.03	0.0	0.2
STELLARIA LONGIFOLIA	CHICKWEED	0.02	0.1	0.15	0.1	0.2
JUNCUS EFFUSUS	RUSH	0.02	0.1	0.15	0.1	0.2
CIRCAEA QUADRISULCATA	ENCHANTER NIGHTSHADE	0.02	0.1	0.14	0.1	0.2
GALIUM PALUSTRE	BEDSTRAW	0.02	0.1	0.10	0.1	0.2
ELEOCHARIS TENUIS	SPIKE-RUSH	0.02	0.1	0.08	0.0	0.1
POLYGONUM HYDROPIPEROIDES	MILD WATER PEPPER	0.02	0.1	0.08	0.0	0.1
VERBENA URTICIFOLIA	WHITE VERVAIN	0.02	0.1	0.06	0.0	0.1
HYPERICUM PYRAMIDATUM	GREAT ST. JOHN'S WORT	0.02	0.1	0.05	0.0	0.1
LOBELIA SIPHILITICA	GREAT LOBELIA	0.02	0.1	0.04	0.0	0.1
CAMPANULA APARINOIDES	MARSH BELLFLOWER	0.02	0.1	0.03	0.0	0.1
CONYZA CANADENSIS	HORSEWEED	0.02	0.1	0.02	0.0	0.1
CLEMATIS VIRGINIANA	VIRGIN BOWER	0.02	0.1	0.02	0.0	0.1
GNAPHALIUM OBTUSIFOLIUM	CUDWEED	0.02	0.1	0.02	0.0	0.1
TRIFOLIUM REPENS	WHITE CLOVER	0.02	0.1	0.02	0.0	0.1
POLYGONUM VIRGINIANUM	VIRGINIA KNOTWEED	0.02	0.1	0.02	0.0	0.1
CIRSIUM ARVENSE	CANADA THISTLE	0.02	0.1	0.01	0.0	0.1
ALLIARIA OFFICINALIS	GARLIC MUSTARD	0.02	0.1	0.01	0.0	0.1
SETARIA GLAUCA	FOXTAIL GRASS	0.02	0.1	0.01	0.0	0.1
TRIFOLIUM PRATENSE	RED CLOVER	0.02	0.1	0.01	0.0	0.1

Table F-25. Vegetation analysis for tree seedlings, shrubs, and herbs in the Switchyard Field, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE
TREE SEEDLINGS						
CORNUS FLORIDA	FLOWERING DOGWOOD	0.34	43.6	1.92	45.4	89.0
FRAXINUS AMERICANA	WHITE ASH	0.20	25.6	0.68	16.1	41.7
BETULA POPULIFOLIA	GRAY BIRCH	0.06	7.7	1.12	26.6	34.3
ACER RUBRUM	RED MAPLE	0.06	7.7	0.30	7.1	14.8
SASSAFRAS ALBIDUM	SASSAFRAS	0.04	5.1	0.09	2.1	7.2
PRUNUS SEROTINA	BLACK CHERRY	0.04	5.1	0.06	1.3	6.5
ACER SACCHARINUM	SILVER MAPLE	0.02	2.6	0.06	1.4	4.0
ULMUS AMERICANA	AMERICAN ELM	0.02	2.6	0.00	0.1	2.7
SHRUBS						
CORNUS RACEMOSA	GRAY DOGWOOD	0.58	50.9	4.20	55.0	105.9
RUBUS FLAGELLARIS	DEWBERRY	0.12	10.5	0.88	11.5	22.0
RHUS RADICANS	POISON IVY	0.12	10.5	0.72	9.4	19.9
CORNUS AMOMUM	SILKY DOGWOOD	0.08	7.0	0.83	10.9	17.9
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.12	10.5	0.55	7.2	17.8
ILEX VERTICELLATA	WINTERBERRY	0.04	3.5	0.16	2.1	5.7
VIBURNUM DENTATUM	ARROWWOOD	0.02	1.8	0.23	3.0	4.7
VITIS AESTIVALIS	SUMMER GRAPE	0.04	3.5	0.05	0.6	4.1
SPIRAEA TOMENTOSA	STEEPLEBUSH	0.02	1.8	0.02	0.3	2.0
HERBS						
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.96	7.8	39.62	31.9	39.7
SOLIDAGO CANADENSIS	CANADA GOLDENROD	0.94	7.7	24.06	19.4	27.0
GRASS (UNIDENTIFIED)	-	0.96	7.8	13.38	10.8	18.6
POTENTILLA SIMPLEX	CINQUEFOIL	0.72	5.9	10.54	8.5	14.4
RUMEX ACETOSELLA	SHEEP SORREL	0.82	6.7	4.99	4.0	10.7
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	0.66	5.4	4.20	3.4	8.8
CAREX SP.	SEDGE	0.74	6.0	1.87	1.5	7.6
SOLIDAGO JUNCEA	EARLY GOLDENROD	0.52	4.2	2.76	2.2	6.5
POA PRATENSIS	KENTUCKY BLUEGRASS	0.16	1.3	6.14	4.9	6.2
DAUCUS CAROTA	QUEEN ANNE'S LACE	0.54	4.4	1.42	1.1	5.6
HIERACIUM PRATENSE	HAWKWEED	0.48	3.9	1.52	1.2	5.1
VERONICA OFFICINALIS	COMMON SPEEDWELL	0.46	3.8	0.90	0.7	4.5
FRAGARIA VIRGINIANA	WILD STRAWBERRY	0.18	1.5	3.39	2.7	4.2
VIOLA PAPILIONACEA	COMMON BLUE VIOLET	0.40	3.3	0.92	0.7	4.0
ASTER ERICOIDES	HEATH ASTER	0.34	2.8	1.23	1.0	3.8
PLANTAGO LANCEOLATA	ENGLISH PLANTAIN	0.38	3.1	0.80	0.6	3.7
BARE SOIL	-	0.26	2.1	1.23	1.0	3.1
SOLIDAGO GIGANTEA	LATE GOLDENROD	0.24	2.0	1.34	1.1	3.0
OXALIS STRICTA	YELLOW WOOD SORREL	0.32	2.6	0.29	0.2	2.8
HYPERICUM PUNCTATUM	SPOTTED ST. JOHN'S WORT	0.18	1.5	0.35	0.3	1.8
TRIFOLIUM SP.	CLOVER	0.18	1.5	0.20	0.2	1.6
CERASTIUM ARVENSE	FIELD CHICKWEED	0.16	1.3	0.14	0.1	1.4
ONOCLEA SENSIBILIS	SENSITIVE FERN	0.12	1.0	0.49	0.4	1.4
PHLEUM PRATENSE	TIMOTHY	0.12	1.0	0.30	0.2	1.2
SOLIDAGO NEMORALIS	LITTLE GREY GOLDENROD	0.10	0.8	0.20	0.2	1.0
HYPERICUM PERFORATUM	COMMON ST. JOHN'S WORT	0.10	0.8	0.14	0.1	0.9
CHRYSANTHEMUM LEUCANTHEMUM	OX-EYE DAISY	0.10	0.8	0.10	0.1	0.9
UNIDENTIFIED HERB #1	-	0.08	0.7	0.11	0.1	0.7
PANICUM SPP.	PANIC-GRASS	0.08	0.7	0.09	0.1	0.7
TARAXACUM OFFICINALE	DANDELION	0.08	0.7	0.08	0.1	0.7
RUDBECKIA HIRTA	BLACK-EYED SUSAN	0.06	0.5	0.25	0.2	0.7
TEUCRIUM CANADENSE	WOOD-SAGE	0.06	0.5	0.15	0.1	0.6
GEUM CANADENSE	AVENS	0.06	0.5	0.14	0.1	0.6
ASTER LATERIFLORUS	CALICO ASTER	0.06	0.5	0.10	0.1	0.6
BOTRYCHIUM DISSECTUM	GRAPE FERN	0.06	0.5	0.06	0.0	0.5
EPILOBIUM COLORATUM	WILLOW-HERB	0.04	0.3	0.09	0.1	0.4
JUNCUS TENUIS	PATH RUSH	0.04	0.3	0.06	0.0	0.4
DIANTHUS ARMERIA	DEPTFORD PINK	0.04	0.3	0.05	0.0	0.4
LOBELIA INFLATA	INDIAN-TOBACCO	0.04	0.3	0.03	0.0	0.4
OENOTHERA BIENNIS	EVENING-PRIMROSE	0.04	0.3	0.03	0.0	0.4
TRIFOLIUM PRATENSE	RED CLOVER	0.04	0.3	0.02	0.0	0.3
SOLANUM CAROLINENSE	HORSE-NETTLE	0.02	0.2	0.11	0.1	0.3
APOCYNUM CANNABINUM	INDIAN HEMP	0.02	0.2	0.06	0.1	0.2
POTENTILLA RECTA	ROUGH-FRUITED CINQUEFOIL	0.02	0.2	0.05	0.0	0.2
STELLARIA MEDIA	COMMON CHICKWEED	0.02	0.2	0.04	0.0	0.2
ACHILLEA MILLEFOLIUM	YARROW	0.02	0.2	0.04	0.0	0.2
PLANTAGO MAJOR	COMMON PLANTAIN	0.02	0.2	0.03	0.0	0.2
PRUNELLA VULARIS	SELF-HEAL	0.02	0.2	0.03	0.0	0.2
GEUM LACINIATUM	AVENS	0.02	0.2	0.02	0.0	0.2
DESMODIUM PANICULATUM	TICK-TREFOIL	0.02	0.2	0.02	0.0	0.2
RUMEX PATIENTA	PATIENCE DOCK	0.02	0.2	0.02	0.0	0.2
AGROSTIS SP.	BENTGRASS	0.02	0.2	0.02	0.0	0.2
VERONICA SERPYLLIFOLIA	SPEEDWELL	0.02	0.2	0.02	0.0	0.2
ASTER SIMPLEX	ASTER	0.02	0.2	0.02	0.0	0.2
ASTER NOVAE-ANGLIAE	NEW ENGLAND ASTER	0.02	0.2	0.01	0.0	0.2
MELILOTUS ALBA	WHITE SWEET CLOVER	0.02	0.2	0.01	0.0	0.2
AMBROSIA ARTEMISIIFOLIA	RAGWEED	0.02	0.2	0.00	0.0	0.2

Table F-26. Vegetation analysis for tree seedlings, shrubs, herbs, and ground cover in the US 11 Marsh, 1978.

SPECIES	COMMON NAME	FREQUENCY	RELATIVE FREQUENCY	DOMINANCE (% COVER)	RELATIVE DOMINANCE	IMPORTANCE VALUE	MEAN HEIGHT(CM)
SEEDLINGS							
ACER RUBRUM	RED MAPLE	0.03	100.0	0.03	100.0	200.0	14.0
SHRUBS							
ALNUS RUGOSA	SPECKLED ALDER	0.03	25.0	3.23	59.2	84.2	300.0
RUBUS ALLEGHENIENSIS	BLACKBERRY	0.06	50.0	0.45	8.3	58.3	75.0
CORNUS AMOMUM	SILKY DOGWOOD	0.03	25.0	1.77	32.5	57.5	140.0
HERBS							
LEERSIA ORYZOIDES	RICE CUTGRASS	0.87	9.9	54.77	31.5	41.4	78.3
SAGITTARIA LATIFOLIA	ARROW-HEAD	0.61	7.0	15.06	8.7	15.6	59.1
SPARGANIUM EURYCARPUM	BUR-REED	0.45	5.1	12.00	6.9	12.0	97.9
SOLIDAGO GIGANTEA	LATE GOLDENROD	0.39	4.4	11.03	6.4	10.7	88.4
IMPATIENS BIFLORA	JEWELWEED	0.58	6.6	6.74	3.9	10.5	61.2
LEMNA MINOR	DUCKWEED	0.23	2.6	8.00	4.6	7.2	1.0
ELEOCHARIS TENUIS	SPIKE-RUSH	0.16	1.8	8.90	5.1	7.0	32.8
GALIUM TRIFIDUM	BEDSTRAW	0.39	4.4	2.97	1.7	6.1	29.3
ONOCLEA SENSIBILIS	SENSITIVE FERN	0.29	3.3	4.87	2.8	6.1	36.3
POLYGONUM SAGITTATUM	ARROW-LEAVED TEARTHUMB	0.39	4.4	2.71	1.6	6.0	48.1
JUNCUS EFFUSUS	RUSH	0.26	2.9	5.10	2.9	5.9	88.1
CAREX SCOPARIA	SEDGE	0.26	2.9	5.06	2.9	5.8	72.8
BOEHMERIA CYLINDRICA	FALSE NETTLE	0.32	3.7	3.61	2.1	5.7	53.7
CAREX LURIDA	SEDGE	0.32	3.7	3.16	1.8	5.5	67.2
LYSIMACHIA TERRESTRIS	YELLOW LOOSESTRIFE	0.23	2.6	2.68	1.5	4.1	45.7
CICUTA BULBIFERA	WATER HEMLOCK	0.19	2.2	2.35	1.4	3.6	81.3
PHALARIS ARUNDINACEA	REED CANARY GRASS	0.06	0.7	4.52	2.6	3.3	136.5
SCIRPUS CYPERINUS	WOOL GRASS	0.13	1.5	3.23	1.9	3.3	115.5
VERBENA HASTATA	BLUE VERVAIN	0.23	2.6	0.84	0.5	3.0	80.4
POLYGONUM HYDROPIPEROIDES	MILD WATER PEPPER	0.19	2.2	1.16	0.7	2.9	46.7
PILEA PUMILA	CLEARWEED	0.23	2.6	0.48	0.3	2.8	14.3
EQUISETUM ARVENSE	FIELD HORSETAIL	0.10	1.1	2.71	1.6	2.7	34.7
CAREX STIPATA	SEDGE	0.16	1.8	1.23	0.7	2.5	58.4
SOLIDAGO RUGOSA	ROUGH GOLDENROD	0.16	1.8	1.00	0.6	2.4	69.4
LYCOPUS AMERICANUS	WATER HOREHOUND	0.16	1.8	0.94	0.5	2.4	47.6
MIMULUS RINGENS	MONKEY-FLOWER	0.13	1.5	0.29	0.2	1.6	44.5
ERECHTITES HIERACIFOLIA	FIREWEED	0.10	1.1	0.77	0.4	1.5	36.3
VERNONIA NOVEBORACENSIS	IRONWEED	0.10	1.1	0.77	0.4	1.5	83.3
LUDWIGIA ALTERNIFOLIA	SEED-BOX	0.10	1.1	0.55	0.3	1.4	69.3
POLYGONUM NATANS	WATER SMARTWEED	0.06	0.7	1.00	0.6	1.3	78.5
HYPERICUM MUTILUM	ST. JOHN'S WORT	0.10	1.1	0.26	0.1	1.2	21.0
CUSCUTA GRONOVII	DODDER	0.10	1.1	0.23	0.1	1.2	63.0
SOLIDAGO GRAMINIFOLIA	FLAT-TOPPED GOLDENROD	0.06	0.7	0.29	0.2	0.9	62.5
SCIRPUS VALIDUS	GREAT BULRUSH	0.03	0.4	0.81	0.5	0.8	140.0
GRASS(UNIDENTIFIED)	-	0.03	0.4	0.81	0.5	0.8	75.0
CYPERUS STRIGOSUS	GALINGALE	0.06	0.7	0.13	0.1	0.8	14.5
POA TRIVIALIS	ROUGH BLUEGRASS	0.06	0.7	0.10	0.1	0.8	60.0
EUPATORIUM PERFOLIATUM	BONESET	0.03	0.4	0.48	0.3	0.6	100.0
BIDENS CERNUA	BEGGAR-TICKS	0.03	0.4	0.32	0.2	0.6	80.0
CAREX SP.	SEDGE	0.03	0.4	0.32	0.2	0.6	15.0
ELEOCHARIS ACICULARIS	SPIKE-RUSH	0.03	0.4	0.23	0.1	0.5	5.0
ANTHOXANTHUM ODORATUM	SWEET VERNAL GRASS	0.03	0.4	0.19	0.1	0.5	40.0
DRYOPTERIS CRISTATA	CRESTED WOOD FERN	0.03	0.4	0.19	0.1	0.5	45.0
TYPHA LATIFOLIA	CAT-TAIL	0.03	0.4	0.16	0.1	0.5	170.0
ELEOCHARIS OVATA	SPIKE-RUSH	0.03	0.4	0.13	0.1	0.4	25.0
LYCOPUS VIRGINICUS	WATER HOREHOUND	0.03	0.4	0.13	0.1	0.4	46.0
GEUM CANADENSE	AVENS	0.03	0.4	0.10	0.1	0.4	20.0
GLYCERIA STRIATA	FOWL MANNAGRASS	0.03	0.4	0.06	0.0	0.4	98.0
GALEOPSIS TETRAHIT	HEMP-NETTLE	0.03	0.4	0.06	0.0	0.4	40.0
POTENTILLA SIMPLEX	CINQUEFOIL	0.03	0.4	0.06	0.0	0.4	10.0
PYCNANTHEUM VIRGINIANUM	MOUNTAIN-MINT	0.03	0.4	0.06	0.0	0.4	70.0
ASCLEPIAS INCARNATA	SWAMP MILKWEED	0.03	0.4	0.06	0.0	0.4	86.0
SELAGINELLA APODA	MEADOW SPIKE-MOSS	0.03	0.4	0.03	0.0	0.4	1.0
GROUND COVER							
LITTER	-	1.00	68.9	85.29	85.3	154.2	-
WATER	-	0.29	20.0	13.65	13.6	33.6	-
BARE SOIL	-	0.13	8.9	0.94	0.9	9.8	-
MOSS	-	0.03	2.2	0.13	0.1	2.4	-

