1980 ANNUAL ENVIRONMENTAL REPORT
NON-RADIOLOGICAL
DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION
UNIT NO. 1
DOCKET #50-334

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I. INTRODUCTION

This report presents a summary of the ecological data collected by Duquesne Light Company (DLCo) during 1980. During the first quarter of 1980, the aquatic monitoring program was identical to previous operational years; fulfilling the requirements set forth in the Environmental Technical Specifications (ETS), Appendix B to Operating License No. DPR-66, for the Beaver Valley Power Station (BVPS) Unit 1. On February 26, 1980 the Nuclear Regulatory Commission (NRC) granted DLCo a request to delete all of the aquatic monitoring program, with the exception of fish impingement, from the ETS (Amendment No. 25, License No. DPR-66). However, DLCo in the interest of providing a non-disruptive data base between BVPS Unit 1 and 2 entered into a modified aquatic monitoring program. This report presents the results of both the ETS requirements for the first quarter and the results of the modified program including impingement for all of 1980.

SCOPE AND OBJECTIVES OF THE PROGRAM

The objectives of the 1980 ecological program were fourfold:

(1) to comply with Nuclear Regulatory Commission requirements

(2) to review chemical releases and thermal discharges from the station to verify that they do not adversely affect public health or the natural environment

(3) to assess the possible environmental impact to the plankton, benthos, fish and ichthyoplankton communities in the Ohio River and the impact due to impingement and entrainment as a result of plant operation, and

(4) to establish long and short range programs based on data.

SITE DESCRIPTION

BVPS is located on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania, on a 486.8 acre tract of land which is owned by Duquesne Light Company. The Shippingport Station shares the site with BVPS. Figure I-1 shows a view of both stations. The site is approximately 1 mile (1.6 km)

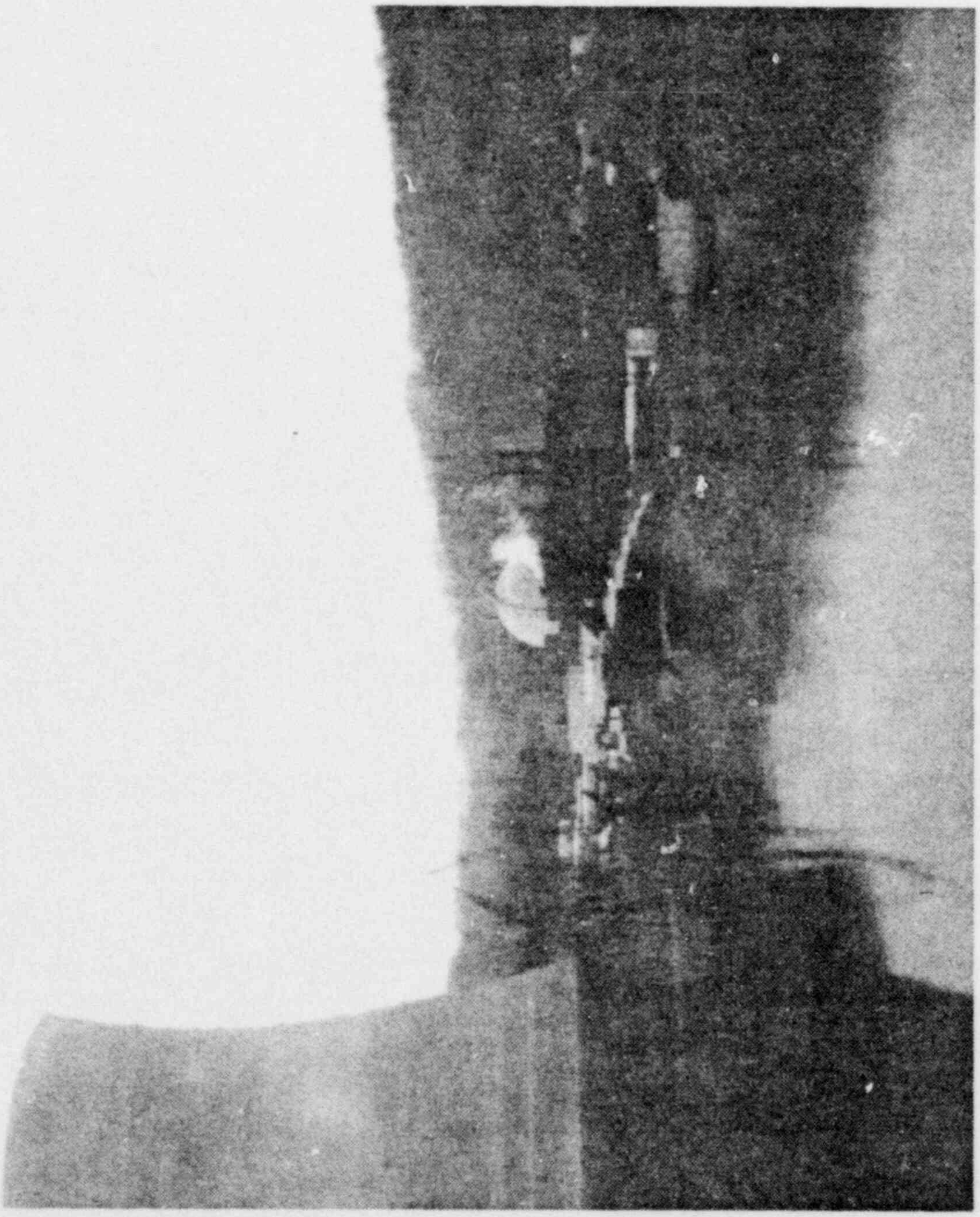


FIGURE I-1
VIEW OF THE BEAVER VALLEY AND SHIPPINGPORT POWER STATIONS

from Midland, Pennsylvania; 5 miles (8 km) from East Liverpool, Ohio; and 25 miles (40 km) from Pittsburgh, Pennsylvania. Figure I-2 shows the site location in relation to the principal population centers. Population density in the immediate vicinity of the site is relatively low. There are no residents within a 0.5 mile (0.8 km) radius of either plant. The population within a 5 mile (8 km) radius of the plant is approximately 18,000 and the only area of concentrated population is the Borough of Midland, Pennsylvania, which has a population of approximately 5,300.

The site lies along the Ohio River in a valley which has a gradual slope extending from the river (elevation 665 ft or 203 m above sea level) to an elevation of 1,160 ft (354 m) along a ridge south of BVPS. Plant entrance elevation at the station is approximately 735 ft (224 m) above sea level.

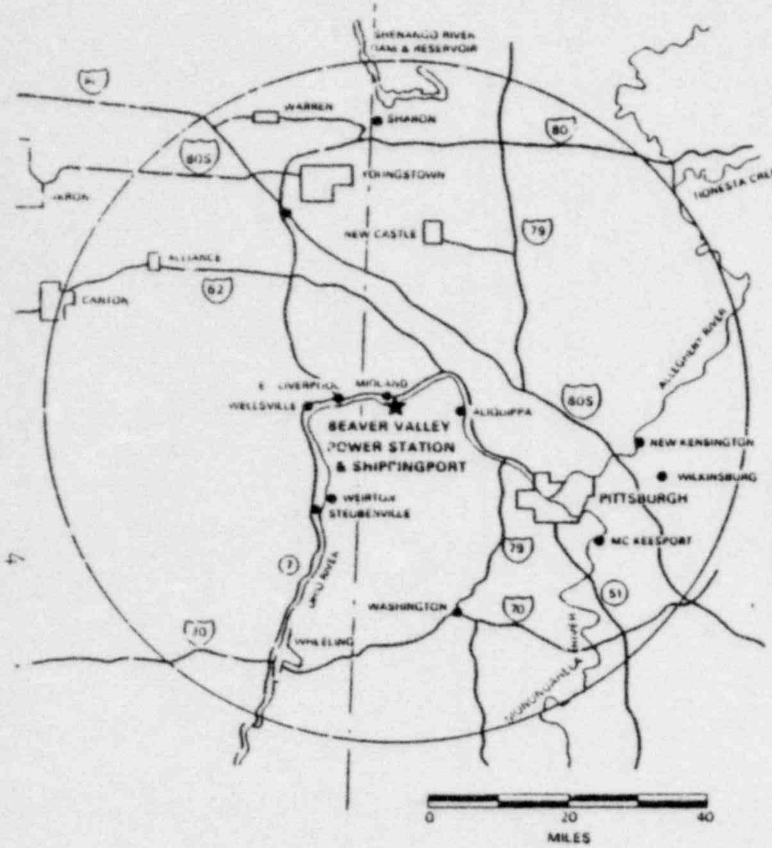
The station is situated on the Ohio River at river mile 34.8, at a location on the New Cumberland Pool that is 3.3 river miles (5.3 km) downstream from Montgomery Lock and Dam and 19.4 miles (31.2 km) upstream from New Cumberland Lock and Dam. The Pennsylvania-Ohio-West Virginia border is 5.2 river miles (8.4 km) downstream from the site. The river flow is regulated by a series of dams and reservoirs on the Beaver, Allegheny, Monongahela and Ohio rivers and their tributaries. Flow generally varies from 5,000 to 100,000 cubic feet per second (cfs). The range of flows in 1980 is shown in Figure I-3 (Table I-1).

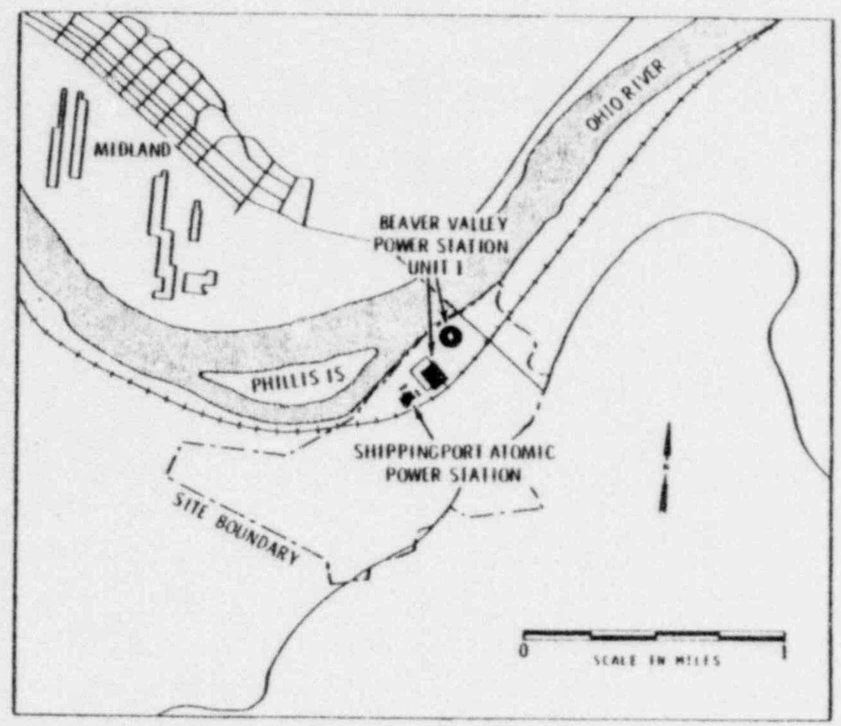
Ohio River temperatures generally vary from 32 to 80°F (0 to 27°C). Minimum and maximum temperatures generally occur in January and July/August, respectively. During 1980, minimum temperatures were observed in January and maximum temperatures in September (Figure I-3) (Table I-1).

BVPS has a thermal rating of 2,600 megawatts (Mw) and an electrical rating of 852 Mw. The circulating water system is a closed cycle system using a cooling tower to minimize heat released to the Ohio River. Commercial operation of BVPS Unit 1 began in 1976.

FIGURE I-2

LOCATION OF STUDY AREA, BEAVER VALLEY POWER STATION,
SHIPPINGPORT, PENNSYLVANIA





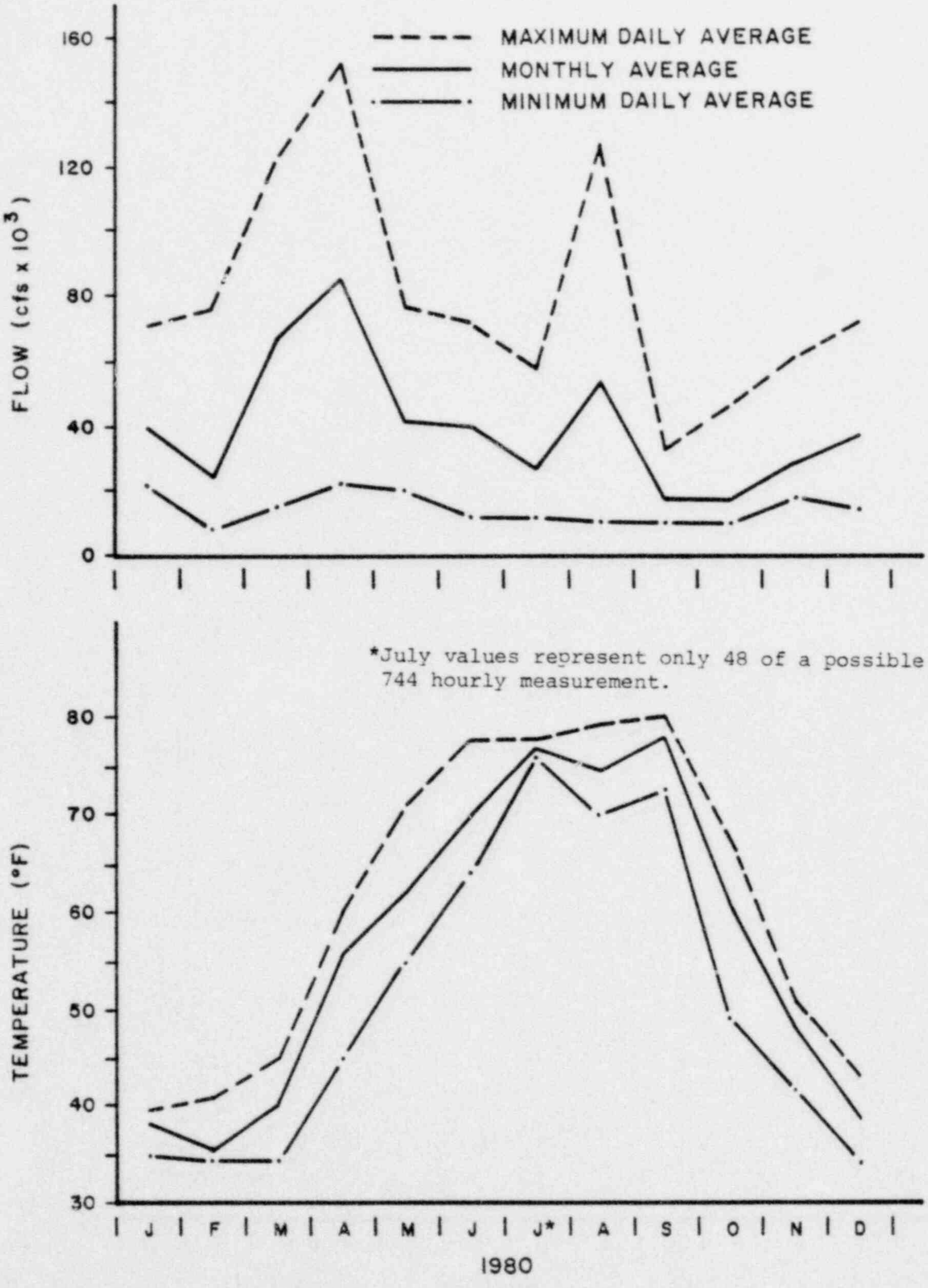


FIGURE I-3

OHIO RIVER DISCHARGE (Flow cfs) AND TEMPERATURE (°F), RECORDED AT EAST LIVERPOOL, OHIO (MP 40.2) BY THE OHIO RIVER VALLEY WATER SANITATION COMMISSION (ORSANCO), 1980

TABLE I-1

OHIO RIVER DISCHARGE (Flow cfs) AND TEMPERATURE (^{o}F) RECORDED AT
EAST LIVERPOOL, OHIO (MP 40.2) BY THE OHIO RIVER VALLEY
WATER SANITATION COMMISSION (ORSANCO)
1980

Month	J	F	M	A	M	J	J*	A	S	O	N	D
Flow (cfs x 10^3)												
Maximum Daily Average	71	75	122	151	78	72	59	128	32	47	61	72
Monthly Average	40	24	68	86	41	40	27	54	17	16	28	37
Minimum Daily Average	21	9	15	22	20	12	12	10	10	10	18	15
Temperature (^{o}F)												
Maximum Hourly Value	39	41	45	60	71	77	77	79	80	67	51	43
Monthly Average	37	36	40	56	62	70	77	74	77	61	47	38
Minimum Hourly Value	35	34	34	45	54	64	76	70	73	49	42	34

*July values for flow and temperatures represent only 48 of a possible 744 hourly measurements, due to technical problems with ORSANCO's automatic monitors.

II. SUMMARY AND CONCLUSIONS

The 1980 BVPS non-radiological environmental monitoring program included surveillance of thermal and chemical effluents, Ohio River aquatic life and a terrestrial ecological survey using aerial infrared photography. This is the fifth year of operational monitoring and, as in the previous operational monitoring years, no evidence of adverse environmental impact to the Ohio River on the surrounding vegetation was found.

Thermal and chemical effluent monitoring included measurement of temperature and free available chlorine at the discharge structure, pH at the chemical waste sump and chromates at the low level waste drain tank. During 1980, none of these limits were exceeded. From January to November 11, 1980, BVPS was shut down for refueling and safety modifications.

The aquatic ecological monitoring program included: benthos, phytoplankton, zooplankton, fish, ichthyoplankton, impingement and plankton entrainment. Sampling was conducted upstream and downstream of the plant during the first quarter of 1980 to assess potential impacts of BVPS discharges. Beginning in April 1980, a modified aquatic program was initiated. In this program, only benthos and fish were collected both upstream and downstream of the plant. These data were also compared to preoperational data and other operational data to assess long term trends. Impingement and entrainment data were assessed to determine the impact of withdrawing river water for in-plant use. The following summarize the findings of each program element and results of impact assessment.

The benthic macroinvertebrate community, organisms living in or on the bottom of the river, during 1980 was similar to communities observed during other operational years (1976-1979) and preoperational years (1972-1975). The predominant macroinvertebrates were oligochaete worms. They comprised greater than 80% of the total each year since 1972. Common genera of Oligochaetes were Limnodrilus, Ilyodrilus, Aulodrilus, Branchiura, Peloscolex and Tubifex. Chironomid (midge) larvae, frequently the second most abundant group of macroinvertebrates, comprised less than 10% of the total each year. During 1980, fingernail clams

(Sphaeridae) accounted for a slightly higher percent composition than Chironomid larvae. Dominance of worms throughout the BVPS study area and during all survey years was primarily related to substrate consistency. Substrates were predominantly soft, unstable muds with only minor quantities of sand, clay and pebble. Soft unstable mud is conducive to worm proliferation. Analysis o data for control and non-control transects found no evidence to indicate that thermal and liquid effluents released from BVPS Unit 1 were adversely affecting the Ohio River benthos.

Phytoplanktor and zooplankton, microscopic plant and animal life suspended in the Ohio River, were typical of temperate flowing waters. The composition and seasonal distribution of phytoplankton and zooplankton during 1980 was basically the same as those observed in other operational and preoperational years.

Phytoplankton during 1980 exhibited a bimodal pattern of abundance with peaks in the summer and early fall. Phytoplankton declined after September to minimal densities during the winter. Zooplankton, which feed upon the phytoplankton, followed a similar abundance pattern.

Spatial variations in densities and species composition of phytoplankton and zooplankton upstream and downstream of BVPS remained within an acceptable ecological range indicated by the limits/criteria which were not exceeded during the first quarter of 1980. All differences in plankton populations were related to natural variability. Results of sampling and analyses during 1980 gave no evidence to indicate that BVPS Unit 1 operation adversely affected the phytoplankton and zooplankton on the Ohio River.

Fish surveys, conducted during May, July, September and November, collected a total of 699 fish in 1980. Collection methods included: electrofishing, gill netting and cast seining. The majority of fish (557) were captured by electrofishing. Approximately 75% of the electrofishing catch consisted of sand shiners, bluntnose minnows, and emerald shiners.

Channel catfish (34.3%) comprised the majority of the (35) gill-netted fish. Walleye, carp, sauger and white crappie were the other species representing the next highest numbers of fish netted. Cast seining produced 107 fish; 97.2% of which were emerald shiners.

Variations in annual total catches have occurred during preoperational and operational years. They have occurred primarily because of fluctuations in population size of the small species (minnows and shiners primarily). Larger fish (carp, channel catfish, smallmouth bass, yellow perch, walleye and sauger) have remained common species near BVPS throughout all years. Members of the pike family, northern pike, muskellunge, and hybrids (tiger muskellunge) not collected during preoperational years, were collected in 1977, 1978, 1979 and 1980. Their presence and the presence of other sport fish is important because it demonstrates that the Ohio River is meeting the minimum water quality, habitat and food requirements of these desirable sport fish. In addition, the Pennsylvania Fish Commission stocking programs has assisted in the restoration of the tiger muskellunge to these waters.

Differences in fish species composition which were observed upstream and downstream of BVPS probably reflect habitat preferences of individual species. No evidence was found to indicate that fish populations near BVPS have been adversely affected by BVPS operation. No fish classified as endangered or threatened by the Commonwealth of Pennsylvania were collected.

Ichthyoplankton (fish eggs, larvae and juveniles) data were evaluated to determine spawning activity near BVPS and in particular spawning in the back channel of Phillis Island. Spawning activity was limited to June and July with little activity in April and May. Cyprinids (minnows and carps) accounted for 89.5% of the 215 larvae collected. Only 12 eggs were collected.

Data collected from 1973 to 1980 in the back channel of Phillis Island, the channel receiving the majority of aqueous discharges from BVPS, indicated that this channel was not used any more extensively for spawning purposes than other main channel areas. No evidence was found to indicate BVPS operation was adversely affecting the ichthyoplankton of the Ohio River.

Impingement surveys were conducted for one 24-hour period per week in 1980. A total of 108 fish weighing 0.46 kg (1.02 lbs) was collected. Emerald shiner (26.9%), channel catfish (19.2%) and bluegill (17.3%) composed 63.4% of the annual catch. Of the 108 fish collected, 35 (32.4%) were alive and returned via the discharge pipe to the Ohio River. The majority of fish were less than 100 mm in length. The 1980 annual impingement catch was less than the 1979 collections (262 fish), the 1978 collection (654 fish), the 1977 collection (10,322 fish) and the 1976 collection (9,102 fish).

Entrainment studies were performed to investigate the impact of withdrawing river water for in-plant use on the ichthyoplankton, phytoplankton and zooplankton.

Entrainment river transect surveys for ichthyoplankton were conducted to ascertain any changes in spawning activity occurring in the Ohio River adjacent to the BVPS intake. As in previous years, ichthyoplankton were most abundant in June and July; collections were dominated by cyprinid (minnows and carps) larvae. Assuming actual entrainment rates were similar to those found in 1976-1978, river abundance of ichthyoplankton indicate no substantial increase in entrainment should have occurred in 1980 due to the operation of BVPS.

Assessment of monthly phytoplankton and zooplankton data indicated that total densities and species composition of intake and river samples were similar throughout the study year. Therefore, fairly uniform distribution can be assumed and under worst case conditions of minimum low river flow (5000 cfs), about 1.2% of the phytoplankton and zooplankton would be withdrawn by the BVPS intake. This is considered as a negligible loss of phytoplankton and zooplankton relative to river populations.

During the summer and fall of 1980, vegetation stress was monitored in the vicinity of BVPS cooling tower. False color infrared photography, photointerpretation of the imagery, and field observations were conducted to detect stressed or damaged vegetation and to identify probable causes. It was concluded that drift from the BVPS cooling tower during 1980 was not directly contributing to vegetation stress in any area identified by aerial photography or field survey.

III. ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE

During the first quarter of 1980, significant environmental change analyses were conducted on benthos, phytoplankton and zooplankton data. These analyses were in accordance with BVPS Unit 1 ETS, Appendix B to Operating License No. DPR-66. However, on February 26, 1980 the NRC granted DLCo a request to delete all the aquatic monitoring program, with the exception of fish impingement, from the ETS (Amendment No. 25, License No. DPR-66). Therefore, this Section deals only with the first quarter of 1980.

These analyses were conducted to serve as an early warning of potential impact on the aquatic ecology of the Ohio River due to BVPS Unit 1 operation. Changes in the aquatic ecology should be discovered as soon as possible in order to minimize potential impacts. Therefore, analyses were designed to obtain results as soon after sampling as possible. Analysis of group densities was chosen as the best method for obtaining meaningful evaluations of potential impact within a short time. Any results that indicated potential impact (significant environmental change) caused by BVPS Unit 1 operation were reported to the Director of the Office of Inspection and Enforcement.

To assess potential impact and to meet ETS requirements, reporting limits/criteria (Table III-1) were developed. These limits/criteria were based on a statistical analysis (analysis of variance) of group density data collected during the preoperational monitoring years. Two reporting limits/criteria were developed for each ecological group listed in Table III-1. The first criterion determines if group densities observed in 1980 were significantly different from densities observed during preoperational years; the second criterion determines if differences between control and non-control group densities were significantly different, based upon differences observed during preoperational years.

Significant changes, beneficial or adverse, in the Ohio River ecosystem near BVPS could result from water quality changes far upstream of BVPS. Such changes could cause the first reporting limit/criterion to be exceeded. Therefore, in order to report only those potential impacts related to BVPS Unit 1 operation, it was

TABLE III-1

REPORTING LIMITS/CRITERIA FOR ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE, 1980, BVPS

Benthos Reporting Limits/Criteria

	Criterion 1 Limits		Criterion 2 Factor
	Lower bound (-2SD)	Upper bound (+2SD)	$\lvert\overline{T1}/\overline{T2B}\rvert >$
Density (number/m^2)			
Total	46	620	99.0
Oligochaeta	21	564	81.0
Chironomidae	0	39	42.0
Mollusca	0	39	31.0

Plankton Reporting Limits/Criteria

	Criterion 1 Limits		Criterion 2 Factor
	Lower bound (Mean minimum Density)	Upper bound (+2SD)	$\lvert\overline{T1}/\overline{T2B}\rvert >$
Phytoplankton			
Density (cells/ml)			
Total	1,975	23,712	2.9
Chlorophyta	883	15,228	2.7
Chrysophyta	768	7,311	3.1
Cyanophyta	16	718	90.5
Cryptophyta	63	1,396	2.5
Microflagellates	17	795	13.7
Zooplankton			
Density (organisms/l)			
Total	1,387	10,196	2.3
Protozoa	797	8,283	2.4
Rotifera	431	5,347	2.1

$\overline{T1}$ Mean density of all samples collected per survey at Transect 1 (upstream control)

$\overline{T2B}$ Mean density of all samples collected per survey at Transect 2B (downstream of BVPS)

$\overline{T1}/\overline{T2B}$ Absolute ratio between $\overline{T1}$ and $\overline{T2B}$

2SD Two Standard Deviations

established that both Criterion 1 and 2 limits would have to be exceeded and if attributable to BVPS operation, a non-routine report would be prepared and submitted to the Nuclear Regulatory Commission.

The following summarizes 1) how the reporting limit for each parameter was established and 2) the 1980 group densities and their use in determining if the limits/criteria were exceeded.

BENTHOS

An analysis of variance (ANOVA) was performed on data collected during preoperational years to set bounds on the natural variability in abundance (density) for the following groups of macroinvertebrates: Oligochaeta (worms), Chironomidae (midges) and Mollusca (clams and snails). These groups together comprised more than 90% of the benthic populations of the Ohio River near BVPS during preoperational years. In addition to group densities, the variability of total macroinvertebrate density was established.

Group and total density values were pooled and the ANOVA performed. Densities were based on the average of three Ponar grab samples taken at four locations (Transects 1, 2A, 2B and 3) within the study area. Seasonal variability was not considered because assessment of upstream vs. downstream conditions under Criterion 2 evaluated discrete sampling times, negating the need for seasonal assesssment under Criterion 1.

The ANOVA determined the lower and upper bounds of Criterion 1, defined as the 95th percentile range or two standard deviations (2SD) of the preoperational data (Table III-1). Statistically significant changes for Criterion 1 were established as those group and total densities falling outside the $\pm$2SD range. Because Criterion 1 was established to assess general study area conditions, all study area data were included in the analysis.

Criterion 2 was established by calculating the absolute ratio for individual group and total densities for Transect 1 (upstream control) and Transect 2B (first transect downstream from BVPS) for each preoperational survey. The maximum ratio observed for a given survey was established as the Criterion 2 reporting limit. Criterion 2 indicated the largest absolute difference observed during preoperational years between Transect 1 and 2B. To determine if differences observed during this operational year were significant, mean group and total densities were calculated for Transects 1 and 2B. For each group and total benthic density, the lowest mean density was divided into the highest to produce a factor greater than 1.0. If this factor exceeded the factor established as Criterion 2, then the change observed was considered significant.

As stated above, a nonroutine report would be prepared in accordance with ETS Section 5.6.2.B, if both Criterion 1 and 2 were exceeded and the change was attributable to BVPS operation. This condition was not observed for the February survey performed in 1980.

PLANKTON

An ANOVA similar to that performed on benthos data was performed on the preoperational phytoplankton and zooplankton data to determine the 95th percentile range for the following groups: Chlorophyta (green algae), Chrysophyta (yellow-green and yellow-brown algae and diatoms) Cyanophyta (blue-green algae), Cryptophyta, microflagellates, Rotifera and Protozoa. These groups accounted for more than 90% of the Ohio River plankton during preoperational years. The 95th percentile ranges for total phytoplankton and zooplankton densities were also determined.

The lower and upper bounds ($\pm$2SD for Criterion 1) were determined; however, most of the lower bounds were zero (0). Recognizing that zero densities are not a realistic number for assessing environmental change, new lower bounds were determined by averaging all minimum group and total density values observed for each preoperational survey and establishing this mean minimum value as the lower bound for Criterion 1. The upper bound remained at $\pm$2SD. Monthly or quarterly (seasonal) criteria were not established because Criterion 2 compares data for a given sampling data (month), negating the need for seasonal assessment under Criterion 1.

To determine if Criterion 1 limits were exceeded, mean group and total phytoplankton and zooplankton densities were calculated. The mean is also the Criterion 1 value.

Criterion 2 was developed as defined above for benthos. To determine if significant changes from control to non-control areas had occurred, mean group and total density values were calculated for Transects 1 and 2B. Differences between the two transects were determined and the ratio (factor) calculated. If this factor exceeded the preoperational factor and Criterion 1 was also exceeded, then a non-routine report was prepared, provided the cause was attributable to BVPS operation.

The ETS reporting limits/criteria for plankton (phyto and zoo) were not exceeded during the first quarter of 1980.

IV. MONITORING NON-RADIOLOGICAL EFFLUENTS

MONITORING CHEMICAL EFFLUENTS

Most of the water required for the operation of BVPS is taken from the Ohio River and discharged at points shown in Figure IV-1. Figure IV-2 is a schematic diagram of liquid flow paths for BVPS.

There are four parameters identified in the Environmental Technical Specifications (ETS) which must be monitored, and if limits are exceeded, reported. The four parameters are:

1. Temperature at the outfall structure
2. Free available chlorine at the outfall structure
3. pH at the Chemical Water Sump
4. Chromates at the low level waste drain tank

In addition, the amounts of chemicals released to the environment are noted in the Beaver Valley - #1 Unit Environmental Statement and are listed below:

Source	Material Released
Cation-Anion Neutralized Waste	Na_2SO_4
Mixed Bed Neutralized Waste	Na_2SO_4
Water Softener Waste	NaCl
Cooling Tower Biocide	Cl_2
Reactivity Control	H_3BO_3
Corrosion Control	$K_2Cr_2O_7$

All of the above chemicals were released during 1980.