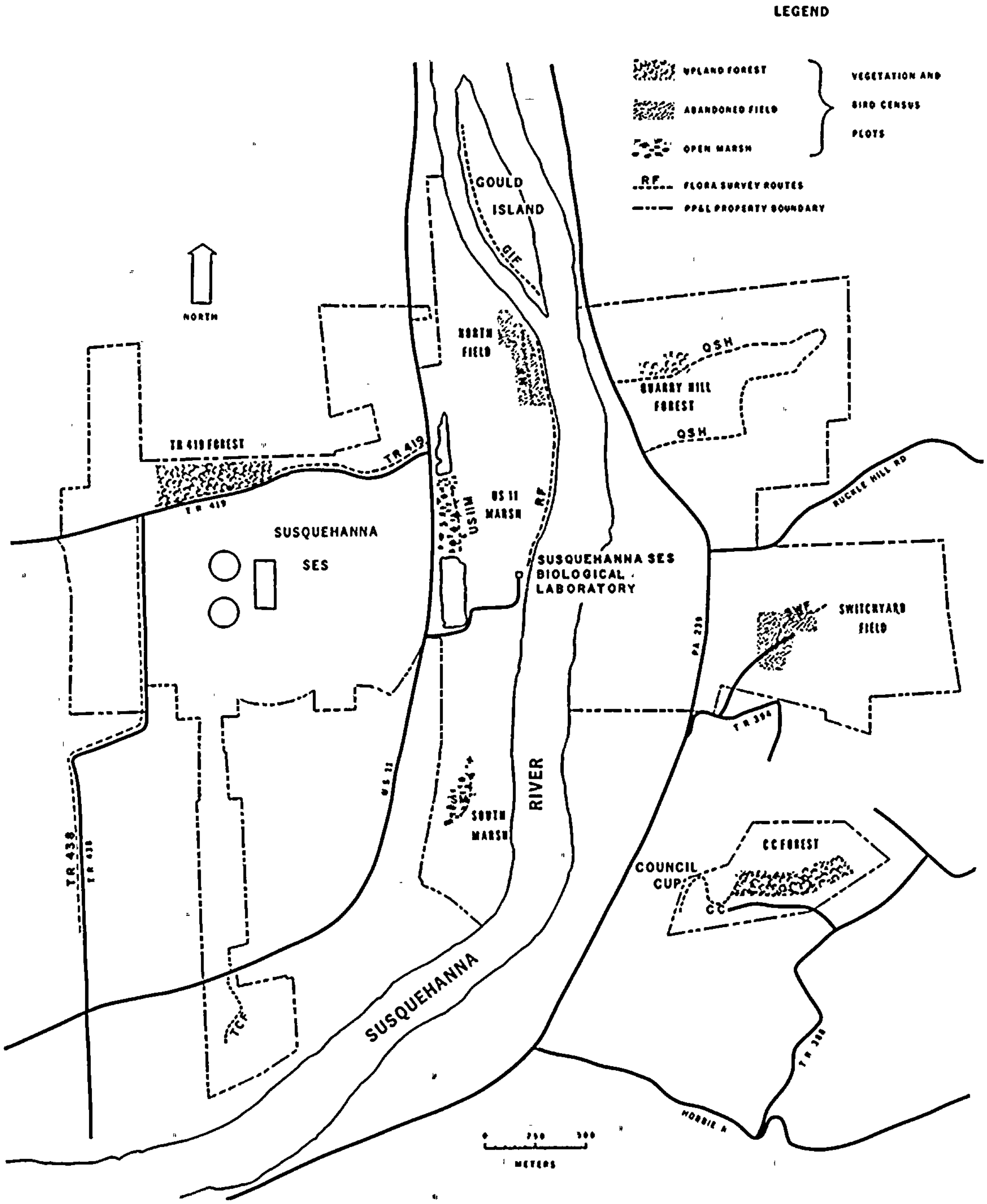

Fig. F-1. Location of vegetation and bird census plots and salt drift transects (flora survey routes) near the Susquehanna SES, 1978.

BIRDS

by

Robert M. Ruhe and James D. Montgomery

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ABSTRACT

In 1978, 185 species of birds, 15 of which had not been reported previously, were observed near the Susquehanna SES. A species of one new family, Alaudidae, was observed bringing the total number of families observed to 44.

Seasonal censuses were conducted on two wooded plots, one abandoned field plot, and one marsh plot. A total of 30 species was observed in winter, 96 in spring, 68 in summer, and 90 in fall. Density of individuals increased from winter through fall on all study plots except the marsh. The total number of species was higher during spring and fall, and lower in winter and summer on all plots except the abandoned field.

Nineteen species of waterfowl were observed during the spring migration. The "endangered" peregrine falcon was observed migrating over the Council Cup Forest on 3 November 1978. Breeding bird censuses revealed that 32 species maintained territories on the four plots.

A total of 82 birds impacted on the Unit 1 Cooling Tower and Meterological Tower in September and October 1978.

INTRODUCTION

Preliminary studies of the bird life on the Susquehanna SES site were begun in 1971 and terminated in 1974. During this period the literature was surveyed, a species list was compiled, and the relative abundance of resident and transient species was monitored (Ichthyological Associates 1973, 1974; Burton 1976).

The current preoperational studies were begun in January 1977 to gather information on bird numbers, behavior, occurrences, and habitats during final construction of the Susquehanna SES (Ruhe 1978). These baseline data will be compared with similar information collected after the station begins operation in 1981. In addition, bird impaction on the Susquehanna SES cooling and meterological towers was investigated to provide bird mortality data during the 1978 fall migration.

PROCEDURES

Four study plots (Council Cup Forest, CC; TR419 Forest, TR419; US 11 Marsh, US11M; and Switchyard Field, SwF) were censused during 1978; SwF was first censused in 1978 (Fig. F-1). Both CC and TR419 were wooded, US11M was a freshwater marsh, and SwF was an abandoned field.

Criteria considered in selection of the plots were: 1) the vegetation be representative of the Susquehanna SES; 2) the areas remain relatively undisturbed throughout construction; and 3) the plots be a minimum of 6 ha of uniform habitat (Hall 1964).

All plots were surveyed and measured using a Brunton pocket transit on a tripod and a 30-m engineer's tape. The boundaries of each plot were marked with flagging. Transect lines were surveyed within each plot at distances dependent upon vegetation density. Transects provided coverage of all parts of the plots when sampling by the strip census method (Kendeigh 1961). A polar planimeter was used to calculate plot areas.

All bird observations were checked against the federal endangered and threatened species list (U.S. Department of the Interior 1979) and the American Birds blue list (Arbib 1977). The species named to the blue list are those which "have recently or are currently giving evidence of population declines, either regionally or continent-wide" (Arbib 1977). Nomenclature follows American Ornithologist's Union (1957).

Seasonal Census

The seasonal censuses were designated and conducted according to the following timetable: winter, 16 December-28 February; spring, 1 March-15 May; summer, 16 May-31 July; fall, 15 August-30 November.

Time and weather conditions were recorded at the beginning of each census and the time noted at the conclusion. Winter, spring, and fall censuses were begun prior to 0800 h and summer censuses started one-half hour before sunrise.

The observer slowly walked along transects in such a manner as to cover all sections of the plot with a minimum of overlap. All species were identified by either sight or vocalization. In the laboratory, the data were transferred to bird census code sheets for computer input.

A minimum of five censuses were conducted in each plot during each season. Censuses were not conducted during periods of inclement weather, such as heavy rains or high winds.

Breeding Bird Census

The four study plots were censused eight times between 1 May and 15 July. Each census began within 30 minutes before sunrise, a period that coincides with the beginning of intense singing by most passerines (Hall 1964). Starting locations were altered on each plot from census to census to minimize bias that might result from changes in singing intensity. During each census, the locations of singing males were marked on a daily census map. All birds were identified and recorded with a symbol that designated species and behavioral activity (i.e. singing, aggression, nest building, etc.). Censuses were not conducted during periods of high winds or heavy rains.

These data were analyzed by "territory mapping" described by Hall (1964) and Oekle (1967). After a census, data on the daily census map were transferred to a similar map for each species. The number of territories for a species was then estimated by counting the clusters of daily census points on the species map; each cluster represented a territory. For each species, mean density (number of territories/km^2) and relative density (number of territories of one species/total number of territories of all species) were calculated.

River Bird Survey

Migratory waterfowl and other water associated birds were censused weekly in the spring from a boat on a 16-km section of the Susquehanna River. The survey route extended from the Shickshinny-Mocanaqua Bridge to the Berwick-Nescopeck Bridge.

The identity and number of birds observed on each survey were recorded. Each survey was begun between 0800 and 1000 h and lasted about 2½ hours. Results were formulated as indices of river usage, i.e. birds/km and waterfowl-days (average number of Anatidae observed for two consecutive surveys X the number of days between surveys).

Conditions limiting surveys were low river levels (surface elevation <149.5 m above mean sea level) and hazardous river conditions such as ice floes and flooding. No fall 1978 surveys were conducted due to the low river levels which made navigation impossible along most of the route.

Bird Impaction

In 1978, bird impaction studies were conducted on and around the nearly completed Unit 1 Cooling Tower and the Meterological Tower (met tower) from 1 September through 31 October. The height of the cooling tower was 152 m and that of the met tower was 91 m. Searches for impacted birds were conducted daily, Monday through Friday, excluding holidays. The circumference of the cooling tower, both inside and outside, was searched in the morning beginning approximately 1 hour prior to the start of construction. The ground around the met tower was checked from the base out to a distance of 50 m, including the area under the guy wires.

All birds at each location were collected and identified. The location of each specimen was recorded with reference to the compass direction from the center of the respective tower and the position from the tower (inside or outside of the base of the cooling tower, or distance from the base of the met tower). Weather conditions were recorded during each search and augmented with data collected at the met tower or by the National Oceanic and Atmospheric Administration (NOAA 1978) for the 12 hours previous to the search.

RESULTS AND DISCUSSION

A total of 210 species of birds was observed near the Susquehanna SES from 1972 through 1974 and 1977 through 1978 (Table G-1). During 1978, 185 species were observed on the site. Fifteen of these species had not been reported during previous years. One new family, Alaudidae, was observed bringing the total number of families observed to 44. The following families composed 48.6% of the species observed in 1978: Parulidae (28 species) 15.1%, Fringillidae (25) 13.5%, Anatidae (21) 11.4%, Scolopacidae (8) 4.3%, and Tyrannidae (8) 4.3%.

One endangered species, peregrine falcon, was observed flying over CC on 3 November 1978. Twenty-one blue-listed birds were observed during the year. Ten were seasonally migratory, seven were summer residents, and four were year-round residents (Table G-1).

Seasonal Census

Winter

A total of 30 species was observed during winter on the four study plots (Table G-2). The US11M supported 22 species; CC, 13 species; TR419, 7 species; and none were observed on SwF. The US11M also supported the highest density of individuals in any of the plots.

The majority of the winter communities was composed of species in the family Fringillidae (Table G-2). Tree and song sparrows were the most abundant species in US11M, the dark-eyed junco in CC, and the golden-crowned kinglet in TR419. The downy woodpecker, black-capped chickadee, and blue jay were the only species to be observed on the three plots where birds were observed.

Densities of most species remained stable throughout the winter, except during a cold spell from 27-31 January when the temperature never exceeded -3.3 C, winds averaged 32 kph (NOAA 1978), and 2.5 cm of snow fell. Throughout this period, there was a 34% decrease in densities in the US11M and a 38% decrease in densities in CC. No data were collected in TR419 during this period.

Spring

A total of 94 species was observed on the study plots during spring (Table G-3). In TR419, 47 species were observed; CC, 46 species; US11M, 40 species; and 16 species in SwF. The black-capped chickadee was the most abundant species in TR419. The pine grosbeak was the most abundant in CC, the red-winged blackbird in US11M, and the field sparrow in SwF. The US11M supported the highest density of individuals than the other plots.

The arrival of most species was from one to two weeks later than last year (Ruhe 1978). The colder than normal temperatures in March through May (NOAA 1978) probably delayed the migration. Warbler migration began on 3 May and lasted into the early summer. From 16-25 May, the largest concentrations of warblers passed through the study plots; a total of 19 species was observed. Warblers composed 36.9% of the 12 May census in TR419 and 60.0% of the 16 May census in CC. On 13 May, warblers were found in the greatest concentrations in SwF and US11M. They composed 46.6% of the census in SwF and 21.4% of the census in US11M. The wood thrush migration peaked on 10-12 May. Black-capped chickadees were abundant all spring in TR419 but decreased in CC after 18 April. Robins first appeared on 12 April as did field sparrows. Tree sparrows were last observed on 10 March. Most sandpipers and yellowlegs were observed on 8 and 13 May.

Summer

A total of 68 species was observed during the summer (Table G-4). In TR419, 45 species were observed, 37 in CC, 26 in US11M, and 17 in SwF. As during the previous seasons, the US11M supported greater densities than the other study plots. Spring migration continued into the summer census period. Migrant species were observed as late as 25 May. The wood thrush was most abundant in TR419, the scarlet tanager in CC, the red-winged blackbird in US11M, and the field sparrow in SwF.

There were changes in populations of several species over the 1977 densities. A noticeable increase of brown-headed cowbirds was observed on the wooded plots from the mean densities of 1977 (Ruhe 1978). This parasitic species may cause decreases in songbird populations (Bent 1963, 1965). Other species that increased in density were great-crested flycatcher, eastern wood pewee, veery, and cedar waxwing. There was a decrease in black-capped chickadees on the wooded plots. In the marsh, only the indigo bunting decreased in number, 5 species remained at approximately 1977 levels, and 13 species increased in numbers.

Fall

A total of 90 species was observed on the four study plots during the fall migration season (Table G-5). The TR419 supported the greatest number of species, 53; followed by US11M, 40; CC, 39; and SwF, 19. The white-throated sparrow was the most abundant species in TR419, song sparrow in US11M, black-capped chickadee in CC, and European starling in SwF.

The peak period of fall migration occurred between 20 September and 18 October. Peak days were 27 September in SwF and US11M, and 10 October in CC, and TR419. Marsh and field species migrated through earlier than species associated with woodlands with the exception of the Parulidae. Twenty-two species of warblers were observed during the fall migration. The majority migrated through the wooded plots between 12-20 September, and composed 40.0% of the individuals present. Warblers were seen in their largest concentrations in SwF and US11M between 13-27 September, at which time they composed 22.0% and 5.8% of the total individuals present, respectively.

The populations of warblers, for the most part, were greater than they were in 1977 (Ruhe 1978). Only the ovenbird and yellow-rumped warbler populations decreased from 1977.

Seasonal Population Comparisons

Certain general trends and relationships in numbers of species and densities were found among the study plots. From winter through fall, the density of individuals increased in each season on all plots except the US11M (Fig. G-1). During the same period, the total number of species for the season was higher during spring and fall and was lower in winter and summer except in SwF. During the winter, the total community density was low because there were fewer species present than in other seasons. Food quantity is a limiting factor in the winter, therefore, competition becomes acute at a lower population density (Kendeigh 1961). As spring migration proceeded, both density and number of species increased. During the summer, the number of species present was less than the total number of species observed during spring migration, but, because reproduction occurred, the total summer densities surpassed those of the spring migration. Fall migration resulted in an increase in number of species and density brought about by the influx of both adult and young-of-the-year individuals.

Breeding Bird Census

A total of 32 species, representing 12 families, was observed on all four census plots (Table G-6). The highest number of species (19) was found in TR419, while US11M supported the most nesting territories (45.5). The ovenbird, wood thrush, field sparrow, and red-winged blackbird maintained the most territories in CC, TR419, SwF, and US11M, respectively.

The families Tyrannidae, Parulidae, and Paridae composed 42.8% of the total species in CC. The families Parulidae and Fringillidae composed 31.6% of the total species in TR419 and 88.9% of the species in SwF. The Fringillidae composed 40.0% of the total species in US11M.

Two broods of mallards and one brood of wood ducks were raised in US11M and the surrounding wetlands. The nesting sites, however, were not discovered.

Comparisons between the two wooded plots indicated some changes in their breeding populations from 1977 to 1978 (Ruhe 1978). Of the total species observed in CC, 93.0% were also seen in TR419, but only 68.0% of the species observed in TR419 were observed in CC in 1978. This was a slight increase from the approximately 65.0% shared in common in 1977. The wood thrush was the most abundant breeding species in TR419 as in 1977. The bluejay and black-capped chickadee were next in abundance in 1977, but there was an 82.0% and 56.0% decrease in their populations, respectively. In 1978, the scarlet tanager was second in abundance in TR419. In CC, the wood thrush decreased 43.0% from 7 to 4 nesting territories and dropped from the most abundant in 1977 to the second in abundance in 1978. The ovenbird increased in abundance from 5 to 6 nesting territories and was the most abundant nesting species in CC in 1978. These changes may not be significant. Balda (1975) noted that bird densities between years may vary as much as 80% for some species in study plots not physically altered between breeding seasons.

For the four plots combined, there was an increase of six breeding species from 1977.

Red-breasted nuthatches were observed nesting for the first time in both CC and TR419. The Susquehanna SES site is a southern extension of this species normal breeding area (personal communication, Chandler S. Robbins, U.S. Fish and Wildlife Service, Laurel, Maryland).

River Bird Survey

Of the 34 species observed during the spring migration (Table G-7), 74.3% of the total number of individuals passed through the area between 22 March and 12 April. The greatest number of individuals (418) was observed on 29 March and the highest number of species (19) was seen on 5 April. The Canada goose was the most abundant waterfowl observed, followed by the mallard, and the wood duck. Of the nonwaterfowl, the ring-billed gull and Bonaparte's gull were the most abundant. Common mergansers composed from 30 to 90% of the early waterfowl populations in February and early March. By 15 March, black ducks, wood ducks, ring-necked ducks, and hooded mergansers began to arrive. On 22 and 29 March, large numbers of Canada geese and wood ducks composed over 50% of the birds observed. Flights of Canada geese were heard migrating during the evenings of 20 and 21 March. While standing on the river bank, 1,300 were observed from 0700 to 1100 h on 23 March. Large numbers of geese continued to migrate through until 12 April. Ring-billed gulls were present during the latter half of March and April and Bonaparte's gulls were observed in late March and early April. On 27 April and 22 May, osprey and spotted sandpipers were the most abundant nonwaterfowl on the river, respectively.

There was an increase in mean numbers of spring migrants from 60.0 in 1977 (Ruhe 1978) to 183.1 in 1978. The index of birds/km (11.4) and the number of waterfowl-days (10,819) both increased about 2-fold during the same time period in 1978 compared with 1977.

Bird Impaction Census

During the observation period, 1 September through 31 October, 80 individuals impacted on the cooling tower, and 2 individuals were found at the met tower (Table G-8). A total of 17 species of 4 families was found. The two most frequently collected species at the cooling tower were the red-eyed vireo (16) and the bay-breasted warbler (10). The highest incidents of impaction were found at the cooling tower on 13 and 14 September when 27 and 13 birds were collected, respectively. Most of these impactions (81.2%) occurred in September, with 51.2% of the total occurring from 11 to 14 September. The two individuals that collided with the met tower were a rose-breasted grosbeak on 14 September and a prarie warbler on 25 September. No endangered or threatened species were found.

Local weather conditions have been reported to increase bird mortality on meteorological towers (Kemper 1964, Avery et al. 1977). Usually such conditions consist of overcast skys, often with precipitation; winds favorable for migration; and in the fall, the passage of cold fronts (Brewer and Ellis 1958). Avery et al. (1977) observed that in the fall in North Dakota, Fringillidae and Parulidae were killed in significantly greater numbers on overcast nights with northeasterly winds.

At the Susquehanna SES, 66.6% of all birds found impacted on overcast nights with northeasterly winds. Fringillidae and Parulidae composed 81.5% of the birds found under these conditions. Of all the losses, 51.6% were found the morning after the passage of cold fronts, which is in agreement with Tardoff and Mengel (1956) and Laskey (1960).

The impact mortality on the cooling tower and met tower at the Susquehanna SES was very low compared to data collected at other towers in the United States. One day kills have ranged from 23-69 birds (Avery et al. 1977), 133-636 (Crawford 1978), to as high as 15,000 (Kemper 1964). Bellrose (1971) observed that small passerines migrate on a broad front with the majority flying at altitudes of 152-457 m above ground level (agl). Currently, the Unit 1 Cooling Tower is 152 m agl; when completed, it will be 158 m agl. The cooling tower for the Susquehanna SES, when completed, will exceed the highest local terrain elevation by about 40 m. The top of the tower is well below the observed altitude utilized the most often by migrant birds. If birds migrate along the river valley, the tower will extend 6 m above the 152 m agl minimum altitude listed by Bellrose (1971): therefore, most migrant birds should pass over the tower.

Additional Animal Observations

Although systematic surveys of terrestrial biota other than birds and plants were not made, observations of unusual occurrences of species not previously reported from the Susquehanna SES site, especially those listed as threatened or endangered, were recorded in field notes. Four such observations were made in 1977 through 1978.

An eastern hognose snake (*Heterodon platyrhinos*) was observed on the QSH salt drift transect (Table F-1) on 30 March 1977. This species is listed as "status indeterminate (apparently threatened or uncommon to rare, but insufficient data currently available on which to base a reliable assessment of status)" by the Pennsylvania Fish Commission (1978). The snake was observed in an area not presently disturbed by construction.

Three species of mammals were observed and added to the species list for the Susquehanna SES site. None of the species are listed as endangered or threatened by the Pennsylvania Fish Commission (1978) or the U.S. Department of Interior (1979). Black bear (*Ursus americanus*) tracks were observed on 27 April 1977 in a tilled field adjacent to North Field (Fig. F-1). The animal was not seen. One southern flying squirrel (*Glaycomys volans*) was observed on a bird feeder at the Susquehanna SES Biological Laboratory on 7 December 1978. A mink (*Mustela vison*) was observed on 11 December 1978 in the canal near Lake Took-a-while. This was the first sighting of a mink, but tracks have been observed since 1977.

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Table G-1. Species of birds observed near the Susquehanna SES site, 1973-74 and 1977-78. An asterisk denotes new species observed in 1978; † denotes blue listed birds observed in 1978.

Gaviidae
Gavia immer - common loon
G. stellata - red-throated loon*

Podicipedidae
Podiceps auritus - horned grebe
Podilymbus podiceps - pied-billed grebe

Phalacrocoracidae
Phalacrocorax auritus - double-crested cormorant†

Ardeidae
Ardea herodias - great blue heron
Butorides virescens - eastern green heron
Florida caerulea - little blue heron
Bubulcus ibis - cattle egret
Casmerodius albus - common egret
Egretta thula - snowy egret
Nycticorax nycticorax - black-crowned night heron†
Ixobrychus exilis - least bittern
Botaurus lentiginosus - American bittern†

Anatidae
Olor columbianus - whistling swan
Branta canadensis - Canada goose
B. bernicla - brant
Chen hyperborea - snow goose
Anas platyrhynchos - mallard
A. rubripes - black duck
A. acuta - pintail
A. carolinensis - green-winged teal
A. discors - blue-winged teal
A. americana - American wigeon
Axis sponsa - wood duck
Aythya americana - redhead
A. collaris - ring-necked duck
A. valisineria - canvasback†
A. marila - greater scaup
A. affinis - lesser scaup
Bucephala clangula - common goldeneye
B. albeola - bufflehead
Clangula hyemalis - oldsquaw
Melanitta deglandi - white-winged scoter
M. perspicillata - surf scoter
M. nigra - black scoter
Oxyura jamaicensis - ruddy duck
Mergus cucullatus - hooded merganser
M. merganser - American merganser
M. serrator - red-breasted merganser

Cathartidae
Cathartes aura - turkey vulture

Accipitridae
Accipiter cooperii - Cooper's hawk†
A. striatus - sharp-shinned hawk†
Buteo jamaicensis - red-tailed hawk
B. lineatus - red-shouldered hawk†
B. platypterus - broad-winged hawk
B. lagopus - rough-legged hawk
Haliaeetus leucocephalus - bald eagle
Circus cyaneus - marsh hawk†

Pandionidae
Pandion haliaetus - osprey†

Falconidae
Falco peregrinus - peregrine falcon*
F. columbarius - merlin
F. sparverius - American kestrel†

Tetraonidae
Bonasa umbellus - ruffed grouse

Phasianidae
Colinus virginianus - bobwhite*
Phasianus colchicus - ring-necked pheasant

Meleagrididae
Meleagris gallopavo - turkey

Rallidae
Porzana carolina - sora
Gallinyla chloropus - common gallinule*
Fulica americana - American coot

Charadriidae
Charadrius vociferus - killdeer

Scolopacidae
Philohela minor - American woodcock
Capella gallinago - common snipe
Actitis macularia - spotted sandpiper
Tringa solitaria - solitary sandpiper
T. melanoleucus - greater yellowlegs
T. flavipes - lesser yellowlegs
Limnodromus griseus - short-billed dowitcher*
Calidris melanotos - pectoral sandpiper

Laridae
Larus marinus - great black-backed gull
L. argentatus - herring gull
L. delawarensis - ring-billed gull
L. philadelphia - Bonaparte's gull
Sterna hirundo - common tern†

Columbidae
Columba livia - rock dove
Zenaidura macroura - mourning dove

Cuculidae
Coccyzus americanus - yellow-billed cuckoo†
C. erythropthalmus - black-billed cuckoo

Strigidae
Otus asio - screech owl
Bubo virginianus - great-horned owl
Asio otus - long-eared owl
A. flammeus - short-eared owl*†

Caprimulgidae
Chordeiles minor - common nighthawk

Apodidae
Chaetura pelagica - chimney swift

Trochilidae
Archilochus colubris - ruby-throated hummingbird†

Alcedinidae
Megaceryle alcyon - belted kingfisher

Picidae
Colaptes auratus - common flicker
Dryocopus pileatus - pileated woodpecker
Centurus carolinus - red-bellied woodpecker
Sphyrapicus varius - yellow-bellied sapsucker
Dendrocopos villosus - hairy woodpecker†
D. pubescens - downy woodpecker

Tyrannidae
Tyrannus tyrannus - eastern kingbird
Myiarchus crinitus - great crested flycatcher
Sayornis phoebe - eastern phoebe
Empidonax flaviventris - yellow-bellied flycatcher
E. virescens - acadian flycatcher
E. traillii - willow flycatcher
E. minimus - least flycatcher

Tyrannidae (cont.)
Contopus virens - eastern wood pewee
Nuttallornis borealis - olive-sided flycatcher*

Alaudidae
Eremophila alpestris - horned lark*

Hirundinidae
Iridoprocne bicolor - tree swallow
Riparia riparia - bank swallow
Stelgidopteryx ruficollis - rough-winged swallow
Hirundo rustica - barn swallow
Petrochelidon pyrrhonota - cliff swallow
Progne subis - purple martin†

Corvidae
Cyanocitta cristata - blue jay
Corvus brachyrhynchos - common crow
C. ossifragus - fish crow