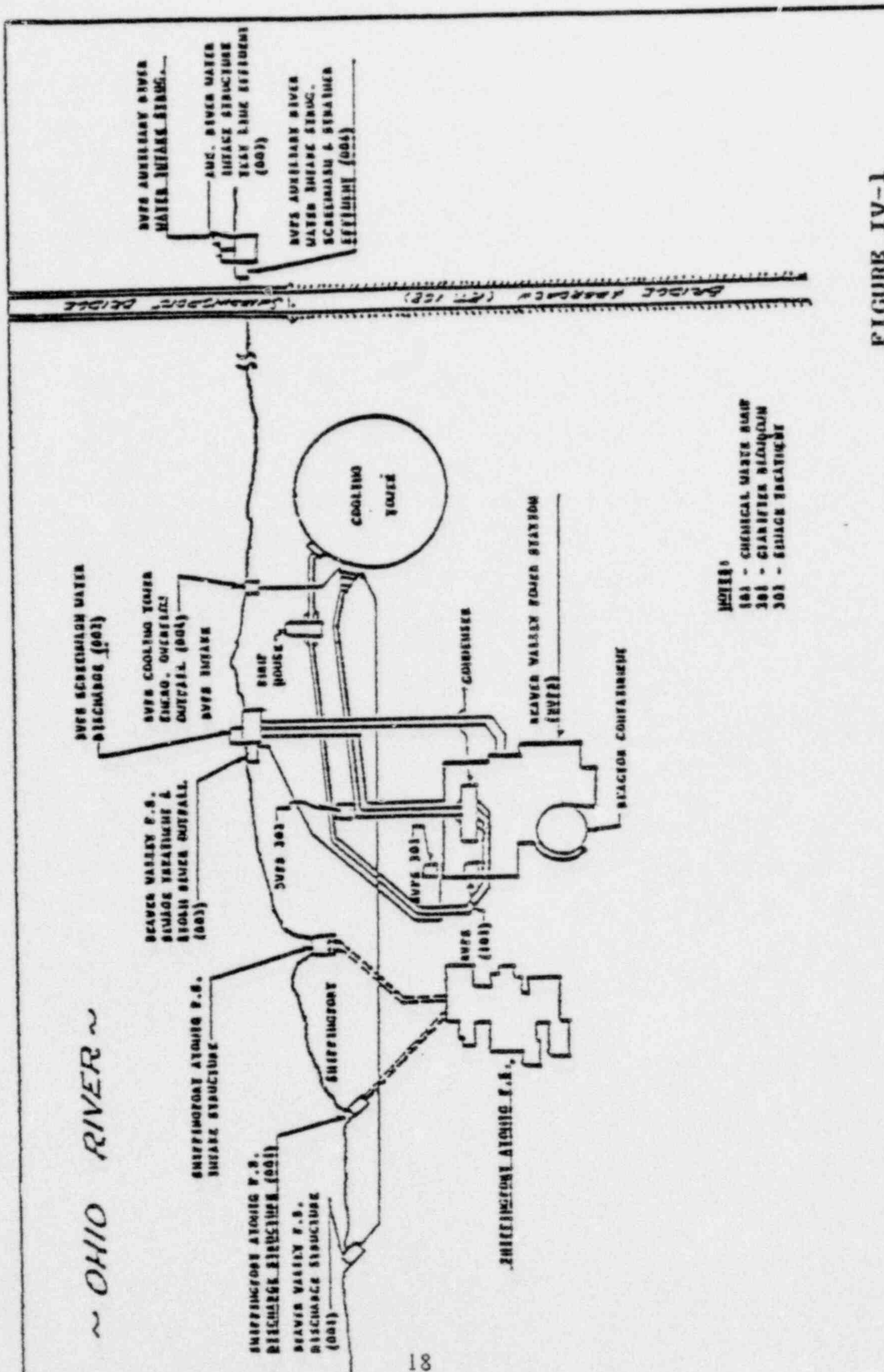


FIGURE IV-1

RIVER INTAKE AND DISCHARGE IN OHIO RIVER
SHIPPINGPORT & BEAVER VALLEY POWER STATIONS

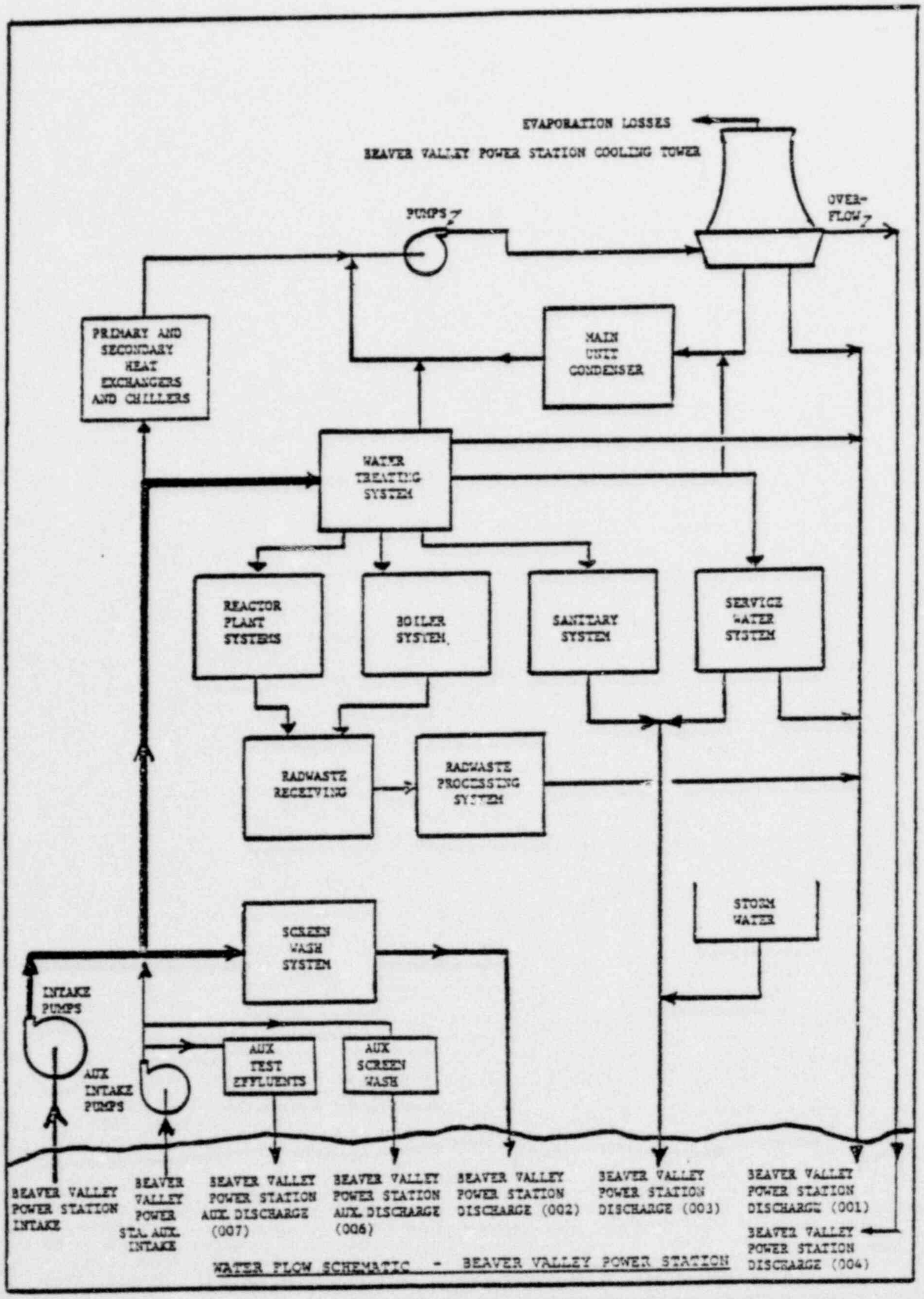


Figure IV-2

POOR ORIGINAL

Results

Limiting Conditions for Operation

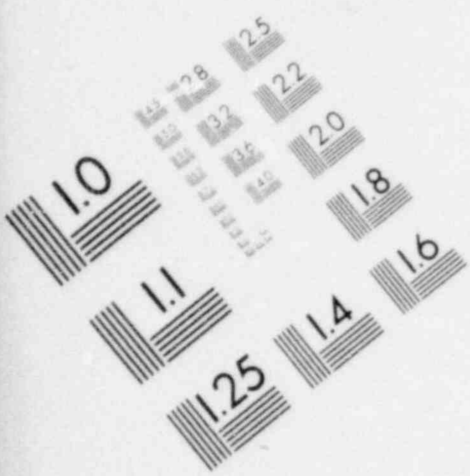
The range observed during 1980 for each of the four parameters monitored in liquid effluents which have specified limits are as follows:

Parameter	Limits	Range of Values Discharged in 1980
Temperature	94°F (4 hrs.)	35 to 81°F
Free Available Chlorine	0.5 mg/l	0.0 to 0.2
pH (released from chemical water sump)	6.0 - 9.0	6.0 to 9.0
Chromates	0.05 mg/l	0.05

During the year, none of the limits noted above were exceeded. From January to November 11, 1980, Beaver Valley Power Station was shut down for refueling and safety related modifications.

Chemicals Released

Source	Estimated Amount Released (lb/yr)	*Actual Amount Released (lb/yr)
Cation - Anion Neutralized Waste (Sodium Sulfate)	20,000	246,800
Mixed Bed Neutralized Waste (Sodium Sulfate)	5,000	21,560
Water Softener Waste (Sodium Chloride)	15,000	146,600
Cooling Water Biocide (Chlorine)	2,380	9.55
Reactivity Control (Boric Acid)	20,000**	13,194
Corrosion Control	4.5	1



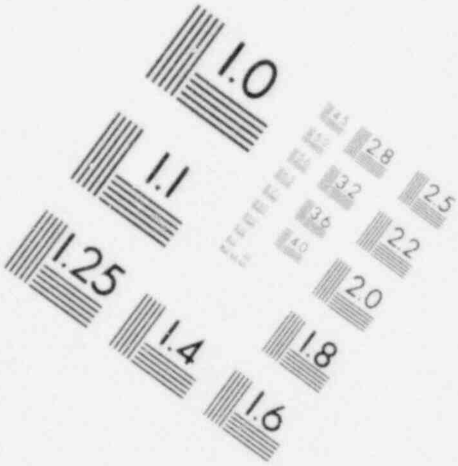
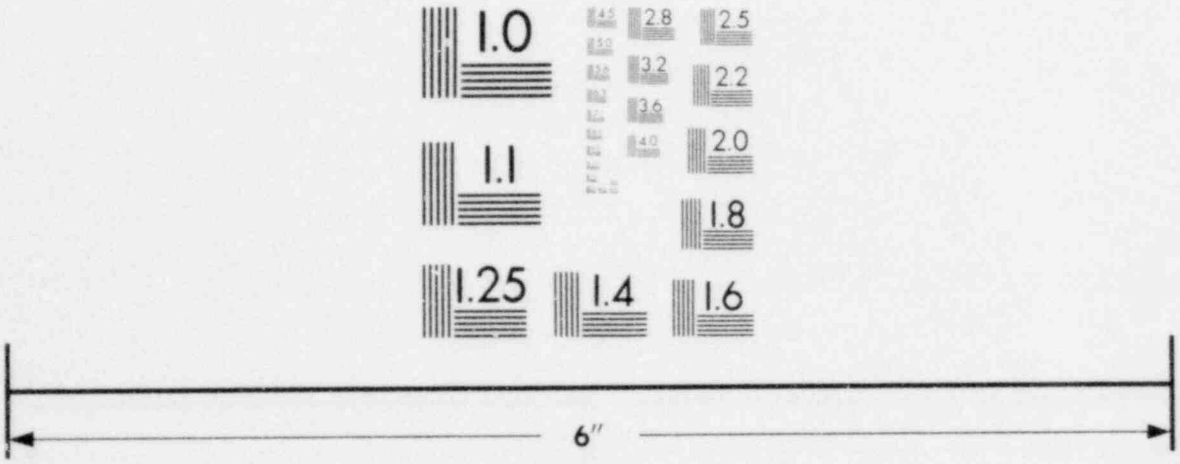
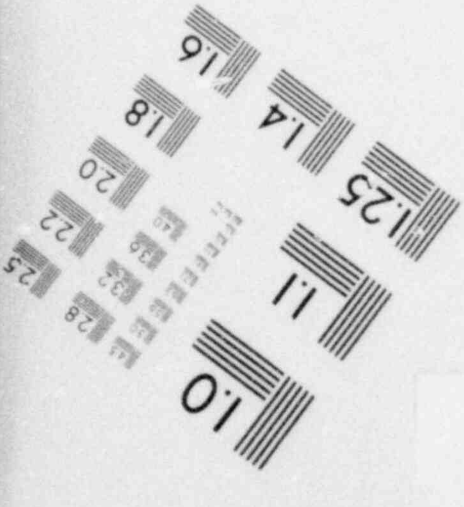


IMAGE EVALUATION TEST TARGET (MT-3)





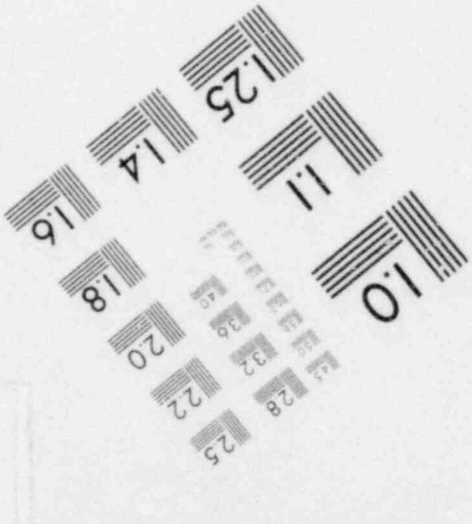


IMAGE EVALUATION
TEST TARGET (MT-3)

6″

*By inventory differential or calculated usage.

**Indicates previous approved change in Technical Specification, Appendix B, Amendment No. 15.

The amounts discharged exceeded the estimated release values in all cases except cooling water biocide, reactivity control and corrosion control (hexavalent chromium). The increased use rate was attributed to the following:

Cation-Anion Neutralized Waste

The water demands for BVPS continue to be greater than originally estimated. The amount discharged in 1980 was reduced from that of 1979 by almost one half due to lowered water demands resulting from the extended plant outage. Although the amount of sodium sulfate exceeded original estimates, there was no impact to the ecosystem. A special assessment (study) was conducted to evaluate the effects of sodium sulfate on the Ohio River and was included in the 1978 Annual Ecological Report (Appendix "B").

The special assessment (study) concluded that no adverse effects to aquatic life would be expected if the annual release of sodium sulfate was increased to 700,000 lb/year due to low release concentration, short exposure time and the minimal amount released in comparison with natural levels in the Ohio River.

Mixed Bed Neutralized Waste

The discharge of mixed bed waste was reduced from that of 1979 due to lower water demands and by the installation of higher efficiency mixed bed resins. As noted above, an assessment of the impact of sodium sulfate on the ecosystem in the Ohio River was presented in the 1978 Annual Ecological Report.

Water Softener Waste

The use of soft water increased beyond that originally estimated because manpower levels at the station (both in-plant personnel, as well as contractors) were much larger than originally predicted.

Although the amount of sodium chloride released to the environment exceeded original estimates, the amounts discharged did not harm the ecosystem. A special assessment was conducted to evaluate the effects of sodium chloride on the Ohio River and was included in the 1978 Annual Ecological Report (Appendix "C").

The special assessment (study) concluded that the release of 250,000 pounds of salt (NaCl) annually will not adversely affect aquatic life in the Ohio River.

Cooling Water Biocide

The circulating water system was not in service during the extended plant outage. The average free available chlorine concentration is limited to 0.2 ppm over a 2-hour period per day. Based on actual analyses and blowdown flow, the total chlorine released during 1980 was 10 pounds. This amount was well below original estimates.

Reactivity Control

The amount of boric acid use during 1980 was determined by actual analyses of all radwaste discharged. This amount was below estimates noted in Amendment 15 of the BVPS Technical Specifications.

Corrosion Control

The amount hexavalent chromate released in 1980 was obtained using chemical analyses of all reactor plant discharge. The maximum chromate discharged, based on total liquid radwaste discharged in 1980 and the detectable level of chromate, was less than one pound. This also is well below original estimates.

HERBICIDES

Herbicides were used for weed control at the Beaver Valley site and the Shippingport site. During CY 1980, none of the transmission line right-of-ways leaving the Beaver Valley site were treated with herbicides. Areas specifically designated for protection and restriction from herbicides application have not been sprayed. No accidental spills of herbicides occurred during the year.

Table IV-1 summarizes the usage of herbicides at the Beaver Valley Power Station and Shippingport Atomic Power Station.

TABLE IV-1

BEAVER VALLEY POWER STATION - HERBICIDES USED

Location Used	Herbicide Type	Concentration of Active Materials	Rate of Application	Method and Frequency of Application	Wind Conditions	Aerial Application	Date Applied
BVPS Met Tower Beaver County, Pa.	Ureabor	Herbicide dry granule, 98% active ingredients	10.4-lb/100 square ft.	Spot application within security fence where needed approx. bi-annually.	Calm wind, speed less than 5 mph.	No	July, 1980
BVPS SS. Switch Yard, Beaver County, Pa.	Ureabor	Herbicide dry granule, 98% active ingredients	1-lb/100 square ft.	Spreader cart. One complete coverage of slagged yard, applied yearly.	Average to calm. Approx. 5 to 10 mph.	No	March, April, 1980
SAPS - within security fence of plant. Beaver County, Pa.	Ureabor	Herbicide dry granule, 98% active ingredients	1-lb/100 square ft.	Spreader cart and spot coverage within security fence.	Average to calm. Approx. 5 to 10 mph.	No	Various dates Completion.

V. MONITORING PROGRAMS

A. AQUATIC

The ecological study area established to assess potential impacts consisted of three sampling transects (Figure V-A-1). Transect 1 is located at river mile (RM 34.5) approximately 0.3 mi (0.5 km) upstream of BVPS and is the control station. Transect 2 is located approximately 0.5 mi (0.8 km) downstream of the BVPS discharge structure. Transect 2 is divided by Phillis Island. The main channel is designated Transect 2A and the back channel Transect 2B. Transect 2B is the principal non-control transect because the majority of aqueous discharges from BVPS Unit 1 are released to the back channel. Transect 3 is located approximately 2 mi (3 km) downstream of BVPS.

Sampling dates for each of the above program elements are presented in Table V-A-1.

The following sections of this report present a summary of findings for each of the program elements.

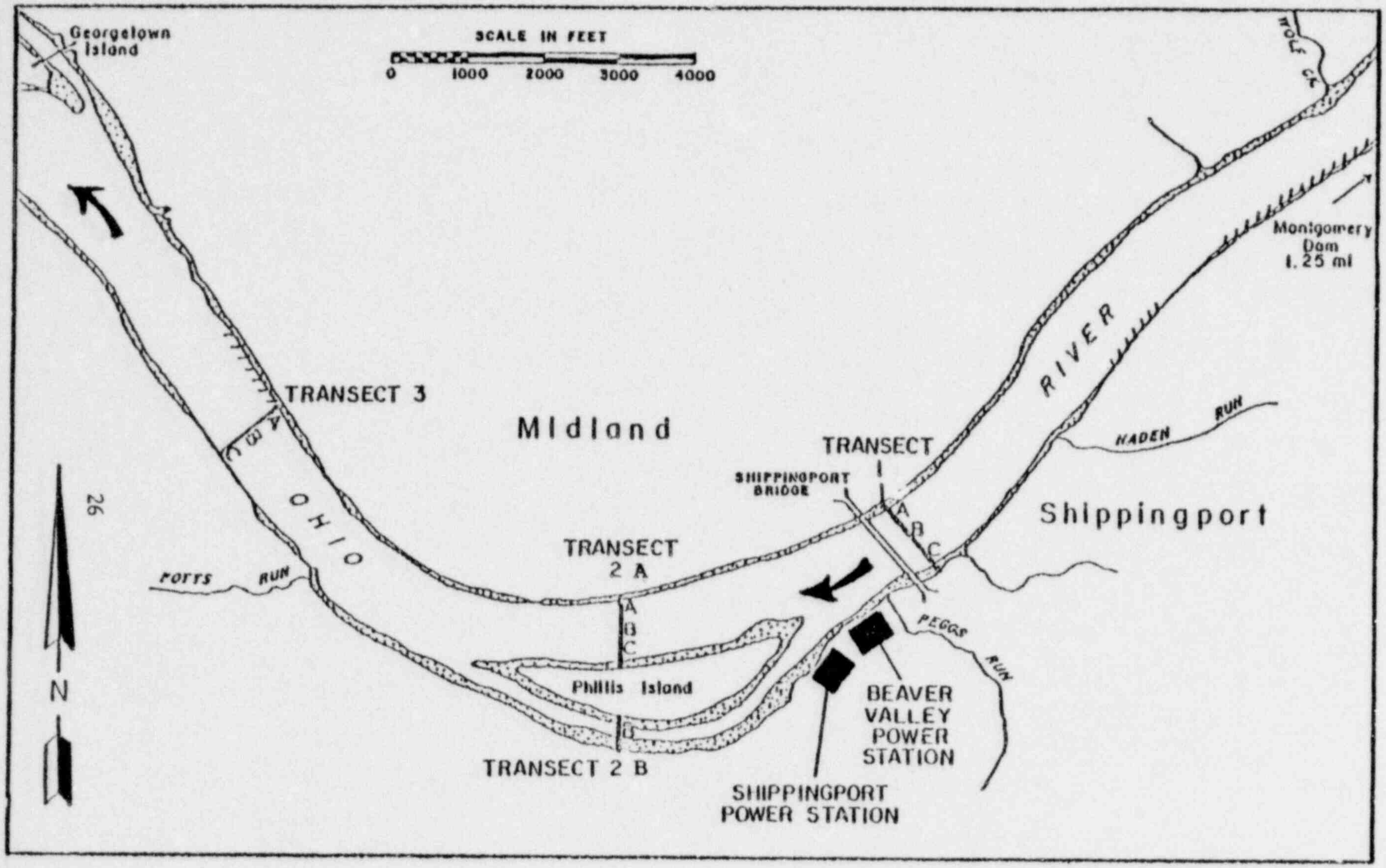


FIGURE V-A-1

SAMPLING TRANSECTS IN THE VICINITY OF THE BEAVER VALLEY AND SHIPPINGPORT POWER STATIONS

TABLE V-A-1

AQUATIC PROGRAM MONITORING SAMPLING DATES
1980, BVPS

Month	Benthos	River Plankton (Phyto and Zoo)	Fish	Impingement	Ichthyoplankton	Entrainment Plankton (Phyto and Zoo)
JAN		10		4,11,18,25		10,11
FEB	13	14		1,8,15,22,29		14,15
MAR		13		7,14,21,28		13,14
APR				4,11,22,25	23	18
MAY	21		22,29	2,9,23,30	21	21
JUN				6,13,20,27	19	13
JUL			23,30	3,15,18,25	22	18
AUG				1,8,15,22,29		22
SEP	23		24	5,12,19,26		26
OCT				3,10,17,24,31		17
NOV			19,26	7,14,22,28		14
DEC				10,12,19,26		12

B. BENTHOS

Objectives

To characterize the benthos of the Ohio River near BVPS and to determine the impact, if any, of BVPS operations.

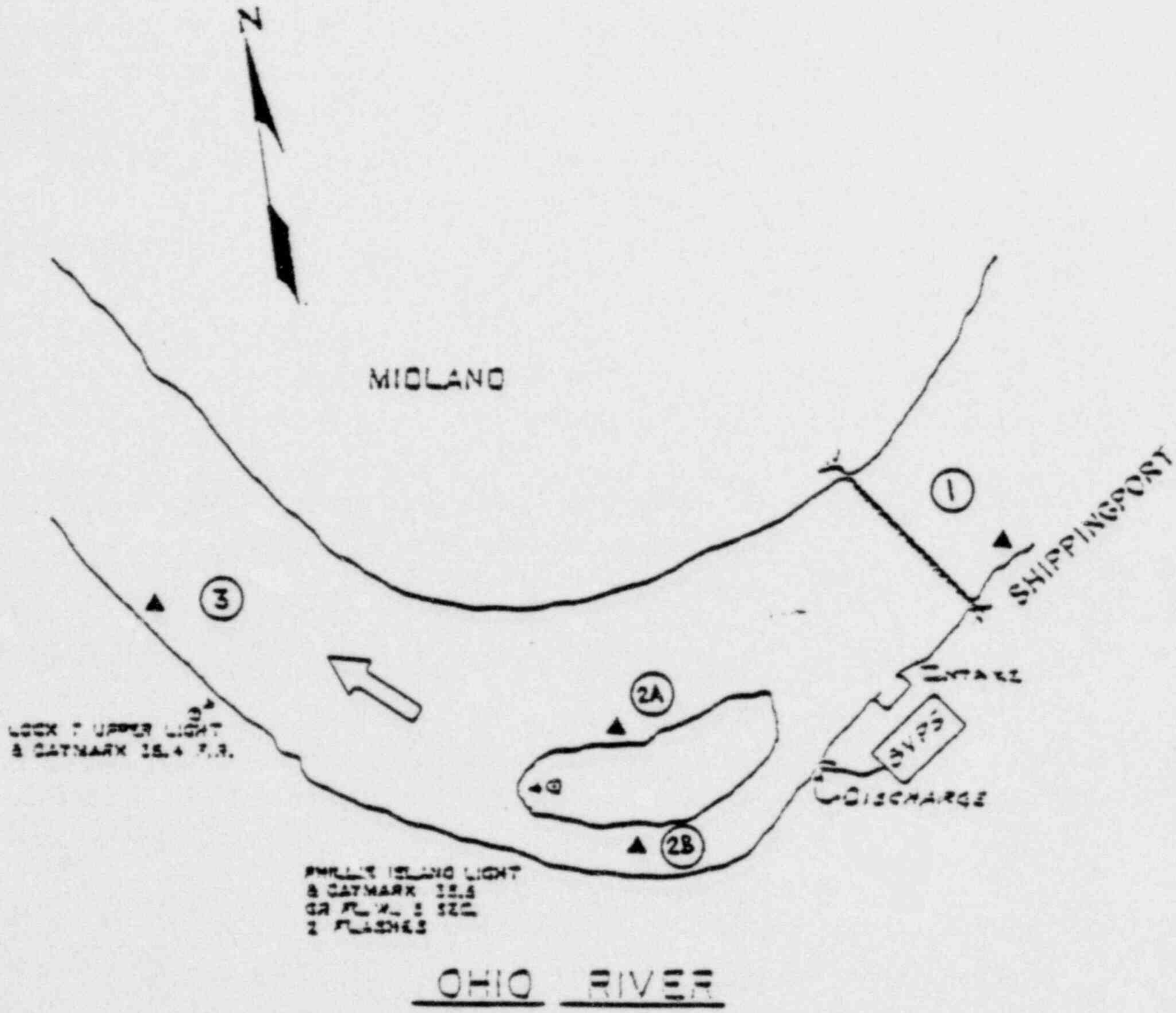
Methods

Three surveys were performed in 1980 to characterize the benthic macroinvertebrate community on a seasonal basis. Surveys were conducted in February (winter), May (spring), and September (summer-fall). The February survey consisted of taking three replicate Ponar grab samples at each river bank and at midriver along Transects 1, 2A and 3. In the back channel of Phillis Island (Transect 2B), one grab sample was taken at each river bank and one at midchannel (Figure V-A-1). The benthos portion of the modified aquatic monitoring program initiated after April 1, 1980 included duplicate ponar grabs collected along the south shore of Transects 1, 2A, and 3 (Figure V-B-1). Benthic sampling at Transect 2B (back channel) remained unchanged i.e., single ponar grabs at the south, midchannel, and north bank.

Each grab was washed with a U.S. Standard No. 30 sieve and the remains placed in a bottle and preserved with formalin. In the laboratory, macroinvertebrates were sorted from each sample, identified to the lowest possible taxon and counted. Mean densities (numbers/m^2) for each taxon were calculated for each of three replicates and three back channel samples. Four species diversity indices were calculated: Shannon and Evenness indices (Pielou 1969), the Richness Index (Dahlberg and Odum 1970) and the number of species (taxa).

Habitats

Substrate type is one of the most important factors in determining the type of benthic community which may develop. Two distinct benthic habitats exist in the Ohio River near BVPS and are the result of damming, channelization, and river traffic. Shoreline habitats are generally soft muck-type substrates composed of sand, silt and detritus. One exception is along the north shoreline of Phillis Island at Transect 2A where clay and sand predominate. This condition was caused by



▲ Sampling Station

O Station Number

FIGURE V-B-1

BENTHOS SAMPLING STATIONS
BVPS

sand dredging operations many years ago. The other distinct habitat is located at midriver. Midriver habitats, unlike shoreline habitats, are hard. A condition caused initially by damming and channelization but aggravated by river currents and tow and barge traffic.

Forty macroinvertebrate taxa were identified during the 1980 monitoring program (Table V-B-1). Species composition during 1980 was similar to previous preoperational (1973-1975) and operational (1976-1980) years. The macroinvertebrate assemblage during 1980 was composed primarily of borrowing organisms typical of soft unconsolidated substrates. Oligochaetes (worms) and chironomid (midge) larvae were abundant (Tables V-B-3, V-B-4, V-B-5). Common genera of oligochaetes were Limnodrilus, Ilydorilus, Aulodrilus, Tubifex, Dero, and Peloscolex. Common genera of chironomids were Procladius, Coelotanypus, and Harnischia. In previous years, the Asiatic clam (Corbiculla) was present and abundant. None were collected during 1979 or 1980.

No ecologically important additions of species were identified nor were any threatened or endangered species collected during 1980.

Community Structure and Spatial Distribution

Oligochaetes accounted for the highest percentages of the macroinvertebrates at all sampling sites with the exception of Transect 2B in September (Table V-B-2) when Mollusca (fingernail clams) was the most abundant macroinvertebrate group. Oligochaetes always accounted for a greater percentage of the macroinvertebrate community at Transects 1 and 3 as compared to Transects 2A and 2B where Chironomidae and Mollusca are usually common.

In general, the density of macroinvertebrates during 1980 was lowest at 2A and higher at Transects 1 and 3 where substrates near the shore were composed of soft mud or various combinations of sand and silt. Lower abundance at Transect 2A is probably related to poor substrate conditions (clay and sand) along the north shore line of Phillis Island.

TABLE V-B-1

SYSTEMATIC LIST OF MACROINVERTEBRATES COLLECTED IN PREOPERATIONAL
AND OPERATIONAL YEARS IN THE OHIO RIVER NEAR
BVPS

	Preoperational			Operational				
	1973	1974	1975	1976	1977	1978	1979	1980
Porifera								
Spongilla fragilis						X		
Cnidaria								
Hydrozoa								
Clavidae								
Cordylophora lacustris		X		X	X	X		
Hydridae								
Craspedacusta sowerbyi				X				
Hydra sp.	X		X	X	X	X	X	
Platyhelminthes								
Tricladida		X		X	X	X		
Rhabdocoela				X	X	X		
Nemertea							X	X
Nematoda	X	X	X	X	X	X	X	X
Entroprocta								
Urnatella gracilis	X	X	X	X	X	X	X	X
Ectoprocta								
Federicella sp.					X	X		
Paludicella articulata					X		X	
Pectinatella sp.	X							
Plumatella sp.	X							
Annelida								
Oligochaeta								
Aeolosomatidae			X	X	X			X
Enchytraeidae		X		X	X	X	X	X
Naididae								
Amphichaeta leydigii						X		
Amphichaeta sp.							X	
Arcteonais lomondi					X			X
Aulophorus sp.					X			X
Chaetogaster diaphanus				X	X	X	X	X
C. diastrophus						X		X
Dero digitata	X		X			X		
D. nivea	X					X		
Dero sp.	X	X		X	X	X	X	X

TABLE V-B-1 (Continued)

	Preoperational			Operational				
	1973	1974	1975	1976	1977	1978	1979	1980
Nais barbata						X		
N. bretscheri	X	X			X	X		
N. communis	X					X		
N. elinguis						X		
N. variabilis						X		
Nais sp.	X	X	X	X	X		X	X
Ophidonais serpentina								X
Paranais frici	X	X		X	X	X	X	X
Paranais sp.							X	
Pristina osborni				X			X	
P. sima				X				
Pristina sp.				X				
Psammoryctides curvisetosus		X						
Slavina appendiculata					X			
Stephensoniana trivandrana				X	X	X		
Stylaria lacustris				X				
Uncinais uncinata			X					
Tubificidae								
Aulodrilus limnobius	X	X	X	X	X	X	X	X
A. pigueti	X		X	X	X	X	X	X
A. pluriseta	X			X	X	X	X	X
Borthrioneurum vejdovskyanum				X	X	X	X	X
Branchiura sowerbyi		X		X	X	X	X	X
Ilyodrilus templetoni	X	X	X	X	X	X	X	X
Limnodrilus cervix	X			X	X	X	X	X
L. cervix (variant)	X	X	X	X		X		X
L. claparedeianus	X	X		X	X	X	X	X
L. hoffmeisteri	X	X	X	X	X	X	X	X
L. spiralis		X	X			X		
L. udekemianus	X	X	X	X	X	X	X	X
Limnodrilus sp.						X		
Peloscolex multisetosus longidentus		X			X	X	X	
P. m. multisetosus	X	X	X	X	X	X	X	X
Potamothrix moldaviensis	X							
Tubifex tubifex	X	X			X	X	X	X
Unidentified immature forms:								
with hair chaetae	X	X	X	X	X	X	X	X
without hair chaetae	X	X	X	X	X	X	X	X
Lumbriculidae								
Hirudinea								
Glossiphoniidae								
Helobdella stagnalis				X				
Helodbella sp.	X							
Erpobdellidae								
Erpobdella sp.	X							
Mooreobdella microstoma		X				X		

TABLE V-B-1 (Continued)

	Preoperational			Operational				
	1973	1974	1975	1976	1977	1978	1979	1980
Arthropoda								
Acarina				X		X		X
Ostracoda				X	X	X		
Amphipoda								
Talitridae								
Hyallela azteca						X	X	
Gammaridae								
Cragonyx pseudogracilis		X						
Cragonyx sp.		X						
Gammarus fasciatus						X		X
Gammarus sp.	X	X		X		X	X	X
Decapoda							X	
Collembolla		X						
Ephemeroptera								
Heptageniidae	X		X					
Stenacron sp.				X				
Stenonema sp.								X
Caenidae								
Caenis sp.				X			X	
Tricorythodes sp.	X							
Ephemeridae								
Ephemera sp.							X	
Megloptera								
Sialis sp.							X	
Odonata								
Gomphidae								
Dromogomphus spoliatus		X						
Dromogomphus sp.							X	
Gomphus sp.		X				X	X	X
Trichoptera								
Psychomiidae								
Polycentropus sp.						X		
Hydropsychidae							X	
Cheumatopsyche sp.	X			X				
Hydropsyche sp.						X		
Hydroptilidae								
Hydroptila sp.						X		
Oxyethira sp.	X							
Leptoceridae								
Oecetis sp.		X		X				
Coleoptera		X						
Hydrophilidae						X		
Elmidae								
Ancyronyx variegatus						X		
Dubiraphia sp.		X				X		
Helichus sp.	X							
Stenelmis sp.	X				X	X		
Psephenidae				X				

TABLE V-B-1 (Continued)

	Preoperational			Operational				
	1973	1974	1975	1976	1977	1978	1979	1980
Diptera								
Unidentified Diptera		X		X	X	X	X	X
Psychodidae				X				
Pericoma sp.						X		
Psychoda sp.						X		
Telmatoscopus sp.		X						
Unidentified Psychodidae pupae						X		
Chaoboridae								
Chaoborus sp.	X	X	X	X		X	X	
Simulidae								
Similium sp.				X				
Chironomidae								
Chironominae							X	
Chironominae pupa							X	
Chironomus sp.		X	X	X		X	X	X
Cryptochironomus sp.	X	X	X	X	X	X	X	X
Dicrotendipes nervosus	X							
Dicrotendipes sp.	X	X		X				
Glyptotendipes sp.						X	X	
Harnischia sp.		X	X	X		X	X	X
Micropsectra sp.				X				
Microtendipes sp.						X		
Parachironomus sp.		X						
Polypedilum (s.s.) *convictum* type						X		
P. (s.s.) *simulans* type						X		
Polypedilum sp.	X	X					X	
Rheotanytarsus sp.	X				X	X	X	
Stenochironomus sp.		X			X	X		X
Stictochironomus sp.				X				
Tanytarsus sp.			X			X	X	
Tanypodinae								
Ablabesmyia sp.	X	X		X				
Coelotanypus scapularis		X	X	X		X		
Procladius (*Procladius*)							X	X
Procladius sp.	X	X	X	X	X	X	X	X
Thienemannimyia group	X		X		X	X	X	
Zavrelimyia sp.						X		
Orthocladiinae							X	
Cricotopus bicinctus						X		
C. (s.s.) *trifascia*						X		
Cricotopus (*Isocladius*) *sylvestris* Group							X	
C. (*Isocladius*) sp.						X		
Cricotopus (s.s.) sp.	X	X		X		X		
Eukiefferiella sp.					X	X	X	
Hydrobaenus sp.						X		
Limnophyes sp.						X		
Nannocladius (s.s.) *distinctus*			X	X	X	X		
Nannocladius sp.							X	

TABLE V-B-1 (Continued)

	Preoperational			Operational				
	1973	1974	1975	1976	1977	1978	1979	1980
Orthocladius sp.	x	x	x	x	x		x	
Parametriocnemus sp.		x				x		
Paraphaenocladius sp.						x	x	
Psectrocladius sp.	x	x						
Pseudorthocladius sp.						x		
Pseudosmittia sp.				x	x			
Smittia sp.		x			x	x	x	x
Diamesinae								
Diamesa sp.		x						
Potthastia sp.		x						
Ceratopogonidae	x	x		x	x	x		
Dolichopodidae					x	x		
Emphididae		x		x	x	x		
Wiedemannia sp.		x						
Ephydridae						x		
Muscidae				x	x			
Rhagionidae						x		
Tipulidae						x		
Stratiomyiidae					x			
Syrphidae						x		
Lepidoptera				x	x			x
Mollusca								
Gastropoda								
Ancylidae								
Ferrissia sp.	x	x			x	x		
Planorbidae							x	
Valvatidae								
Valvata perde ressa								
Pelecypoda						x		
Corbiculidae								
Corbicula manilensis		x	x	x	x	x		
Sphaeridae							x	x
Pisidium sp.	x			x				
Sphaerium sp.	x			x	x	x	x	
Unidentified immature Sphaeriidae				x	x	x		
Unionidae								
Anadonta grandis						x		
Elliptio sp.						x		
Unidentified immature Unionidae	x				x	x		

TABLE V-B-2

MEAN NUMBER OF MACROINVERTEBRATES (Number/m^2) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA AND OTHER ORGANISMS FOR 1980

	Sampling Transect							
	No. 1		No. 2A		No. 2B		No. 3	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
February 13*								
Oligochaeta	1,011	99	361	53	1,015	80	4,931	99
Chironomidae	9	<1	7	1	3	1	29	<1
Mollusca	4	<1	257	38	171	13	16	<1
Others	2	<1	57	8	80	6	9	<1
Totals	1,026	101	682	100	1,279	100	4,985	101
May 21								
Oligochaeta	1,029	99	40	69	741	99	594	95
Chironomidae	6	<1	6	10			12	2
Mollusca	6	<1			6	<1		
Others			12	21			20	3
Totals	1,041	101	58	100	747	100	626	100
September 23								
Oligochaeta	1,483	97	839	79	107	24	1,128	100
Chironomidae			40	4	124	28		
Mollusca	20	1	188	18	217	48		
Others	20	1						
Totals	1,523	99	1,067	101	448	100	1,128	100

*February samples were 3 replicates from stations at the north and south banks, midriver and back channel.