Paridae
Parus atricapillus - black-capped chickadee
P. bicolor - tufted titmouse

Sittidae
Sitta carolinensis - white-breasted nuthatch
S. canadensis - red-breasted nuthatch

Certhiidae
Certhia familiaris - brown creeper

Troglodytidae
Troglodytes aedon - house wren
T. troglodytes - winter wren
Thryothorus ludovicianus - Carolina wren
Telmatodytes palustris - long-billed marsh

Mimidae
Mimus polyglottos - mockingbird
Dumetella carolinensis - catbird
Toxostoma rufum - brown thrasher

Turdidae
Turdus migratorius - robin
Hylocichla mustelina - wood thrush
Catharus guttata - hermit thrush
C. ustulata - Swainson's thrush
C. minima - gray-cheeked thrush
C. fuscescens - veery
Sialia sialis - eastern bluebird†

Sylviidae
Polioptila caerulea - blue-gray gnatcatcher
Regulus satrapa - golden-crowned kinglet
R. calendula - ruby-crowned kinglet

Motacillidae
Anthus spinoletta - water pipit

Bombycillidae
Bombycilla cedrorum - cedar waxwing

Sturnidae
Sturnus vulgaris - starling

Vireonidae
Vireo griseus - white-eyed vireo
V. flavifrons - yellow-throated vireo
V. solitarius - solitary vireo
V. olivaceus - red-eyed vireo
V. gilvus - warbling vireo†

Parulidae
Mniotilta varia - black and white warbler
Helmitheros vermivorus - worm-eating warbler
Vermivora chrysoptera - golden-winged warbler*
V. pinus - blue-winged warbler
V. peregrina - Tennessee warbler
V. ruficapilla - Nashville warbler

Parulidae (cont.)
Parula americana - northern parula*
Dendroica petechia - yellow warbler †
D. magnolia - magnolia warbler
D. tigrina - Cape May warbler
D. caerulescens - black-throated blue warbler
D. coronata - yellow-rumped warbler
D. virens - black-throated green warbler
D. cerulea - Cerulean warbler
D. fusca - blackburnian warbler
D. dominica - yellow-throated warbler
D. pensylvanica - chestnut-sided warbler
D. castanea - bay-breasted warbler
D. striata - blackpoll warbler
D. pinus - pine warbler*
D. discolor - prairie warbler
D. palmarum - palm warbler
Seiurus aurocapillus - ovenbird
S. noveboracensis - northern waterthrush
S. motacilla - Louisiana waterthrush
Oporonis agilis - Connecticut warbler
O. philadelphia - mourning warbler
Geothlypis trichas - yellowthroat
Icteria virens - yellow-breasted chat*†
Wilsonia citrina - hooded warbler
W. pusilla - Wilson's warbler*
W. canadensis - Canada warbler
Setophaga ruticilla - American redstart

Ploceidae
Passer domesticus - house sparrow

Icteridae
Dolichonyx oryzivorus - bobolink
Sturnella magna - eastern meadowlark
Agelaius phoeniceus - red-winged blackbird
Icterus spurius - orchard oriole
I. galbula - northern oriole
Euphagus carolinus - rusty blackbird
Quiscalus quiscula - common grackle
Molothrus ater - brown-headed cowbird

Thraupidae
Piranga olivacea - scarlet tanager

Fringillidae
Cardinalis cardinalis - cardinal
Pheucticus ludovicianus - rose-breasted grosbeak
Guiraca caerulea - blue grosbeak
Passerina cyanea - indigo bunting
Hesperiphona vespertina - evening grosbeak
Carpodacus purpureus - purple finch
C. mexicanus - house finch
Acanthis flammea - common redpoll
Spinus pinus - pine siskin
S. tristis - American goldfinch
Pipilo erythrophthalmus - rufous-sided towhee
Passerculus sandwichensis - savannah sparrow
Ammodramus savannarum - grasshopper sparrow
Ammospiza caudacuta - sharp-tailed sparrow*
Pooecetes gramineus - vesper sparrow †
Junco hyemalis - dark-eyed junco
Spizella arborea - tree sparrow
S. passerina - chipping sparrow
S. pusilla - field sparrow
Zonothrichia leucophrys - white-crowned sparrow
Z. albicollis - white-throated sparrow
Passerella iliaca - fox sparrow
Melospiza lincolnii - Lincoln's sparrow*
M. georgiana - swamp sparrow
M. melodia - song sparrow
Plectrophenax nivalis - snow bunting

Table G-2. Mean density (no./km^2), relative density (%), and relative frequency (%) of birds observed in Council Cup Forest, TR419 Forest, Switchyard Field, and US 11 Marsh during the winter bird census, 15 December 1977 through February 1978.

SPECIES	CC FOREST			TR419 FOREST			SWITCHYARD FIELD			US 11 MARSH		
	MD	RD	RF	MD	RD	RF	MD	RD	RF	MD	RD	RF
RED-TAILED HAWK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.5	3.1
AMERICAN KESTREL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.5	3.1
RUFFED GROUSE	13.3	2.5	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RING-NECK PHEASANT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.4	1.5	4.6
KILLDEER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.5
COMMON SNIPE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.5
HAIRY WOODPECKER	3.3	0.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOWNY WOODPECKER	43.3	8.0	11.8	9.0	5.1	12.0	0.0	0.0	0.0	7.2	0.7	3.1
BLUE JAY	13.3	2.5	5.9	9.0	5.1	16.0	0.0	0.0	0.0	14.4	1.5	6.2
COMMON CROW	20.0	3.7	5.9	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.5	1.5
BLACK-CAPPED CHICKADEE	70.0	12.9	11.8	57.9	32.3	20.0	0.0	0.0	0.0	4.8	0.5	3.1
TUFTED TITMOUSE	16.7	3.1	2.9	16.3	9.1	12.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITE-BREASTED NUTHATCH	36.7	6.7	14.7	16.3	9.1	12.0	0.0	0.0	0.0	0.0	0.0	0.0
BROWN CREEPER	16.7	3.1	8.8	5.4	3.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCKINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.5	3.1
EASTERN BLUEBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.3	5.2	7.7
GOLDEN-CROWNED KINGLET	56.7	10.4	5.9	63.3	35.4	16.0	0.0	0.0	0.0	0.0	0.0	0.0
REDWINGED BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.5
NORTHERN CARDINAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.1	6.9	10.8
EVENING GROSBEAK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.9	4.9	1.5
PURPLE FINCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	1.0	1.5
PINE GROSBEAK	3.3	0.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMON REDPOLL	66.7	12.3	2.9	0.0	0.0	0.0	0.0	0.0	0.0	9.6	1.0	3.1
AMERICAN GOLDFINCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	1.0	1.5
DARK-EYED JUNCO	170.0	31.3	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TREE SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	335.6	34.5	10.8
FIELD SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	1.7	7.7
WHITE-THROATED SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.5	1.5
SWAMP SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.5	4.7	10.8
SONG SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	309.2	31.8	10.8

Table G-3. Mean density (no./km^2), relative density (%), and relative frequency (%) of birds observed in Council Cup Forest, TR419 Forest, Switchyard Field, and US 11 Marsh during the spring migration bird census, March through 14 May 1978.

	CC FOREST			TR419 FOREST			SWITCHYARD FIELD			US 11 MARSH		
SPECIES	MD	RD	RF	MD	RD	RF	MD	RD	RF	MD	RD	RF
EASTERN GREEN HERON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
AMERICAN BITTERN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
MALLARD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.1	5.7	4.4
WOOD DUCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.6	1.7	3.3
GOSHAWK	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SHARP-SHINNED HAWK	4.8	0.8	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RED-TAILED HAWK	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN KESTREL	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.1	2.9	5.6	0.5	2.2
RUFFED GROUSE	2.4	0.4	1.0	7.5	1.9	3.1	0.0	0.0	0.0	0.0	0.0	0.0
TURKEY	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SORA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
COMMON GALLINULE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
KILLDEER	0.0	0.0	0.0	0.0	0.0	0.0	4.8	2.2	2.9	8.4	0.7	2.2
COMMON SNIPE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.1	5.7	5.5
SPOTTED SANDPIPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
SOLITARY SANDPIPER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.4	3.1	3.3
GREATER YELLOWLEGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.7	2.2
LESSER YELLOWLEGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.5	1.1
MOURNING DOVE	0.0	0.0	0.0	3.0	0.7	1.0	4.8	2.2	2.9	0.0	0.0	0.0
GREAT HORNED OWL	0.0	0.0	0.0	3.0	0.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMON FLICKER	19.0	3.2	4.2	10.6	2.6	4.1	4.8	2.2	5.7	0.0	0.0	0.0
YELLOW-BELLIED SAPSUCKER	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HAIRY WOODPECKER	9.5	1.6	3.1	3.0	0.7	2.0	0.0	0.0	0.0	2.8	0.2	1.1
DOWNY WOODPECKER	9.5	1.6	3.1	6.0	1.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN KINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
GREAT CRESTED FLYCATCHER	4.8	0.8	1.0	3.0	0.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN PHOEBE	2.4	0.4	1.0	3.0	0.7	1.0	2.4	1.1	2.9	0.0	0.0	0.0
WILLOW FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
LEAST FLYCATCHER	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN WOOD PEWEE	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUE JAY	23.8	4.0	5.2	21.1	5.2	4.1	0.0	0.0	0.0	5.6	0.5	2.2
COMMON CROW	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-CAPPED CHICKADEE	57.1	9.7	6.3	67.9	16.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0
TUFTED TITMOUSE	9.5	1.6	3.1	22.6	5.6	6.1	0.0	0.0	0.0	2.8	0.2	1.1
WHITE-BREASTED NUTHATCH	19.0	3.2	3.1	3.0	0.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0
RED-BREASTED NUTHATCH	19.0	3.2	3.1	3.0	0.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0
BROWN CREEPER	4.8	0.8	2.1	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
HOUSE WREN	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
LONG-BILLED MARSH WREN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.2	1.1
GRAY CATBIRD	4.8	0.8	2.1	9.0	2.2	1.0	0.0	0.0	0.0	19.6	1.7	3.3
AMERICAN ROBIN	2.4	0.4	1.0	7.5	1.9	3.1	19.2	9.0	8.6	64.3	5.5	6.6
WOOD THRUSH	33.3	5.7	3.1	18.1	4.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0
HERMIT THRUSH	28.6	4.9	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SWAINSON'S THRUSH	4.8	0.8	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEERY	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
BLUE-GRAY GNATCATCHER	0.0	0.0	0.0	4.5	1.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0
GOLDEN-CROWNED KINGLET	11.9	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RUBY-CROWNED KINGLET	16.7	2.8	3.1	4.5	1.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0
CEDAR WAXWING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	1.2	1.1
STARLING	0.0	0.0	0.0	0.0	0.0	0.0	14.4	6.7	8.6	0.0	0.0	0.0
SOLITARY VIREO	4.8	0.8	2.1	3.0	0.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0
RED-EYED VIREO	4.8	0.8	1.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
WARBLING VIREO	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-AND-WHITE WARBLER	4.8	0.8	1.0	7.5	1.9	3.1	0.0	0.0	0.0	0.0	0.0	0.0
WORM-EATING WARBLER	0.0	0.0	0.0	6.0	1.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0
GOLDEN-WINGED WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	4.8	2.2	2.9	0.0	0.0	0.0
BLUE-WINGED WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.1	2.9	0.0	0.0	0.0
YELLOW WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8	2.6	4.4
MAGNOLIA WARBLER	7.1	1.2	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-THROATED BLUE WARBLER	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW-RUMPED WARBLER	14.3	2.4	3.1	10.6	2.6	2.0	0.0	0.0	0.0	5.6	0.5	1.1
BLACK-THROATED GREEN WARBLER	7.1	1.2	2.1	9.0	2.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACKBURNIAN WARBLER	4.8	0.8	2.1	4.5	1.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0
CHESTNUT-SIDED WARBLER	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACKPOLL WARBLER	2.4	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINE WARBLER	4.8	0.8	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRAIRIE WARBLER	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
OVENBIRD	21.4	3.6	2.1	15.1	3.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWTHROAT	0.0	0.0	0.0	12.1	3.0	1.0	19.2	9.0	8.6	16.8	1.4	2.2
WILSON'S WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.5	1.1
CANADA WARBLER	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN REDSTART	4.8	0.8	1.0	6.0	1.5	1.0	0.0	0.0	0.0	5.6	0.5	1.1
EASTERN MEADOWLARK	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.1	2.9	0.0	0.0	0.0
REDWINGED BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	7.2	3.4	8.6	371.9	31.7	6.6
ORCHARD ORIOLE	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.1	2.9	0.0	0.0	0.0
NORTHERN ORIOLE	4.8	0.8	1.0	7.5	1.9	2.0	0.0	0.0	0.0	2.8	0.2	1.1
RUSTY BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	1.4	1.1
COMMON GRACKLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	86.7	7.4	5.5
BROWN-HEADED COWBIRD	21.4	3.6	3.1	22.6	5.6	4.1	0.0	0.0	0.0	2.8	0.2	1.1
SCARLET TANAGER	14.3	2.4	3.1	7.5	1.9	2.0	0.0	0.0	0.0	0.0	0.0	0.0
NORTHERN CARDINAL	0.0	0.0	0.0	10.6	2.6	3.1	0.0	0.0	0.0	16.8	1.4	4.4
ROSE-BREASTED GROSBEAK	9.5	1.6	2.1	7.5	1.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0
EVENING GROSBEAK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.5	1.1
PURPLE FINCH	28.6	4.9	3.1	4.5	1.1	2.0	0.0	0.0	0.0	58.7	5.0	3.3
PINE GROSBEAK	83.3	14.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN GOLDFINCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.5	2.2
RUFOUS-SIDED TOWHEE	11.9	2.0	2.1	18.1	4.5	5.1	0.0	0.0	0.0	0.0	0.0	0.0
DARK-EYED JUNCO	28.6	4.9	2.1	13.6	3.4	2.0	0.0	0.0	0.0	0.0	0.0	0.0
CHIPPING SPARROW	0.0	0.0	0.0	1.5	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0
FIELD SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	69.7	32.6	17.1	11.2	1.0	1.1
WHITE-THROATED SPARROW	0.0	0.0	0.0	9.0	2.2	2.0	0.0	0.0	0.0	5.6	0.5	2.2
FOX SPARROW	0.0	0.0	0.0	12.1	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
SWAMP SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	12.0	5.6	2.9	50.3	4.3	5.5
SONG SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	40.9	19.1	17.1	125.8	10.7	6.6

Table G-4. Mean density (no./km^2), relative density (%), and relative frequency (%) of birds observed in Council Cup Forest, TR419 Forest, Switchyard Field, and US 11 Marsh during the summer bird census, 15 May through July 1978.

	CC FOREST			TR419 FOREST			SWITCHYARD FIELD			US 11 MARSH		
SPECIES	MD	RD	RF	MD	RD	RF	MD	RD	RF	MD	RD	RF
EASTERN GREEN HERON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.7	1.8
AMERICAN BITTERN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.7	3.6
MALLARD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.5	6.5	3.6
WOOD DUCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.5	4.7	1.8
RUFFED GROUSE	6.7	1.0	2.3	1.8	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN WOODCOCK	0.0	0.0	0.0	9.0	1.5	0.9	0.0	0.0	0.0	0.0	0.0	0.0
MOURNING DOVE	3.3	0.5	1.2	3.6	0.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW-BILLED CUCKOO	3.3	0.5	1.2	1.8	0.3	0.9	4.8	0.8	2.4	0.0	0.0	0.0
BLACK-BILLED CUCKOO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.4	1.8
COMMON FLICKER	0.0	0.0	0.0	7.2	1.2	2.6	0.0	0.0	0.0	0.0	0.0	0.0
HAIRY WOODPECKER	6.7	1.0	2.3	7.2	1.2	1.7	0.0	0.0	0.0	0.0	0.0	0.0
DOWNY WOODPECKER	3.3	0.5	1.2	3.6	0.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN KINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	24.0	4.1	7.3	8.4	0.7	1.8
GREAT CRESTED FLYCATCHER	46.7	7.3	5.8	7.2	1.2	2.6	0.0	0.0	0.0	0.0	0.0	0.0
WILLOW FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.7	5.0	7.1
LEAST FLYCATCHER	0.0	0.0	0.0	1.8	0.3	0.9	0.0	0.0	0.0	4.2	0.4	1.8
EASTERN WOOD PEWEE	20.0	3.1	5.8	18.1	2.9	3.4	0.0	0.0	0.0	0.0	0.0	0.0
BLUE JAY	30.0	4.7	4.7	29.0	4.7	4.3	0.0	0.0	0.0	4.2	0.4	1.8
BLACK-CAPPED CHICKADEE	13.3	2.1	2.3	25.3	4.1	4.3	0.0	0.0	0.0	0.0	0.0	0.0
TUFTED TITMOUSE	13.3	2.1	3.5	16.3	2.6	4.3	0.0	0.0	0.0	0.0	0.0	0.0
WHITE-BREASTED NUTHATCH	10.0	1.6	2.3	1.8	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
RED-BREASTED NUTHATCH	6.7	1.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HOUSE WREN	0.0	0.0	0.0	7.2	1.2	1.7	4.8	0.8	2.4	0.0	0.0	0.0
GRAY CATBIRD	0.0	0.0	0.0	23.5	3.8	3.4	24.0	4.1	4.9	29.4	2.5	5.4
BROWN THRASHER	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.8	2.4	0.0	0.0	0.0
AMERICAN ROBIN	10.0	1.6	3.5	10.9	1.7	2.6	0.0	0.0	0.0	58.7	5.0	7.1
WOOD THRUSH	33.3	5.2	4.7	63.3	10.2	4.3	0.0	0.0	0.0	0.0	0.0	0.0
SWAINSON'S THRUSH	3.3	0.5	1.2	19.9	3.2	0.9	0.0	0.0	0.0	0.0	0.0	0.0
GRAY-CHEEKED THRUSH	6.7	1.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VEERY	6.7	1.0	1.2	3.6	0.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0
BLUE-GRAY GNATCATCHER	0.0	0.0	0.0	3.6	0.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0
RUBY-CROWNED KINGLET	3.3	0.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CEDAR WAXWING	43.3	6.8	3.5	3.6	0.6	0.9	0.0	0.0	0.0	29.4	2.5	1.8
STARLING	0.0	0.0	0.0	0.0	0.0	0.0	52.9	9.1	9.8	0.0	0.0	0.0
RED-EYED VIREO	50.0	7.9	5.8	25.3	4.1	3.4	4.8	0.8	2.4	0.0	0.0	0.0
BLACK-AND-WHITE WARBLER	30.0	4.7	5.8	25.3	4.1	3.4	0.0	0.0	0.0	0.0	0.0	0.0
WORM-EATING WARBLER	0.0	0.0	0.0	3.6	0.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0
GOLDEN-WINGED WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	9.6	1.7	4.9	0.0	0.0	0.0
TENNESSEE WARBLER	6.7	1.0	1.2	43.4	7.0	1.7	4.8	0.8	2.4	0.0	0.0	0.0
YELLOW WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	24.0	4.1	7.3	71.3	6.1	7.1
MAGNOLIA WARBLER	3.3	0.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-THROATED BLUE WARBLER	16.7	2.6	1.2	3.6	0.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW-RUMPED WARBLER	33.3	5.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-THROATED GREEN WARBLER	10.0	1.6	1.2	1.8	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
BLACKBURNIAN WARBLER	13.3	2.1	1.2	1.8	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
CHESTNUT-SIDED WARBLER	0.0	0.0	0.0	5.4	0.9	1.7	0.0	0.0	0.0	0.0	0.0	0.0
BAY-BREASTED WARBLER	16.7	2.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACKPOLL WARBLER	0.0	0.0	0.0	9.0	1.5	0.9	0.0	0.0	0.0	4.2	0.4	1.8
PINE WARBLER	3.3	0.5	1.2	1.8	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0
OVENBIRD	50.0	7.9	5.8	18.1	2.9	4.3	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWTHROAT	0.0	0.0	0.0	5.4	0.9	1.7	86.5	14.9	9.8	54.5	4.7	7.1
YELLOW-BREASTED CHAT	0.0	0.0	0.0	0.0	0.0	0.0	38.5	6.6	9.8	0.0	0.0	0.0
AMERICAN REDSTART	16.7	2.6	2.3	27.1	4.4	4.3	0.0	0.0	0.0	0.0	0.0	0.0
REDWINGED BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	440.4	37.6	7.1
NORTHERN ORIOLE	3.3	0.5	1.2	7.2	1.2	2.6	9.6	1.7	2.4	4.2	0.4	1.8
COMMON GRACKLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	1.4	5.4
BROWN-HEADED COWBIRD	16.7	2.6	3.5	38.0	6.1	4.3	0.0	0.0	0.0	0.0	0.0	0.0
SCARLET TANAGER	56.7	8.9	5.8	34.4	5.5	4.3	0.0	0.0	0.0	0.0	0.0	0.0
NORTHERN CARDINAL	0.0	0.0	0.0	21.7	3.5	4.3	0.0	0.0	0.0	16.8	1.4	3.6
ROSE-BREASTED GROSBEAK	20.0	3.1	5.8	27.1	4.4	4.3	0.0	0.0	0.0	4.2	0.4	1.8
INDIGO BUNTING	6.7	1.0	1.2	7.2	1.2	2.6	43.3	7.4	7.3	4.2	0.4	1.8
PURPLE FINCH	0.0	0.0	0.0	16.3	2.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN GOLDFINCH	0.0	0.0	0.0	1.8	0.3	0.9	4.8	0.8	2.4	50.3	4.3	5.4
RUFOUS-SIDED TOWHEE	13.3	2.1	3.5	19.9	3.2	3.4	0.0	0.0	0.0	0.0	0.0	0.0
CHIPPING SPARROW	0.0	0.0	0.0	1.8	0.3	0.9	0.0	0.0	0.0	4.2	0.4	1.8
FIELD SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	173.1	29.8	9.8	12.6	1.1	3.6
SWAMP SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.6	2.9	5.4
SONG SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	57.7	9.9	9.8	109.1	9.3	7.1

Table G-5. Mean density (no./km^2), relative density (%), and relative frequency (%) of birds observed in Council Cup Forest, TR419 Forest, Switchyard Field, and US 11 Marsh during the fall migration bird census, 15 August through November 1978.

SPECIES	CC FOREST			TR419 FOREST			SWITCHYARD FIELD			US 11 MARSH		
	MD	RD	RF	MD	RD	RF	MD	RD	RF	MD	RD	RF
GREAT BLUE HERON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
EASTERN GREEN HERON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
MALLARD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.6	2.3
GREEN-WINGED TEAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
BLUE-WINGED TEAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.6	1.2
RED-TAILED HAWK	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
BROAD-WINGED HAWK	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN KESTREL	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.4	2.4	0.0	0.0	0.0
RUFFED GROUSE	26.2	4.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COMMON SNIPE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.8	2.3
MOURNING DOVE	0.0	0.0	0.0	0.0	0.0	0.0	11.0	1.5	2.4	0.0	0.0	0.0
RUBY-THROATED HUMMINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
COMMON FLICKER	11.9	1.8	3.4	6.5	0.9	2.2	5.5	0.7	4.8	0.0	0.0	0.0
YELLOW-BELLIED SAPSUCKER	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
HAIRY WOODPECKER	4.8	0.7	2.3	6.5	0.9	3.7	0.0	0.0	0.0	0.0	0.0	0.0
DOWNY WOODPECKER	31.0	4.8	6.9	9.0	1.3	3.7	0.0	0.0	0.0	2.4	0.2	1.2
EASTERN KINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.8	2.3
GREAT CRESTED FLYCATCHER	2.4	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN PHOEBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
WILLOW FLYCATCHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.4	1.3	2.3
EASTERN WOOD PEWEE	4.8	0.7	1.1	11.6	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0
OLIVE-SIDED FLYCATCHER	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
BLUE JAY	45.2	7.0	5.7	18.1	2.6	3.7	0.0	0.0	0.0	4.8	0.4	1.2
BLACK-CAPPED CHICKADEE	104.8	16.2	8.0	68.5	9.9	5.2	0.0	0.0	0.0	4.8	0.4	1.2
TUFTED TITMOUSE	14.3	2.2	2.3	14.2	2.1	3.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITE-BREASTED NUTHATCH	28.6	4.4	5.7	9.0	1.3	3.7	0.0	0.0	0.0	0.0	0.0	0.0
BROWN CREEPER	4.8	0.7	1.1	6.5	0.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0
HOUSE WREN	0.0	0.0	0.0	2.6	0.4	1.5	24.7	3.3	7.1	0.0	0.0	0.0
MOCKINGBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
GRAY CATBIRD	2.4	0.4	1.1	10.3	1.5	3.0	13.7	1.8	7.1	55.1	4.9	5.8
BROWN THRASHER	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN ROBIN	14.3	2.2	5.7	109.9	15.9	3.0	2.7	0.4	2.4	21.6	1.9	2.3
WOOD THRUSH	2.4	0.4	1.1	7.8	1.1	2.2	0.0	0.0	0.0	0.0	0.0	0.0
HERMIT THRUSH	0.0	0.0	0.0	3.9	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0
SWAINSON'S THRUSH	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
GRAY-CHEEKED THRUSH	0.0	0.0	0.0	2.6	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0
EASTERN BLUEBIRD	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.4	2.4	0.0	0.0	0.0
BLUE-GRAY GNATCATCHER	0.0	0.0	0.0	3.9	0.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0
GOLDEN-CROWNED KINGLET	26.2	4.0	3.4	28.4	4.1	2.2	0.0	0.0	0.0	0.0	0.0	0.0
RUBY-CROWNED KINGLET	11.9	1.8	2.3	7.8	1.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0
CEDAR WAXWING	7.1	1.1	1.1	32.3	4.7	0.7	11.0	1.5	2.4	50.3	4.4	3.5
STARLING	0.0	0.0	0.0	0.0	0.0	0.0	274.7	36.9	2.4	33.6	3.0	1.2
SOLITARY VIREO	0.0	0.0	0.0	2.6	0.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0
RED-EYED VIREO	14.3	2.2	2.3	6.5	0.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0
WARBLING VIREO	4.8	0.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-AND-WHITE WARBLER	2.4	0.4	1.1	9.0	1.3	2.2	0.0	0.0	0.0	0.0	0.0	0.0
WORM-EATING WARBLER	0.0	0.0	0.0	3.9	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0
TENNESSEE WARBLER	11.9	1.8	2.3	5.2	0.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0
NORTHERN PARULA	2.4	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAGNOLIA WARBLER	11.9	1.8	2.3	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
CAPE MAY WARBLER	0.0	0.0	0.0	9.0	1.3	2.2	0.0	0.0	0.0	0.0	0.0	0.0
BLACK-THROATED BLUE WARBLER	14.3	2.2	1.1	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW-RUMPED WARBLER	31.0	4.8	2.3	2.6	0.4	0.7	2.7	0.4	2.4	2.4	0.2	1.2
BLACK-THROATED GREEN WARBLER	21.4	3.3	3.4	9.0	1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0
BLACKBURNIAN WARBLER	0.0	0.0	0.0	3.9	0.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0
CHESTNUT-SIDED WARBLER	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
BAY-BREASTED WARBLER	14.3	2.2	1.1	15.5	2.3	2.2	0.0	0.0	0.0	0.0	0.0	0.0
BLACKPOLL WARBLER	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	4.8	0.4	1.2
PINE WARBLER	0.0	0.0	0.0	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
PALM WARBLER	7.1	1.1	2.3	1.3	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0
OVENBIRD	4.8	0.7	2.3	3.9	0.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0
NORTHERN WATERTHRUSH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
YELLOWTHROAT	0.0	0.0	0.0	0.0	0.0	0.0	96.2	12.9	9.5	28.8	2.5	3.5
YELLOW-BREASTED CHAT	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.4	2.4	0.0	0.0	0.0
WILSON'S WARBLER	2.4	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CANADA WARBLER	7.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN REDSTART	16.7	2.6	3.4	9.0	1.3	3.0	0.0	0.0	0.0	0.0	0.0	0.0
REDWINGED BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.8	12.7	3.5
NORTHERN ORIOLE	0.0	0.0	0.0	5.2	0.8	1.5	0.0	0.0	0.0	2.4	0.2	1.2
COMMON GRACKLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
BROWN-HEADED COWBIRD	0.0	0.0	0.0	2.6	0.4	0.7	0.0	0.0	0.0	24.0	2.1	1.2
SCARLET TANAGER	0.0	0.0	0.0	5.2	0.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0
NORTHERN CARDINAL	0.0	0.0	0.0	16.8	2.4	3.7	0.0	0.0	0.0	16.8	1.5	4.7
ROSE-BREASTED GROSBEAK	2.4	0.4	1.1	6.5	0.9	1.5	0.0	0.0	0.0	7.2	0.6	2.3
INDIGO BUNTING	0.0	0.0	0.0	6.5	0.9	2.2	0.0	0.0	0.0	4.8	0.4	1.2
PURPLE FINCH	2.4	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.4	2.3
HOUSE FINCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.6	1.2
PINE SISKIN	16.7	2.6	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AMERICAN GOLDFINCH	11.9	1.8	1.1	5.2	0.8	0.7	46.7	6.3	7.1	79.1	7.0	7.0
RUFOUS-SIDED TOWHEE	4.8	0.7	2.3	15.5	2.3	4.5	13.7	1.8	4.8	0.0	0.0	0.0
SAVANNAH SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.4	1.2
SHARP-TAILED SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2	1.2
DARK-EYED JUNCO	61.9	9.6	3.4	12.9	1.9	2.2	68.7	9.2	7.1	0.0	0.0	0.0
TREE SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.7	4.8	0.0	0.0	0.0
FIELD SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	71.4	9.6	7.1	2.4	0.2	1.2
WHITE-CROWNED SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.4	1.3	1.2
WHITE-THROATED SPARROW	2.4	0.4	1.1	118.9	17.3	1.5	5.5	0.7	2.4	47.9	4.2	4.7
LINCOLN'S SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.8	2.3
SWAMP SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.9	7.4	8.1
SONG SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	76.9	10.3	16.7	352.3	31.1	8.1

Table G-6. Number, density (no./km^2), and relative density (R.D.) of breeding bird territories observed in Council Cup and TR419 Forests, Switchyard Field, and US 11 Marsh during the breeding bird survey, May through June 1978.