TABLE V-B-3

BENTHIC MACROINVERTEBRATE DENSITIES (Individuals/m^2), MEAN OF TRIPLICATE SAMPLES COLLECTED IN THE OHIO RIVER NEAR BVPS ON FEBRUARY 13, 1980

Taxa	Sampling Transect No. 1 South Bank	No. 1 Mid River	No. 1 North Bank	No. 2A South Bank	No. 2A Mid River	No. 2A North Bank	No. 2B	No. 3 South Bank	No. 3 Mid River	No. 3 North Bank
Platyhelminthes										
Planariidae							7			
Entoprocta										
Urnatella gracilis	+					+	+	+		
Nemertea			7			7	27			
Nematoda										20
Annelida										
Oligochaeta										
Aeolosomatidae										7
Enchytraeidae	7						7	26		7
Lumbriculidae								7		
Arcteonais lomondi								7		13
Chaetogaster diaphanus						7				
C. diastrophus						7				
Dero sp.	7		92			20	7	125		26
Nais sp.		20	33	7		79	27	7		119
Paranais frici	7		125				13	171		40
Aulodrilus limnobius	13		7		7					20
A. piqueti										
A. pluriseta										7
Bothrioneurum vejdovskyanum								20		
Branchiura sowerbyi	7							13		
Ilyodrilus templetoni	53			132				20		40
Limnodrilus cervix	20			59	40		53	7		342
L. claparedeianus					7		13	184		33
L. hoffmeisteri	369	7	26	270	99		112			1,220
L. udekemianus				7			33			
Peloscolex m. multisetosus	46		171		20	7	112	283		902
Tubifex tubifex							13			79
Immatures w/o capilliform chaetae	1,541		244	92	178	39	586	810		7,681
Immatures w/ capilliform chaetae	132		99				26	356		474
Cocoon	7					7	13	99		1,647
Hirudinea					13		7			

TABLE V-B-3 (Continued)

Taxa	Sampling Transect No. 1 South Bank	No. 1 Mid River	No. 1 North Bank	No. 2A South Bank	No. 2A Mid River	No. 2A North Bank	No. 2B	No. 3 South Bank	No. 3 Mid River	No. 3 North Bank
Arthropoda										
Acarina										7
Amphipoda										
Gammarus fasciatus	7						59			
Gammarus sp.				7		138	7			
Insecta										
Ephemeroptera										
Stenonema sp.						13				
Odonata										
Gomphus sp.										7
Diptera										
Unidentified Diptera								13		
Chironomidae										
Ablabesmyia sp.										
Chironomus sp.							3			7
Orthocladius sp.					7					
Procladius sp.	7							7		
Procladius (*Procladius*) sp.	13		7					40		26
Smittia sp.								7		
Stenochironomus sp.					7					
Chironomid adult					7					
Mollusca										
Sphaeriidae	13			20	725	26	171	7		40
Totals	2,249	27	811	594	1,110	350	1,296	2,209		12,764

TABLE V-B-4

BENTHIC MACROINVERTEBRATE DENSITIES (Individuals/m^2), MEAN OF TRIPLICATE FOR BACK CHANNEL AND DUPLICATE SAMPLES COLLECTED IN THE MAIN CHANNEL, OHIO RIVER NEAR BVPS ON MAY 21, 1980

Taxa	No. 1 South Bank	No. 2A South Bank	No. 2B	No. 3 South Bank
Nematoda				10
Bryozoa				
Urnatella gracilis	+		+	+
Annelida				
Oligochaeta				
Enchytraeidae			7	
Dero sp.				
Nais sp.			7	
Ophidonais serpentina			20	
Paranais frici		20	7	10
Aulodrilus limnobius	10		7	
Ilyodrilus templetoni	10			
Limnodrilus cervix	10		7	10
L. claparedeianus	10			
L. hoffmeisteri	276		40	168
L. udekemianus	20		27	30
Peloscolex m. multisetosus			7	10
Tubifex tubifex	10			30
Immatures w/o capilliform chaetae	593	20	573	227
Immatures w/ capilliform chaetae	30		13	40
Cocoon	30		26	69
Arthropoda				
Gammarus sp.		6		
Lepidoptera		6		
Diptera				
Unidentified Diptera				10
Orthocladiinae				6
Ceratopogonidae	6	6		6
Mollusca				
Sphaeriidae	6		6	
Total	1,041	58	747	626

TABLE V-B-5

BENTHIC MACROINVERTEBRATE DENSITIES (Individuals/m^2), MEAN OF TRIPLICATE FOR BACK CHANNEL AND DUPLICATE SAMPLES COLLECTED IN THE MAIN CHANNEL, OHIO RIVER NEAR BVPS ON SEPTEMBER 23, 1980

Taxa	No. 1 South Bank	No. 2A South Bank	No. 2B	No. 3 South Bank
Cnidaria				
Hydra				
Nematoda	20			
Bryozoa				
Urnatella gracilis			+	+
Annelida				
Oligochaeta				
Dero sp.		10		
Aulodrilus limnobius	40	10	27	
Aulodrilus pigueti		10		
Bothrioneurum vejdovskyanum	10			
Branchiura sowerbyi	30			10
Ilyodrilus templetoni	40		7	20
Limnodrilus cervix	20	30		20
L. hoffmeisteri	434	128	13	583
L. udekemianus	20	108	7	30
Immatures w/o capilliform chaetae	810	474	40	415
Immatures w/ capilliform chaetae	79	69	13	40
Cocoon				10
Arthropoda				
Diptera				
Chironomus sp.			7	
Coelotanypus sp.		10	51	
Cryptochironomus sp.		10	7	
Harnischia sp.		10	20	
Orthocladius sp.			13	
Procladius sp.			13	
Procladius (Procladius)		10	13	
Mollusca				
Sphaeriidae	20	188	217	
Total	1,523	1,067	448	1,128

Density and species composition variations observed within the BVPS study area is due largely to habitat differences and the tendency to cluster of certain types of macroinvertebrates (e.g., oligochaetes). Overall, abundance and species composition within the study area were similar. This conclusion is based on an understanding of habitat differences and species observed near BVPS.

Comparison of Control and Non-Control Transects

The benthos portion of the modified aquatic monitoring program initiated after April 1, 1980 included duplicate ponar grabs collected along the south shore of Transects 1, 2A and 3. Benthic sampling at Transect 2B (back channel) remained unchanged i.e., single ponar grabs at the south midchannel and north bank locations.

No adverse impact to the benthic community was observed during 1980. This is based on data analyses performed to determine significant environmental change between Transects 1 (control) and 2B (non-nontrol) and assessment of species composition and densities.

Data indicate that oligochaetes are usually predominate throughout the study area (Figure V-B-2). The most abundant taxa at Transects 1 and 2B in February, May and September were immature tubificids without capilliform chaetae (Tables V-B-3, -4 and -5). The oligochaetes which were common or abundant at both transects during February were *Limnodrilus hoffmeisteri*, *Paranais frici*, and *Peloscolex multisetosus*. In May, *Limnodrilus hoffmeisteri* was the dominant species at Transects 1 and 2B. *Limnodrilus hoffmeisteri* and *Aulodrilus limnobius* were the most abundant worms at Transect 2B.

Frequently more chironomid larvae and sphaeriid clams [illegible]e found at Transect 2B as compared to Transect 1. This usually results in a slightly higher Shannon diversity and evenness at Transect 2B (Table V-B-6) and suggests that the macroinvertebrate community at Transect 2B is as "healthy" or healthier" than that at Transect 1. The mean number of taxa and Shannon indices for the back channel were within the range of values observed for other transects in the study area. Differences

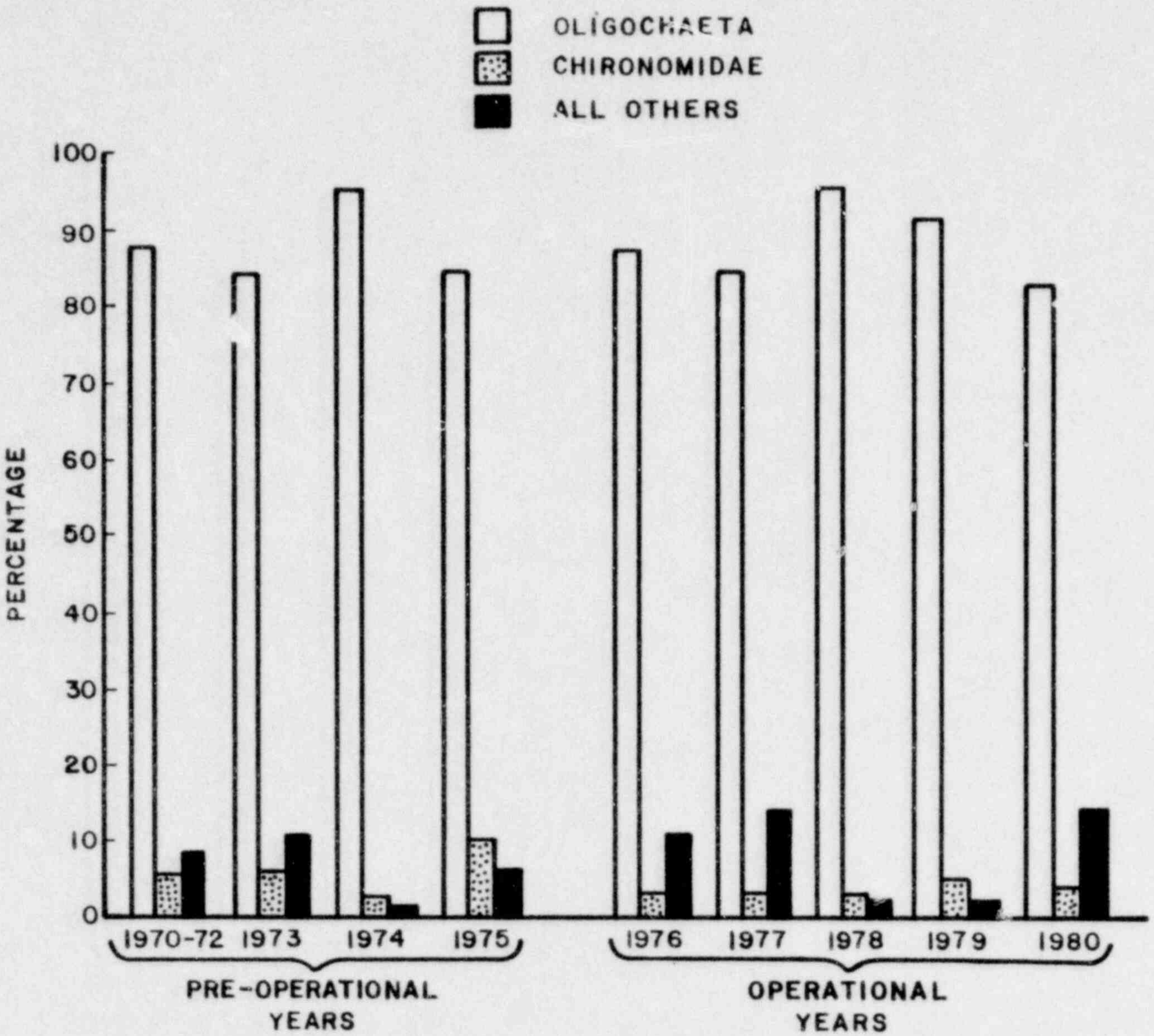


FIGURE V-B-2

PERCENT COMPOSITION OF THE BENTHOS COMMUNITY IN THE OHIO RIVER NEAR BVPS DURING PREOPERATIONAL AND OPERATIONAL YEARS

Table V-B-6

MEAN DIVERSITY VALUES FOR BENTHIC MACROINVERTEBRATES
COLLECTED IN THE OHIO RIVER NEAR BVPS, 1980

	Transect 1			Transect 2A			Transect 2B	Transect 3		
Date	South Bank	Mid Channel	North Bank	South Channel	Mid Channel	North Bank	Back Channel	South Bank	Mid Channel	North Bank
February 13										
No. of Taxa	9	2	5	5	5	6	10	13	0	16
Shannon Index	1.52	0.82	1.54	1.69	1.13	1.88	2.19	2.76		1.97
Evenness	0.49	0.82	0.59	0.72	0.39	0.88	0.59	0.74		0.50
May 21										
No. of Taxa	8			2			6	10		
Shannon Index	1.79			1.12			1.27	2.57		
Evenness	0.64			0.48			0.46	0.79		
September 23										
No. of Taxa	9			10			6	6		
Shannon Index	1.87			2.34			1.98	1.62		
Evenness	0.59			0.72			0.72	0.60		

observed between Transect 1 (control) and 2B (non-control) and between other transects can be related to differences in habitat. None of the differences could be related to BVPS operation.

During the first quarter of 1980, no significant changes in benthic group and total macroinvertebrate densities were detected from the reporting limits/criteria established for benthos.

Comparison of Preoperational and Operational Data

Composition, percent occurrence and overall abundance of macroinvertebrates has changed little from preoperational years through the current study year. Oligochaetes have predominated the community each year and they composed 83% of the community in 1980 (Figure V-B-2). A similar oligochaete assemblage has been reported each year. Chironomids and mollusks have composed the remaining minor fractions of the community each year. The potential nuisance clam, Corbicula, had increased in abundance from 1974 through 1976, but declined in number after 1977. No Corbicula were collected during 1979 or 1980.

Total macroinvertebrate densities for Transect 1 (control) and 2B (non-control) for each year since 1973 are presented in Table V-B-7. Mean densities of macroinvertebrates have gradually increased from 1973 through BVPS Unit 1 start-up (1976) until the current study year 1980. Mean densities were frequently higher in the back channel of Phillis Island (non-control) as compared to densities at Transect 1 (control). In years when mean densities were lower at Transect 2B than at Transect 1 the differences were negligible. These differences can be related to substrate and variability and randomness of sample grabs. Similar or higher total densities of macroinvertebrates in the back channel as compared to Transect 1 indicate that the back channel is as "healthy", if not "healthier" than the benthos of the control transect.

Summary and Conclusions

Substrate composition is probably the most important factor controlling the benthic macroinvertebrate community of the Ohio River near BVPS. Soft muck-

TABLE V-B-7

BENTHIC MACROINVERTEBRATE DENSITIES (Number/m^2) FOR TRANSECT 1 (CONTROL) AND TRANSECT 2B (NON CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS BVPS

	Preoperational Years						Operational Years									
	1973		1974		1975		1976		1977		1978		1979		1980	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
January																
February	205	0	703	311			358	200	312	1,100	1,499	2,545			1,029	1,296
March													425	457		
April																
May	248	508	1,116	2,197			927	3,660	674	848	351	126	1,004	840	1,041	747
June	5	40	507	686												
July	653	119	421	410												
August	99	244	143	541	1,017	1,124	851	785	591	3,474	601	1,896	1,185	588		
September			175	92											1,523	448
October	256	239														
November	149	292	318	263	75	617	388	1,295	108	931	386	1,543	812	806		
December																
Mean	231	206	483	643	546	871	631	1,485	421	1,588	709	1,528	856	673	1,198	830

type substrates along the shoreline are conducive to worm and midge proliferation while limiting macroinvertebrates which require a more stable bottom. The predominant macroinvertebrates were burrowing taxa typical of soft substrates. Oligochaeta accounted for over 83% of the macrobenthos. Mollusca, the next most abundant group in 1980, accounted for 10% of the macroinvertebrates.

Community structure has changed little since preoperational years and there was no evidence that BVPS operations are affecting the benthic community of the Ohio River.

C. PHYTOPLANKTON

Objectives

Plankton sampling shall be conducted to determine the condition of the phytoplankton community of the Ohio River in the vicinity of the BVPS Unit 1 and to assess possible environmental impact to the phytoplankton.

Methods

During the first quarter of 1980, two replicate samples were collected monthly at the surface (1 ft) and bottom (15 ft) at the Transects 1, 2A, 2B, and 3 (Figure V-A-1). Each sample was a composite prepared by collecting water in a 5 gal carboy from a submersible pump which was slowly towed along the transect. Separate passes were made to collect duplicate samples. A 1 gal sample was taken from the carboy and preserved with Lugol's solution. This 1 gal sample was used for the analysis of both phytoplankton and zooplankton. After April 1, 1980, plankton sampling was reduced to one entrainment sample collected monthly. Each sample was a 1 gal composite which contained equal volumes of surface and bottom water.

In the laboratory, a known aliquot of well-mixed sample was concentrated by settling, the supernatant was decanted and the concentrate diluted to a final volume. An aliquot of 0.1 ml from the final concentrate was placed in a Palmer-Maloney cell and examined at 400X magnification. Approximately 200 cells were identifed and counted in each sample. For each collection date, aliquot size was adjusted depending on cell density, however the same area of the Palmer cell was examined for all samples. A Hyrax diatom slide was prepared monthly from a composite of all river samples. This slide was examined at 1000X magnification for the purpose of making positive diatom identification. This information was used as an aid in identifying diatoms seen in individual samples.

Mean densities (cells/ml), Shannon and Evenness diversity indices (Pielou 1969), and Richness index (Dahlberg and Odum 1970) were calculated based upon two replicate surface and two replicate bottom samples.

Samples for pigment analysis were taken from the 5 gal carboy. Each sample was filtered through 0.45 micron membrane filter. Filters were retained as samples. Analyses were performed in accordance with "Biological Field and Laboratory Methods" (EPA 1973).

Seasonal Distribution

During the first quarter of 1980, phytoplankton was sparce, a common occurrence during the winter. Total mean densities were between 464 and 838 cells/ml (Table V-C-1). On April 1, 1980 the phytoplankton sampling program was reduced to one entrainment sample collected monthly. Total cell densities of phytoplankton from stations on the Ohio River and in the intake samples have been similar during the past four years (Figure V-C-1). Data from past Annual Ecological Reports also indicate that the species composition has been similar in entrainment samples and those from the Ohio River. Therefore, samples collected from the intake bays should provide an adequate characterization of the phytoplankton community in the Ohio River.

Total mean densities increased in May and developed the annual maximum of 21,600 cells/ml) in July (Table V-C-2). Populations decreased sharply in August and increased again in September to a secondary maximum (Figure V-C-2). The two peaked cycle of phytoplankton development is common in many large rivers and lakes in north temperate climates (Hutchinson 1967, Hynes 1970). Densities decreased steadily after September to low densities normally observed during December.

Diatoms (Chrysophyta) and green algae (Chlorophyta) were usually the most abundant groups of the phytoplankton during 1980 (Figure V-C-3). The group Microflagellates were dominant (48%) in February and common (38 and 21%) in June and August. Blue-greens (Cyanophyta) were also common (28%) during August (Table V-C-2). The decrease of phytoplankton densities and shift of composition in algal groups in June and August was probably due to increased flow and turbidity which were caused by frequent rains during the summer of 1980. Hynes (1970) noted that silty, high water conditions reduce plankton densities and alter the species composition.

TABLE V-C-1

MEAN PHYTOPLANKTON GROUP DENSITIES (Number/ml) AND PERCENT COMPOSITION FOR DUPLICATE SURFACE (1 ft) AND BOTTOM (15 ft) SAMPLES COLLECTED IN THE OHIO RIVER NEAR BVPS, JANUARY TO MARCH 1980

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
Group	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
January										
Chlorophyta	232	28	143	20	133	24	132	19	160	23
Chrysophyta	343	41	273	39	264	47	296	43	294	42
Cyanophyta	113	14	74	10	50	9	69	10	76	11
Cryptophyta	26	3	16	2	18	3	11	2	18	3
Microflagellates	119	14	200	28	90	16	178	26	147	21
Other Groups	9	1	1	<1	6	1	0	0	4	<1
Total	838	101	707	100	561	100	686	100	699	101
February										
Chlorophyta	142	26	86	18	90	18	92	16	102	20
Chrysophyta	139	26	113	24	143	28	221	38	154	30
Cyanophyta	12	2	5	1	15	3	9	2	10	2
Cryptophyta	6	1	4	1	4	1	3	<1	4	<1
Microflagellates	241	45	256	55	251	50	251	43	250	48
Other Groups	0	0	0	0	0	0	2	<1	1	<1
Total	540	100	464	99	503	100	578	101	521	101
March										
Chlorophyta	116	14	84	12	96	17	96	12	98	14
Chrysophyta	462	58	432	63	334	59	542	69	442	62
Cyanophyta	21	3	16	2	12	2	8	1	14	2
Cryptophyta	4	<1	6	1	0	0	4	<1	4	1
Microflagellates	196	24	146	21	122	22	138	18	150	21
Other Groups	0	0	0	0	0	0	0	0	0	0
Total	799	100	684	99	564	100	788	101	708	100

TABLE V-C-2

MONTHLY PHYTOPLANKTON GROUP DENSITIES (Number/ml) AND PERCENT COMPOSITION FOR ENTRAINMENT AND OHIO RIVER SAMPLES COLLECTED AT BVPS, 1980

Group	Jan x̄ #/ml		Jan x̄ %		Feb x̄ #/ml		Feb x̄ %		Mar x̄ #/ml		Mar x̄ %		Apr #/ml	Apr %	May #/ml	May %	Jun #/ml	Jun %
Chlorophyta	99[a]	(160)[b]	18	(23)	87	(102)	21	(20)	32	(102)	7	(14)	25	6	560	19	180	14
Chrysophyta	256	(294)	47	(42)	105	(154)	26	(30)	312	(442)	70	(62)	315	81	1,900	65	580	45
Cyanophyta	33	(76)	6	(11)	9	(10)	2	(2)	7	(14)	2	(2)						
Cryptophyta	13	(18)	2	(3)	3	(4)	1	(1)	1	(4)	<1	(1)	5	1			40	3
Microflagellates	146	(147)	27	(21)	205	(250)	50	(48)	89	(150)	20	(21)	45	12	480	16	480	38
Other Groups	<1	(4)		(1)		(1)		(1)	1	[illegible]	<1	(0)						
Total	548	(699)	100	(101)	410	(521)	100	(101)	443	(708)	101	(100)	390	100	2,940	100	1,280	100

Group	Jul #/ml	Jul %	Aug #/ml	Aug %	Sept #/ml	Sept %	Oct #/ml	Oct %	Nov #/ml	Nov %	Dec #/ml	Dec %
Chlorophyta	16,040	74	400	17	6,640	59	4,060	56	1,520	52	64	8
Chrysophyta	4,440	21	720	31	3,960	35	2,940	40	1,050	36	624	79
Cyanophyta			640	28					60	2	12	2
Cryptophyta	280	1	80	3	80	1	80	1	60	2	20	2
Microflagellates	840	4	480	21	400	4	200	3	230	8	68	9
Other Groups					80	1						
Total	21,600	100	2,320	100	11,160	100	7,280	100	2,920	100	788	100

[a]Entrainment samples.

[b]Values ( ) are means from 16 river samples.

TABLE V-C-3

CHLOROPHYLL a AND PHEOPHYTIN CONCENTRATIONS (ug/liter)
MEAN CONCENTRATION OF DUPLICATE SAMPLES
COLLECTED IN THE OHIO RIVER NEAR BVPS DURING
JANUARY AND FEBRUARY 1980

	Sampling Transect								
	No. 1		No. 2A		No. 2B		No. 3		
Depth:	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	$\bar{x}$
January 10, 1980									
Chlorophyll a	2.0	1.6	1.6	1.0	1.4	2.2	1.8	<0.5	1.5
Pheophytin	<0.8	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5	<0.6
February 14, 1980									
Chlorophyll a	0.8	0.9	<0.7	0.6	0.6	1.0	<0.6	1.4	<0.8
Pheophytin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.6

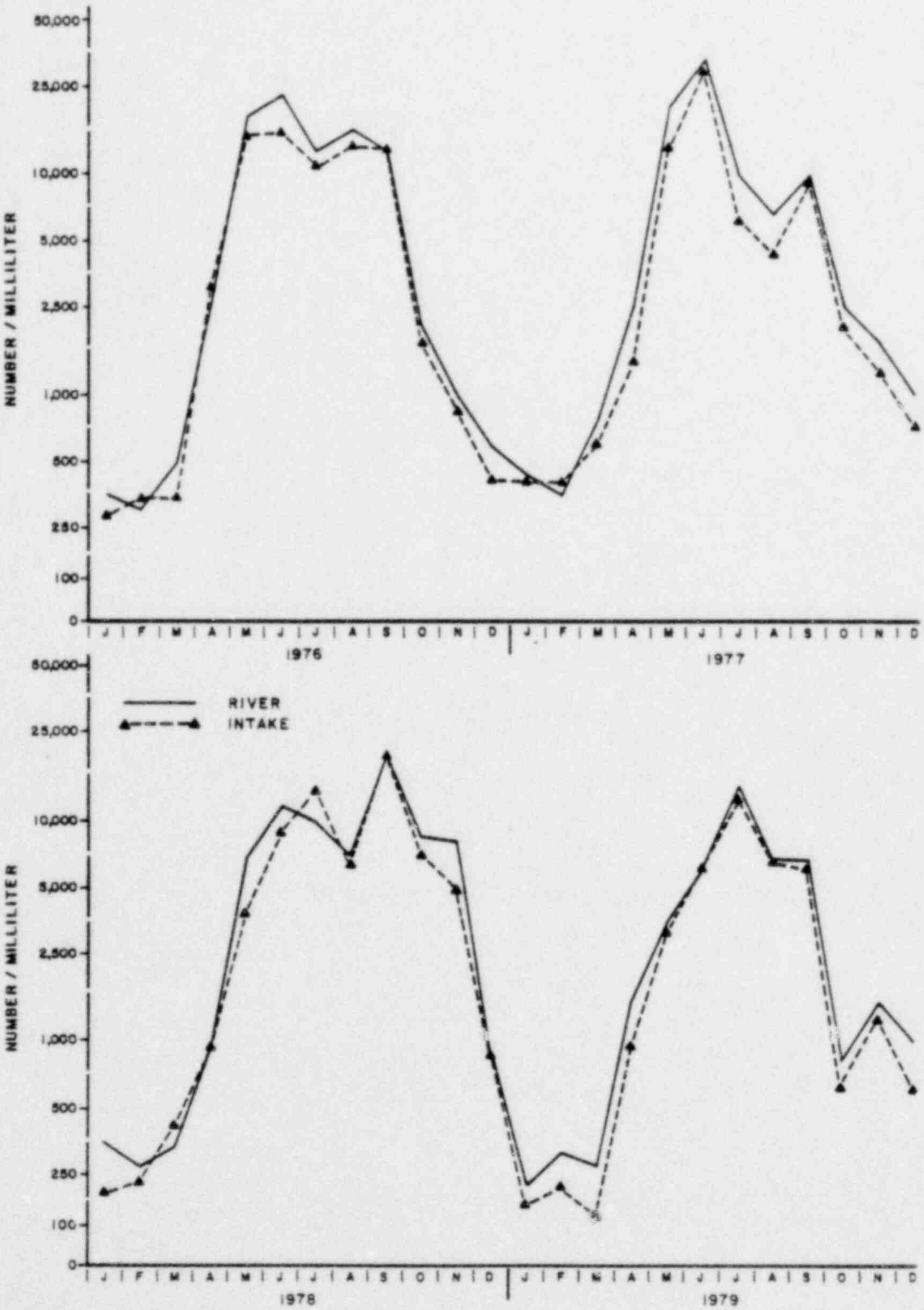


FIGURE V-C-1

MEAN TOTAL PHYTOPLANKTON DENSITIES FOR OHIO RIVER
AND ENTRAINMENT (INTAKE) SAMPLE[illegible] 1976-1979
BVPS

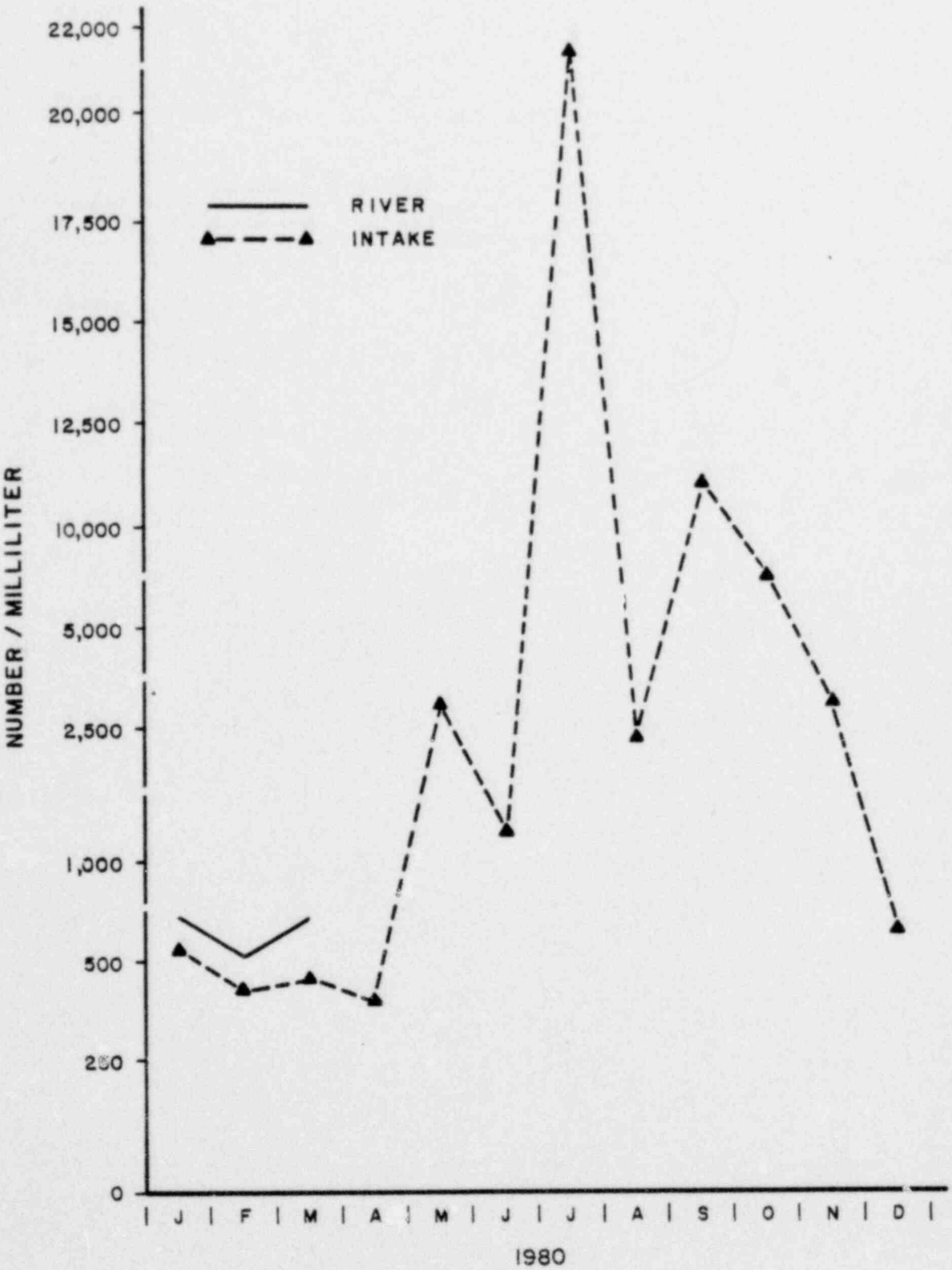


FIGURE V-C-2

MEAN TOTAL PHYTOPLANKTON DENSITIES FOR OHIO RIVER
AND ENTRAINMENT (INTAKE) SAMPLES, 1980
BVPS

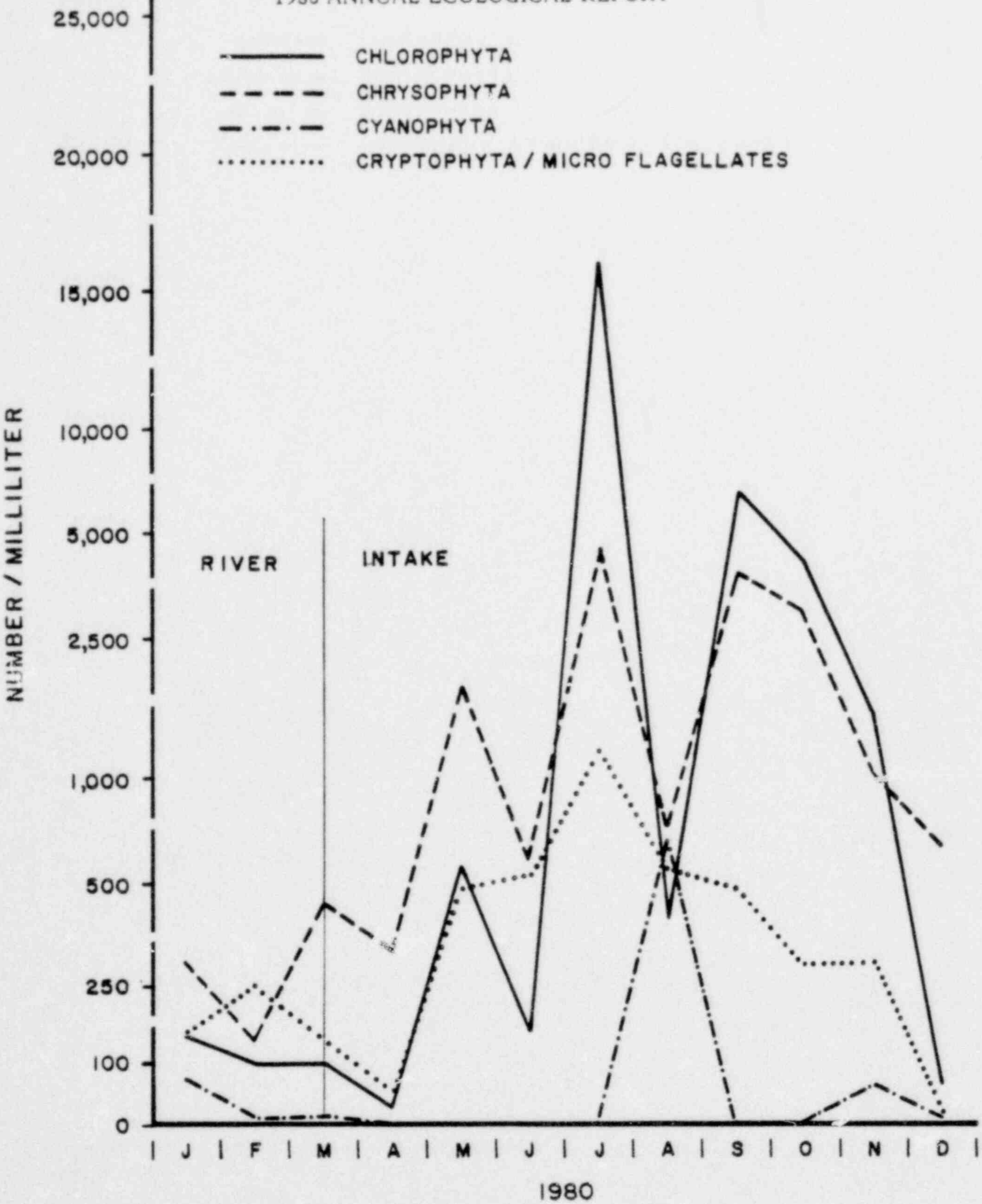


FIGURE V-C-3

SEASONAL PATTERNS OF CHLOROPHYTA, CHRYSOPHYTA, CYANOPHYTA AND CRYPTOPHYTA/MICROFLAGELLATE DENSITIES WHICH COMPRISED PHYTOPLANKTON IN THE OHIO RIVER AND ENTRAINMENT (INTAKE) OF BVPS 1980

In January and February, 1980 chlorophyll a and phaeophytin concentrations varied little among the sampling transects upstream and downstream of BVPS (Table V-C-3). Concentrations of chlorophyll a ranged from 0.5 to 2.2 ug/l whereas phaeophytin ranged from 0.5 to 1.2 ug/l. These values are similar to those observed during January and February of previous years (NUS 1976, 1977, 1979, NALCO 1978) Chlorophyll a and phaeophytin were not measured after April 1, 1980.