Family/Species	CC Forest			TR419 Forest			Switchyard Field			US 11 Marsh		
Territories	No.	No./km^2	R.D.	No.	No./km^2	R.D.	No.	No./km^2	R.D.	No.	No./km^2	R.D.
Tetraonidae												
Ruffed grouse	1.0	16.5	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tyrannidae												
Great-crested flycatcher	2.0	33.0	6.2	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Willow flycatcher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	57.6	6.5
Eastern wood pewee	2.0	33.0	6.2	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Corvidae												
Blue jay	2.0	33.0	6.2	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Paridae												
Black-capped chickadee	1.0	16.5	3.1	3.0	27.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Tufted titmouse	1.0	16.5	3.1	2.0	18.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Sittidae												
White-breasted nuthatch	0.0	0.0	0.0	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Red-breasted nuthatch	1.0	16.5	3.1	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Mimidae												
Gray catbird	0.0	0.0	0.0	2.0	18.0	4.6	1.5	25.2	7.3	2.0	38.4	4.4
Turdidae												
American robin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	38.4	4.4
Wood thrush	4.0	66.0	12.5	7.0	63.0	16.3	0.0	0.0	0.0	0.0	0.0	0.0
Vireonidae												
Red-eyed vireo	4.0	66.0	12.5	3.0	27.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Parulidae												
Black and white warbler	2.0	33.0	6.2	2.0	18.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Yellow warbler	0.0	0.0	0.0	0.0	0.0	0.0	1.5	25.2	7.3	4.0	76.8	8.7
Ovenbird	6.0	99.0	18.8	3.0	27.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellowthroat	0.0	0.0	0.0	0.0	0.0	0.0	3.0	50.4	14.6	3.0	57.6	6.6
Yellow-breasted chat	0.0	0.0	0.0	0.0	0.0	0.0	1.0	16.8	4.9	0.0	0.0	0.0
Golden-winged warbler	0.0	0.0	0.0	0.0	0.0	0.0	0.5	8.4	2.4	0.0	0.0	0.0
American redstart	0.0	0.0	0.0	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Icteridae												
Northern oriole	0.0	0.0	0.0	1.0	9.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Red-winged blackbird	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	422.4	48.4
Brown-headed cowbird	2.0	33.0	6.2	4.0	36.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0
Thraupidae												
Scarlet tanager	3.0	49.5	9.4	4.0	36.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0
Fringillidae												
Northern cardinal	0.0	0.0	0.0	2.0	18.0	4.6	0.0	0.0	0.0	2.0	38.4	4.4
Rose-breasted grosbeak	1.0	16.5	3.1	2.0	18.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Indigo bunting	0.0	0.0	0.0	0.0	0.0	0.0	1.0	16.8	4.9	0.5	9.6	1.1
American goldfinch	0.0	0.0	0.0	0.0	0.0	0.0	4.0	67.2	19.5	5.0	96.0	10.9
Rufous-sided towhee	0.0	0.0	0.0	2.0	18.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Swamp sparrow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	38.4	4.4
Field sparrow	0.0	0.0	0.0	0.0	0.0	0.0	7.5	126.0	36.6	0.0	0.0	0.0
Song sparrow	0.0	0.0	0.0	0.0	0.0	0.0	0.5	8.4	2.4	0.0	0.0	0.0
Totals	32.0	528.0	99.7	43.0	387.0	99.6	20.5	344.4	100.0	45.5	873.6	99.9

Table G-7. Number of birds observed during nine censuses on the Susquehanna River, 28 February through 22 May 1978.

SPECIES	28 FEB	15 MAR	22 MAR	29 MAR	5 APR	12 APR	21 APR	27 APR	22 MAY	MEAN	% TOTAL
HORNED GREBE	0	0	2	0	3	0	0	0	0	0.6	0.3
PIED-BILLED GREBE	0	1	0	0	0	0	0	0	0	0.1	0.1
DOUBLE-CRESTED CORMORANT	0	0	0	0	0	0	0	0	1	0.1	0.1
GREAT BLUE HERON	0	0	1	5	3	0	4	0	2	1.7	0.9
EASTERN GREEN HERON	0	0	0	0	0	0	0	0	1	0.1	0.1
BLACK-CROWNED NIGHT HERON	0	0	0	0	2	0	2	0	0	0.4	0.2
CANADA GOOSE	0	0	79	200	3	75	15	14	2	43.1	23.5
DUCK SP.	0	12	0	16	33	32	10	3	0	11.8	6.4
MALLARD	4	2	10	42	66	44	17	16	9	23.3	12.7
BLACK DUCK	0	13	8	15	30	24	10	1	1	11.3	6.2
PINTAIL	0	0	0	3	0	0	0	0	0	0.3	0.2
GREEN-WINGED TEAL	0	0	0	0	2	2	0	0	0	0.4	0.2
BLUE-WINGED TEAL	0	7	0	4	16	10	24	2	0	7.0	3.8
AMERICAN WIDGEON	0	0	0	0	0	3	0	0	0	0.3	0.2
WOOD DUCK	0	14	46	45	28	26	26	6	2	21.4	11.7
RING-NECKED DUCK	0	10	0	40	50	10	0	0	0	12.2	6.7
CANVASBACK	0	0	0	0	11	2	0	0	0	1.4	0.8
GREATER SCAUP	0	0	0	0	40	0	0	0	0	4.4	2.4
LESSER SCAUP	0	0	2	0	0	0	0	0	0	0.2	0.1
COMMON GOLDENEYE	2	4	0	0	0	0	0	0	0	0.7	0.4
BUFFLEHEAD	1	0	0	5	3	0	1	0	0	1.1	0.6
OLDSQUAW	0	0	0	2	2	0	0	0	0	0.4	0.2
WHITE-WINGED SCOTER	0	0	0	0	3	0	0	0	0	0.3	0.2
HOODED MERGANSER	0	10	20	14	20	0	0	2	0	7.3	4.0
COMMON MERGANSER	75	33	9	3	2	0	0	0	0	13.6	7.4
RED-BREASTED MERGANSER	0	0	0	0	4	7	5	0	0	1.8	1.0
OSPREY	0	0	0	0	0	3	10	9	0	2.4	1.3
KILLDEER	0	0	1	0	0	0	0	0	0	0.1	0.1
SPOTTED SANDPIPER	0	0	0	0	0	1	0	1	11	1.4	0.8
GREATER YELLOWLEGS	0	0	0	0	0	0	4	0	0	0.4	0.2
LESSER YELLOWLEGS	0	0	0	0	0	0	3	0	0	0.3	0.2
HERRING GULL	0	1	3	0	0	1	1	0	0	0.7	0.4
RING-BILLED GULL	0	11	28	20	0	0	1	1	0	6.8	3.7
BONAPARTE'S GULL	0	0	0	4	32	0	0	0	0	4.0	2.2
BELTED KINGFISHER	1	0	1	0	0	3	3	1	2	1.2	0.7
TOTAL	83	118	210	418	353	243	136	56	31	183.1	

Table G-8. Combined weekly bird impaction totals from the Meteorological Tower and Unit 1 Cooling Tower, 1 September through 31 October 1978.

Species	September				October				Total
	1-9	11-15	18-22	25-29	2-6	8-13	16-20	23-27	
Sylviidae									
Ruby-crowned kinglet	0	0	0	1	1	0	0	0	2
Vireonidae									
Red-eyed vireo	4	4	0	3	4	0	1	0	16
Vireo spp.	0	1	0	0	0	0	0	0	1
Parulidae									
Black and white warbler	0	1	0	0	0	0	0	0	1
Tennessee warbler	1	3	0	0	0	0	0	0	4
Northern parula	0	1	0	1	0	0	0	0	2
Magnolia warbler	1	5	0	0	0	1	0	0	7
Black-throated green warbler	0	3	0	3	2	0	0	0	8
Black-throated blue warbler	1	0	0	0	0	0	0	0	1
Blackburnian warbler	1	3	0	0	1	0	0	0	5
Bay-breasted warbler	0	8	0	1	1	0	0	0	10
Blackpoll warbler	0	0	0	0	2	0	0	0	2
Pine warbler	2	0	0	0	1	0	0	0	3
Prairie warbler	0	0	0	2[a]	0	0	0	0	2
Ovenbird	2	4	0	0	0	0	0	0	6
Common yellowthroat	0	7	0	1	0	1	0	0	9
Connecticut warbler	0	1	0	0	0	0	0	0	1
Fringillidae									
Rose-breasted grosbeak	0	1[a]	0	1	0	0	0	0	2
Total	12	42	0	13	12	2	1	0	82

[a]One bird observed at the meterological tower.

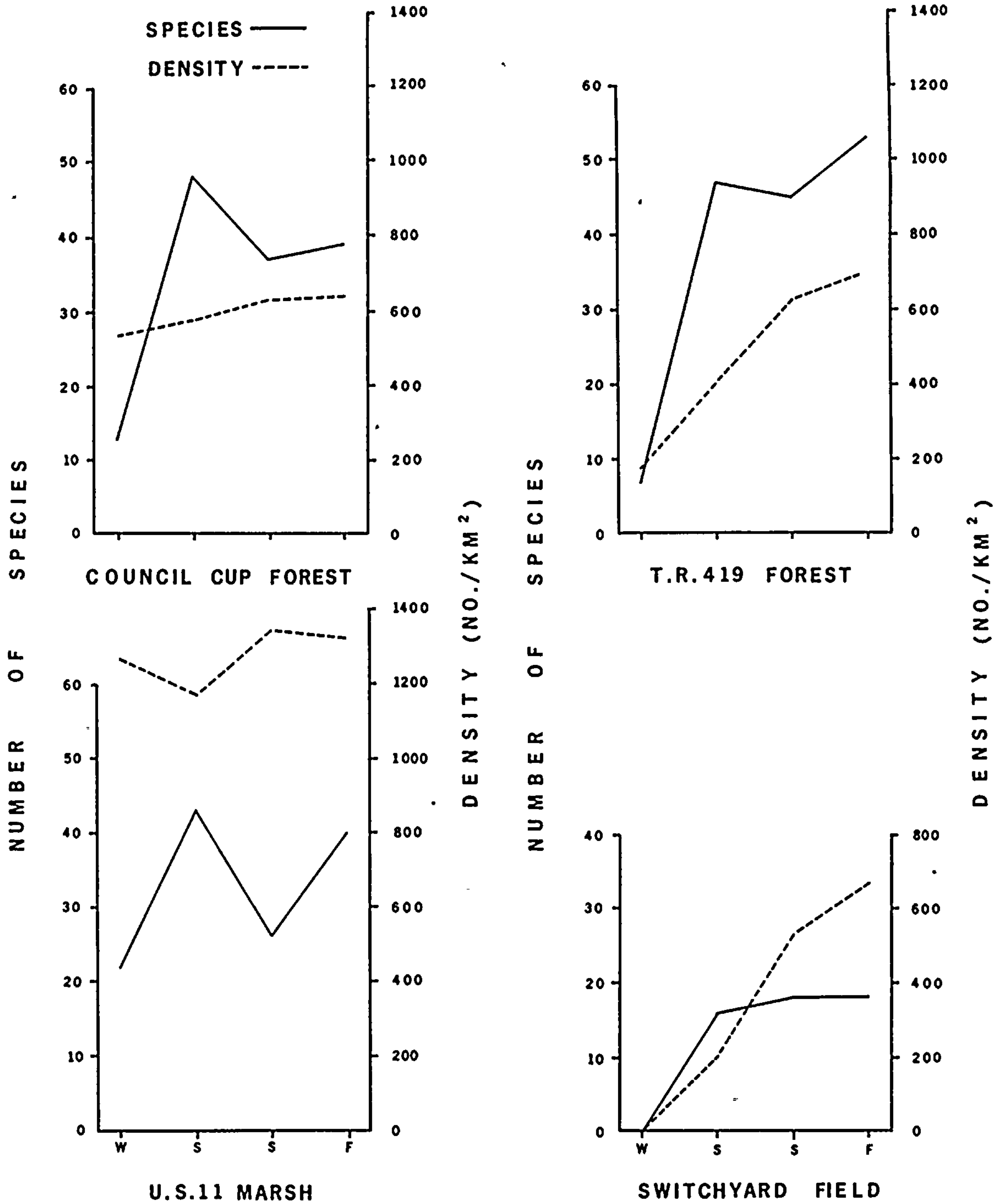

Fig. G-1. Number of species and community density (no./km^2) for four seasonal censuses in Council Cup Forest, TR419 Forest, US 11 Marsh, and Switchyard Field, 1978.