Diversity indices of the phytoplankton during 1980 are presented in Tables V-C-4 and V-C-5. Shannon indices ranged from 2.50 to 4.56, evenness values were from 0.58 to 0.88 and richness values were from 1.94 to 5.40. Higher diversities tended to be in late summer and fall. The highest values of Shannon and Richness occurred in December when numerous taxa were common and no taxa were predominant.

Phytoplankton communities are not usually dominated by one or two species during the year. Different taxa generally predominate during each season. The most abundant taxa during winter (January, February and March) were microflagellates; Navicula virdula a Chrysophyte diatom, was also dominant in March (Table V-C-6). The group Microflagellates were small (10 um), unicellular, flagellated, organisms which are very difficult to positively identify when preserved. During the spring, Navicula viridula and Nitzschia acicularis were dominant in April and May respectively. Microflagellates were dominant in June when turbid, high water conditions were present in the Ohio River. The most abundant taxa during the seasonal maximum in July were Scenedesmus bicellularis, Scenedermus quadricauda (green algae) and "small centrics" (diatoms). Small centric diatoms were present in all phytoplankton samples, and include several small (4 to 12 um dia.) species. Positive species identification was not possible during quantitative analysis at 400X magnification. Burn mount analysis at 1000X magnification revealed the group "small centrics" included primarily Cyclotella atomus, C. pseudostelligera, C. meneghiniana, Stephanidisus hantzschia, and S. astraea. Microflagellates, "small centrics", and a blue-green algae, Coelosphaerium naegelianum, were the most abundant taxa in August when turbid, high water conditions caused a large decrease

TABLE V-C-4

PHYTOPLANKTON DIVERSITY INDICES OF OHIO RIVER SAMPLES COLLECTED FROM
JANUARY 10 TO MARCH 13, 1980. INDICES ARE MEANS OF DUPLICATE
SURFACE AND BOTTOM SAMPLES
BVPS

Transect	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
Depth	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
January 10, 1980										
No. of Species	31	32	26	26	28	31	24	23	27	28
Shannon Index	4.17	4.17	3.66	3.70	3.97	4.24	3.64	3.46	3.86	3.89
Evenness	0.84	0.83	0.78	0.79	0.82	0.85	0.79	.76	0.81	0.81
Richness	4.50	4.57	3.71	3.76	4.41	4.68	3.61	3.35	4.06	4.09
February 14, 1980										
No. of Species	16	15	18	17	17	16	16	27	17	19
Shannon Index	2.77	2.36	2.56	2.42	2.72	2.49	2.39	3.39	2.61	2.66
Evenness	0.69	0.60	0.62	0.58	0.66	0.62	0.60	0.71	0.64	0.63
Richness	2.36	2.25	2.70	2.60	2.56	2.41	2.38	3.96	2.50	2.80
March 13, 1980										
No. of Species	26	25	23	20	18	26	25	27	23	24
Shannon Index	3.74	3.71	3.74	3.57	3.41	4.16	3.86	4.03	3.69	3.87
Evenness	0.81	0.80	0.82	0.82	0.81	0.88	0.83	0.85	0.82	0.84
Richness	3.70	3.57	3.40	2.97	2.76	3.98	3.62	3.91	3.37	3.60

TABLE V-C-5

PHYTOPLANKTON DIVERSITY INDICES BY MONTH FOR ENTRAINMENT SAMPLES* DURING 1980
BVPS

Date	Jan $\bar{x}$	Feb $\bar{x}$	Mar $\bar{x}$	Apr	May	Jun
No. of Species	26[a] (28)[b]	14 (18)	17 (24)	25	21	18
Shannon Index	3.66 (3.87)	2.50 (2.63)	3.36 (3.78)	3.82	3.28	3.26
Evenness	0.78 (0.81)	0.65 (0.6[illegible])	0.82 (0.83)	0.82	0.75	0.78
Richness	3.90 (4.07)	2.20 (2.65)	2.68 (3.48)	4.02	2.50	2.38

Date	Jul	Aug	Sep	Oct	Nov	Dec	$\bar{x}$
No. of Species	30	16	32	24	33	37	24
Shannon Index	3.61	3.45	4.10	3.54	3.73	4.56	3.57
Evenness	0.74	0.86	0.82	0.77	0.74	0.87	0.78
Richness	2.90	1.94	3.33	2.59	4.01	5.40	3.15

*Indices for January, February and March are monthly mean values from six samples (one collected per 4 hrs. for 24 hrs.). Remaining indices are values from one sample collected each month.

[a]Entrainment samples.

[b]Values in ( ) are means from 16 river samples.

TABLE V-C-6

DENSITIES (Number/ml) OF MOST ABUNDANT PHYTOPLANKTON TAXA (fifteen most abundant on any date) COLLECTED
FROM THE NEW CUMBERLAND POOL, OHIO RIVER AND ENTRAINMENT SAMPLES
JANUARY THROUGH DECEMBER 1980[a]
BVPS

Taxa	Jan x̄		Feb x̄		Mar x̄		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CYANOPHYTA															
Anabaena sp.														[illegible]0	
Aphanizomneon flos-aquae	21	(47)													
Coelosphaerium naegelianum											400				
Oscillatoria sp.											120				
Schizothrix calcicola	12	(28)	7	(7)	7	(9)					120				12
CHLOROPHYTA															
Actinastrum hantzschii												240			
Ankistrodesmus convolutus	3	(3)						40		360		480	100	20	
Ankistrodesmus falcatus	9	(14)	7	(6)	1	(2)	10	260	20	360		560	160	110	4
Chlamydomonas globosa	2	(9)	12	(15)	3	(6)		40				40	40	40	
Coelastrum cambricum										800					
Dictyosphaerium pulchellum		(10)	8	(2)									160		
Lagerheimia quadriseta										520		80	60	10	
Macractinim pusillum	3	(16)	5	(12)								120			8
Pediastrum duplex										320					
Scenedesmus acuminatus										640					
Scenedesmus bicellularis	8	(6)	3	(4)					40	6,080		1,880	2,120	890	
Scenedesmus obliques										440					
Scenedesmus quadricauda	5	(10)	3	(2)	5	(6)				3,200	120	680	340	100	40
Schroederia setigera					4	(2)									
Selenastrum minutum								20		520	40	200	480		
Sphaerocystis schroeteri										480		160			
Tetrastrum glabrum	3									560		320	160	40	
Chlorophyta I	59	(76)	47	(54)	17	(66)	15	200	120	1,120	200	1,200	300	280	12
CHRYSOPHYTA															
Achnanthes minutissima							20	20	20	40				30	44
Asterionella formosa	19	(48)	61	(68)	67	(59)	10	20						90	28
Cymbella ventricosa							5		40		40			10	
Diatoma tenue			3	(3)		(7)	15			40					
Diatoma vulgare	10	(5)			7	(9)	10	20						10	16
Dinobryon sertularia							15							30	4
Fragilaria crotonensis												240			
Fragilaria vaucheriae					5	(8)		40			40			10	
Gomphonema parvulum							10	20	20					10	8
Melosira ambigua										120		200			
Melosira distans	7	(9)				(4)				120		1,720	320		12
Melosira granulata												600	360	220	56
Melosira varians	16	(4)	5	(4)	12	(20)	35	40				280		70	32
Navicula cryptocephala	19	(14)	3	(6)	25	(31)	5	60	80			40	20	20	88
Navicula viridula	20	(22)	1	(7)	93	(124)	115	80	120	40	40	40			48
Nitzschia acicularis		(12)					5	900	20	120		40	100	10	12
Nitzschia agnita													300		

TABLE V-C-6 (Continued)

Taxa	Jan x̄		Feb x̄		Mar x̄		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nitzschia dissipata	14	(7)	1	(4)	9	(28)		60	20	80	40			30	48
Nitzschia palea	3	(5)	2	(2)	9	(17)	10	40	60	120	80		20	20	32
Skeletonema potamos										200			1,260	30	8
Synedra filiformis	31	(52)	2	(8)	3	(12)	5	120	20			40		10	16
Synedra ulna							5	40			80				12
Synura uvella							5							60	12
Small Centrics	7[illegible]	(82)	16	(33)	11	(18)	20	420	120	3,520	360	76[illegible]	560	350	76
CRYPTOPHYTA															
Cryptomonas erosa	[illegible]	(8)	3	(2)		(2)	5		40	200		40	20	50	8
Rhodomonas minuta	8	(10[illegible]	1	(2)	1	(2)				80	80	40	60	10	12
MICROFLAGELLATES	146	(147[illegible]	205	(250)	89	(150)	45	480	480	840	480	400	200	230	68
TOTAL PHYTOPLANKTON	548	(698)	410	(521)	443	(710)	390	2,940	1,280	21,600	2,320	11,160	7,280	2,920	788
TOTAL OF MOST ABUNDANT TAXA	497	(644)	39	(491)	364	(582)	365	2,920	1,220	20,9[illegible]0	2,120	10,400	7,140	2,790	716
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	91	(92)	95	(94)	82	(82)	94	99	95	97	91	93	98	96	91

( )Mea[illegible] densities for samples collected from the Ohio River

[a]Densities for January, February and March are means from six entra[illegible]ent samples and 16 river samples collected each month. Densities for April through December are results from [illegible] entrainment sample collected monthly.

of phytoplankton densities. Scenedesmus bicellularis and Melosira distans were the dominant taxa in September. Scenedesmus bicellularis continued as the dominant species during October and November. The diatoms, Navicula cryptocephala, Melosira granulata and "small centrics" together with microflagellates were the most abundant taxa in December.

Comparison of Control and Non-Control Transects

Analysis of control and non-control transects emphasizes the comparison of data collected upstream of the plant (Transect 1) to data collected in the back channel of Phillis Island (Transect 2B), which is immediately downstream of the BVPS discharge structure. Plankton samples were not collected at the river stations after April 1, 1980 due to a reduction of the aquatic sampling program. Analyses were performed to determine if reporting limits/criteria were exceeded (See Section III). The reporting limits/criteria were not exceeded during the first quarter of 1980. This verifies the qualitative conclusions that the phytoplankton populations were not changed by the BVPS discharge during the first quarter.

Comparison of Preoperation and Operational Data

The seasonal succession of phytoplankton varied from year to year, but overall the phytoplankton has remained generally consistant. Phytoplankton communities in running waters respond quickly to changes in water temperature, turbidity, nutrients, velocity and turbulence (Hynes 1970). The phytoplankton of the Ohio River near BVPS generally exhibited a bimodal pattern (Figure V-C-4). During the preoperational year 1974, total densities peaked in August and October while in the operational years of 1976 through 1979 mean peak densities occurred in June and September. Phytoplankton densities displayed a bimodal pattern in 1980 (Figure V-C-4). The small, tertiary peak in May should not be considered a true population peak because the population increase during the spring was interrupted in June by high water and increased turbidity from frequent heavy rain showers. In general, the phytoplankton in 1980 was similar to those of preoperational and operational years. No major change in community structure was observed during 1980. The slight variations in the phytoplankton community between 1980 and the previous years were natural fluctuations and were not a result of BVPS operations.

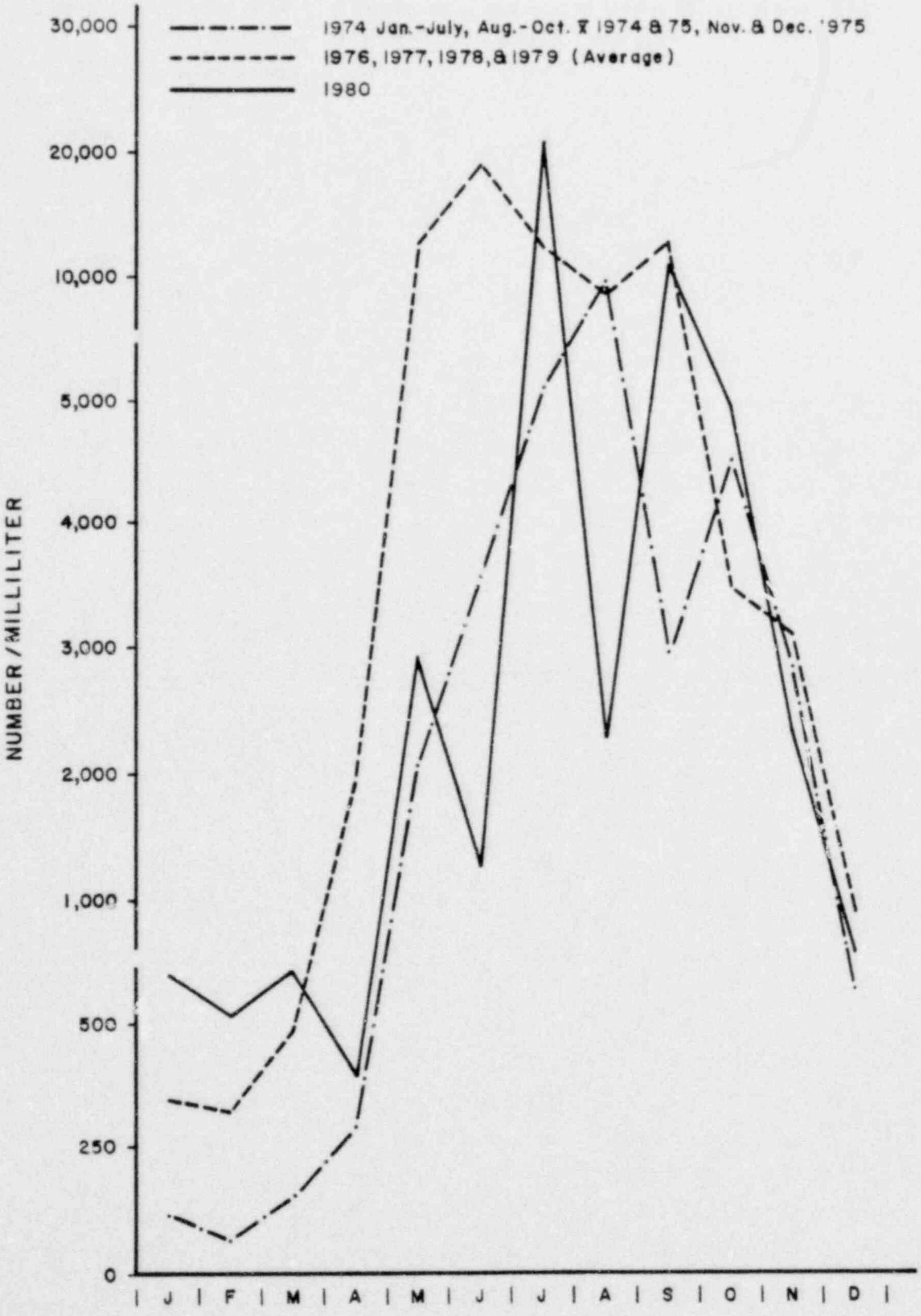


FIGURE V-C-4

SEASONAL PATTERNS OF PHYTOPLANKTON DENSITIES IN THE OHIO RIVER NEAR BVPS DURING PREOPERATIONAL (1974-197) AND OPERATIONAL (1976-1980) YEARS

Yearly mean shannon diversity indices from 1974 to 1980 were similar, ranging from 3.57 in 1980 to 4.36 in 1975 (Table V-C-7). Evenness values were also similar, except during 1973 and 1974 when values were lower. From 1975 to 1980, evenness ranged from 0.73 to 0.83. The greatest possible evenness diversity value is 1.0 and would occur when all individuals are evenly distributed among species. The mean number of taxa each year ranged from 19 in 1973 to 40 in 1975, both preoperational years. Number of taxa during operational years ranged between 24 and 39 and were within the range observed during preoperational years.

Summary and Conclusions

The phytoplankton community of the Ohio River near BVPS exhibited a seasonal pattern similar to that observed in previous years and a pattern common to temperate, lotic environments. Total cell densities were within the range observed during previous years.

Results of sampling during 1980 gave no evidence to indicate that BVPS Unit 1 operational adversely affected the Ohio River phytoplankton.

TABLE V-C-7

PHYTOPLANKTON DIVERSITY INDICES (MEAN OF ALL SAMPLES 1973 TO 1980)
NEW CUMBERLAND POOL OF THE OHIO RIVER
BVPS

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	x̄
1973													
No. of Species	7	2		13	24	27	28	30		24	17	16	19
Shannon Index	1.55	0.54	No	0.63	1.64	2.28	3.55	3.72	No	3.37	3.25	3.27	2.38
Evenness	0.33	0.15	Sample	0.11	0.25	0.35	0.55	0.52	Sample	0.50	0.54	0.53	0.38
Richness	1.24	0.29		1.50	2.63	3.17	3.61	3.46		3.24	2.89	2.80	2.48
1974													
No. of Species	12	8	17	22	44	46	47	60	34	47			34
Shannon Index	2.96	2.23	3.18	3.50	4.89	4.40	4.03	4.25	3.85	5.02	No Sample		3.83
Eveneas	0.55	0.46	0.57	0.58	0.62	0.62	0.56	0.55	0.54	6.58			0.56
Richness	2.55	1.82	3.05	3.74	5.56	5.45	5.46	6.49	4.77	5.44			4.43
1975													
No. of Species								52	34	43	32	40	40
Shannon Index				No Sample				4.53	4.22	4.[illegible]	4.22	4.48	4.36
Evenness								0.80	0.83	0.81	0.87	0.85	0.83
Richness								5.57	3.96	4.89	3.92	6.19	4.9[illegible]
1976													
No. of Species	31	35	31	38	47	49	46	43	38	33	35	38	39
Shannon Index	3.98	4.36	3.90	4.25	4.14	4.27	4.28	4.30	3.93	4.16	4.24	4.45	4.19
Evenness	0.80	0.85	0.78	0.81	0.75	0.76	0.78	0.80	0.75	0.83	0.83	0.85	0.80
Richness	5.15	5.89	4.92	4.70	4.68	4.79	4.72	4.34	3.85	4.17	4.[illegible]5	5.79	4.83
1977													
No. of Species	20	28	31	24	36	30	44	39	37	32	33	27	32
Shannon Index	1.96	3.31	3.00	2.78	4.16	3.52	4.36	4.26	4.29	3.92	4.12	4.00	3.64
Evenness	0.44	0.70	0.61	0.60	0.80	0.72	0.80	0.81	0.82	0.78	0.82	0.83	0.73
Richness	3.14	4.57	4.44	2.95	3.53	2.77	4.63	4.26	3.87	3.98	4.18	3.72	3.[illegible]
1978													
No. of Species	37	29	32	42	28	42	36	37	35	37	34		35
Shannon Index	4.08	3.68	3.77	4.67	3.30	4.16	3.95	4.17	3.81	3.99	3.80	-	3.99
Evenness	0.78	0.76	0.76	0.87	0.69	0.78	0.77	0.80	0.76	0.77	0.76	0.90	0.78
Richness[a]													
1979													
No. of Species	18	16	19	36	34	27	34	24	29	25	28	38	27
Shannon Index	3.49	3.36	3.7[illegible]	3.22	3.78	3.84	4.10	3.88	4.12	4.07	3.68	4.32	3.80
Evenness	0.84	0.82	0.88	0.62	0.74	0.81	0.80	0.84	0.84	0.88	0.77	0.83	0.81
Richness	2.97	2.64	3.36	4.69	4.08	2.98	3.46	2.72	3.26	3.52	3.57	5.19	3.54
1980													
No. of Species	28	18	24	[25	21	18	30	16	32	24	33	37]	24
Shannon Index	3.88	2.64	3.78	[3.82	[illegible].28	3.26	3.61	3.45	4.10	3.54	3.73	4.56]	3.57
Evenness	0.81	0.64	0.83	[0.82	0.75	0.78	0.74	0.86	0.82	0.77	0.74	0.87]	0.78
Richness	4.[illegible]	2.65	3.49	[4.02	2.50	2.38	2.90	1.94	3.33	2.59	4.01	5.40]	3.15

(a) No data

[ ] Data represent single entrainment samples collected monthly.

D. ZOOPLANKTON

Objective

Plankton sampling shall be conducted to determine the condition of the zooplankton community of the Ohio River in the vicinity of the BVPS Unit 1 and to assess possible environmental impact to the zooplankton.

Methods

During the first quarter of 1980, zooplankton samples were one liter aliquots which were taken from the Lugol samples previously described for phytoplankton. One liter samples were filtered through a 35 micron (.035 mm) mesh screen. The portion retained was washed into a graduated cylinder and allowed to settle for a minimum of 24 hr. The supernatant was drawn off to 10 ml. One milliter of this thoroughly mixed concentrate was placed in a Sedgwick-Rafter cell and examined at 100X magnifications. All zooplankters within the cell were identified to the lowest practicable taxon and enumerated. Mean densities (individual /1), Shannon and Evenness diversity indices (Pielou 1969), and Richness index (Dahlberg and Odum 1970) were calculated based upon two replicate surface and two replicate bottom samples.

Seasonal Distribution

The zooplankton community of a river system is primarily composed of protozoans and rotifers (Hynes 1970, Winner 1975). The zooplankton community of the Ohio River near BVPS during preoperational and operational monitoring years was primarily composed of protozoans and rotifers.

On April 1, 1980 the zooplankton sampling program was reduced to one entrainment sample collected monthly. Total organism density of zooplankton from the Ohio River and entrainment samples have been similar during the past four years (Figure V-D-1). Also, the species composition has been similar in samples collected from the Ohio River and Intake bays. Therefore, samples collected from the Intake bays should provide an adequate characterization of the zooplankton community of the Ohio River.

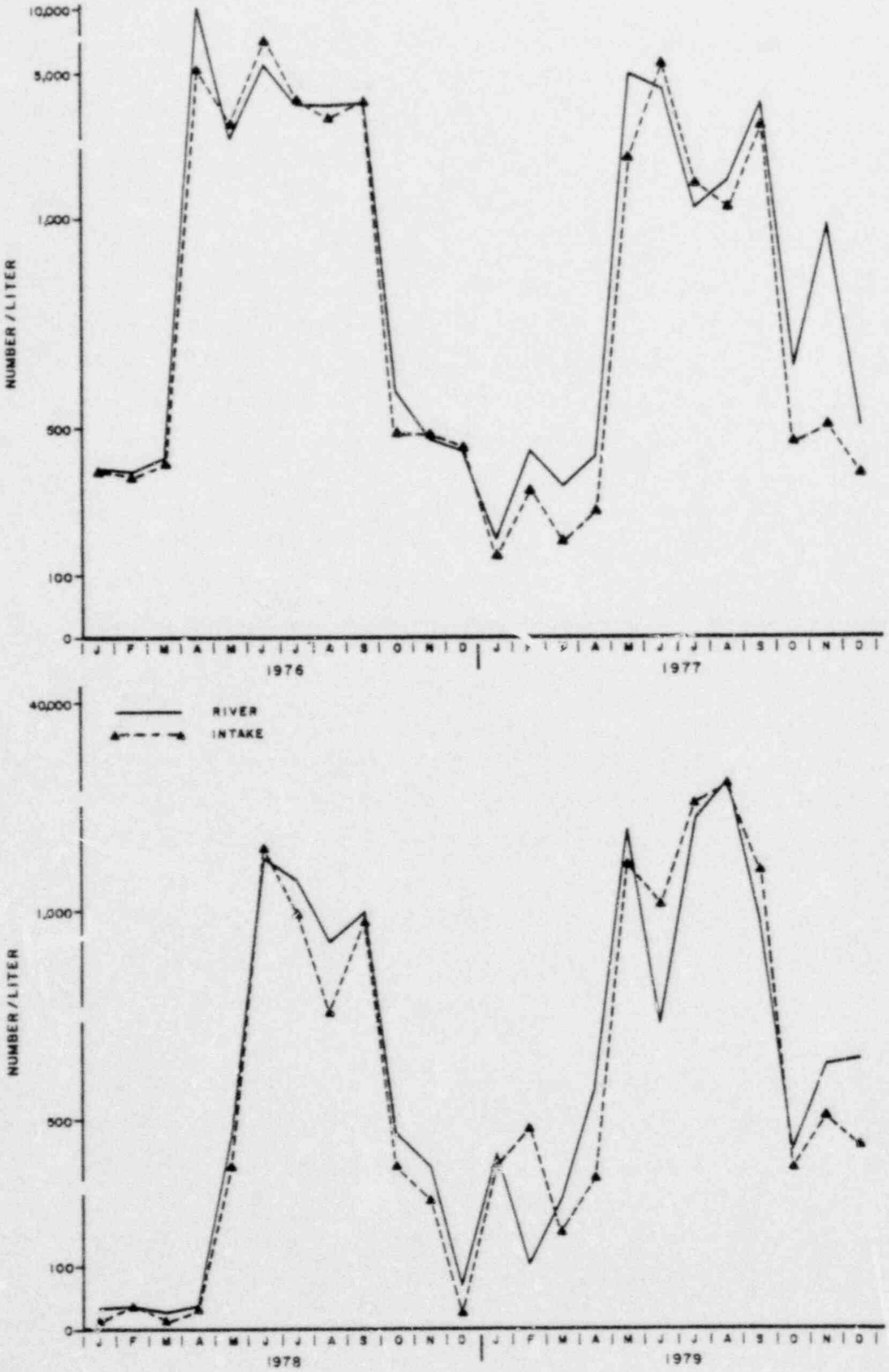


FIGURE V-D-1

MEAN TOTAL ZOOPLANKTON DENSITIES FOR OHIO RIVER AND
ENTRAINMENT (INTAKE) SAMPLES 1976-1979
BVPS

During 1980, protozoans and rotifers accounted for 98% or more of all zooplankton on all sampling dates (Table V-D-1 and V-D-2). Total organism densities during the winter and early spring (January through April) were less than 410/liter. Lowest total density during 1980 was 270/liter which occurred in April (Figure V-D-2). Total organism densities increased slightly in May and June. A secondary maximum of total densities occurred in July and the annual maximum occurred in October. This population trend was similar to the one which occurred in the 1974 preoperational year (Figure V-D-3). Zooplankton populations in the Ohio River usually exhibit a bimodal pattern. The maximum zooplankton density in the Ohio River near BVPS frequently occurs in the spring, although high water conditions and turbidity can sometimes alter or delay the maximum until summer or early fall. This effect of floods and turbidity on plankton communities has been described by Hynes (1970).

The seasonal pattern of zooplankton densities observed in the Ohio River near BVPS is typical of temperate climates (Hutchinson 1967). Zooplankton densities in winter are low primarily due to low water temperatures and limited food availability (Winner 1975). In the spring, food availability and water temperatures increase which stimulate growth and reproduction. Zooplankton populations decrease during the fall and winter from the summer maximum because optimum conditions for growth and reproduction decrease during fall and winter.

Densities of protozoans during January through June of 1980 were between 300 and 390/liter except during April when densites were 190/liter (Table V-D-3). Protozoans increased in July to 1620/liter. High water conditions and turbidity caused a sharp decrease of protozoan populations to 380/liter in August. The densities increased in September until the seasonal maximum of 3010/liter was reached in October. Protozoans decreased in November and December to densities near 700/liter. The most common protozoan during 1980 was Vorticella sp. which dominated the protozoan assemblage during seven months (Table V-D-4). The most abundant protozoans in the other months were Cyclotrichium (February), Strombidium (July), Codonella cratera (August), Difflugia acuminata (September),

TABLE V-D-1

MEAN ZOOPLANKTON GROUP DENSITIES (Number/liter) AND PERCENT COMPOSITION FOR DUPLICATE SURFACE (1 ft) AND BOTTOM (15 ft) SAMPLES COLLECTED IN THE OHIO RIVER NEAR BVPS, JANUARY TO MARCH 1980

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
Group	#/l	%	#/l	%	#/l	%	#/l	%	#/l	%
January										
Protozoa	311	72	219	69	412	87	301	74	311	76
Rotifera	116	27	94	30	58	12	104	26	93	23
Crustacea	6	1	2	1	4	1	1	1	3	1
Total	433	100	315	100	474	100	406	101	407	100
February										
Protozoa	304	97	296	97	279	94	346	92	306	95
Rotifera	9	3	8	3	18	6	31	8	16	5
Crustacea	0	0	0	0	0	0	0	0	0	0
Total	313	100	304	100	297	100	377	100	322	100
March										
Protozoa	408	88	392	85	315	90	240	93	339	88
Rotifera	52	11	70	15	32	9	18	7	43	11
Crustacea	2	1	0	0	5	1	0	0	2	1
Total	462	100	462	100	352	100	258	100	384	100

TABLE V-D-2

MONTHLY ZOOPLANKTON GROUP DENSITIES (Number/liter) AND PERCENT COMPOSITION FOR ENTRAINMENT AND OHIO RIVER SAMPLES COLLECTED AT BVPS, 1980

Group	Jan $\bar{x}$ #/l	Jan $\bar{x}$ %	Feb $\bar{x}$ #/l	Feb $\bar{x}$ %	Mar $\bar{x}$ #/l	Mar $\bar{x}$ %	Apr #/l	Apr %	May #/l	May %	Jun #/l	Jun %
Protozoa	176[a] (311)[b]	76 (76)	195 (306)	94 (95)	370 (339)	94 (88)	190	70	390	74	370	88
Rotifera	51 (93)	22 (23)	12 (16)	6 (5)	23 (43)	6 (11)	80	30	140	26	50	12
Crustacea	3 (3)	1 (1)	1 (0)	1 (0)	0 (2)	0 (1)	0	0	0	0	0	0
Total	231 (410)	99 (100)	208 (322)	100 (100)	393 (384)	100 (100)	270	100	530	100	420	100

Group	Jul #/l	Jul %	Aug #/l	Aug %	Sept #/l	Sept %	Oct #/l	Oct %	Nov #/l	Nov %	Dec #/l	Dec %
Protozoa	1,620	52	380	78	1,180	58	3,010	79	760	74	640	91
Rotifera	1,470	47	110	22	790	39	780	20	260	25	50	7
Crustacea	20	1	0	0	50	2	30	1	10	1	10	1
Total	3,110	100	490	100	2,020	99	3,820	100	1,030	100	700	99

[a] Entrainment samples.

[b] Mean values for 16 river samples.

TABLE V-D-3

DENSITIES (Number/liter) OF MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2% on any date) COLLECTED FROM THE NEW CUMBERLAND POOL, OHIO RIVER AND ENTRAINMENT SAMPLES
JANUARY THROUGH DECEMBER 1980[a]
BVPS

Taxa	Jan $\bar{x}$	Feb $\bar{x}$	Mar $\bar{x}$	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PROTOZOA												
Acropisthium sp.						20			30			
Arcella sp.	14 (9)	8 (6)	5 (18)				10			10	20	30
Bursaria sp.							190		60			
Centropyxis sp.			3 (1)			10		20			60	30
Codonella cratera	15 (12)	3 (8)	8 (22)	20	40	40	370	200	80	30	30	160
Colpidium sp.		16 (34)	5 (7)			10					30	
Cyclotrichium sp.	70 (116)	60 (103)	30 (56)			10						
Cyphoderia ampulla	1 (1)		2 (8)									
Difflugia acuminata	1		2						690			
Difflugia sp.	2 (1)		3 (8)			10						
Epistilis sp.	10 (20)		15 (12)									
Euglypha compressa			2 (2)	10		10						10
Lionotus sp.		50 (67)	2 (1)								20	
Nebela caudata	4		2 (4)	10								20
Paramecium sp.	1 (2)	2 (9)	2 (4)					10				10
Strobilidium gyrans			187 (68)				40	10		470		
Strobilidium sp.							650	10	130	420	150	20
Tintinnidium fluvitale			2									
Trachelius sp.						10						
Vorticella sp.	54 (143)	38 (50)	83 (108)	140	310	190	120	120	140	1,710	360	60
Holophyrid ciliate		1 (3)				10	50			100	70	10
Oxytrich ciliate		2 (1)	2									
Suctorian ciliate	(1)		2 (1)				20				10	10
Ciliate Unidentified	4 (8)	11 (16)	15 (20)	10	40	50	90	10	30	40	10	30

TABLE V-D-3 (Continued)

Taxa	Jan x̄		Feb x̄		Mar x̄		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ROTIFERA															
Asplanchna sp.	6	(3)	1	(4)	5	(2)								10	
Bdelloids	5	(4)			3	(4)	10							10	10
Brachionus bidentatus			2												
Brachionus calciflorus										220		10		10	
Kellicottia longispina						(4)		10							
Keratella cochlearis	28	(58)	2	(2)	3	(5)	10	20	20	510	30	110	380	70	
Keratella quadrata			1												
Lecane sp.			1			(2)					10				
Monostyla sp.								10							
Ploesoma sp.													100		
Polyarthra dolichoptera	4	(12)		(1)	5	(7)			10	330	10	100	130	80	10
Synchaeta sp.							10	80	10	80		210	80	50	
Tricocerca pusilla										160	20	280			
Tricocerca sp.							10								
Rotifer Unidentified	4	(12)	3	(8)	7	(12)	40	20	10	70		60	80	30	30
CRUSTACEA															
Cyclops bicuspidatus thomasi	2													10	
Cyclopoid copepodite															
Nauplii															
Total Zooplankton	230	(407)	208	(322)	396	(384)	270	530	420	3,110	490	2,020	3,820	1,030	700
Total of Most Abundant Zoplankton	225	(402)	201	(312)	395	(366)	270	530	420	2,880	450	1,930	3,550	1,030	600
Percent Compositon of Most Abundant Zooplankton	98	(99)	97	(97)	100	(95)	100	100	100	93	92	96	93	100	86

( ) Values for samples collected from the Ohio River

[a] Densities for January, February and March are means from six entrainment samples and 16 river samples collected each month. Densities for April through December are results from one entrainment sample collected monthly.

TABLE V-D-4

ZOOPLANKTON DIVERSITY INDICES OF OHIO RIVER SAMPLES COLLECTED FROM JANUARY 10, FEBRUARY 14, AND MARCH 13, 1980. INDICES ARE MEANS OF DUPLICATE SURFACE AND BOTTOM SAMPLES
BVPS

Transect	No. 1		No. 2A		No. 2B		No. 3		x̄	
Depth	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
January 10, 1980										
No. of Species	14	14	10	10	11	14	10	10	11	12
Shannon Index	3.08	2.60	2.57	2.47	2.44	2.02	2.38	2.50	2.62	2.40
Evenness	0.81	0.69	0.75	0.73	0.70	0.52	0.70	0.73	0.74	0.67
Richness	2.25	1.97	1.68	1.63	1.76	2.09	1.57	1.60	1.82	1.82
February 14, 1980										
No. of Species	10	11	10	10	10	13	10	14	10	12
Shannon Index	2.56	2.60	2.54	2.66	2.59	2.73	2.58	3.30	2.57	2.82
Evenness	0.77	0.75	0.74	0.82	0.78	0.74	0.76	0.86	0.76	0.79
Richness	1.64	1.69	1.67	1.50	1.64	2.05	1.65	2.23	1.65	1.87
March 13, 1980										
No. of Species	14	13	12	16	11	11	12	11	12	13
Shannon Index	3.10	2.83	3.06	3.35	2.85	2.96	2.91	3.20	2.98	3.08
Evenness	0.81	0.76	0.84	0.84	0.82	0.86	0.82	0.93	0.82	0.85
Richness	2.17	1.91	1.95	2.37	1.67	1.75	1.81	1.93	1.90	1.99

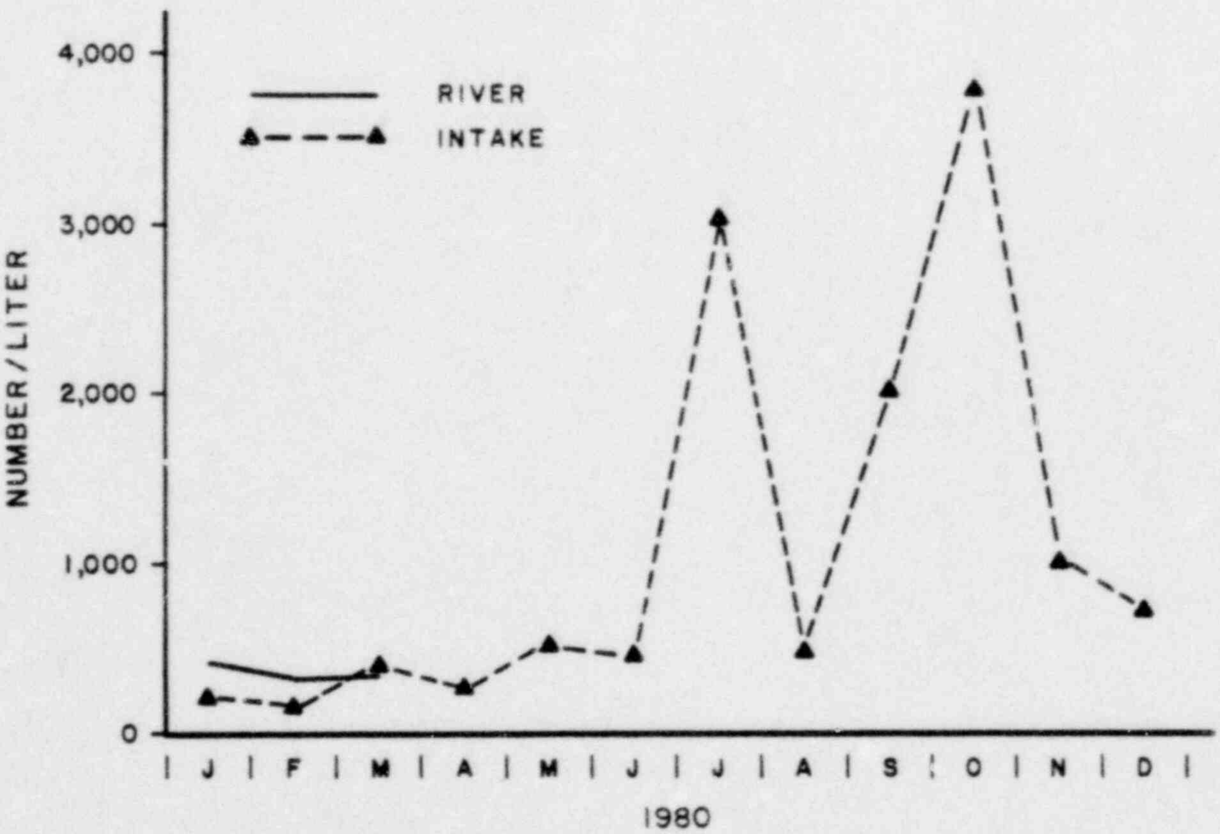


FIGURE V-D-2

MEAN TOTAL ZOOPLANKTON DENSITIES FOR OHIO RIVER AND
ENTRAINMENT (INTAKE) SAMPLES, 1980
BVPS

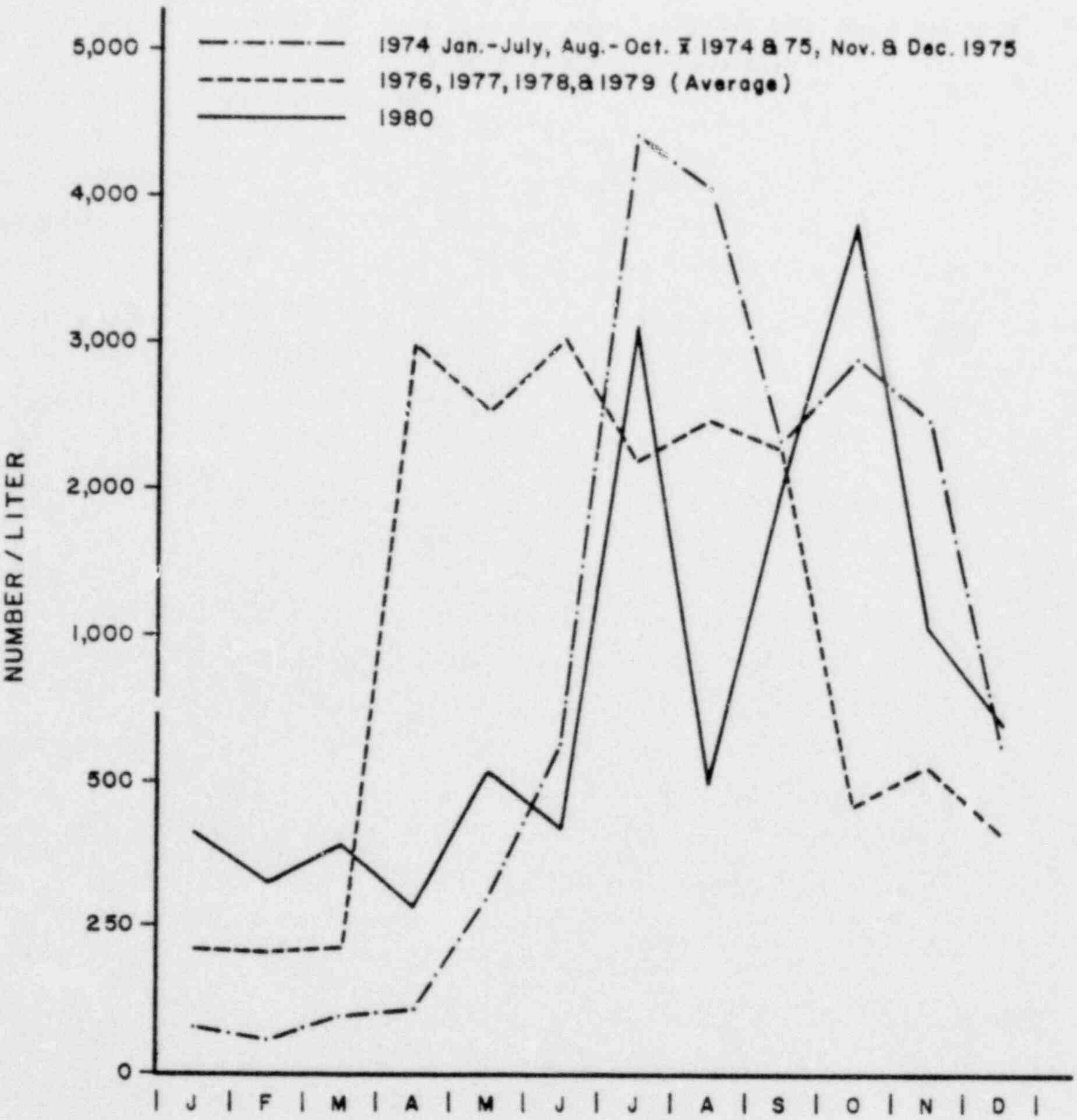


FIGURE V-D-3

SEASONAL PATTERNS OF ZOOPLANKTON DENSITIES IN THE OHIO RIVER NEAR BVPS DURING PREOPERATIONAL (1974-1975) AND OPERATIONAL (1976-1980) YEARS and Arcella (December). These taxa have been a main part of the protozoan assemblage of the Ohio River near BVPS since 1972.

The Rotifer assemblage in 1980 (Figure V-D-4) displayed a typical pattern of rotifer populations in temperate inland waters (Hutchinson 1967). Rotifer densities increased from a minimum of 12/liter (mean) in February to a maximum of 1,470/liter in July (Table V-D-2). Rotifer populations decreased sharply in August when high water levels and increased turbidity were present in the Ohio River. Densities increased to almost 800/liter in September and October before populations declined to densities of 50/liter in December. Rotifers were always the second most abundant group during 1980 when rotifers comprised 5% of the zooplankton community in February and 47% of the community in July. Keratella cochlearis was the most common rotifer during the maximum in July (Table V-D-3). Polyarthra dolichoptera was also a common or abundant rotifer especially from July through December. Brachionus calyciflorus was common in July whereas Trichocerca pusilla was abundant in September.

Densities of crustaceans during 1980 reached their peak in September (Figure V-D-4). Crustacean densities were low (0 to 3/liter) from January through June and increased slightly in July to 20/liter (Table V-D-2). Densities decreased in August and increased to the second maximum (50/liter) for Crustacea in September. Populations decreased from October through December. Crustacean densities never exceeded protozoan or rotifer densities and constituted 0 to 2% of the total zooplankton density each month. Copepod nauplii were the most numerous crustaceans during 1980. Other crustacean taxa occasionally present in low numbers were cyclopoid copepodites, Cyclops bicuspidatus thomasi, and Bosmina longirostris. Crustacean populations were suppressed during the spring and summer of 1980 due to the high water conditions together with increased current and turbidity from frequent rain showers. Crustaceans are rarely numerous in the open waters of rivers and many are eliminated by silt and turbulent water (Hynes 1970).

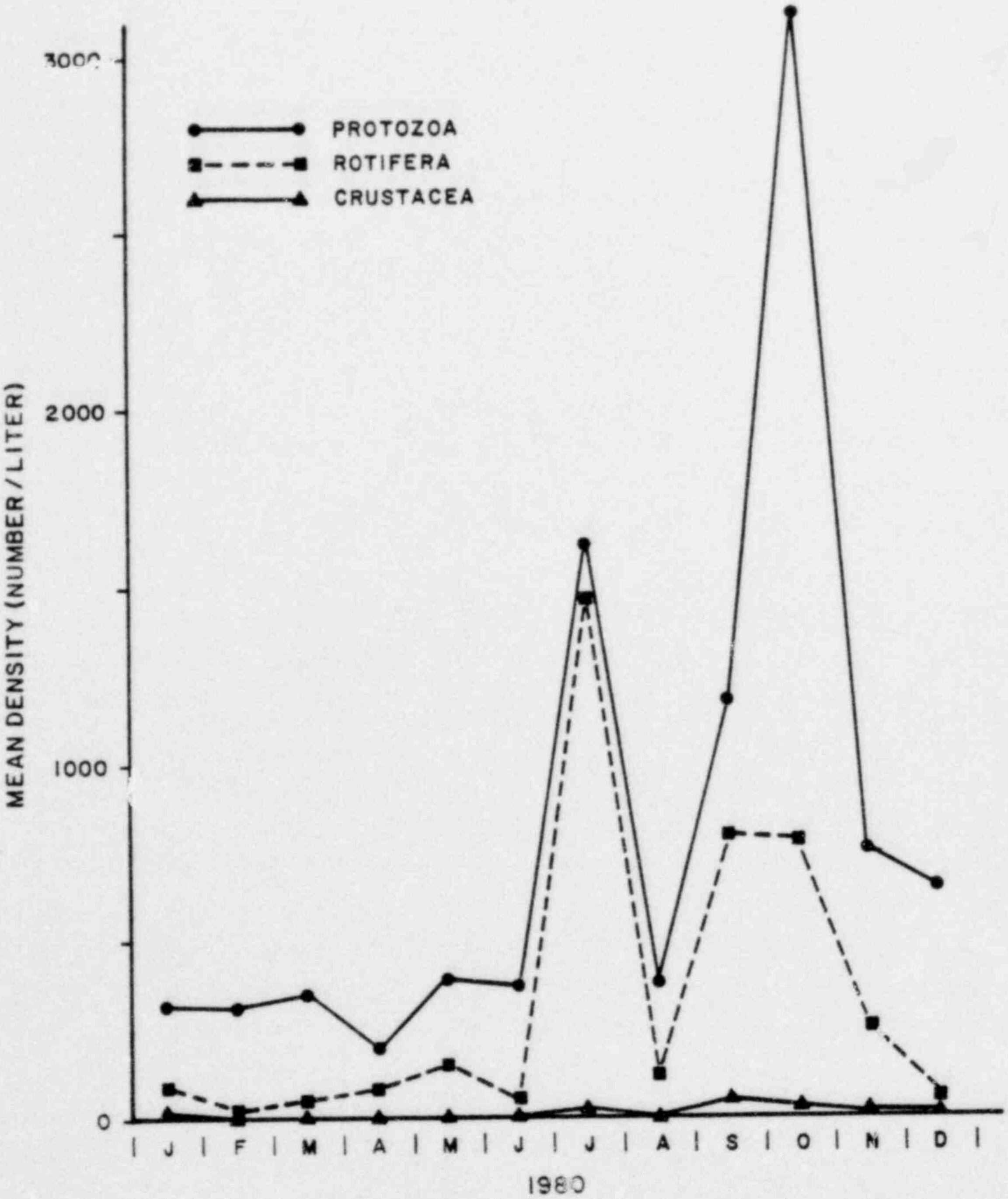


FIGURE V-D-4

MEAN ZOOPLANKTON GROUP DENSITIES FOR ENTRAINMENT (INTAKE) SAMPLES, 1980
BVPS

Shannon diversity indices were above 3.00 during the months when total zooplankton densities were above 600/liter (Tables V-D-4 and V-D-5). The exception occurred during the maximum in October when the Shannon Index was 2.88. Evenness ranged from 0.64 in October to 0.82 in July. Richness varied from 1.12 in May to a maximum of 2.60 in December. The number of species ranged from 8 in May to 22 in October. Low diversity indices in April, May, June and August reflect the adverse river conditions which commonly occurred during the spring and summer of 1980.

Comparison of Control and Non-Control Transects

During the first quarter of 1980, the zooplankton species composition of Transect 1 (control) was similar to that at Transect 2B (non-control) located 0.5 mi (0.8 km) downstream of BVPS discharge structure. Zooplankton densities at Transect 1 were similar to those at Transect 2B especially at 1 ft depths (Table V-D-1). The maximum difference which occurred in March was less than 1.8 times. Diversity indices were similar between Transect 1 and Transect 2B during the first quarter in 1980. Zooplankton samples were not collected from stations on the Ohio River after April 1, 1980.

Comparison of Preoperational and Operational Data

The population dynamics of the zooplankton community during the seasons of preoperational and operational years is displayed in Figure V-D-3. Total zooplankton densities were lowest in winter, usually greatest in summer and transitional in spring and autumn. This pattern in the Ohio River sometimes varies from year to year which is normal for zooplankton populations in other river habitats. Hynes (1970) concluded that the zooplankton community of rivers is inherently unstable and subject to constant change due to variations of temperature, spates, current, turbidity and food source. Mean total densities of zooplankton during 1980 were frequently higher than those of preoperational years (1973-1975) and similar to those observed during operational years (1976-1980) (Table V-D-6).

The species composition of zooplankton in the Ohio River near BVPS has remained stable during preoperational and operational years. The common or abundant

TABLE V-D-5

ZOOPLANKTON DIVERSITY INDICES BY MONTH FOR ENTRAINMENT SAMPLES, 1980
BVPS

Date	Jan	$\bar{x}$	Feb	$\bar{x}$	Mar	$\bar{x}$	Apr	May	Jun
No. of Species	11	(12)	10	(11)	9	(13)	10	8	15
Shannon Index	2.65	(2.51)	2.55	(2.69)	2.21	(3.03)	2.41	2.00	2.91
Evenness	0.76	(0.70)	0.79	(0.77)	0.69	(0.83)	0.72	0.66	0.74
Richness	1.84	(1.82)	1.62	(1.76)	1.52	(1.94)	1.61	1.12	2.32

Date	Jul	Aug	Sept	Oct	Nov	Dec	$\bar{x}$
No. of Species	21	15	18	22	18	18	15
Shannon Index	3.63	2.79	3.23	2.88	3.26	3.36	2.82
Evenness	0.82	0.71	0.77	0.64	0.78	0.80	0.74
Richness	2.49	2.26	2.23	2.55	2.45	2.60	2.05

TABLE V-D-6

MEAN ZOOPLANKTON DENSITIES (Number/liter) BY MONTH FROM 1973 THROUGH 1980, OHIO RIVER AND BVPS

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Total Zooplankton												
1973	-[a]	50	-	90	154	588	945	1,341	-	425	180	87
1974	78	56	96	118	299	625	4,487	3,740	1,120	4,321	-	-
1975	-	-	-	-	-	-	-	4,426	3,621	1,591	2,491	623
1976	327	311	347	10,948	2,516	5,711	3,344	3,296	3,521	518	446	577
1977	147	396	264	393	5,153	4,128	1,143	1,503	3,601	553	934	486
1978	31	30	20	35	403	1,861	1,526	800	1,003	435	297	60
1979	357	96	228	534	2,226	599	2,672	4,238	950	370	542	550
1980	410 (230)	322 (208)	385 (393)	270	530	420	3,110	490	2,029	3,820	1,030	700
Protozoa												
1973	-	45	-	63	82	188	56	331	-	346	135	58
1974	50	42	72	91	138	409	1,690	716	1,006	4,195	-	-
1975	-	-	-	-	-	-	-	835	3,295	1,141	2,239	452
1976	278	274	305	10,774	1,698	6	1,903	1,676	808	425	396	492
1977	135	365	236	312	4,509	2,048	808	947	2,529	401	825	344
1978	18	14	14	27	332	1,360	407	315	256	222	227	26
1979	312	64	188	380	2,052	459	340	712	609	326	454	328
1980	311 (177)	306 (195)	339 (370)	190	390	370	1,620	380	1,180	[illegible],010	760	640
Rotifera												
1973	-	5	-	25	64	388	859	1,001	-	75	43	27
1974	26	12	22	24	155	213	2,783	2,939	115	120	-	-
1975	-	-	-	-	-	-	-	3,339	313	444	250	164
1976	48	36	38	169	808	4,864	1,398	1,597	2,643	89	48	78
1977	12	31	26	76	631	1,984	328	539	1,022	147	108	136
1978	29	33	15	14	16	24	72	61	67	47	22	48
1979	44	33	37	151	172	135	2,255	3,482	324	42	86	220
1980	93 (51)	16 (12)	43 (23)	80	140	50	1,470	110	790	780	260	50
Crustacea												
1973	-	1	-	1	3	12	29	9	-	3	2	2
1974	2	2	3	3	6	3	14	85	7	6	-	-
1975	-	-	-	-	-	-	-	51	12	6	3	6
1976	2	1	5	4	10	141	43	23	69	3	2	8
1977	-	-	2	5	13	96	7	17	50	5	1	6
1978	4	6	3	2	6	48	12	27	75	9	5	5
1979	<1	0	3	3	2	4	78	44	17	2	2	2
1980	3 (3)	0 (2)	2 (0)	0	0	0	20	0	50	30	10	10

[a]No sample collected.

protozoans during the past seven years have been Vorticella, Codonella, Difflugia, Strombilidium, Cyclotrichium, Strombilidium, Arcella and Centropyxis. The most numerous and frequently occurring rotifers have been Keratella, Polyarthia, Synchaeta, Branchionus and Trichocerca. Copepod nauplii have been the only crustacean taxa found consistently. Comparisons between zooplankton densities at Transect 1 and Transect 2B during preoperational and operational years failed to isolate any consistent difference attributable to BVPS operation (Table V-D-7).

Community structure, as compared by diversity indices, has been similar during the past 8 years (Table V-D-8). In previous years low diversity indices and number of species occurred in winter; high diversities and number of species usually occurred in late spring and summer.

In 1980, the diversity indices and species numbers remained relatively low until June which was caused by a delay of the zooplankton peaks attributed to high water and increased turbidity. Shannon diversity indices in 1980 ranged from 2.00 to 3.63 and were consistant with the range of 1.80 to 3.28 that occurred during preoperational years to 1973 to 1975. The variation in evenness during 1980 (0.66 to 0.80) was at the upper portion of the range reported from 1973 to 1979 (0.21 to 0.93).

Summary and Conclusions

Zooplankton densities throughout 1980 were typical of a temperate zooplankton community found in river habitats. Total densities were similar to those reported in previous years, although the population peaks were frequently delayed or interrupted by increased current and turbidity caused by high water conditions from frequent rain showers. Protozoans and rotifers were always predominate. The common and abundant taxa in 1980 were similar to those reported during preoperational and other operational years. Shannon diversity, number of species and evenness were within the ranges or slightly greater than those of preceeding years. Total densities and diversity indices of the control (Transect 1) and non-control (Transect 2) were not different in the first quarter of 1980 from those of previous years. Based on the data collected during the five operating years (1976

TABLE V-D-7

MEAN TOTAL ZOOPLANKTON DENSITIES[a] (Number/liter) FOR TRANSECT 1 (CONTROL) AND TRANSECT 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS[b]
BVPS

	Preoperational Years						Operational Years									
	1973		1974		1975		1976		1977		1978		1979		1980	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
January			77	47			460	240	195	105	22	24	385	255	446	475
February	70	44	46	27			345	235	398	318	35	21	90	100	312	296
March			92	85			375	330	325	243	30	15	255	145	462	352
April	124	37	150	74			10,163	11,998	478	225	24	24	625	227		
May	188	92	353	160			2,275	2,590	4,890	5,450	377	352	2,048	[illegible],865		
June	647	0	539	610			6,658	5,500	3,453	4,620	2,018	1,568	512	670		
July	896	925	6,085	3,794			3,288	3,190	1,148	1,205	1,525	1,412	2,576	2,852		
August	1,127	1,768	3,894	3,360	4,243	3,575	3,303	3,605	1,628	1,375	780	885	3,925	4,085		
September			1,397	1,060	4,255	2,860	4,065	3,093	3,660	3,620	930	998	900	825		
October	427	392	3,597	3,965	1,568	1,695	533	465	610	505	335	470	435	330		
November	229		785	635	2,600	2,308	408	510	775	513	311	272	455	938		
December	67		265	185	645	498	583	393	578	368	65	37	698	390		

[a]Means were calculated based upon duplicate surface and duplicate bottom samples combined.

[b]Blanks represent periods when no collections were made.

TABLE V-D-8

MEAN ZOOPLANKTON DIVERSITY INDICES BY MONTH FROM 1973 THROUGH 1980 IN THE OHIO RIVER NEAR BVPS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973												
Number of Species	a	8.44		15.29	21.28	25.07	21.96[b]	22.86		16.33	14.40	14.30
Shannon Index		1.80		3.06	3.08	2.79	2.25	2.20		2.21	2.31	3.10
Evenness		0.37		0.63	0.58	0.46	0.39	0.36		0.37	0.44	0.61
1974												
Number of Species	14.64	9.18	14.92	17.75	23.25	15.56	21.14	18.89	9.56	14.47		
Shannon Index	3.18	2.53	2.91	3.06	3.25	2.32	3.28	2.24	2.15	1.84		
Evenness	0.62	0.56	0.57	0.58	0.55	0.41	0.60	0.41	0.42	0.30		
1975												
Number of Species								24.75	18.75	14.38	17.44	15.38
Shannon Index								3.20	1.86	2.90	2.01	3.20
Evenness								0.69	0.44	0.77	0.49	0.82
1976												
Number of Species	7.00	9.13	8.69	17.[illegible]	19.19	23.56	28.06	23.50	23.56	11.19	8.75	11.75
Shannon Index	1.67	2.64	2.24	0.89	3.06	2.33	3.36	3.63	2.76	2.73	1.60	2.64
Evenness	0.60	0.84	0.73	0.21	0.72	0.51	0.70	0.80	0.61	0.79	0.51	0.75
1977												
Number of Species	4.00	10.00	12.00	13.31	21.00	25.62	22.88	25.50	36.75	16.88	20.31	15.31
Shannon Index	1.53	2.59	3.01	2.98	3.15	3.45	3.32	3.60	3.71	3.35	3.42	3.42
Evenness	0.78	0.79	0.87	0.81	0.72	0.74	0.73	0.77	0.71	0.82	0.79	0.86
1978												
Number of Species	0.12	7.12	4.31	5.12	7.62	6.25	10.25	11.25	12.50	0.25	10.88	10.38
Shannon Index	2.48	2.41	1.53	1.70	1.53	1.33	2.50	2.44	2.53	2.28	2.15	2.00
Evenness	0.83	0.85	0.74	0.71	0.52	0.50	0.76	0.70	0.70	0.73	0.62	0.83
1979												
Number of Species	10.62	6.00	10.25	15.88	17.25	14.25	16.88	21.50	18.12	12.00	14.62	14.00
Shannon Index	2.51	2.52	3.05	3.42	2.36	3.02	2.42	3.30	3.36	2.99	2.84	3.10
Evenness	0.74	0.93	0.90	0.86	0.58	0.80	0.60	0.74	0.80	0.84	0.74	0.83
1980												
Number of Species	11.62	11.00	12.50	10.00	8.00	15.00	21.00	15.00	18.00	22.00	18.00	18.00
Shannon Index	2.51	2.70	3.03	2.41	2.00	2.91	3.63	2.79	3.23	2.88	3.26	3.36
Evenness	0.70	0.78	0.84	0.72	0.66	0.74	0.82	0.71	0.77	0.64	0.78	0.80

[a] Blanks represent periods when no collections were made.

[b] Value cannot be verified.

through 1980) and the three preoperating years (1973, 1974, and 1975), it is concluded that the overall abundance and species composition of the zooplankton in the Ohio River near BVPS has remained stable and possibly improved slightly over the seven year period from 1973 to 1980. No evidence of appreciable harm to the river zooplankton from BVPS Unit 1 operation was found. The data indicate that increased turbidity and current from high water conditions have the strongest effects of delaying the population peaks and temporarily decreasing total zooplankton densities in the Ohio River near BVPS.

E. FISH

Objective

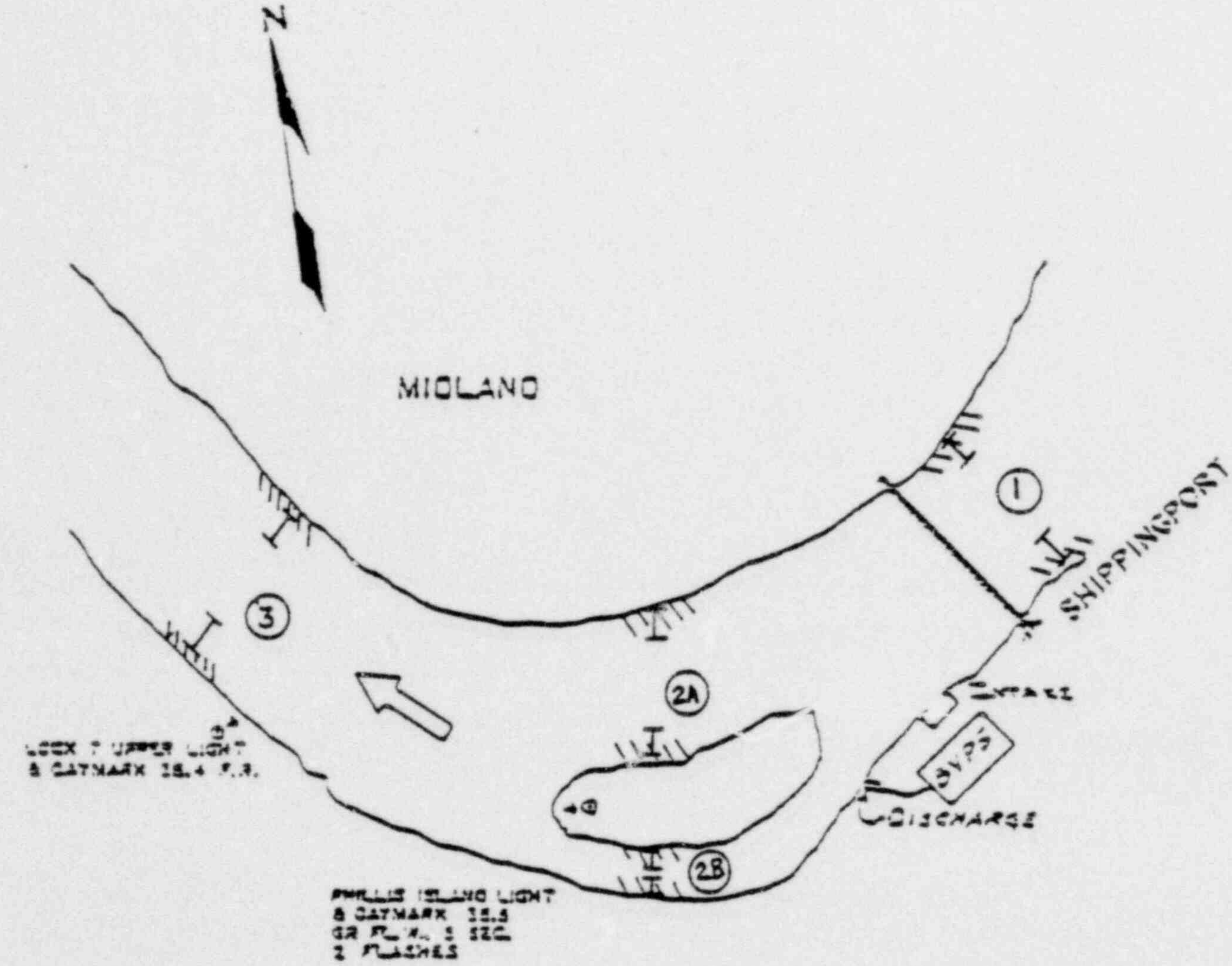
To detect changes which might occur to fish populations in the Ohio River near BVPS.

Methods

Adult fish surveys were performed in the months of May, July, September and November 1980. During each survey, fish samples were collected at the three study areas transects (Figure V-E-1), using gill nets and electrofishing gear. Cast seining was conducted during November.

Gill nets, consisting of five, 25 ft panels of 1.0, 2.0, 2.5, 3.0 and 3.5 inch square mesh were used. Two nets were positioned perpendicular to shore, and with the small mesh inshore, at each transect. As transect 2 consists of the main river channel (2A) and the back channel, south of Phillis Island (2B), a total of eight gill nets were set per sampling month. Nets were set for approximately 24 hours and all captured fish were identified, counted, measured for total length (mm) and weighted (g).

Electrofishing was conducted using a boat-mounted boom electroshocker. Direct current of 220 volts and two to four amps were generally used. Shocking time was maintained at 10 minutes per station for each survey. The shoreline areas of each transect were shocked and large fish processed as described for the gill net collections. Small fish were immediately preserved with 10% formalin and returned to the laboratory for analysis in the following manner. All game fish were measured and weighed individually. Samples of non-game fish containing 30 specimens or less were measured individually and weighed together. Samples of non-game fish containing more than 30 specimens were subsampled. Total lengths were recorded for 30 randomly chosen specimens, and a batch weight obtained for the entire sample. The length range was chosen by visual inspection of the largest and smallest fish.



OHIO RIVER

I - Gill Netting
//// - Electrofishing
O - Sampling Station

FIGURE V-E-1

FISH SAMPLING STATIONS
BVPS

Cast seining was conducted from the boat using a 10 ft seine. Three hauls were performed at each station. All captured fish were preserved and processed in the laboratory in the manner described for electrofishing.

Results

Fish population studies have been conducted in the Ohio River near BVPS since 1974 to present. These surveys have reported 52 fish taxa captured (Table V-E-1). In 1980, specimens of 27 fish taxa were collected, with two species (golden redhorse and freshwater drum) that had not been captured previously. A combined total of 699 individuals were collected in 1980 by electrofishing, gill netting and seining (Table V-E-2).