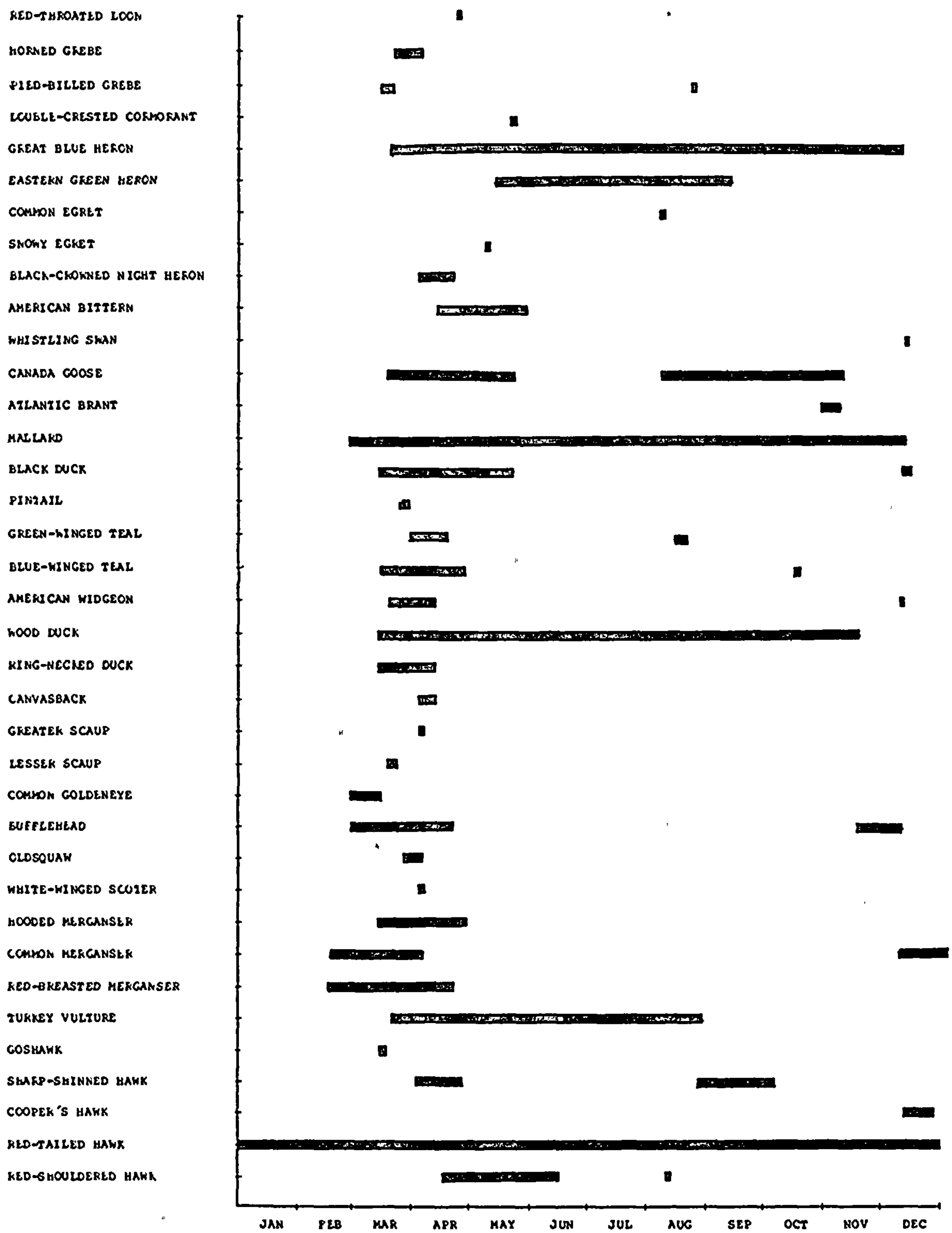

Fig. G-2. Phenological occurrence of birds observed near the Susquehanna SES, 1978.

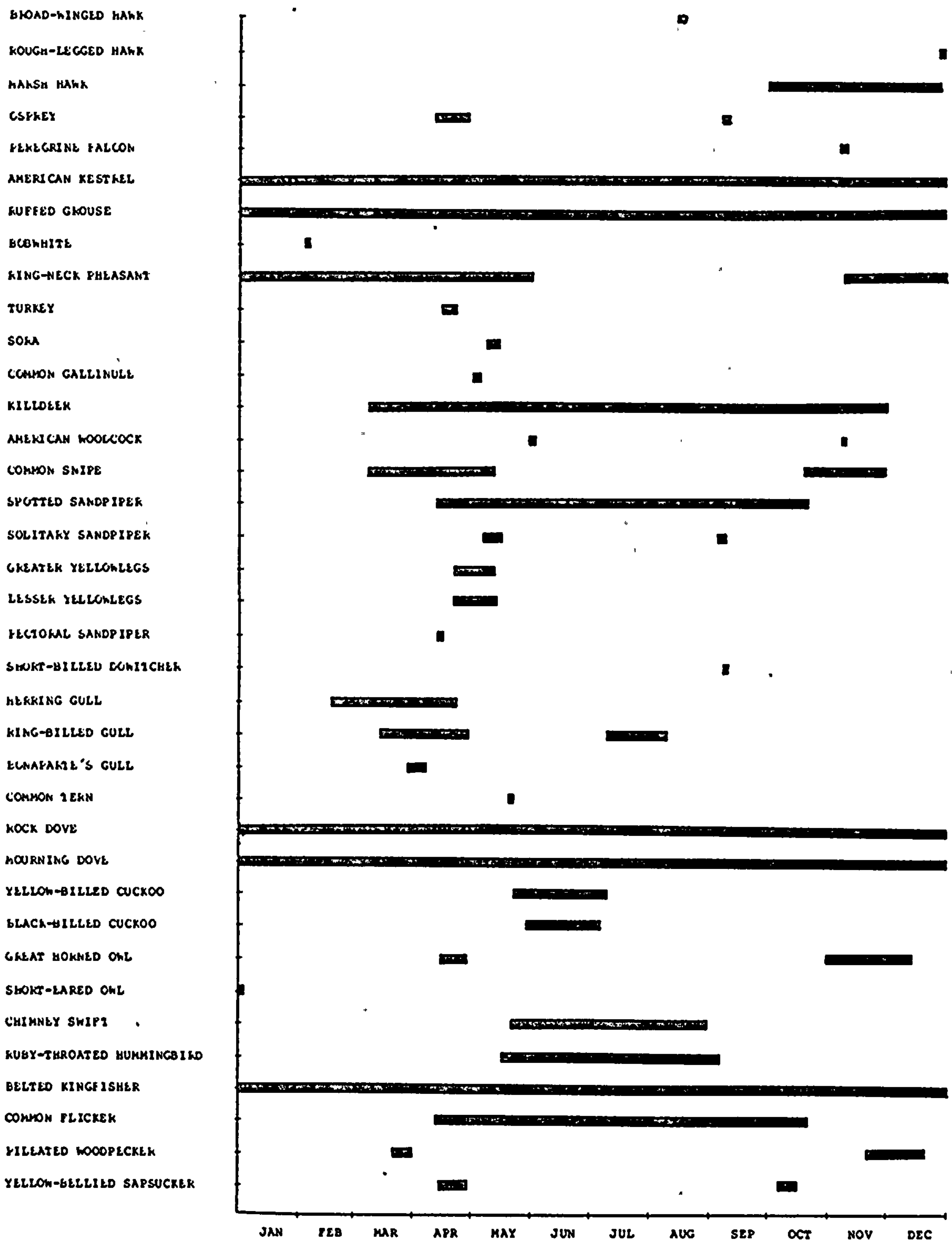
BROAD-WINGED HAWK
ROUGH-LEGGED HAWK
MARSH HAWK
OSPREY
PEREGRINE FALCON
AMERICAN KESTREL
RUFFED GROUSE
BOBWHITE
RING-NECK PHEASANT
TURKEY
SORA
COMMON GALLINULE
KILLDEER
AMERICAN WOODCOCK
COMMON SNIPE
SPOTTED SANDPIPER
SOLITARY SANDPIPER
GREATER YELLOWLEGS
LESSER YELLOWLEGS
PECTORAL SANDPIPER
SHORT-BILLED DOWITCHER
HERRING GULL
RING-BILLED GULL
BONAPARTE'S GULL
COMMON TERN
ROCK DOVE
MOURNING DOVE
YELLOW-BILLED CUCKOO
BLACK-BILLED CUCKOO
GREAT HORNED OWL
SHORT-EARED OWL
CHIMNEY SWIFT
RUBY-THROATED HUMMINGBIRD
BELTED KINGFISHER
COMMON FLICKER
PILEATED WOODPECKER
YELLOW-BELLIED SAPSUCKER
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. G-2 (cont.)

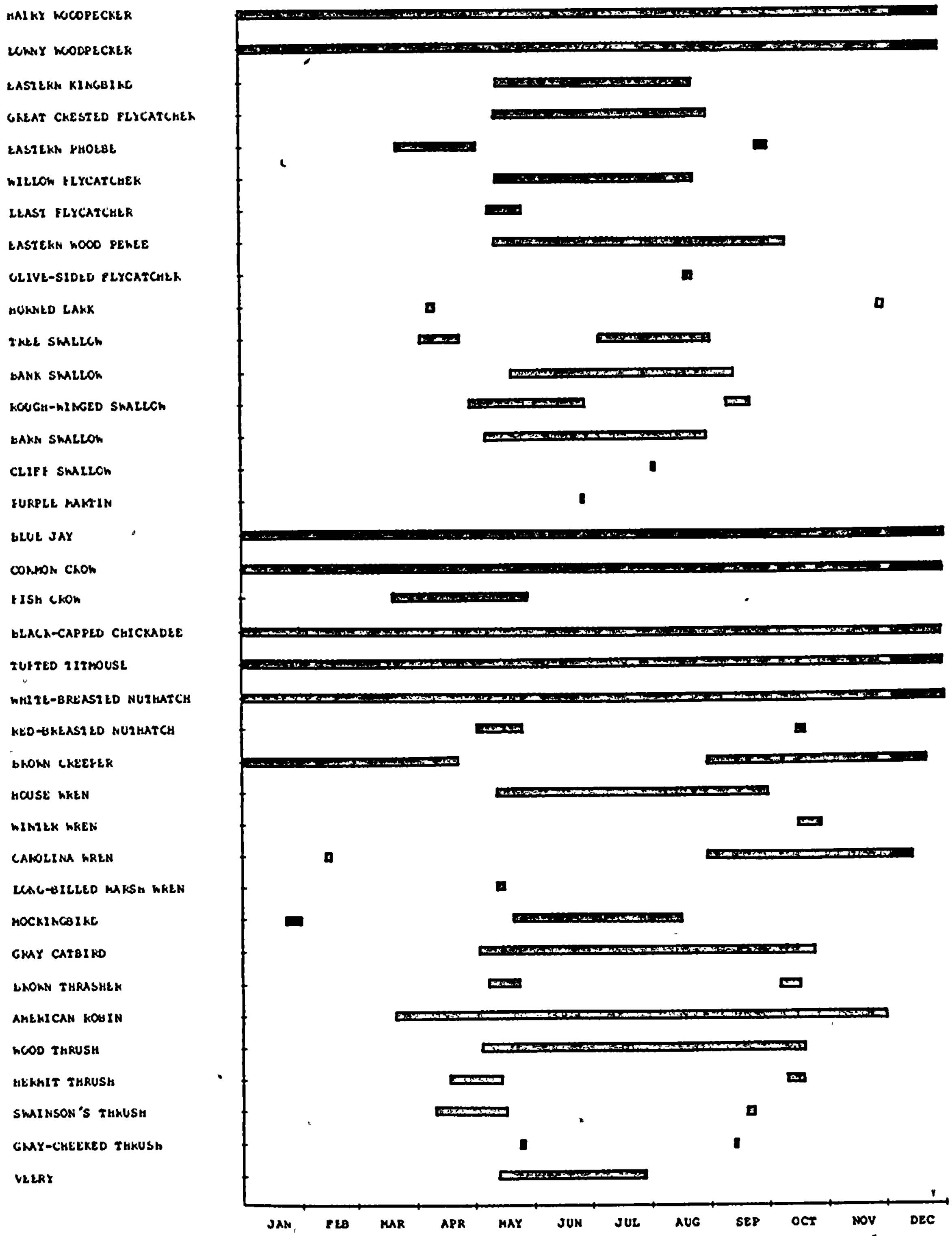
HAIRY WOODPECKER
DOWNY WOODPECKER
EASTERN KINGBIRD
GREAT CRESTED FLYCATCHER
EASTERN PHOEBE
WILLOW FLYCATCHER
LEAST FLYCATCHER
EASTERN WOOD PEWEE
OLIVE-SIDED FLYCATCHER
HORNED LARK
TREE SWALLOW
BANK SWALLOW
ROUGH-WINGED SWALLOW
BARN SWALLOW
CLIFF SWALLOW
PURPLE MARTIN
BLUE JAY
COMMON CROW
FISH CROW
BLACK-CAPPED CHICKADEE
TUFTED TITMOUSE
WHITE-BREASTED NUTHATCH
RED-BREASTED NUTHATCH
BROWN CREEPER
HOUSE WREN
WINTER WREN
CAROLINA WREN
LONG-BILLED MARSH WREN
MOCKINGBIRD
GRAY CATBIRD
BROWN THRASHER
AMERICAN ROBIN
WOOD THRUSH
HERMIT THRUSH
SWAINSON'S THRUSH
GRAY-CHEEKED THRUSH
VEERY
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. G-2 (cont.)

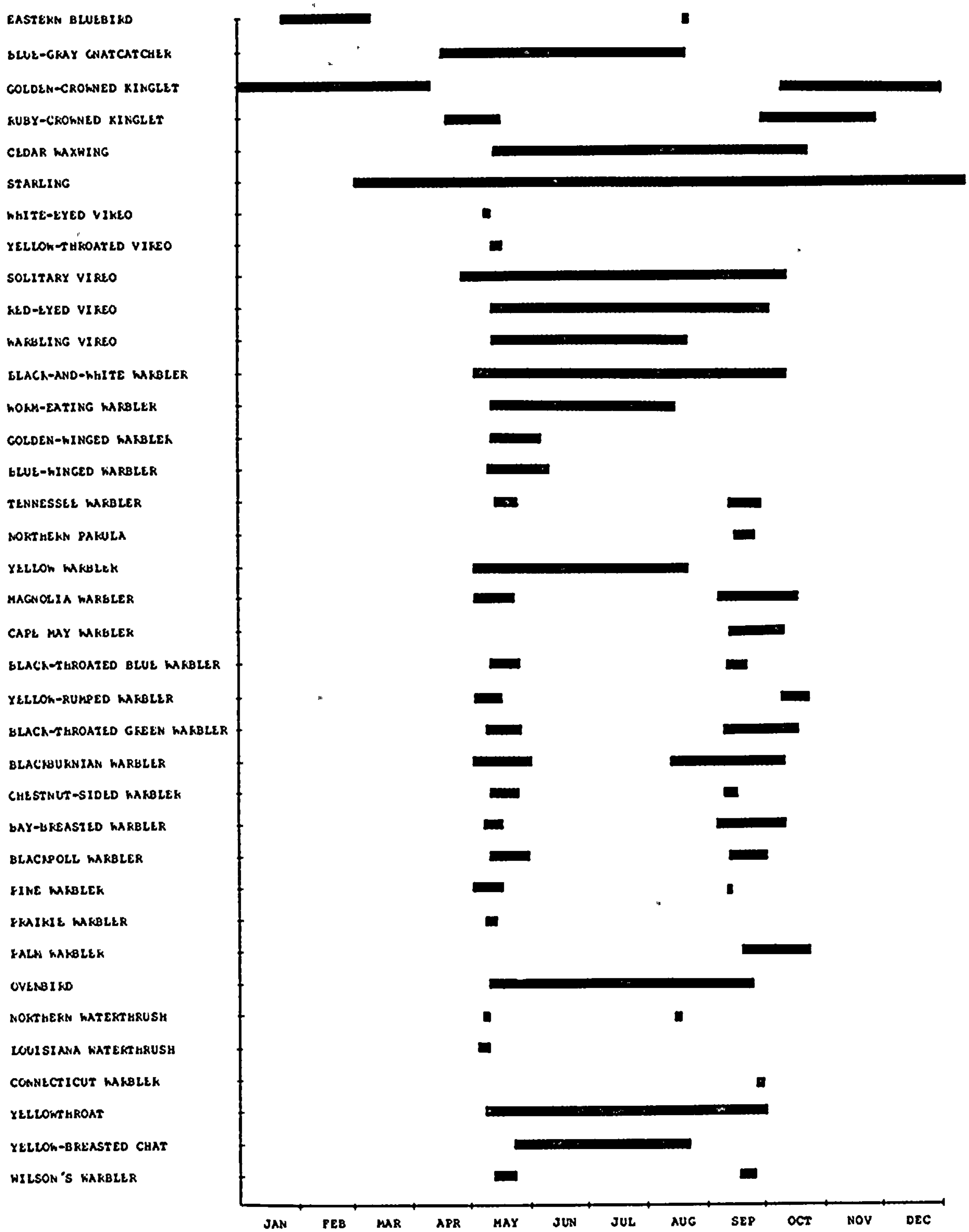
EASTERN BLUEBIRD
BLUE-GRAY GNATCATCHER
GOLDEN-CROWNED KINGLET
RUBY-CROWNED KINGLET
CEDAR WAXWING
STARLING
WHITE-EYED VIREO
YELLOW-THROATED VIREO
SOLITARY VIREO
RED-EYED VIREO
WARBLING VIREO
BLACK-AND-WHITE WARBLER
WORM-EATING WARBLER
GOLDEN-WINGED WARBLER
BLUE-WINGED WARBLER
TENNESSEE WARBLER
NORTHERN PARULA
YELLOW WARBLER
MAGNOLIA WARBLER
CAPE MAY WARBLER
BLACK-THROATED BLUE WARBLER
YELLOW-RUMPED WARBLER
BLACK-THROATED GREEN WARBLER
BLACKBURNIAN WARBLER
CHESTNUT-SIDED WARBLER
BAY-BREASTED WARBLER
BLACKPOLL WARBLER
PINE WARBLER
PRAIRIE WARBLER
PALM WARBLER
OVENBIRD
NORTHERN WATERTHRUSH
LOUISIANA WATERTHRUSH
CONNECTICUT WARBLER
YELLOWTHROAT
YELLOW-BREASTED CHAT
WILSON'S WARBLER
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Fig. G-2 (cont.)