A total of 557 fish, representing 23 taxa, were collected by electrofishing (Table V-E-3). Emerald shiners, sand shiners and bluntnose minnows dominated the catch numerically, accounting for 75.6% of the total electrofishing catch.

Collectively, the minnow family accounted for 87.5% of the total electrofishing catch in 1980. Gizzard shad (another forage species for the larger predator species) represented 2.5% of the catch. The most abundant sport species were smallmouth and spotted basses which composed 3.1% and 2.2%, respectively. Each of the other taxa accounted for less than 1% of the total. Most of fish were collected in May (33.6%), with the fewest collected in November (15.4%). Species composition varied between the November and the other three collecting periods. This variation may be explained by higher water elevations and increased turbidity of the river during November. Under these conditions some species, particularly carp and goldfish, may move into the shallow, shoreline areas, where the velocity is less. However, territorial species such as bass and sunfish will probably remain at their selected locations, covered by higher water. This situation results in carp and goldfish becoming more susceptible and the sunfishes being less vulnerable to electrofishing. Small forage species such as minnows and shiners, although still present in the shoreline areas, were not collected in large numbers because they were more difficult to see in the swift, turbid water. Table V-E-3 shows this shift in the species composition with electrofishing between November and the three

TABLE V-E-1

(SCIENTIFIC AND COMMON NAME)[a]
FAMILIES AND SPECIES OF FISH COLLECTED IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1970-1980
BVPS

Family and Scientific Name	Common Name
Lepisosteidae (gars)	
Lepisosteus osseus	Longnose gar
Clupeidae (herrings)	
Dorosoma cepedianum	Gizzard shad
Alosa chrysochloris	Skipjack herring
Esocidae (pikes)	
Esox lucius	Northern pike
E. masquinongy	Muskellunge
E. lucius X E. masquinongy	Tiger muskellunge
Cyprinidae (minnows and carps)	
Carassius auratus	Goldfish
Cyprinus carpio	Carp
C. auratus X cyprinus carpio	Goldfish-carp hybird
Notropis cornutus	Common shiner
N. atherionoides	Emerald shiner
N. rubellus	Rosyface shiner
N. spilopterus	Spotfin shiner
N. stramineus	Sand shiner
N. volucellus	Mimic shiner
Pimephales notatus	Bluntnose minnow
Semotilus atromaculatus	Creek chub
Campostoma anomalum	Central stoneroller
Rhinichthys atratulus	Blacknose dace
Catostomidae (suckers)	
Carpiodes cyprinus	Quillback
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hog sucker
Moxostoma anisurum	Silver redhorse
M. duquesnei	Black redhorse
M. erythrurum	Golden redhorse
M. macrolepidotum	Shorthead redhorse
Moxostoma spp.	Redhorse
Ictiobus niger	Black buffalo

TABLE V-E-1 (Continued)

Family and Scientific Name	Common Name
Ictaluridae (bullhead catfishes)	
Ictalurus catus	White catfish
I. melas	Black bullhead
I. natalis	Yellow bullhead
I. nebulosus	Brown bullhead
I. punctatus	Channel catfish
Percopsidae (trout-perches)	
Percopsis omiscomaycus	Trout-perch
Cyprinodontidae (killifishes)	
Fundulus diaphanus	Banded killifish
Percichthyidae (temperate basses)	
Morone chrysops	White bass
Centrarchidae (sunfishes)	
Ambloplites rupestris	Rock bass
Lepomis cyanellus	Green sunfish
L. gibbosus	Pumpkinseed
L. macrochirus	Bluegill
Micropterus dolomieui	Smallmouth bass
M. punctulatus	Spotted bass
M. salmoides	Largemouth bass
Pomoxis annularis	White crappie
P. nigromaculatus	Black crappie
Percidae (perches)	
Etheostoma nigrum	Johnny darter
E. zonale	Banded darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
Stizostedion canadense	Sauger
S. vitreum vitreum	Walleye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum

[a] Nomenclature follows Bailey et al. (1980).

TABLE V-E-2

NUMBER OF FISH COLLECTED BY ELECTROFISHING (E), GILL NETTING (GN) AND SEINING (S) AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1980
BVPS

Taxa	Transect 1			Transect 2A			Transect 2B			Transect 3				Annual	Percent of
	E	GN	Total	E	GN	Total	E	GN	Total	E	GN	S	Total	Total	Annual Total
Gizzard shad	4	-	4	7	-	7	1	-	1	2	-	-	2	14	2.0
Northern pike	-	-	-	-	-	-	-	-	-	-	1	-	1	1	0.1
Tiger muskellunge[(a)]	1	-	1	-	-	-	-	-	-	-	1	-	1	2	0.3
Goldfish	3	-	3	1	-	1	-	-	-	2	1	-	3	7	1.0
Carp	27	1	28	4	-	4	4	1	5	9	3	-	12	49	7.0
Sand shiner	42	-	42	52	-	52	9	-	9	42	-	-	42	145	20.7
Spotfin shiner	-	-	-	1	-	1	2	-	2	1	-	-	1	4	0.6
Emerald shiner	67	-	67	32	-	32	56	-	56	60	-	104	164	319	45.6
Mimic shiner	8	-	8	1	-	1	2	-	2	1	-	3	4	15	2.1
Bluntnose minnow	20	-	20	21		21	15	-	15	5	-	-	5	61	8.7
White sucker	-	-	-	-	-	-	-	-	-	-	1	-	1	1	0.1
Quillback	-	-	-	-	-	-	-	-	-	-	1	-	1	1	0.1
Northern hog sucker	-	-	-	1	-	1	-	-	-	-	-	-	-	1	0.1
Golden redhorse	2	-	2	-	-	-	1	-	1	2	-	-	2	5	0.7
Channel catfish	-	2	2	-	-	-	1	-	1	1	10	-	11	14	2.0
Trout-perch	2	-	2	-	-	-	-	-	-	1	-	-	1	3	0.4
White bass	-	-	-	-	-	-	-	-	-	2	-	-	2	2	0.3
Green sunfish	-	-	-	-	-	-	1	-	1	-	-	-	-	1	0.1
Smallmouth bass	6	-	6	4	-	4	6	-	6	1	-	-	1	17	2.4
Spotted bass	6	-	6	-	1	1	5	-	5	1	1	-	2	14	2.0
Largemouth bass	1	-	1	-	-	-	-	-	-	1	-	-	1	2	0.3
White crappie	2	-	2	1	-	1	2	-	2	-	3	-	3	8	1.1
Yellow perch	-	-	-	1	-	1	-	-	-	-	-	-	-	1	0.1
Logperch	-	-	-	1	-	1	-	-	-	-	-	-	-	1	0.1
Sauger	-	1	1	-	2	2	1	-	1	1	-	-	1	5	0.7
Walleye	-	-	-	-	4	4	-	-	-	-	1	-	1	5	0.7
Freshwater drum	-	-	-	-	-	-	1	-	1	-	-	-	-	1	0.1
Total	191	4	195	127	7	134	107	1	108	132	23	107	262	699	
Total number of taxa	14	3	16	13	3	16	15	1	15	16	10	2	22	27	
Percent of total transect catch	97.9	2.1		94.8	5.2		99.1	0.9		50.4	8.8	40.8			
Percent of total annual catch			27.9			19.2			15.4				37.5		

(a) Hybrid of northern pike and muskellunge

TABLE V-E-3

NUMBER OF FISH COLLECTED PER MONTH BY ELECTROFISHING IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1980
BVPS

Taxa	Month: May	Jul	Sep	Nov	Annual Total	Percent of Annual Total
Gizzard shad		3	4	7	14	2.5
Tiger muskellunge				1	1	0.2
Goldfish			2	4	6	1.1
Carp	5	4	1	34	44	7.9
Sand shiner	36	40	66	3	145	26.0
Spotfin shiner	2	2			4	0.7
Emerald shiner	105	48	33	29	215	38.6
Mimic shine	1	7	4		12	2.2
Bluntnose minnow	24	28	7	2	61	11.0
Northern hog sucker		1			1	0.2
Golden redhorse	2	2		1	5	0.9
Channel catfish		1		1	2	0.4
Trout-perch	1	1		1	3	0.5
White bass		2			2	0.4
Green sunfish		1			1	0.2
Smallmouth bass	7	7	3		17	3.1
Spotted bass	2	5	4	1	12	2.2
Largemouth bass	1		1		2	0.4
White crappie		5			5	0.9
Yellow perch		1			1	0.2
Logperch	1				1	0.2
Sauger				2	2	0.4
Freshwater drum			1		1	0.2
Total	187	158	126	86	557	
Percent of total Annual Catch	33.6	28.4	22.6	15.4		

other sampling periods. This shift shows carp and goldfish being collected in higher than normal numbers with sunfishes, and shiners comprising a smaller percentage of the total monthly catch for electrofishing.

Numerical and species composition differences between transects were not apparent from the electrofishing surveys in the vicinity of BVPS in 1980 (Table V-E-2 and V-E-4).

Gill netting yielded a total of 35 fish, representing 11 ta[illegible]ables V-E-2 and V-E-5). Channel catfish were the most abundant fish ca[illegible]%). Walleye and carp were the next abundant species, each representing 1[illegible].3% of the total gill net catch. Sauger and white crappie each accounted for 8.6% of the catch. The remaining catch consisted of spotted bass (5.7%), with northern pike, tiger muskellunge, goldfish, white sucker and quillback each accounting for 2.8% of the total (Table V-E-5).

The gill net catch varied by month from a high of 13 fish caught in July to a low of 6 fish collected in May (Table V-E-5). The mean annual gill net catch was 2.2 fish, and ranged from 0.2 fish at Transect 2B to 5.8 fish at Transect 3 (Table V-E-4). The highest number of collected taxa (10) also occurred at Transect 3 (Table V-E-2). These data was very similar to the 1979 fish report for this transect. It should be noted that this transect is usually influenced by a heated discharge from a ferrous metal factory (Station 3 North). The warmer waters may attract schools of forage fish (shad and shiners) into this area which may result in larger predators (sport species) utilizing this area as feeding grounds. This may account for the effectiveness of the gill nets at Station 3 North. Gill nets work on the principle that a fish actively forces its head through an opening and then it is unable to retreat because its gill flaps gets tangled in the mesh. It follows that a predator feeding in this area might be more active and therefore susceptible to captured by this method.

A total of 107 fish were captured using cast seines in 1980 (Table V-E-2). The catch was composed of emerald shiners (97.2%) and mimic shiners (2.8%). Transect

TABLE V-E-4

NUMBER OF FISH COLLECTED BY GILL NETTING AND ELECTROFISHING AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1980
BVPS

Electrofishing[a]	Transect 1	Transect 2A	Transect 2B	Transect 3	Annual Total	Average
May 29	72	40	45	30	187	46.8
July 30	60	52	29	17	158	39.5
September 24	24	29	4	69	126	31.5
November 26	35	6	29	16	86	21.5
Total	191	127	107	132	557	
Average	47.8	31.8	26.8	33.0		
Gill Netting[b]						
May 22	3	1		2	6	1.5
July 23		1		12	13	3.2
September 24	1	2	1	4	8	2.0
November 19		3		5	8	2.0
Total	4	7	1	23	35	
Average	1.0	1.8	0.2	5.8		

[a] Electrofishing time was 10 minutes/station or 20 minutes/transect for each date.

[b] Gill net collection time was 24 hours/station or 48 hours/transect for each date.

TABLE V-E-5

NUMBER OF FISH COLLECTED PER MONTH BY GILL NETTING IN THE
NEW CUMBERLAND POOL OF THE OHIO RIVER, 1980
BVPS

	Month				Annual	Percent of
Taxa	May	Jul	Sep	Nov	Total	Annual Total
Northern pike		1			1	2.8
Tiger muskellunge				1	1	2.8
Goldfish			1		1	2.8
Carp	2	1	1	1	5	14.3
White sucker	1				1	2.8
Quillback			1		1	2.8
Channel catfish	1	9	2		12	34.3
Spotted bass			2		2	5.7
White crappie		1		2	3	8.6
Sauger	1	1	1		3	8.6
Walleye	1			4	5	14.3
Total	6	13	8	8	35	
Percent of Total Annual Catch	17.1	37.1	22.9	22.9		

3 was the only area that this method resulted in captures, with 97.2% of the fish being collected at Station 3 North. Again this station is usually influenced by a heated discharge and the warmer water may be attracting schools of shiners into this area. Gizzard shad were also observed at this station but not captured in the seines.

Comparison of Preoperational and Operational Data

Electrofishing and gill net data, expressed as catch-per-unit-effort, for the years 1974 thorugh 1978 are presented in Tables V-E-6 and V-E-7. These seven years represent two preoperational years (1974 and 1975) and five operational years (1976, 1977, 1978, 1979 and 1980). Fish data for Transect 1 (control transect) and the averages of Transects 2A, 2B and 3 are tabulated separately. Comparisons of the fish population data between preoperational and operational periods, as well as between control and non-control transects, may be used to detect potential effects of operation of BVPS on fish populations.

Fluctuations in the total annual fish catches have occurred since the 1974 study. For example, at the control transect, mean electrofishing catches have varied from 645.2 fish/hour in 1975 to 65.6 fish/hour in 1978. Electrofishing values for the 1979 study period were the highest since operation of BVPS, Unit 1 in 1976. However, the 1980 data shows a reduced value of 146.9 fish/hour for the control transect.

Summary and Conclusions

The fish population of the Ohio River in the vicinity of BVPS have been sampled from 1974 to present using a multi-fishing gear approach (electrofishing, gill netting and seines). The results of these fish surveys show normal population structure based on species composition and relative abundance. In all the surveys since 1974 to present, forage species (minnows and shiners) were collected in the highest numbers. This indicates a normal population since sport species and predators rely heavily on this base for their survival. Variations in annual total catch are attributable primarily to fluctuations in the population size of the small species. Small species with high reproductive potentials, frequently respond to changes in natural environmental factors such as competition, food

TABLE V-E-6

ELECTROFISHING CATCH (FISH/HOUR) MEANS ($\bar{x}$) AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1974-1980
BVPS

Species	Transect 1							Transect 2A, 2B, 3						
	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]
Gizzard shad	-	2.1	1.2	2.0	-	-	3.1	0.9	1.0	1.4	0.7	0.3	2.1	2.5
Tiger muskellunge	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-
Muskellunge	-	-	-	-	-	0.5	-	-	-	-	-	-	0.3	-
Northern pike	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-
Goldfish	-	-	0.7	-	-	-	2.3	-	-	-	-	-	-	0.8
Carp	5.9	-	-	1.0	12.5	-	20.8	3.3	0.5	0.7	1.2	6.6	1.2	4.2
Emerald shiner	42.0	441.7	18.7	57.0	22.8	58.4	51.5	67.7	239.9	13.1	32.8	23.9	53.7	37.0
Spotfin shiner	0.9	-	4.8	7.0	0.5	-	-	4.3	2.0	6.1	4.9	0.5	0.5	1.0
Sand shiner	57.6	129.1	52.5	95.9	8.8	93.6	32.5	17.4	81.0	52.6	26.2	13.3	45.2	25.8
Mimic shiner	-	-	3.5	7.0	0.5	1.6	6.2	-	-	1.8	1.1	0.3	2.2	1.0
Bluntnose minnow	33.3	72.3	53.2	57.8	12.8	89.4	15.4	6.1	31.2	45.3	44.9	21.4	40.8	10.2
Creek chub	0.9	-	0.5	0.5	-	-	-	-	-	-	-	-	-	-
Stoneroller	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-
Blacknose dace	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-
White sucker	-	-	-	-	0.3	-	-	-	0.5	-	0.3	0.1	0.3	-
Northern hog sucker	0.7	-	-	1.0	0.3	-	-	-	-	-	0.3	0.3	0.3	0.2
Redhorse	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-
Silver redhorse	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-
Black redhorse	-	-	-	-	0.8	1.0	-	-	-	-	0.3	0.3	-	-
Golden redhorse	-	-	-	-	-	-	1.5	-	-	-	-	-	-	0.8
Shorthead redhorse	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-
Yellow bullhead	-	-	-	-	-	-	-	0.6	-	0.2	-	0.2	-	-
Brown bullhead	-	-	-	-	-	-	-	0.4	-	0.2	-	0.1	-	-
Channel catfish	-	-	-	-	0.3	-	-	-	1.0	0.2	1.1	0.3	0.7	0.5
Trout-perch	-	-	-	-	-	-	1.5	-	-	-	-	0.1	0.5	0.2
Banded killifish	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-
White bass	-	-	-	-	0.5	-	-	-	-	-	-	0.1	-	0.5
Rock bass	-	-	-	-	-	-	-	-	-	[illegible]	-	0.1	-	-
Sunfish (Lepomis) hybrid	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-
Green sunfish	-	-	-	-	0.3	0.5	-	-	-	-	1.4	0.3	0.5	0.2
Pumpkinseed	-	-	-	-	0.3	0.5	-	-	0.5	0.7	1.0	0.5	-	-
Bluegill	6.6	-	1.5	-	3.0	0.5	-	1.9	0.6	0.2	0.3	1.4	0.2	-
Smallmouth bass	0.9	-	2.3	3.0	0.3	0.5	4.6	0.8	-	0.6	1.0	0.3	0.9	2.8
Spotted bass	0.9	-	-	2.7	-	2.6	4.6	0.4	-	-	2.7	-	2.1	1.5
Largemouth bass	1.1	-	-	1.0	1.0	-	0.8	1.4	-	1.1	0.7	0.7	0.3	0.2
White crappie	-	-	-	-	-	-	1.5	-	-	-	-	0.1	-	0.8
Black crappie	-	-	-	-	-	-	-	0.5	-	0.3	-	-	0.2	-
Johnny darter	-	-	-	-	-	0.5	-	1.0	1.0	0.4	-	0.1	0.2	-
Yellow perch	-	-	-	-	0.3	0.5	-	-	-	-	-	0.1	0.2	0.2
Logperch	-	-	-	-	0.3	0.5	-	-	-	-	0.3	-	0.7	0.2
Sauger	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5
Walleye	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-
Freshwater drum	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
Total	150.8	645.2	139.4	235.9	65.6	250.6	146.9	106.5	359.2	125.3	122.8	72.5	153.6	91.3

[a] MAY-JUL

[b] AUG, NOV

[c] MAY-SEP, NOV

[d] MAY, JUL, SEP AND NOV

TABLE V-E-7

GILL NET CATCH (FISH/24 HOUR) MEANS ($\bar{x}$) AT TRANSECTS IN THE NEW CUMBERLAND POOL
OF THE OHIO RIVER, 1974-1980
BVPS

	Transect 1							Transect 2A, 2B, 3						
Species	1974[a]	1975[b]	1976[c]	1977[d]	1978[d]	1979[d]	1980[e]	1974[a]	1975[b]	1976[c]	1977[d]	1978[d]	1979[d]	1980[e]
Longnose gar	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-
Gizzard shad	-	-	-	-	-	-	0.1	0.2	0.1	-	0.1	-	<0.1	-
Northern Pike	-	-	-	0.1	-	-	-	-	-	-	0.1	<0.1	-	<0.1
Muskellunge	-	-	-	-	-	-	-	-	-	-	-	<0.1	-	-
Tiger muskellunge	-	-	-	0.1	0.1	-	-	-	-	-	-	<0.1	-	<0.1
Goldfish	-	-	-	-	-	-	-	-	-	<0.1	0.1	-	-	<0.1
Carp	0.8	1.2	0.1	0.4	0.6	<0.1	-	0.9	0.3	0.2	0.6	0.3	0.3	0.2
Goldfish x Carp hybrid	-	-	-	-	-	-	-	-	0.1	-	0.1	-	-	-
Quillback	-	-	0.1	0.2	-	-	-	-	-	<0.1	0.2	0.1	<0.1	<0.1
White sucker	-	0.3	-	0.2	0.2	-	-	0.1	-	-	<0.1	-	<0.1	<0.1
Black redhorse	-	-	-	-	-	-	-	-	-	-	<0.1	0.1	<0.1	-
Silver redhorse	-	-	-	-	-	<0.1	-	-	-	-	-	-	<0.1	-
Black bullhead	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-
Brown bullhead	0.4	-	-	-	0.1	-	-	0.2	-	<0.1	<0.1	-	-	-
Yellow bullhead	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-
White catfish	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-
Channel catfish	-	0.8	-	0.7	0.7	0.2	0.2	0.3	1.3	0.4	1.0	0.4	0.5	0.4
Rock bass	-	0.3	-	0.2	0.1	0.2	-	-	0.1	-	0.1	<0.1	<0.1	-
Green sunfish	-	-	0.1	-	0.1	-	-	-	-	-	0.1	-	-	-
Pumpkinseed	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-
Bluegill	-	-	-	-	-	-	-	-	-	-	<0.1	-	-	-
Smallmouth bass	-	-	-	-	0.1	<0.1	-	-	-	<0.1	-	-	-	-
Largemouth bass	-	-	0.2	-	-	<0.1	-	0.2	0.1	0.1	<0.1	<0.1	-	-
Spotted bass	-	0.2	0.7	0.1	-	<0.1	-	-	-	0.2	0.1	<0.1	<0.1	0.1
White crappie	-	-	-	-	0.1	-	-	-	-	<0.1	<0.1	-	0.1	0.1
Black crappie	-	-	-	0.1	-	-	-	-	-	<0.1	0.1	-	<0.1	-
Yellow perch	0.4	0.6	0.5	0.8	0.3	0.2	-	-	0.7	0.5	0.7	0.1	0.1	-
Walleye	0.2	-	0.3	0.3	0.3	0.2	-	0.2	0.2	0.1	0.2	0.1	<0.1	0.2
Sauger	-	-	-	-	0.2	-	0.1	-	0.1	-	<0.1	0.2	0.3	<0.1
Total	1.8	3.4	2.2	3.2	2.9	0.8-1.3	0.4-0.5	2.2	3.1	1.5-2.2	3.6-4.3	1.3-1.9	1.3-1.9	1.2-1.6

[a] MAY, SEP, NOV

[b] AUG, SEP, NOV

[c] MAY-SEP

[d] MAY-SEP, NOV

[e] MAY, JUL, SEP, NOV

availability, cover and water quality with large changes in population size. Thus, these fluctuations are naturally occurring and do take place in the vicinity of BVPS.

It is important to mention that while variation in total catches has occurred, species composition has remained fairly stable. Since the initiation of studies in 1974, forage fish of the family Cyprinidae have dominated the catches. Emerald shiners, sand shiners and bluntnose minnows have consistently been the most numerous fish. Carp, channel catfish, smallmouth bass, yellow perch and walleye have all remained common species.

Differences in the 1980 electrofishing and gill net catches, between the control and non-control transects were consistent with previous years (both operational and preoperational) and are most likely due to the habitat preferences of individual species. Carp, gizzard shad, channel catfish and sauger were more abundant at the non-control transects (2A, 2B and 3), while sand shiners and bluntnose minnows were more numerous at the control transect (1).

Shiners and minnows were the most abundant fish species in the Ohio River near BVPS and have experienced fluctuations in population size in both the preoperational and operational study years. Differences in fish abundance above and below BVPS probably reflect the habitat preferences of individual species. Data collected from 1975 to 1980 do not indicate that fish populations in the study area have been adversely affected by BVPS operation.

F. ICHTHYOPLANKTON

Objective

To monitor the extent fishes utilize the back channel of Phillis Island as spawning and nursery grounds. This is important because of the area's potential as a spawning ground and relative proximity to the BVPS discharge structure.

Methods

Four monthly surveys were conducted during the primary spawning season for most resident species (23 April, 21 May, 19 June, and 22 July). One surface and one bottom collection were taken at Transect 2B (back channel of Phillis Island) during each survey (Figure V-F-1). Tows were made in a zig-zag fashion across the channel utilizing a 0.5 m conical 505 micron mesh plankton net. A General Oceanics Model 2030 digital flowmeter, mounted centrically in the net mouth, was used to determine the volume of water filtered. Samples were preserved in 10% buffered formalin containing rose bengal dye.

In the laboratory, ichthyoplankton was sorted from the sample and enumerated. Each specimen was identified to its stage of development and lowest possible taxon. Densities of ichthyoplankton (#/100 m^3) were calculated for each sample using flowmeter data.

Results

A total of 12 eggs, 215 larvae, and one adult were collected in 1980 (Table V-F-1). Seven taxa representing five families were identified. Cyprinidae spp. (minnows and carps) accounted for 89.5% (one egg, 202 larvae, one adult) of the total catch. Gizzard shad (Dorosoma cepedianum) was the only other taxon represented by more than a single specimen; it represented 3.9% (nine larvae) of the total catch. A total of 10 eggs (4.4% of the total catch; 83.3% of the total eggs) were unidentifiable. One egg could not be identified to species based on the available taxonomic information.

Surveys on 23 April and 21 May each yielded only a single specimen, one unidentifiable egg and one yellow perch larvae (Perca flavescens), respectively

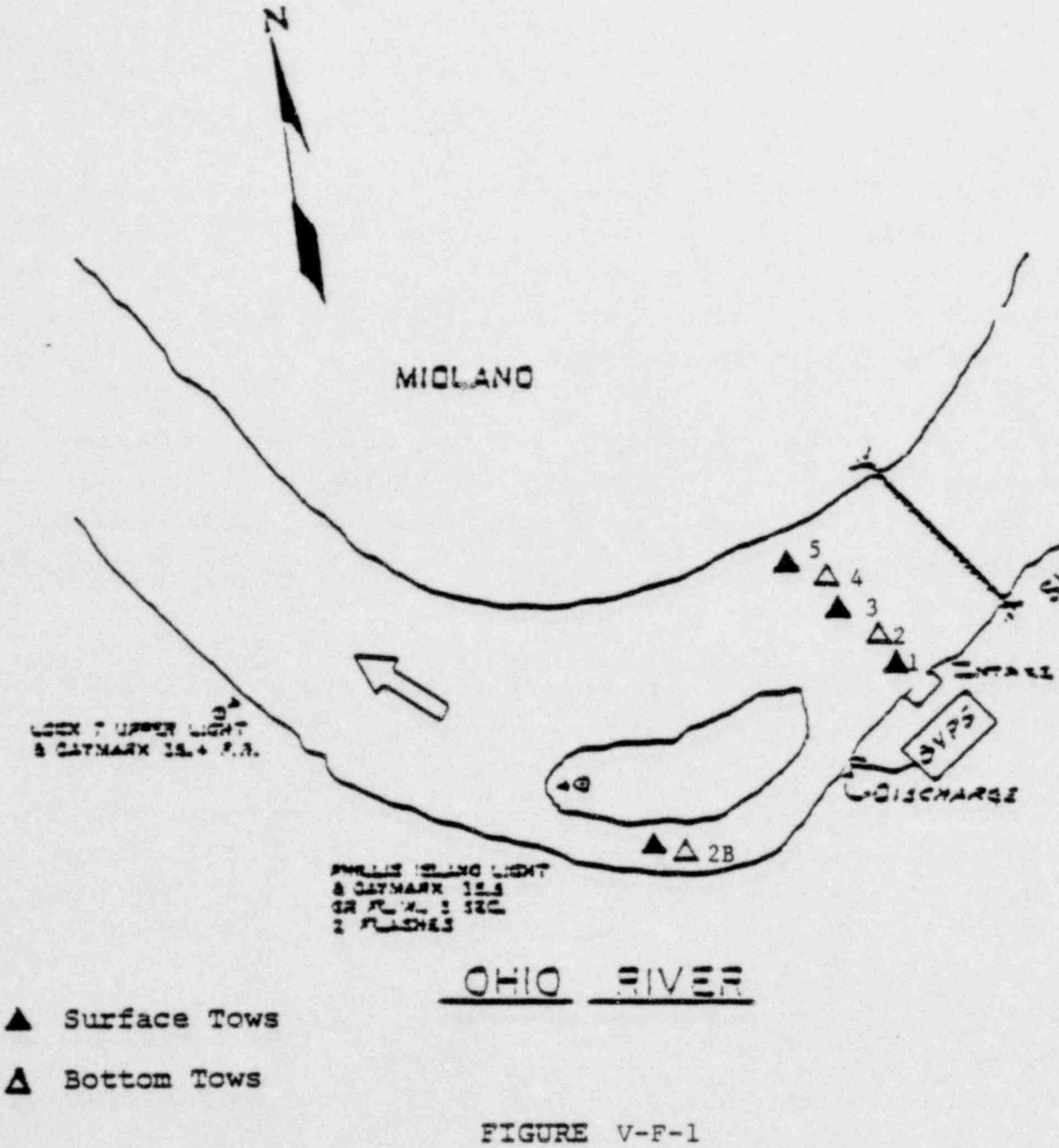


FIGURE V-F-1

ICHTHYOPLANKTON SAMPLING STATIONS
BVPS

TABLE V-F-1

NUMBER AND DENSITY OF FISH EGGS, LARVAE, JUVENILES, AND ADULTS (Number/100 m^3) COLLECTED WITH A 0.5 m PLANKTON NET IN THE OHIO RIVER BACK CHANNEL OF PHILLIS ISLAND (STATION 2B) NEAR BVPS, 1980

Date	Depth of Collection		Total Collected and
23 April	Surface	Bottom	Taxa Density
Vol. water filtered (m^3)	118.9	118.8	237.7
No. eggs collected	1	0	1
No. larvae collected	0	0	0
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Unidentifiable	0.89 (1)	0	0.42 (1)
Total density (number collected)	0.89 (1)	0	0.42 (1)
21 May			
Vol. water filtered (m^3)	106.8	81.3	188.1
No. eggs collected	0	0	0
No. larvae collected	1	0	1
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (Number collected)			
Larvae			
Perca flavescens (YL)[a]	0.94 (1)	0	0.53 (1)
Total density (number collected)	0.94 (1)	0	0.53 (1)

TABLE V-F-1 (Continued)

Date	Depth of Collection		Total Collected and
19 June	Surface	Bottom	Taxa Density
Vol. water filtered (m^3)	55.9	78.4	134.3
No. eggs collected	5	5	10
No. larvae collected	1	1	2
No. juveniles collected	0	0	0
No. adults collected	1	0	1
Density (number collected)			
Eggs			
Unidentified	1.79 (1)	0	0.74 (1)
Unidentifiable	7.16 (4)	6.38 (5)	6.70 (9)
Larvae			
Catostomides spp. (YL)	1.79 (1)	0	0.74 (1)
Percidae: Etheostomatini (YL)	0	1.28 (1)	0.74 (1)
Adults			
Notropis athenoides	1.79 (1)	0	0.74 (1)
Total density	12.52 (7)	7.65 (6)	9.68 (13)
22 July			
Vol. water filtered (m^3)	127.7	71.3	199.0
No. eggs collected	0	1	1
No. larvae collected	168	44	212
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Cyprinidae spp.	0	1.40 (1)	0.50 (1)
Larvae			
Dorosoma cepediunum (EL)	3.92 (5)	5.61 (4)	4.52 (9)
Cyprinidae spp. (YL)	1.57 (2)	4.21 (3)	2.51 (5)
Cyprinidae spp. (EL)	120.60 (154)	51.90 (37)	95.98 (191)
Cyprinidae spp. (LL)	4.70 (6)	0	3.02 (6)
Pomoxis spp. (YL)	0.78 (1)	0	0.50 (1)
Total density	131.56 (168)	63.11 (45)	107.04 (213)

TABLE V-F-1 (Continued)

Yearly Totals	Depth of Collection: Surface	Depth of Collection: Bottom	Total Collected and Taxa Density
Vol. water filtered (m^3)	409.3	349.8	759.1
No. eggs collected	6	6	12
No. larvae collected	170	45	215
No. juveniles collected	0	0	0
No. adults collected	1	0	1
Density (number collected)			
Eggs			
Cyprinidae spp.	0	0.29 (1)	0.13 (1)
Unidentified	0.24 (1)	0	0.13 (1)
Unidentifiable	1.22 (5)	1.43 (5)	1.32 (10)
Larvae			
Dorosoma cepedianum (EL)	1.22 (5)	1.14 (4)	1.19 (9)
Cyprinidae spp. (YL)	0.49 (2)	0.86 (3)	0.66 (5)
Cyprinidae spp. (EL)	37.63 (154)	10.58 (37)	25.16 (191)
Cyprinidae spp. (LL)	1.47 (6)	0	0.79 (6)
Catostomidae spp. (YL)	0.24 (1)	0	0.13 (1)
Pomoxis spp. (YL)	0.24 (1)	0	0.13 (1)
Percidae: Etheostomatini (YL)	0	0.29 (1)	0.13 (1)
Perca flavescens (YL)	0.24 (1)	0	0.13 (1)
Adults			
Notropis athernoides	0.24 (1)	0	0.13 (1)
Total density (number collected)	43.24 (177)	14.58 (51)	30.04 (228)

(Table V-F-1). Most (93.4%) ichthyoplankton was taken during the 22 July survey. Sampling on this date yield the highest density (107.04/100 m^3) ever recorded at this station (Table V-F-2); most (91.7%) were cyprinid early larvae.

Eggs were found in highest abundance on 19 June (Table V-F-1); 83.3% of the total were collected. While none could be positively identified, most were probably cyprinid based on general characteristics of the egg and the abundance of minnow larvae that were subsequently collected.

Comparison of Preoperational and Operational Data

While species composition was similar to that found in previous years, cyprinid larval densities were substantially higher. Whether this will result in more successful minnow recruitment is debatable. Most (94.5%) of the minnows were early larvae, a very brief life stage during which substantial natural mortality is known to occur.

Summary and Conclusions

As in previous years, cyprinids dominated the 1980 ichthyoplankton catch from the back channel of Phillis Island. Peak densities of minnows occurred in June and July and consisted mostly of the early larval stage. Little spawning was noted in April and May with percids and catostomids dominating the catch in those months. No substantial differences were observed in species composition or spawning activity of most species over previous years.

TABLE V-F-2

DENSITY OF ICHTHYOPLANKTON (Number/100m^3) COLLECTED IN THE OHIO RIVER BACK CHANNEL OF PHILLIS ISLAND (STATION 2B) NEAR BVPS, 1973-1974, 1976-1980

Date	Density	Date	Density
1973		1978	
12 April	0	22 April	0
17 May	0	5 May	0
20 June	16.10	20 May	0.98
26 July	3.25	2 June	4.01
		16 June	12.15
		2 July	13.32
1974		1979	
16 April	0	19 April	0
24 May	0	1 May	0
13 June	6.98	17 May	0.81
26 June	9.25	7 June	0.39
16 July	59.59	20 June	11.69
1 August	6.85	5 July	14.82
1976		1980	
29 April	0.70	23 April	0.42
19 May	0	21 May	0.53
18 June	5.99	19 June	9.68
2 July	6.63	22 July	107.04
15 July	3.69		
29 July	4.05		
1977			
14 April	0		
11 May	0.90		
9 June	24.22		
22 June	3.44		
7 July	3.31		
20 July	28.37		

G. FISH IMPINGEMENT (ETS Reference 3.1.3.7)

Objective

Impingement surveys were conducted to monitor the quantity of impinged fish on the traveling screens.

Methods

Impingement surveys were conducted weekly throughout 1980 (Table V-A-1). Except when technical difficulties delayed sampling, weekly fish impingement sampling began on Thursday mornings when all four traveling screens were washed and a collection basket of 0.25 inch mesh netting was placed at the end of the screen washwater sluiceway (Figure V-G-1). On Friday mornings, after approximately 24 hours, each screen was washed individually for 15 minutes (one complete revolution of the screen) and all aquatic organisms collected. Fish were identified, counted, measured for total length (mm) and weighed (g). Data was summarized according to operating intake bays (bays that had intake pumps operating in the 24 hr sampling period) and non-operating intake bays.

Results

The BVPS impingement surveys of 1976 through 1980 have resulted in the collection of 31 species of fish representing nine families (Table V-G-1). A total of 108 fish, representing 17 species (21 taxa) was collected in 1980 (Table V-G-2). Emerald shiner were dominant with 29.6% of the total annual catch, followed by channel catfish (19.2%), and bluegill (17.3%). Smallmouth and largemouth basses accounted for 7.7% and 3.8%, respectively. Carp with four specimens represented 5.8% of the total. No endangered or threatened species were collected (Commonwealth of Pennsylvania 1979). In addition, 211 crayfish and 40 clams were also collected on the traveling screens in 1980 (Table V-G-6).

One black crappie, a species not collected in previous years, was collected in 1980. All fishes ranged in size from 22 mm to 256 mm, with the majority under 100 mm. The total weight of the yearly collection was 0.46 kg (1.02 lbs) (Table V-G-2).

TABLE V-G-1

(SCIENTIFIC AND COMMON NAME) [a]
FAMILIES AND SPECIES OF FISH COLLECTD DURING THE
IMPINGEMENT SURVEYS, 1976-1980
BVPS

Family and Scientific Name	Common Name
Clupeidae (herrings)	
Dorosoma cepedianum	Gizzard shad
Cyprinidae (minnows and carps)	
Cyprinus carpio	Carp
Notropis atherinoides	Emerald shiner
N. spilopterus	Spotfin shiner
N. stramineus	Sand shiner
N. volucellus	Mimic shiner
Pimephales notatus	Bluntnose minnow
Catostomidae (suckers)	
Carpiodes cyprinus	Quillback
Catostomus commersoni	White sucker
Moxostoma carinatum	River redhorse
Ictaluridae (bullhead catfishes)	
Ictalurus natalis	Yellow bullhead
I. nebulosus	Brown bullhead
I. punctatus	Channel catfish
I. catus	White catfish
Noturus flavus	Stonecat
Percopsidae (trout-perches)	
Percopsis omiscomaycus	Trout-perch
Cyprinodontidae (killifish)	
Fundulus diaphanus	Banded killifish
Centrarchidae (sunfishes)	
Ambloplites rupestris	Rock bass
Lepomis cyanellus	Green sunfish
L. gibbosus	Pumpkinseed
L. macrochirus	Bluegill
Micropterus dolomieui	Smallmouth bass
M. salmoides	Largemouth bass
M. punctulatus	Spotted bass
Pomoxis annularis	White crappie
P. nigromaculatus	Black crappie

TABLE V-G-1 (Continued)

Family and Scientific Name	Common Name
Percidae (perches)	
Etheostoma nigrum	Johnny darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
Stizostedion vitreum	Walleye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum

[a] Nomenclature follows Bailey et al. (1980)

TABLE V-G-2

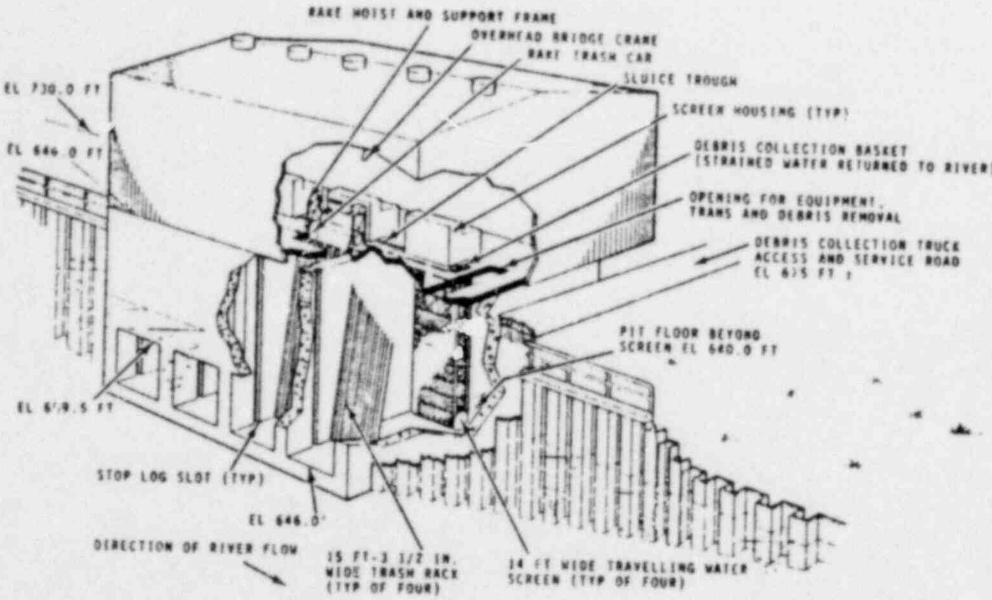
SUMMARY OF FISH COLLECTED IN IMPINGEMENT SURVEYS CONDUCTED FOR ONE 24 HOUR PERIOD
PER WEEK DURING 1980
BVPS

				Operating Intake Bays[(a)]				Non-Operating Intake Bays[(b)]				
				Alive		Dead		Alive		Dead		
Taxa	Number	Percent Frequency of Occurrence	Percent Composition	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)	Length Range (mm)
Gizzard shad	1	1.9	0.9	1	163.0							256
Carp	4	5.8	3.7	2	2.0	1	1.0	2	3.0	1	1.0	25-53
Sand Shiner	2	3.8	1.9			1	1.0			1	2.0	42-73
Emerald shiner	37	26.9	34.3	1	1.0	17	21.7	1	0.8	18	19.5	33-77
Common shiner	1	1.9	0.9			1	1.0					34
Shiner (*Notropis* sp.)	3	3.8	2.8			1	(c)			2	(c)	41[(c)]
Channel catfish	21	19.2	19.4	5	12.4	10	30.0	4	7.0	2	7.0	40-126
Yellow bullhead	5	5.8	4.6	1	1.0	1	1.0	1	1.0	2	2.0	24-32
Bullhead (*Ictalurus* sp.)	1	1.9	0.9							1	1.0	22
Trout-perch	2	1.9	1.9			1	2.0	1	3.0			64-67
Smallmouth bass	4	7.7	3.7			1	2.5	1	20.0	2	27.0	60-118
Largemouth bass	3	3.8	2.8	2	19.0			1	6.0			85-104
Green sunfish	1	1.9	0.9					1	11.0			94
Bluegill	13	17.3	12.0	4	10.0	1	18.0	4	32.5	4	11.1	42-111
Sunfish (*Lepomis* sp.)	1	1.9	0.9			1	1.0					24
White crappie	1	1.9	0.9					1	2.0			56
Black crappie	1	1.9	0.9							1	1.0	40
Logperch	1	1.9	0.9	1	1.0							58
Johnny darter	2	3.8	1.9			1	(c)	1	1.0			47[(c)]
Walleye	2	3.8	1.9	1	8.0			1	9.0			46-91
Unidentifiable	2	3.8	1.9			1	(c)			1	(c)	(c)
TOTALS	108			16	215.4	38	79.2	19	96.3	35	71.6	
Percent of Totals				14.8	46.4	35.2	17.1	17.6	20.7	32.4	15.4	

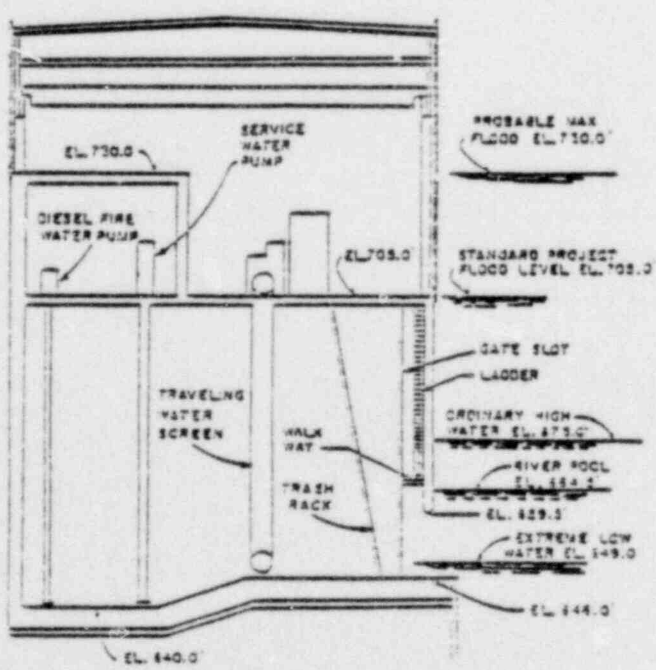
(a) Intake bays that had intake pumps operating within the 24 hr sampling period
(b) Intake bays that had no pumps operating within the 24 hr sampling period
(c) No weight or length obtained for damaged fish

FIGURE V-G-1

INTAKE STRUCTURE
BVPS



(Three dimensional: Cutaway View)



(Two dimensional: Side View)

The temporal distribution of the 1980 impingement catch follows closely with the pattern of catches of previous years (1976 to 1979) (Tables V-G-3 and V-G-4). During each year, the largest numbers of fish are collected in the winter months (January-February) and then the catch gradually decreases until July-August when another small peak occurred.

Comparison of Impinged and River Fish

A comparison of the number of fish collected in the river and traveling screens is presented in Table V-G-5. Five species of fish were collected only in the impingement surveys, while 15 species were taken exclusively in the river. The major difference in species composition between the two collections is the absence of many large species in the impingement collections. Four species of suckers and redhorses, and six species of sport fish (tiger muskellunge, northern pike, white bass, spotted bass, sauger and yellow perch) were not collected in the impingement surveys. Those sport fish which were collected on the traveling screens (channel catfish, smallmouth bass, and walleye) were smaller than individuals of those species collected by river sampling. Minnows and shiners constituted a larger percentage of the river collections than in the impingement collections.

Comparison of Operating and Non-Operating Intake Bay Collections

Of the 108 fish collected during the 1980 impingement studies, 54 (50%) were collected from operating intake bays and 54 (50%)from non-operating intake bays (Table V-G-2). However, due to differences between the number of operating (74) and non-operating (119) screens washed in 1980, the impingement data were computed with catch expressed as fish per 1000 sq m of screen surface area washed. These results showed 4.1 and 2.5 fish for operating and non-operating screens, respectively. As in previous years, the substantial number of fish collected in non-operating bays indicates that fish entrapment, rather than impingement, accounts for some of the catch. Entrapment occurred when fish were lifted out of the water on the frame plates as the traveling screen rotates. Alternatively, when fish were impinged they were forced against the screens due to velocities created by the circulating water pumps.

TABLE V-G-3

SUMMARY OF IMPINGEMENT SURVEY DATA FOR 1980
BVPS

Date		Number	Percent of	Number of Fish Collected				Intake Bays				Intake	River
				Operating Intake Bays[a]		Non-Operating Intake Bays[b]		Operating				Water	Elevation Above Mean
Month	Day	Collected	Annual Total	Alive	Dead	Alive	Dead	A	B	C	D	Temp. °F	Sea Level
January	4	3	2.2	2	1	0	0			X		36.0	665.4
	11	1	0.9	0	1	0	0			X		34.8	664.7
	18	0	0	0	0	0	0			X		36.2	666.2
	25	1	0.9	0	1	0	0			X		35.2	663.8
February	1	1	0.9	0	0	0	1			X		33.0	664.5
	8	2	1.9	0	1	0	1			X		33.2	664.6
	15	2	1.9	0	1	1	0			X		34.9	664.8
	22	1	0.9	0	1	0	0	X				37.4	664.5
	29	6	5.6	1	1	1	3	X				34.5	665.8
March	7	2	1.9	0	1	0	1	X				37.0	666.5
	14	17	15.7	1	10	2	4	X				36.0	667.0
	21	9	8.3	1	3	1	4	X				38.0	668.5
	28	1	0.9	0	0	0	1	X				42.0	667.0
April	4	2	1.9	0	0	0	2	X				44.0	670.0
	11	8	7.4	0	0	1	7			X		-	-
	22	1	0.9	0	0	0	1		X		X	48.0	666.0
	25	0	0	0	0	0	0		X			49.0	664.5
May	2	0	0	0	0	0	0	X				52.0	667.5
	9	0	0	0	0	0	0	X				53.0	664.5
	23	1	0.9	0	0	0	1	X				58.4	667.0
	30	1	0.9	0	0	1	0	X				61.5	664.2
June	6	0	0	0	0	0	0			X		61.5	666.0
	13	1	0.9	0	0	0	1			X		58.5	666.0
	20	3	2.2	0	0	2	1			X		61.9	664.8
	27	0	0	0	0	0	0	X				66.5	664.2
July	3	2	1.9	0	0	0	2	X				68.0	664.0
	15	5	4.6	0	0	3	2	X				68.0	664.9
	18	3	2.2	0	0	2	1	X				71.0	664.5
	25	3	2.2	0	3	0	0	X			X	69.0	665.5
August	1	2	1.9	0	1	0	1	X			X	67.8	664.5
	8	5	4.6	1	3	1	0			X	X	66.8	665.0
	15	1	0.9	1	0	0	0			X	X	66.5	667.3
	22	4	3.7	0	3	1	0			X	X	63.0	666.0
	29	2	1.9	0	1	1	0			X	X	66.5	664.0
September	5	0	0	0	0	0	0			X	X	67.9	664.2
	12	1	0.9	0	1	0	0	X	X			65.8	664.3
	19	3	2.2	2	1	0	0	X	X			62.5	664.0
	26	0	0	0	0	0	0	X	X			61.5	664.2

TABLE V-G-3 (Continued)

Date		Number	Percent of	Number of Fish Collected				Intake Bays Operating				Intake	River Elevation
				Operating Intake Bays[a]		Non-Operating Intake Bays[b]						Water	Above Mean
Month	Day	Collected	Annual Total	Alive	Dead	Alive	Dead	A	B	C	D	Temp. °F	Sea Level
October	3	0	0	0	0	0	0	X	X			59.4	664.2
	10	0	0	0	0	0	0	X	X			56.0	664.0
	17	1	0.9	0	0	0	1	X	X			52.5	664.0
	24	2	1.9	1	0	1	0	X		X		52.5	664.5
	31	1	0.9	0	1	0	0			X	X	44.0	666.0
November	7	1	0.9	1	0	0	0			X	X	44.0	666.0
	14	0	0	0	0	0	0			X	X	43.5	665.5
	22	0	0	0	0	0	0			X	X	40.0	666.0
	28	3	2.2	2	0	1	0		X	X	X	38.5	667.0
December	10	2	1.9	1	1	0	0			X	X	39.4	668.3
	12	1	0.9	0	1	0	0			X	X	38.0	667.5
	19	2	1.9	1	1	0	0		X		X	34.0	666.0
	26	1	0.9	1	0	0	0		X		X	32.0	665.5
Total		108		16	38	19	35						

[a] Intake bays that had intake pumps operating in the 24 hr sampling period.

[b] Intake bays that had no pumps operating in the 24 hr sampling period.

TABLE V-G-4

SUMMARY OF FISH COLLECTED IN IMPINGEMENT SURVEYS, 1976-1980
BVPS

Month	1976 Operating Intake Bays[(a)]	1976 Non-operating Intake Bays[(b)]	1976 Total	1977 Operating Intake Bays	1977 Non-operating Intake Bays	1977 Total	1978 Operating Intake Bays	1978 Non-operating Intake Bays	1978 Total
January	3,792	2,021	5,813	1,136	2,869	4,005	186	41	227
February	1,087	1,034	2,121	3,622	2,039	5,661	99	73	172
March	260	128	388	314	72	386	36	113	149
April	19	11	30	7	3	10	3	1	4
May	5	2	7	3	0	3	-	-	-
June	4	1	5	4	3	7	2	4	6
July	20	12	32	27	5	32	9	3	12
August	27	10	37	6	1	7	6	12	18
September	8	6	14	1	4	5	7	15	22
October	35	8	43	8	3	11	4	14	18
November	15	4	19	9	0	9	1	2	3
December	374	219	593	174	12	186	20	3	23
Total	5,646	3,456	9,102	5,311	5,011	10,322	373	281	654

Month	1979 Operating Intake Bays	1979 Non-operating Intake Bays	1979 Total	1980 Operating Intake Bays	1980 Non-operating Intake Bays	1980 Total	Average 1976-1979 Operating Intake Bays	Average 1976-1979 Non-operating Intake Bays	Average 1976-1979 Total
January	66	16	82	5	0	5	1,295	1,237	2,532
February	9	8	17	5	7	12	1,204	789	1,993
March	15	10	25	16	13	29	156	81	237
April	1	0	1	0	11	11	8	4	12
May	3	1	4	0	2	2	4	1	5
June	2	0	2	0	4	4	3	2	5
July	5	2	7	3	10	13	15	6	21
August	20	34	54	10	4	14	15	14	29
September	9	9	18	4	0	4	6	8	14
October	21	6	27	2	2	4	17	8	25
November	7	6	13	3	1	4	8	3	11
December	8	4	12	6	0	6	144	60	204
Total	162	100	262	54	54	108	2,875	2,213	5,088

(a) Intake bays that had intake pumps operating in the 24 hr sampling period.

(b) Intake bays that had no pumps operating in the 24 hr sampling period.

TABLE V-G-5

NUMBER AND PERCENT OF ANNUAL TOTAL OF FISH COLLECTED IN IMPINGEMENT SURVEYS AND IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1980
BVPS

Taxa[(a)]	Total Number of Fish Collected		Percent of Annual Total	
	Impingement	River	Impingement	River
Gizzard shad	1	14	1.0	2.0
Northern pike	0	1	0	0.1
Tiger muskellunge	0	2	0	0.3
Goldfish	0	7	0	1.0
Carp	4	49	4.0	7.0
Common shiner	1	0	1.0	0
Sand shiner	2	145	2.0	20.7
Spotfin shinr	0	4	0	0.6
Emerald shiner	37	319	36.6	45.6
Mimic shiner	0	15	0	2.1
Bluntnose minnow	0	61	0	8.7
White sucker	0	1	0	0.1
Quillback	0	1	0	0.1
Northern hog sucker	0	1	0	0.1
Golden redhorse	0	5	0	0.7
Yellow bullhead	5	0	5.0	0
Channel catfish	21	14	21.0	2.0
Trout-perch	2	3	2.0	0.4
White bass	0	2	0	0.3
Green sunfish	1	1	1.0	0.1
Bluegill	13	0	13.0	0
Smallmouth bass	4	17	4.0	2.4
Spotted bass	0	14	0	2.0
Largemouth bass	3	2	3.0	0.3
White crappie	1	8	1.0	1.1
Black crappie	1	0	1.0	0
Johnny darter	2	0	2.0	0
Yellow perch	0	1	0	0.1
Logperch	1	1	1.0	0.1
Sauger	0	5	0	0.7
Walleye	2	5	2.0	0.7
Freshwater drum	0	1	0	0.1
Total	101	699		

(a) Includes only those specimens identified to the lowest possible taxa.

TABLE V-G-6

SUMMARY OF INVERTEBRATES COLLECTED IN IMPINGEMENT SURVEYS CONDUCTED FOR ONE 24 HOUR PERIOD PER WEEK 1980
BVPS

Date		Crayfish Operating Intake Bays	Crayfish Non-Operating Intake Bays	Pelecypoda (Clams) All Bays
January	4	2	8	0
	11	1	3	0
	18	0	10	0
	25	1	4	0
February	1	0	6	0
	8	0	1	0
	15	0	0	0
	22	0	1	0
	29	2	2	0
March	7	2	2	0
	14	11	7	3
	21	5	1	0
	28	7	5	0
April	4	6	4	0
	11	1	4	2
	22	10	2	0
	25	3	3	0
May	2	0	0	0
	9	0	0	0
	23	0	1	0
	30	0	0	0
June	6	1	1	0
	13	0	0	0
	20	0	1	0
	27	1	1	0
July	3	0	0	0
	15	1	5	1
	18	2	3	1
	25	2	2	2
August	1	3	2	0
	8	6	2	0
	15	6	1	12
	22	0	1	1
	29	2	4	0
September	5	2	3	1
	12	2	2	4
	19	0	0	1
	26	2	1	4

TABLE V-G-6 (Continued)

Date		Crayfish Operating Intake Bays	Crayfish Non-Operating Intake Bays	Pelecypoda (Clams) All Bays
October	3	0	2	2
	10	2	0	2
	17	2	0	1
	24	2	1	0
	31	2	0	1
November	7	1	1	0
	14	0	1	1
	22	4	0	0
	28	1	1	0
December	10	6	0	0
	12	3	0	1
	19	6	2	0
	26	0	0	0
Total		110	101	40

In addition, of the 211 crayfish collected in the 1980 impingement studies, 110 (52.1%) were collected from operating bays and 101 (47.9%) were collected from non-operating bays. Adjusting these data for screen surface area washed (crayfish per 1000 sq. m) the results show 8.3 and 4.8 crayfish for operating and non-operating screens, respectively.

Summary and Conclusions

The results of the 1980 impingement surveys indicate that withdrawal of river water at the BVPS intake for cooling purposes had little or no effect on the fish populations. Only 108 fish were collected, which is the fewest collected since initial operation of BVPS in 1976. Of the 108 fish collected, 35 (32.4%) were alive and returned via the discharge pipe to the Ohio River.

H. PLANKTON ENTRAINMENT

1. Ichthyoplankton

Objective

To determine the species composition, relative abundance, and distribution of ichthyoplankton found in proximity to the BVPS intake structure.

Methods

Day samples were collected monthly in the Ohio River, April through July along a five station transect, perpendicular to the BVPS intake structure (Figure V-F-1). Surface tows were made at Stations 1, 3 and 5 while bottom tows were conducted at Stations 2 and 4. A 0.5 m diameter, 505 micron mesh plankton net was used to collect a total of 20 samples. Sample volumes were measured utilizing a General Oceanics Model 2030 digital flowmeter mounted centrically in the mouth of the net. Samples were preserved in 10% buffered formalin containing rose bengal dye.

In the laboratory, eggs, larvae, juveniles, and adults were sorted from the sample and identified to the lowest possible taxon and stage of development. Densities of the ichthyoplankton (#/100 m^3) were calculated using appropriate flowmeter data.

Results

A total of 64 eggs, 510 larvae, one juvenile, and three adults of nine taxa representing seven families were collected from the river entrainment transect sampling locations (Table V-H-1). Cyprinids were the most common taxa collected representing 79.4% of the total catch (12.5% of the eggs, 87.8% of the larvae, and 100% of the adults). Eggs represented 11% of the ichthyoplankton collected; most (87.5%) were not identifiable. Larvae accounted for 88.2% of the total specimens. Minnow (Cyprinidae spp.) early larvae comprised 75.9% of the total larval catch. The second most abundant taxa was gizzard shad (Dorosoma cepedianum) comprising 8.2% of the catch; all were either yolk-sac or early larvae. Yellow perch (Perca flavescens) accounted for 1.4% of the larvae collected. All other taxa each comprised less than one percent of the larval catch. A single young white catfish (Ictalurus catus) represented the only juvenile fish collected during the survey. Three adult emerald shiners (Notropis atherinoides) comprised the only adults taken.

TABLE V-H-1

NUMBER AND DENSITY OF FISH EGGS, LARVAE, JUVENILES AND ADULTS (Number/100 m^3) COLLECTED WITH A 0.5m PLANKTON NET AT THE ENTRAINMENT RIVER TRANSECT IN THE OHIO RIVER NEAR BVPS, 1980

Date	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
23 April						
Vol. water filtered (m^3)	86.2	110.6	121.3	99.5	95.0	393.5
No. eggs collected	0	0	0	1	0	1
No. larvae collected	0	0	0	0	0	0
No. juveniles collected	0	0	0	0	0	0
No. adults collected	0	0	0	0	0	0
Density						
Eggs						
Unidentified	0	0	0	1.01 (1)	0	0.25 (1)
Total Station Density (Number Collected)	0	0	0	1.01 (1)	0	0.25 (1)
21 May						
Vol. water filtered	75.5	79.0	119.6	83.6	88.9	446.6
No. eggs collected	0	0	0	1	0	1
No. larvae collected	0	1	1	0	7	9
No. juveniles collected	0	0	0	0	0	0
No. adults collected	1	0	1	0	1	3
Density						
Eggs						
Unidentifiable	0	0	0	1.20 (1)	0	0.22 (1)
Larvae						
Catostomidae spp. (EL)[b]	0	0	0.84 (1)	0	2.25 (2)	0.67 (3)
Perca flavescens (YL)	0	0	0	0	1.12 (1)	0.22 (1)
Perca flavescens (EL)	0	0	0	0	3.37 (3)	0.67 (3)
Stizostedion spp. (YL)	0	1.27 (1)	0	0	1.12 (1)	0.45 (2)
Adults						
Notropis athernoides	1.32 (1)	0	0.84 (1)	0	1.12 (1)	0.67 (3)
Total Station Density (Number Collected)	1.32 (1)	1.27 (1)	1.67 (2)	1.20 (1)	9.00 (8)	2.91 (13)

TABLE V-H-1 (Continued)

Date	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
19 June						
Vol. water filtered (m^3)	90.5	95.5	98.4	85.1	101.0	470.5
No. eggs collected	6	4	7	4	34	55
No. larvae collected	3	9	7	0	4	23
No. juveniles collected	0	0	0	0	0	0
No. adults collected	0	0	0	0	0	0
Density						
Eggs						
Cyprinidae spp.	0	0	0	0	0.99 (1)	0.21 (1)
Unidentified	0	0	0	0	32.67 (33)	7.01 (33)
Unidentifiable	6.63 (6)	4.19 (4)	7.11 (7)	4.70 (4)	0	4.46 (21)
Larvae						
Dorosoma cepedianum (YL)	0	1.05 (1)	2.03 (2)	0	0	0.64 (3)
Cyprinidae spp. (YL)	1.10 (1)	7.33 (7)	3.05 (3)	0	3.96 (4)	3.19 (15)
Cyprinidae spp. (EL)	2.21 (2)	1.05 (1)	1.02 (1)	0	0	0.85 (4)
Lepomis spp. (EL)	0	0	1.02 (1)	0	0	0.21 (1)
Total Station Density (Number Collected)	9.94 (9)	13.61 (13)	14.23 (14)	4.70 (4)	37.62 (38)	16.58 (78)
22 July						
Vol. water filtered (m^3)	74.9	95.5	143.2	89.9	106.3	509.8
No. eggs collected	0	0	1	1	5	7
No. larvae collected	300	112	34	13	19	478
No. juveniles collected	0	0	0	0	1	1
No. adults	0	0	0	0	0	0
Density						
Eggs						
Cyprinidae spp.	0	0	0.70 (1)	1.11 (1)	4.70 (5)	1.37 (7)
Larvae						
Dorosoma cepedianum (EL)	37.38 (28)	10.47 (10)	0	0	0.94 (1)	7.65 (39)
Cyprinidae spp. (YL)	4.01 (3)	9.42 (9)	12.57 (18)	4.45 (4)	7.53 (8)	8.24 (42)
Cyprinidae spp. (EL)	348.46 (261)	97.38 (93)	8.38 (12)	8.89 (8)	8.47 (9)	75.13 (383)
Cyprinidae spp. (LL)	5.34 (4)	0	0	0	0	0.78 (4)
Fundulus diaphanus (YL)	0	0	2.09 (3)	0	0	0.59 (3)
Lepomis spp. (YL)	1.34 (1)	0	0.70 (1)	1.11 (1)	0.94 (1)	0.78 (4)
Perca flavescens (EL)	4.01 (3)	0	0	0	0	0.59 (3)
Juveniles						
Ictalurus catus	0	0	0	0	0.94 (1)	0.20 (1)
Total Station Density (Number Collected)	400.53 (300)	117.28 (35)	24.44 (35)	15.57 (14)	23.52 (25)	95.33 (486)

TABLE V-H-1 (Continued)

Yearly Total	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
Vol. of water filtered (m^3)	327.1	380.6	482.5	358.1	391.2	1,939.5
No. eggs collected	6	4	8	7	39	64
No. larvae collected	303	122	42	13	30	510
No. juveniles collected	0	0	0	0	1	1
No. adults collected	1	0	1	0	1	3
Density						
Eggs						
Cyprinidae spp.	0	0	0.21 (1)	0.28 (1)	1.53 (6)	0.41 (8)
Unidentified	0	0	0	0.28 (1)	8.44 (33)	1.75 (34)
Unidentifiable	1.83 (6)	1.05 (4)	1.45 (7)	1.40 (5)	0	1.13 (22)
Larvae						
Dorosoma cepedianum (YL)	0	0.26 (1)	0.41 (2)	0	0	0.15 (3)
Dorosoma cepedianum (EL)	8.56 (28)	2.63 (10)	0	0	0.26 (1)	2.01 (39)
Cyprinidae spp. (YL)	1.22 (4)	4.20 [illegible]	4.35 (21)	1.12 (4)	3.07 (12)	2.94 (57)
Cyprinidae spp. (EL)	80.40 (263)	24 [illegible]	2.69 (13)	2.23 (8)	2.30 (9)	19.95 (387)
Cyprinidae spp. (LL)	1.22 (4)	[illegible]	0	0	0	0.21 (4)
Catostomidae spp. (EL)	0	[illegible]	0.21 (1)	0	0.51 (2)	0.15 (3)
Fundulus diaphanus (YL)	0	0	0.62 (3)	0	0	0.15 (3)
Lepomis spp. (YL)	0.3[illegible]	0	0.21 (1)	0.28 (1)	0.26 (1)	0.21 (4)
Lepomis spp. (EL)	[illegible]	0	0.21 (1)	0	0	0.05 (1)
Perca flavescens (YL)	[illegible]	0	0	0	0.26 (1)	0.05 (1)
Perca flavescens (EL)	0.92 (3)	0	0	0	0.77 (3)	0.31 (6)
Stizostedion spp. (YL)	0	0.26 (1)	0	0	0.26 (1)	0.10 (2)
Juveniles						
Ictalurus catus	0	0	0	0	0.26 (1)	0.05 (1)
Adults						
Notropis athernoides	0.31 (1)	0	0.21 (1)	0	0.26 (1)	0.15 (3)
Total Station Density (Number Collected)	94.77 (310)	33.11 (126)	10.57 (51)	5.59 (20)	18.15 (71)	29.80 (578)

[a]Station 1 - South shoreline; Station 3 - Midchannel; Station 5 - North shoreline.
[b]Developmental Stages
YL - Hatched specimens in which yolk and/or oil globules are present.
EL - Specimens in which yolk and/or oil globules are not present and in which fin rays and/or spiny elements have been developed.
LL - Specimens in which fin ray and spiny elements of the dorsal and anal fins approximate the number found in adults but in which reminants of the finfolds remain.

Seasonal Distribution

Only a single, unidentified egg was collected during the first survey (23 April) (Table V-H-1). Samples taken on 21 May yielded one unidentifiable egg, nine larvae, and three adults (2.2% of the total catch). The larvae consisted of three taxa, the most abundant being yellow perch (Perca flavescens) representing 44.4% of the total catch. May was the only month when adult fish were captured during the entrainment transect survey.

Species composition of samples taken in June and July were similar (Table V-H-1). Cyprinid eggs, yolk sac larvae, and early larvae, gizzard shad (Dorosoma cepedianum) larvae; and sunfish (Lepomis spp.) larvae were first taken in June. These taxa were also collected in July but in substantially greater numbers. More than 94% of the year's catch was collected in July; nearly 90% of these were minnows (Cyprinidae spp.). Yellow perch (Perca flavescens) and banded killifish (Fundulus diaphanus) larvae were also taken in July.

Spatial Distribution

Most (53.6%) of the ichthyoplankton were collected at Station 1 (Table V-H-1). Total density decreased across the channel except for a slight increase near the north shoreline (Station 5). This north-south density gradient was only evident in larval minnows (Cyprinidae spp.) and gizzard shad (Dorosoma cepedianum). Sucker (Catostomidae spp.) larvae were only taken at midchannel and north shoreline stations (Stations 3 and 5, respectively). Banded killifish (Fundulus diaphanus) was found in a single midchannel surface collection (Station 3). Sunfish (Lepomis spp.) were slightly more abundant in the midchannel but were generally found all along the transect. Yellow perch (Perca flavescens) larvae were found exclusively along either shoreline (Stations 1 and 5).

Eggs were most abundant (60.9% of the total egg catch) along the north shoreline (Station 5) (Table V-H-1). The single juvenile white catfish (Ictalurus catus) collected was taken along the north shore. The three adult emerald shiners (Notropis athernoides) were collected equally along the transect only in surface tows.

Summary and Conclusions

Species composition and relative abundance of ichthyoplankton taken in 1980 along the river entrainment transect was generally similar to that found in 1979. As in 1979, cyprinid larvae comprised the vast majority of the ichthyoplankton catch and were found most concentrated at stations closest to the BVPS intake structure. However, the relatively high reproductive capabilities of this group should more than offset any entrainment loss to BVPS.

2. Phytoplankton

Objective

To determine the composition and abundance of phytoplankton entrained in the intake water system.

Methods

During the first quarter of 1980, plankton (phytoplankton and zooplankton) entrainment samples were collected six times during one 24-hour period (every 4 hours) per month. These collections were initiated on the same day or within one day of river collections. Every four hours, a surface and bottom water sample from an operating intake bay was taken with a Kemmerer sampler. Surface and bottom waters were mixed and a 1 gal sample taken and preserved with Lugol's solution. All operating intake bays were sampled. After April 1, 1980, plankton sampling was reduced to one entrainment sample collected monthly. Each sample was a 1 gal composite which contained equal volumes of surface and bottom water from 1 operating intake bay.

In the laboratory, phytoplankton analysis was performed in accordance with procedures identified for river plankton.

Although densities (cells/ml) were calculated for all taxa, only densities of the 15 most abundant taxa were presented in this report. Densities were tabulated for each of the six 4-hour periods. If more than one sample was collected for each 4-hour period, results were combined to present a mean density for that given time.

An overall 24 hour mean was calculated for each of the 15 most abundant taxa. These means were compared to overall means of taxa calculated for river samples.

Comparison of Entrainment and River Samples

Total density of phytoplankton in entrainment samples at BVPS from January to March 1980 was slightly lower than the total densities observed in the river (Figure V-C-2). During the past four years, phytoplankton densities of entrainment samples were frequently lower than those of mean total densities observed from river samples (Figure V-C-1).