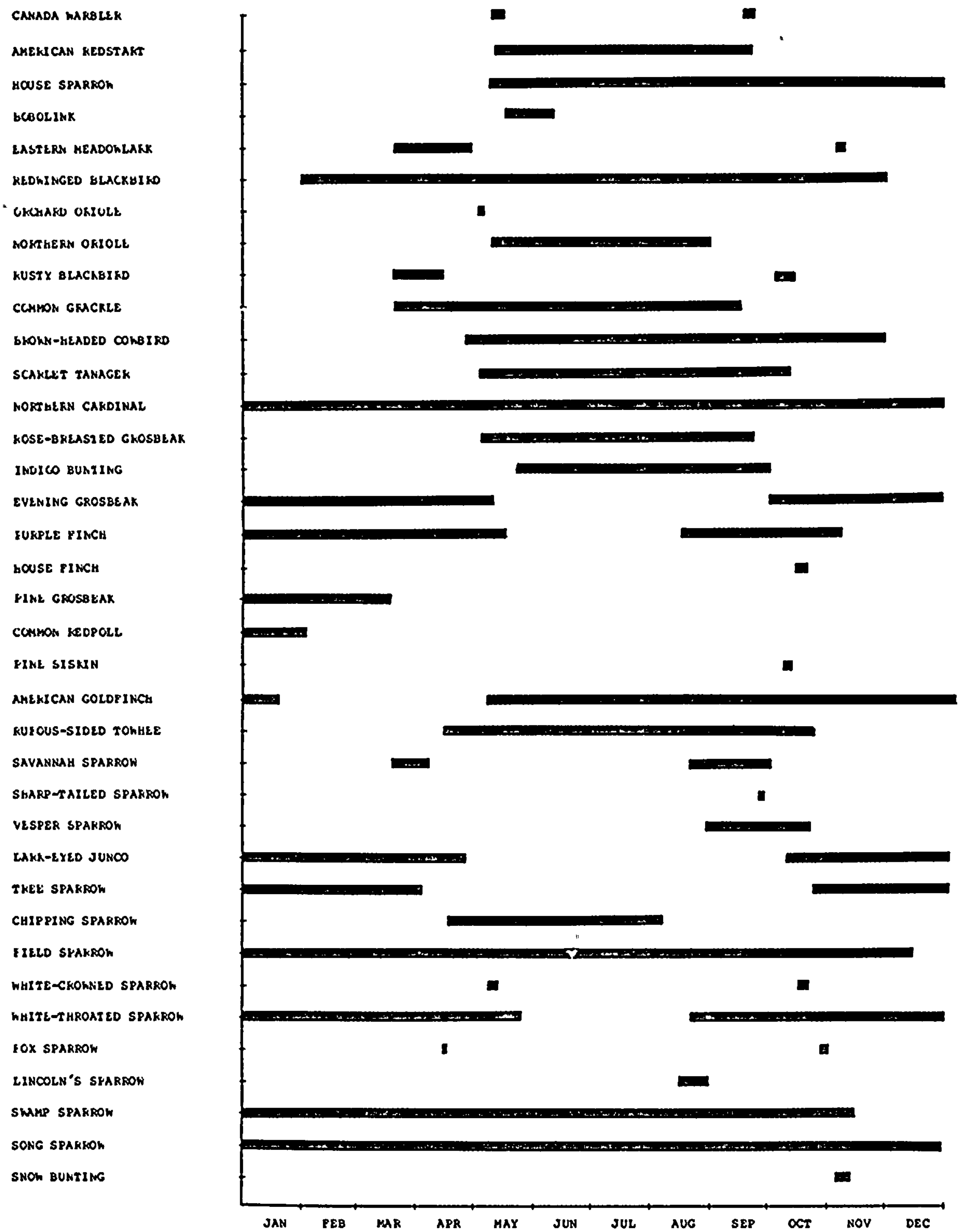
CANADA WARBLER
AMERICAN REDSTART
HOUSE SPARROW
BOBOLINK
EASTERN MEADOWLARK
REDWINGED BLACKBIRD
ORCHARD ORIOLE
NORTHERN ORIOLE
RUSTY BLACKBIRD
COMMON GRACKLE
BROWN-HEADED COWBIRD
SCARLET TANAGER
NORTHERN CARDINAL
ROSE-BREASTED GROSBEAK
INDIGO BUNTING
EVENING GROSBEAK
PURPLE FINCH
HOUSE FINCH
PINE GROSBEAK
COMMON REDPOLL
PINE SISKIN
AMERICAN GOLDFINCH
RUFOUS-SIDED TOWHEE
SAVANNAH SPARROW
SHARP-TAILED SPARROW
VESPER SPARROW
DARK-EYED JUNCO
TREE SPARROW
CHIPPING SPARROW
FIELD SPARROW
WHITE-CROWNED SPARROW
WHITE-THROATED SPARROW
FOX SPARROW
LINCOLN'S SPARROW
SWAMP SPARROW
SONG SPARROW
SNOW BUNTING
JAN
FEB
MAR
APR
MAY
JUN
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Fig. G-2 (cont.)

ACKNOWLEDGMENTS

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ABSTRACTS OF SCIENTIFIC PUBLICATIONS BY THE STAFF OF THE SUSQUEHANNA SES BIOLOGICAL LABORATORY, 1978

Buynak, G. L. and A. J. Gurzynski. 1978. Lymphocystis disease in walleye *(Stizostedion vitreum)* captured in the Susquehanna River. Proc. Pa. Acad. Sci. 52(1): 49-50.

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

Buynak, G. L. and A. J. Gurzynski. 1978. Age and growth of smallmouth bass *(Micropterus dolomieui)* in a large river polluted by acid mine drainages. Proc. Pa. Acad. Sci. 52(2): 176-178.

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

Buynak, G. L. and H. W. Mohr, Jr. 1978. Micro-projector for drawing larval fishes. Prog. Fish-Cult. 40(1): 37-38.

This paper describes a technique which can be used to obtain good quality illustrations of larval fish with relative ease. With this method, dorsal, ventral, and lateral views of various sized fish ranging from newly hatched through early juveniles can be drawn. The major advantages of using the micro-projector technique are: 1) a person with limited artistic talents can quickly make well-proportioned drawings; 2) the illustrations can be drawn at different sizes, depending on the magnification of the objective; and 3) the equipment is portable and can be used in a limited space. (This abstract was not presented in the paper).

Buynak, G. L. and H. W. Mohr, Jr. 1978. Larval development of the northern hog sucker *(Hypentelium nigricans)* from the Susquehanna River. Trans. Am. Fish Soc. 107(4): 595-599.

Northern hog sucker (*Hypentelium nigricans*) eggs hatched in 10 days at a mean temperature of 17.4 C. Newly hatched larvae measured from 9.0 to 10.6 mm total length (TL) with a mean of 10.0 mm (standard or notochord length ranged from 8.7 to 10.1 mm with a mean of 9.6 mm). The newly hatched larvae were melanophore-free and had heads that were decurved over a bulbous yolk sac. They had slightly upturned urostyles, pectoral fin buds, and incomplete mouths. Throughout the protolarval phase, they remained relatively melanophore-free. In mesolarvae 15.8 mm TL, an almost triangular patch of melanophores was apparent on the occipital region and was separated from more anterior pigmentation by a melanophore-free area between the eyes. Similar pigmentation was found in metalarvae. Fin rays were visible in caudal, pectoral, dorsal, anal, and pelvic fins by 12.0, 12.6, 15.8, 17.8, and 17.8 mm TL, respectively. Transformation to mesolarval phase occurred by 12.0 mm TL, to metalarval phase by 19.8 mm TL, and to the juvenile period by 27.8 mm TL. Useful characteristics for distinguishing sucker larvae in the Susquehanna River are flexed urostyles in protolarvae, size, and pigmentation patterns.

Buynak, G. L. and H. W. Mohr, Jr. 1978. Larval development of the redbreast sunfish (*Lepomis auritus*) from the Susquehanna River. Trans. Am. Fish. Soc. 107(4): 600-604.

A redbreast sunfish (*Lepomis auritus*) nest with eggs was found in the Susquehanna River near Berwick, Pennsylvania. At hatching, the total length (TL) of the larvae ranged from 4.6 to 5.1 mm with a mean of 4.9 mm (standard or notochord length ranged from 4.5 to 5.0 mm with a mean of 4.8 mm). Newly hatched larvae had incomplete mouths, large ovoid yolk sacs, pectoral fin buds, and straight urostyles. Pigmentation appeared on the dorsal surface of the head in 7.8-mm TL larvae. The caudal fin rays began to develop by 7.8 mm TL; dorsal, anal, and pectoral fin rays began to develop by 8.1 mm TL; and the pelvic fin rays by 15.0 mm TL. Transformation to mesolarval phase occurred by 7.8 mm TL, to metalarval phase by 11.8 mm TL, and to the juvenile period by 19.0 mm TL. Useful characteristics for distinguishing redbreast sunfish larvae in the Susquehanna River are their larger size at hatching and swim-up, massively coiled guts, and the elongated patch of 20-30 melanophores on the venter between the opercle and vent.

Buynak, G. L. and H. W. Mohr, Jr. 1978. Larval development of the white sucker *(Catostomus commeroni)* from the Susquehanna River. Proc. Pa. Acad. Sci. 52(2): 143-145.

White sucker *(Catostomus commersoni)* eggs hatched eight days after fertilization at a mean temperature of 14.3 C. Total length (TL) of newly hatched larvae ranged from 8.7 to 9.2 mm ($\bar{x}$ = 8.9 mm); standard or notochord length ranged from 8.5 to 9.2 mm ($\bar{x}$ = 8.7 mm). The newly hatched larvae were unpigmented, had pectoral fin buds, straight urostyles, and incomplete mouths. Transformation to the postlarval phase occurred by 14.4 mm TL and to the late postlarval phase by 17.9 mm TL.

Useful characteristics for distinguishing white sucker larvae in the Susquehanna River are the straight urostyles, size, pigmentation patterns, and preanal myomere count.

Deutsch, W. G. 1978. *Lernaea cyprinacea* on two catostomid fishes. Proc. Pa. Acad. Sci. 52(1): 57-59.

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

Gale, W. F. and G. L. Buynak. 1978. Spawning frequency and fecundity of satinfin shiner (*Notropis analostanus*) -- a fractional, crevice spawner. Trans. Am. Fish. Soc. 107(3): 460-463.

Satinfin shiners (*Notropis analostanus*) proved to be fractional spawners and pairs of them in outdoor wading pools spawned up to 11 times between June 3 and August 11, 1977 (totals 381 to 3,268 eggs per pair). They released from 6 to 634 eggs per fish per session at intervals of 3 to 31 days (mean 7.6 days; modes 5 and 8 days). Spawning behavior was similar to that of spotfin shiner (*Notropis spilopterus*). Overall, eggs averaged 1.5 mm in diameter. Significant differences ($P<0.001$) were found in the size of eggs spawned by different females. Eggs in the first spawn were significantly ($P<0.001$) larger than those in the last spawn. Spawning occurred during the day and activity was most intense between 0600 and 1000 h. Only 12.2% of the 7,290 eggs were spawned after 1200 h.

Gale, W. F. and H. W. Mohr, Jr. 1978. Larval fish drift in a large river with a comparison of sampling methods. Trans. Am. Fish. Soc. 107(1): 46-54.

Larval fish drift in the rocky-bottomed Susquehanna River (northeastern Pennsylvania) was investigated during 1974-1975. Near SSES (Susquehanna Steam Electric Station) at least 18 species of drifting larvae were collected by nets mounted on a stationary boat or by pumping. Maximum densities of 15.4 and 27.1 larvae/10 m^3 were found in June 1974 and 1975, respectively. Quillback, *Carpiodes cyprinus* (56%), minnows (25%), and carp, *Cyprinus carpio* (14% of the total) were the most abundant larvae caught in 1974 by pumping. The few larvae that drifted during the day were mostly near the bottom. Large numbers of quillback, white sucker (*Catostomus commersoni*), shorthead redhorse (*Moxostoma macrolepidotum*), and tessellated darter (*Etheostoma olmstedi*) larvae drifted near the river surface at night. Drift was maximum at about 2400 h. Overall, the day/night drift ratio was 1/3.8.

In 1974 at Falls, the control station upstream of SSES and several intervening coal mine effluents, maximum density of drifting larvae was 1.4 fish/10 m^3, less than 10% of that at SSES. Density of spawning-sized fish was about threefold higher at Falls than at SSES.

Boat-mounted nets and the pump sampler had equal sampling efficiencies. Condition of larvae in pump samples was related to net material, mesh size, net shape, and pumping duration. Larvae in best condition were in 5-min samples pumped into slender nets (mouth/length ratio 1/10) made of fine-meshed monofilament nylon.

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Buynak, G. L. and H. W. Mohr, Jr. 1978 Larval development of the white sucker *(Catostomus commersoni)* from the Susquehanna River. Proc. Pa. Acad. Sci. 52(2): 143-145.

Deutsch, W. G. 1978. *Lernaea cyprinacea* on two catostomid fishes. Proc. Pa. Acad. Sci. 52(1): 57-59.

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