The composition of phytoplankton in the river and entrainment samples was similar. Densities of five abundant taxa during the first quarter were tabulated to demonstrate this similarity (Table V-H-2). Each month dominant taxa in the entrainment samples were also dominant in the river (Tables V-H-3 through V-H-8).

Each month mean Shannon indices, evenness and richness values of entrainment samples were very similar to the river samples (Tables V-H-9 and V-H-10).

Summary and Conclusions

Results of monthly sampling of phytoplankton in the Ohio River near BVPS and within the intake structure showed little difference in densities (cells/ml) and species compositon. During periods of minimum low river flow (5000 cfs), about 1.25% of the river would be withdrawn into the condenser cooling system. Based on the similarity of density of phytoplankton in the river and the BVPS intake structure, and the small amount of water withdrawn from the river, the loss of phytoplankton was negligible, even under worst case low flow conditions.

3. Zooplankton

Objective

To determine the composition and abundance of zooplankton entrained in the intake water system.

TABLE V-H-2

COMPARISON OF FIVE PHYTOPLANKTON TAXA DENSITIES (Cells/ml) FOUND IN MONTHLY ENTRAINMENT AND OHIO RIVER SAMPLES DURING JANUARY, FEBRUARY AND MARCH, 1980
BVPS

	Entrainment	River
JANUARY		
Chlorophyta I	48	76
Synedra filiformis	31	52
Small centrics	73	82
Aphanizomenon flos-aquae	21	47
Microflagellates	146	147
FEBRUARY		
Small centrics	16	33
Microflagellates	205	250
Chlamydomonas globosa	12	15
Chlorophyta I	47	54
Asterionella formosa	61	68
MARCH		
Microflagellates	89	150
Chlorophyta I	11	18
Navicula cryptocephala	25	31
Asterionella formosa	67	59
Navicula viridula	93	124

TABLE V-H-3

FIFTEEN MOST ABUNDANT ENTRAINED PHYTOPLANKTON TAXA
DENSITIES (Cells/ml) OF SAMPLES COLLECTED
IN OPERATING INTAKE BAY C
JANUARY 1980
BVPS

Date	January 10, 1980			January 11, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
CYANOPHYTA							
Aphanizomenon flos-aquae	4	20	32	28	40	4	21
Schizothrix calcicola	16	32	4	12		8	12
CHLOROPHYTA							
Ankistrodesmus falcatus	24	8	8	4	4	4	9
Scenedesmus bicellularis	8	8	8	8	8	8	8
Chlorophyta I	76	36	60	64	84	36	59
CHRYSOPHYTA							
Asterionella formosa	24		28	32	12	20	19
Diatoma vulgare	4	28	8	16		4	10
Melosira varians	8	68	4	8	8		16
Navicula cryptocphala	12	48	8	16	8	20	19
Navicula viridula	20	68	4	4	12	12	20
Nitzschia dissipata	8	32	8	8	20	8	14
Synedra filiformis	24	20	28	60	20	32	31
Small centrics	80	64	52	100	56	88	73
CRYPTOPHYTA							
Rhodomonas minuta	20	4		8		8	8
MICROFLAGELLATES	192	148	168	88	204	76	146
TOTAL PHYTOPLANKTON	624	752	492	512	532	376	548
TOTAL OF 15 MOST ABUNDANT TAXA	520	584	420	456	476	328	464
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	83	78	85	89	89	87	85

TABLE V-H-4

FIFTEEN MOST ABUNDANT ENTRAINED PHYTOPLANKTON TAXA
DENSITIES (Cells/ml) OF SAMPLES COLLECTED
IN OPERATING INTAKE BAY C
FEBRUARY 1980
BVPS

Date	February 14, 1980				February 15, 1980		
Time	0930	1330	1730	2130	0130	0530	$\bar{x}$
CYANOPHYTA							
Schizothrix calcicola		12	8	12	12		7
CHLOROPHYTA							
Ankistrodesmus falcatus	8			4	12	16	7
Chlamydomonas globosa	4	24	12	26		4	12
Dictyosphaerium pulchellum						48	8
Micractinium pusillum		8	8	8	4		5
Scenedesmus bicellularis		8			8		3
Scenedesmus quadricauda	8					8	3
Chlorophyta I	32	48	56	40	56	48	47
CHRYSOPHYTA							
Asterionella formosa	20	48	68	72	76	84	61
Diatoma tenue	4	4	4		4		3
Melosira varians	20					8	5
Navicula cryptocephala			8	4	8		3
Synedra filiformis		4		4	4		2
Small centrics	8	16	12	20	28	12	16
MICROFLAGELLATES	140	212	176	220	120	364	205
TOTAL PHYTOPLANKTON	276	400	364	446	356	616	410
TOTAL OF 15 MOST ABUNDANT TAXA	244	384	352	410	332	592	386
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	88	96	97	92	93	96	94

TABLE V-H-5

FIFTEEN MOST ABUNDANT ENTRAINED PHYTOPLANKTON TAXA
DENSITIES (Cells/ml) OF SAMPLES COLLECTED
IN OPERATING INTAKE BAY A
MARCH 1980
BVPS

	Date	March 13, 1980			March 14, 1980			
	Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
CYANOPHYTA								
Schizothrix calcicola		16	24					7
CHLOROPHYTA								
Chlamydomonas globosa		8	8					3
Schroderia setigera		24						4
Scenedesmus quadricauda		32						5
Chlorophyta I		8	40	24	8	8	16	17
CHRYSOPHYTA								
Asterionella formosa		56	56	72	80	88	48	67
Diatoma tenue			16	24				7
Fragilaria vaucheriae		16	8	8				5
Melosira varians		24	32				16	12
Navicula cryptocephala		24	24	24	24	16	40	25
Navicula viridula		136	104	72	104	64	80	93
Nitzschia dissipata			16	16		8	16	9
Nitzschia palea		8	16	8	16		8	9
Small centrics		8	8	8	16	8	16	11
MICROFLAGELLATES		96	72	120	40	136	72	89
TOTAL PHYTOPLANKTON		520	504	488	392	384	366	443
TOTAL OF 15 MOST ABUNDANT TAXA		456	424	376	288	328	312	363
PERCENT OF COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON		88	84	77	73	85	85	82

TABLE V-H-6

FIFTEEN MOST ABUNDANT PHYTOPLANKTON TAXA - JANUARY 10, 1980
MEAN DENSITY (Cells/ml) OF DUPLICATE SAMPLES
NEW CUMBERLAND POOL OF THE OHIO RIVER
BVPS

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		x̄	
	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
CYANOPHYTA										
Aphanizomenon flos-aquae	74	100	34	32	38	26	48	28	48	46
Schizothrix calcicola	28	24	42	34	20	16	36	24	32	24
CHLOROPHYTA										
Ankistrodesmus falcatus	12	22	14	14	4	8	14	20	11	16
Dictyosphaerium pulchellum	24	30		8	8			8	8	12
Micractinium pusillum	20	29	10	22	14	18	16		14	17
Scenedesmus quadricauda	20		16	28		4		8	9	10
Chlorophyta I	92	96	58	60	78	68	68	84	74	77
CHRYSOPHYTA										
Asterionella formosa	40	58	68	46	8	42	68	52	46	50
Navicula cryptocephala	12	8	34	12	8	18	18	6	18	11
Navicula viridula	26	28	18	14	20	38	12	18	19	24
Nitzschia acicularis	20	44			16	14			9	14
Synedra filiformis	38	40	66	78	18	18	76	84	50	55
Small centrics	102	122	66	50	86	84	60	88	78	86
CHRYPTOPHYTA										
Rhodomonas minuta	18	20	4	6	12	10	4	6	10	10
MICROFLAGELLATES	120	118	214	186	84	96	156	200	144	150
TOTAL PHYTOPLANKTON	788	889	740	674	510	612	664	708	676	721
TOTAL OF MOST ABUNDANT PHYTOPLANKTON	646	739	644	590	414	460	575	626	570	602
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	82	83	87	88	81	75	87	89	84	84

TABLE V-H-7

FIFTEEN MOST ABUNDANT PHYTOPLANKTON TAXA - FEBRUARY 14, 1980
MEAN DENSITY (Cells/ml) OF DUPLICATE SAMPLES
NEW CUMBERLAND POOL OF THE OHIO RIVER
BVPS

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		x̄	
	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
CYANOPHYTA										
Schizothrix calcicola	6	14	6	2	8	4	4	14	6	8
CHLOROPHYTA										
Ankistrodesmus falcatus		6	6	6	4	12	6	6	4	8
Chlamydomonas globosa	34	12	12	12	28	10	6	8	20	10
Micractinium pusillum	32	12	8	2	16	12	10	2	16	7
Scenedesmus bicellularis	4	4		4	8	4	4		4	3
Chlorophyta I	100	60	46	44	30	40	50	62	56	52
CHRYSOPHYTA										
Asterionella formosa	80	36	60	46	84	72	72	92	74	62
Melosira varians	2	2				4		18	1	6
Navicula cryptocephala	6	8	2	4	4	2	4	14	4	7
Navicula viridula	2	2	2	6	6	8		32	2	12
Nitzschia dissipata	2		4	2	2		4	16	3	4
Nitzschia palea	2	2	4		4			6	2	2
Synedra filiformis	6	4	6	12	8	12	4	16	6	11
Small centrics	76	32	28	18	28	30	28	26	40	26
MICROFLAGELLATES	200	282	238	274	242	260	232	270	228	272
TOTAL PHYTOPLANKTON	578	502	456	472	510	496	446	710	498	545
TOTAL OF MOST ABUNDANT PHYTOPLANKTON	552	476	422	432	472	470	424	582	466	490
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	96	95	92	92	92	95	95	82	94	90

TABLE V-H-8

FIFTEEN MOST ABUNDANT PHYTOPLANKTON TAXA - MARCH 13, 1980
MEAN DENSITY (cells/ml) OF DUPLICATE SAMPLES
NEW CUMBERLAND POOL OF THE OHIO RIVER
BVPS

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		x̄	
	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
CYANOPHYTA										
Schizothrix calcicola	22	4	12	8	4	16		4	[illegible]	8
CHLOROPHYTA										
Chlamydomonas globosa	8	12	12	4			8	4	7	5
Scenedesmus quadricauda	24					20			6	5
Chlorophyta I	78	64	60	84	76	48	56	56	68	63
CHRYSOPHYTA										
Asterionella formosa	66	60	40	76	44	36	60	92	52	66
Diatoma tenue		12	12	12			8	12	5	9
Fragilaria vaucheriae	14	8	4	20	16		4		10	7
Navicula cryptocephala	32	32	24	44	12	16	36	52	26	36
Navicula viridula	158	132	132	132	100	60	128	148	130	118
Nitzschia dissipata	26	28	20	24	44	44	12	24	26	30
Nitzschia palea	16	28	24	12	12	12	12	20	16	18
Pediastrum simplex							32		8	
Synedra filiformis	16	16	12	4		20	12	12	11	13
Small centrics	16	12	12	16	24	20	16	24	17	18
MICROFLAGELLATES	172	220	144	148	144	100	168	108	157	144
TOTAL PHYTOPLANKTON	786	812	652	716	572	556	776	804	697	722
TOTAL OF MOST ABUNDANT PHYTOPLANKTON	648	628	508	584	480	392	552	556	549	540
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	82	77	78	82	84	70	71	69	79	74

TABLE V-H-9

PHYTOPLANKTON DIVERSITY INDICES OF ENTRAINMENT SAMPLES COLLECTED FROM JANUARY 10 to MARCH 14, 1980. RESULTS ARE FROM ONE OPERATING INTAKE BAY BVPS

Date	January 10, 1980			January 11, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
No. of Species	28	29	25	24	23	24	26
Shannon Index	3.72	4.16	3.50	3.71	3.18	3.66	3.66
Evenness	0.77	0.86	0.75	0.81	0.70	0.80	0.78
Richness	4.20	4.23	3.87	3.69	3.50	3.88	3.90

Date	February 14, 1980			February 15, 1980			
Time	0930	1330	1730	2130	0130	0530	$\bar{x}$
No. of Species	13	13	12	17	16	14	14
Shannon Index	2.59	2.40	2.35	2.61	2.92	2.14	2.50
Evenness	0.69	0.64	0.65	0.63	0.73	0.56	0.65
Richness	2.14	2.00	1.86	2.62	2.55	2.02	2.20

Date	March 13, 1980			March 14, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
No. of Species	21	21	19	14	13	16	17
Shannon Index	3.58	3.82	3.56	3.22	2.76	3.42	3.36
Evenness	0.81	0.87	0.84	0.84	0.74	0.85	0.82
Richness	3.20	3.21	2.91	2.18	2.02	2.54	2.68

TABLE V-H-10

PHYTOPLANKTON DIVERSITY INDICES OF OHIO RIVER SAMPLES COLLECTED FROM JANUARY 10 TO MARCH 13, 1980. INDICES ARE MEANS OF DUPLICATE SURFACE AND BOTTOM SAMPLES
BVPS

Transect	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
Depth	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
January 10, 1980										
No. of Species	31	32	26	26	28	31	24	23	27	28
Shannon Index	4.17	4.17	3.66	3.70	3.97	4.24	3.64	3.46	3.86	3.89
Evenness	0.84	0.83	0.78	0.79	0.82	0.85	0.79	0.76	0.81	0.81
Richness	4.50	4.57	3.71	3.76	4.41	4.68	3.61	3.35	4.06	4.09
February 14, 1980										
No. of Species	16	15	18	17	17	16	16	27	17	19
Shannon Index	2.77	2.36	2.56	2.42	2.72	2.49	2.39	3.39	2.61	2.66
Evenness	0.69	0.60	0.62	0.58	0.66	0.62	0.60	0.71	0.64	0.63
Richness	2.36	2.25	2.70	2.60	2.56	2.41	2.38	3.96	2.50	2.80
March 13, 1980										
No. of Species	26	25	23	20	18	26	25	27	23	24
Shannon Index	3.74	3.71	3.74	3.57	3.41	4.16	3.86	4.03	3.69	3.87
Evenness	0.81	0.80	0.82	0.82	0.81	0.88	0.83	0.85	0.82	0.84
Richness	3.70	3.57	3.40	2.97	2.76	3.98	3.62	3.91	3.37	3.60

Methods

During the first quarter of 1980, plankton entrainment samples, described in Subsection 2, were collected for the purpose of counting both phytoplankton and zooplankton. For zooplankton analysis, a well-mixed sample was taken and processed using the same procedures described for river zooplankton samples. After April 1, 1980, plankton sampling was reduced to one entrainment sample collected monthly. Each sample was a 1 gal composite which contained equal volumes of surface and bottom water.

Although densities (number/liter) were calculated for all taxa, only taxa which comprised greater than 2% of the total were presented in this report. Densities were tabulated for each of the six 4-hour periods. If more than one sample was collected for each 4-hour sample, results were combined to present a mean density for that given time. An overall 24 hour mean was calculated for each taxon for the 24-hour period. These means were compared to overall means of taxa for river samples.

Comparison of Intake and River Samples

Total number of zooplankton entrained at the BVPS was similar to total number observed in the river (Figure V-D-2).

The composition of zooplankton was similar in entrainment and river samples (Tables V-H-11 through V-H-16). Protozoans and rotifers were predominant, whereas crustaceans were sparse.

Densities of four of the most abundant taxa for each month were compared (Table V-H-17). This comparison showed that the same taxa were present in both river and intake samples and they were present in similar quantities. Shannon indices, evenness, and richness values for river and entrainment samples were also similar (Tables V-H-18 and V-H-19), further demonstrating similarity between entrained and river zooplankton.

TABLE V-H-11

MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2%)
DENSITIES (Number/liter) OF SAMPLES COLLECTED
IN OPERATING INTAKE BAY C
JANUARY 1980
BVPS

Date	January 10, 1980			January 11, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
PROTOZOA							
Arcella sp		65		10		10	14
Codonella cratera	15	35	10	15	5	10	15
Cyclotrichium sp.	35	5	90	75	105	115	70
Difflugia sp.				10			2
Epistylis sp.	15	20	15	5	5	5	10
Nebela caudata	10					10	4
Paramecium sp.					5		1
Vorticella sp.	70	55	40	50	35	70	54
Ciliate unidentified	5		5	5		5	4
ROTIFERA							
Asplanchna sp.	5	5		10	10	10	6
Bdelloids	5	10		5		10	5
Keratella cochlearis	35	45		35	25	25	28
Polyarthra dolichoptera			10	5	5		4
Rotifers-unidentified	10		5	5		5	4
CRUSTACEA							
Cyclops bicuspidatus thomasi			10		5		
TOTAL ZOOPLANKTON	215	265	185	235	200	285	230
TOTAL OF MOST ABUNDANT ZOOPLANKTON	205	240	185	230	200	275	221
PERCENT COMPOSITION OF MOST ABUNDANT ZOOPLANKTON	95	90	100	98	100	96	96

TABLE V-H-12

MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2%)
DENSITIES (Number/liter) OF SAMPLES COLLECTED
IN OPERATING INTAKE BAY C
FEBRUARY 1980
BVPS

Date	February 14, 1980			February 15, 1980			
Time	0930	1330	1730	2130	0130	0530	$\bar{x}$
PROTOZOA							
Arcella sp.	15	5	10		5	10	8
Colpidium sp.	15		15	5	30	30	16
Codonella cratera				5	15	5	3
Cyclotrichium sp.	65	25	40	45	110	80	60
Lionotus sp.			70	40	90	95	50
Paramecium sp.				5		10	2
Vorticella sp.	50	20	45	35	30	50	38
Oxytrich ciliate		10		5			2
Ciliate unidentified	5		5	5	20	30	11
ROTIFERA							
Asplanchna sp.			5				1
Brachionus bidentatus		5			5		2
Keratella cochlearis		5	5	5	5		3
Keratella quadrata				5			1
Lecane sp.				5			1
Rotifer unidentified	5		5	5		5	3
TOTAL ZOOPLANKTON	170	70	205	160	325	315	208
TOTAL OF MOST ABUNDANT ZOOPLANKTON	155	70	200	160	310	315	201
PERCENT COMPOSITION OF MOST ABUNDANT ZOOPLANKTON	91	100	98	100	95	100	97

TABLE V-H-13

MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2%)
DENSITIES (Number/liter) OF SAMPLES COLLECTED
IN OPERATING INTAKE BAY A
MARCH 1980
BVPS

Date	March 13, 1980			March 14, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
PROTOZOA							
Arcella sp.	10		10		10		5
Centropyxis sp.		10		10			3
Colpidium sp.	10					20	5
Condonella cratera	10			20	20		8
Cyclotrichium sp.		50	30	30	20	50	30
Cyphodera ampulla			10				2
Difflugia acuminata				10			2
Difflugia sp.			10			10	3
Epistylis sp.		90					15
Euglypha compressa	10						2
Lionotus sp.				10			2
Nebela caudata	10						2
Paramecium sp.				10			2
Strobilidium gyrans	180	120	240	210	260	110	187
Tintinnidium fluvitale				10			2
Vorticella sp.	130	150	130	20	20	50	83
Oxytrich ciliate			10				2
Suctorian ciliate	10						2
Ciliate unidentified	10	10		40	10	20	15
ROTIFERA							
Asplanchna sp.				20		10	5
Keratella cochlearis					10	10	3
Polyarthra dolichoptera			10	10	10		5
Bdelloids				20			3
Rotifer unidentified	10	10		10		10	7
TOTAL ZOOPLANKTON	390	440	450	430	360	290	393
TOTAL OF MOST ABUNDANT ZOOPLANKTON	390	440	450	430	360	290	393
PERCENT COMPOSITION OF MOST ABUNDANT ZOOPLANKTON	100	100	100	100	100	100	100

TABLE V-H-14

MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2%)
MEAN OF DUPLICATE SAMPLES (Number/liter)
NEW CUMBERLAND POOL OF THE OHIO RIVER
JANUARY 10, 1980
BVPS

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
PROTOZOA										
Arcella sp.	10	8	5	8	2	8	22	10	10	8
Codonella cratera	5	32	5	8	5	25	5	5	5	18
Cyclotrichium sp.	78	132	80	130	138	102	155	115	113	120
Epistylis sp.	32	28	12	20	12	15	20	15	19	20
Vorticella sp.	58	220	78	82	55	412	140	98	83	203
Suctorian ciliate	8				2				2	
Ciliate unidentified	10	12	2		15	22	2	5	7	10
ROTIFERA										
Keratella cochlearis	58	90	70	58	35	10	55	95	54	63
Polyarthra dolichoptera	18	8	5	18	10	8	10	12	11	12
Bdelloids	12	2	5		5	2	2	2	6	2
Rotifers-unidentified	15	12	10	5	8	22	5	12	10	13
TOTAL ZOOPLANKTON	320	572	288	342	295	655	432	380	334	487
TOTAL OF MOST ABUNDANT ZOOPLANKTON	304	544	272	329	287	626	416	369	320	469
PERCENT COMPOSITION OF MOST ABUNDANT ZOOPLANKTON	95	95	94	96	97	96	96	97	94	96

TABLE V-H-15

MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2%)
MEAN OF DUPLICATE SAMPLES (Number/liter)
NEW CUMBERLAND POOL OF THE OHIO RIVER
FEBRUARY 14, 1980
BVPS

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
PROTOZOA										
Arcella sp.		8		8	5	2	8	15	3	8
Colpidium sp.	20	50	32	30	28	32	50	30	32	36
Codonella cratera	5	8		2	2	2	2	35	4	12
Cyclotrichium sp.	98	162	95	68	90	112	118	80	100	106
Lionotus sp.	55	40	82	68	58	90	55	90	62	72
Paramecium sp.	20	20	2	10	2	8	5	5	7	11
Vorticella sp.	18	52	75	65	25	48	50	70	42	58
Ciliate unidentified	12	22	10	22	20	18	5	15	12	19
ROTIFERA										
Asplanchna sp.		2	5		5	5	8	5	4	3
Polyarthra dolichoptera	5					2			1	1
Rotifera-unidentified	5	2	2	5	8	8	10	20	6	9
TOTAL ZOOPLANKTON	245	380	322	285	248	345	320	435	284	361
TOTAL OF MOST ABUNDANT ZOOPLANKTON	238	366	303	278	243	327	311	365	273	334
PERCENT COMPOSITION OF MOST ABUNDANT ZOOPLANKTON	97	96	94	98	98	95	97	84	96	92

TABLE V-H-16

MOST ABUNDANT ZOOPLANKTON TAXA (Greater than 2%)
MEAN OF DUPLICATE SAMPLES (Number/liter)
NEW CUMBERLAND POOL OF THE OHIO RIVER
MARCH 13, 1980
BVPS

	Sampling Transect									
	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
PROTOZOA										
Arcella sp.	20	20	5	20	20	20	10	5	14	16
Colpidium sp.	15	10	10		5	5	20		12	4
Codonella cratera	15	30	30	30	15	20	15	15	19	24
Cyclotrichium sp.	45	80	25	100	45	45	80	25	49	62
Cyphodera ampulla		20	10	5	5	5	5	10	5	10
Difflugia sp.		5	5	15	5	10	5	10	4	10
Epistylis sp.				55	15	10	5	5	5	18
Euglypha compressa				10			5	5	1	4
Nebela caudata			5				15	10	5	2
Paramecium sp.	15			10		5			4	4
Strobilidium gyrans	110	60	115	55	80	55	60	10	91	45
Vorticella sp.	100	210	55	140	130	90	80	55	91	124
Ciliate unidentified	10	20	50	10	35	5	15	15	28	12
ROTIFERA										
Bdelloids	5		15		5	5	5		8	[illegible]
Kellicottia longispina	5	20				5		5	1	8
Keratella cochlearis	5	10		15	5	5			2	8
Polyarthra dolichoptera	15	10	5	15	5		5		8	6
Rotifera unidentified	10	5	20	15	20	15	10	5	15	10
TOTAL ZOOPLANKTON	400	525	370	555	400	305	335	190	376	394
TOTAL OF MOST ABUNDANT ZOOPLANKTON	370	500	350	495	390	300	335	175	362	368
PERCENT COMPOSITION OF MOST ABUNDANT ZOOPLANKTON	92	95	94	89	98	98	100	92	96	93

TABLE V-H-17

COMPARISON OF FOUR ZOOPLANKTON TAXA DENSITIES
(Number/liter) FOUND IN MONTHLY ENTRAINMENT
AND OHIO RIVER SAMPLES DURING 1980
BVPS

	Entrainment	River
JANUARY		
Vorticella sp.	54	143
Codonella cratèra	15	12
Cyclotrichium sp.	70	116
Keratella cochlearis	28	58
FEBRUARY		
Vorticella sp.	38	50
Cyclotrichium sp.	70	103
Lionotus sp.	50	67
Colpidium sp.	16	34
MARCH		
Vorticella sp.	83	108
Strobilidium gyrans	187	68
Cyclotrichium sp.	30	56
Epistylis sp.	15	12

TABLE V-H-18

ZOOPLANKTON DIVERSITY INDICES OF ENTRAINMENT SAMPLES COLLECTED FROM JANUARY 10, TO MARCH 14, 1980. RESULTS ARE FROM ONE OPERATING INTAKE BAY BVPS

Date	January 10, 1980			January 11, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
No. of Species	12	12	8	13	9	12	11
Shannon Index	2.96	2.97	2.24	2.95	2.18	2.61	2.65
Evenness	0.82	0.82	0.74	0.79	0.68	0.72	0.76
Richness	2.05	1.97	1.34	2.20	1.51	1.95	1.84

Date	February 14, 1980			February 15, 1980			
Time	0930	1330	1730	2130	0130	0530	$\bar{x}$
No. of Species	9	6	10	11	12	9	10
Shannon Index	2.42	2.26	2.61	2.74	2.68	2.60	2.55
Evenness	0.76	0.87	0.78	0.79	0.74	0.82	0.79
Richness	1.56	1.18	1.69	1.97	1.90	1.39	1.62

Date	March 13, 1980			March 14, 1980			
Time	1400	1800	2200	0200	0600	1000	$\bar{x}$
No. of Species	10	7	8	14	8	9	9
Shannon Index	2.13	2.24	1.87	2.80	1.61	2.61	2.21
Evenness	0.64	0.80	0.62	0.73	0.53	0.82	0.69
Richness	1.51	0.99	1.15	2.14	1.89	1.41	1.52

TABLE V-H-13

ZOOPLANKTON DIVERSITY INDICES OF OHIO RIVER SAMPLES COLLECTED FROM January 10 TO MARCH 13, 1980. INDICES ARE MEANS OF DUPLICATE SURFACE AND BOTTOM SAMPLES
BVPS

Transect	No. 1		No. 2A		No. 2B		No. 3		$\bar{x}$	
Depth	1 ft	15 ft	1 ft	15 ft	1 ft	10 ft	1 ft	15 ft	1 ft	15 ft
January 10, 1980										
No. of Species	14	14	10	10	11	14	10	10	11	12
Shannon Index	3.08	2.60	2.57	2.47	2.44	2.02	2.38	2.50	2.62	2.40
Evenness	0.81	0.69	0.75	0.73	0.70	0.52	0.70	0.73	0.74	0.67
Richness	2.25	1.97	1.68	1.63	1.76	2.09	1.57	1.60	1.82	1.82
February 14, 1980										
No. of Species	10	11	10	10	10	13	10	14	10	12
Shannon Index	2.56	2.60	2.54	2.66	2.59	2.73	2.58	3.30	2.57	2.82
Evenness	0.77	0.75	0.74	0.82	0.78	0.74	0.76	0.86	0.76	0.79
Richness	1.64	1.69	1.67	1.50	1.64	2.05	1.65	2.23	1.65	1.87
March 13, 1980										
No. of Species	14	13	12	16	11	11	12	11	12	13
Shannon Index	3.10	2.83	3.06	3.35	2.85	2.96	2.91	3.20	2.98	3.08
Evenness	0.81	0.76	0.84	0.84	0.82	0.86	0.82	0.93	0.82	0.85
Richness	2.17	1.91	1.95	2.37	1.67	1.75	1.81	1.93	1.90	1.99

Summary and Conclusions

Results of monthly sampling of zooplankton in the Ohio River near BVPS and within the intake structure showed little di ference in densities (number/liter) and species composition. During periods of minimum low river flow (5000 cfs), about 1.25% of the river would be withdrawn into the condenser cooling system. Based on the similarity of density of zooplankton in the river and the BVPS intake structure, and the small amount of water withdrawn from the river, the loss of zooplankton was negligible, even under worst case low flow conditions.

VI. MONITORING PROGRAM

TERRESTRIAL

The terrestrial ecological survey for 1980 at the Beaver Valley Power Station (BVPS) included a program to detect and document vegetation stress using aerial false color infrared (CIR) photography combined with ground observations.

Healthy vegetation reflects light in the green (0.5-0.6 um) and near infrared (0.7-1.0 um) portions of the electromagnetic spectrum. Vegetation stress due to disease, insect damage, weather variations, or human impacts can be detected by experienced photointerpreters using either color or CIR film. Because the reflectance of near infrared radiation from healthy green leaves is even higher than for green light, changes in the condition or vigor of the leaf will result in changes in reflectivity which are more apparent when using film sensitive to near infrared wavelengths (Shipley et al. 1980).

Using aerial CIR photography allows large areas of vegetation to be remotely sensed to delineate areas which have experienced stress. Ground surveys must then be conducted to determine the causes of that stress (Hilborn 1978). Aerial CIR has an added advantage in that yellow filters can be used to decrease the absorbance of blue wavelengths, thus reducing the effect of haze which often obscures detail in aerial true color photography.

AERIAL INFRARED PHOTOGRAPHY (ETS Reference 3.1.3.9)

Objectives

The objective of this study was to utilize aerial CIR imagery and ground surveys to evaluate vegetation stress in the vicinity of the currently operating BVPS cooling tower and determine if drift from the tower is adversely affecting the terrestrial ecosystem.

Methods

(1) Aerial Photography

During the 1980 growing season, CIR photographic coverage was flown at BVPS and its vicinity using a Zeiss RMK-A 15/23 camera and Kodak Aerochrome 2443 color infrared film (Table VI-1). The photo index is shown in Figure VI-1. The photomission was conducted on September 4 from 1025 to 1149 hours Eastern Standard Time, in a north-south direction, and at an altitude of 3420 feet above sea level. In order to provide stereo coverage, the mission was flown with a 60% overlap in line of flight and a 30% sidelap between flight lines. Single coverage prints were also obtained. All photographs were free of clouds, and processing methods and conditions remained the same throughout the project.

A flight log was kept in accordance with the Environmental Technical Specifications. Information recorded included model and serial number of camera and lens, film and lot number, filter number, altitude and time at the end of each flight line, flight line map, and date of flight. A copy of the flight log is provided in Table VI-4.

(2) Airphoto Interpretation

Photographs were scanned in the laboratory for quality of color, resolution, scale, and clarity. Equipment utilized included the following:

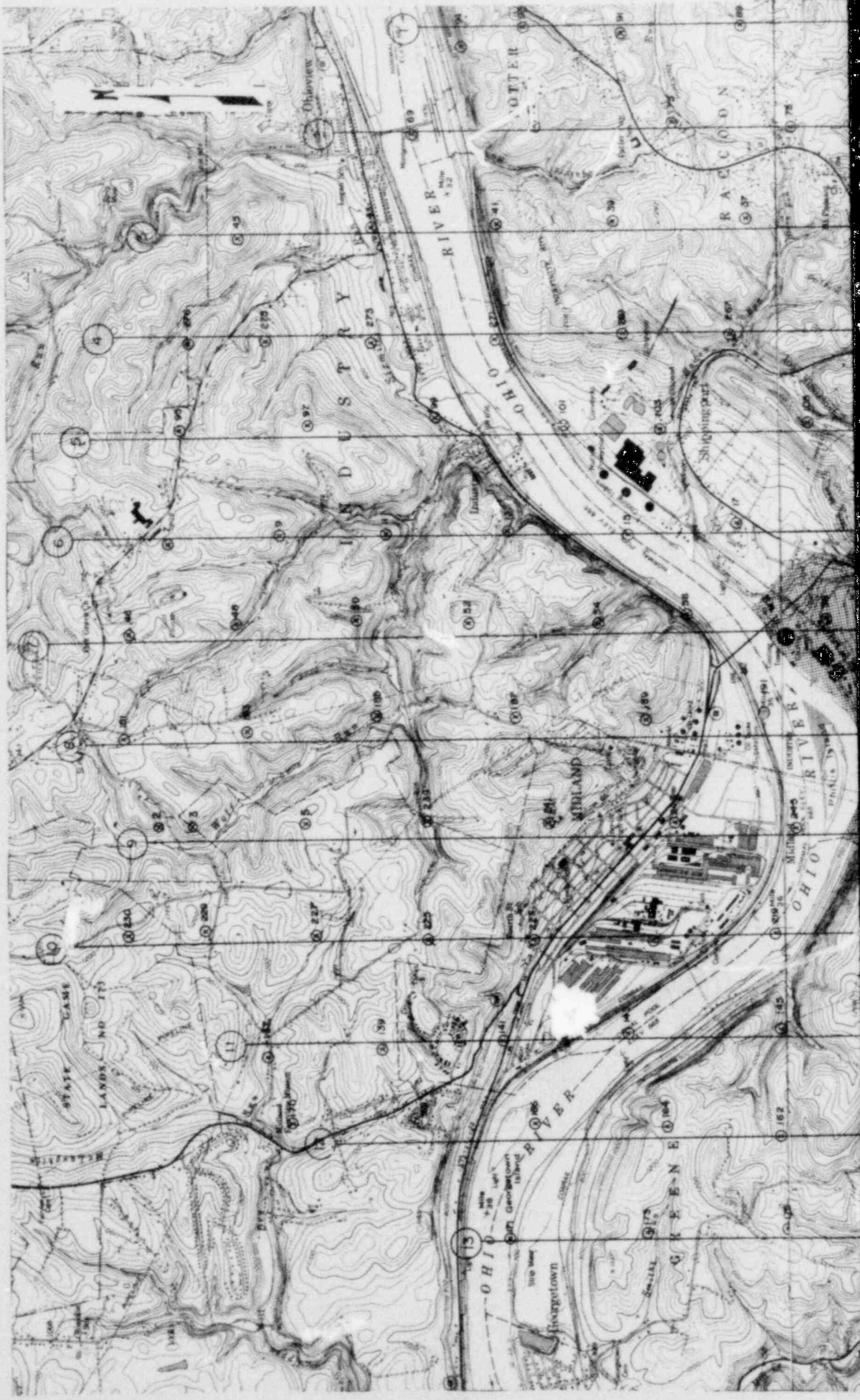
1. Zoom Transfer Scope, Bausch and Lomb Model ZT4
2. Mirror Stereo Viewer, Airphoto Supply Model F71E
3. Microscope, Bausch and Lomb Model MC-1
4. Elevating Light Table, Richards Model GFL-940MCE

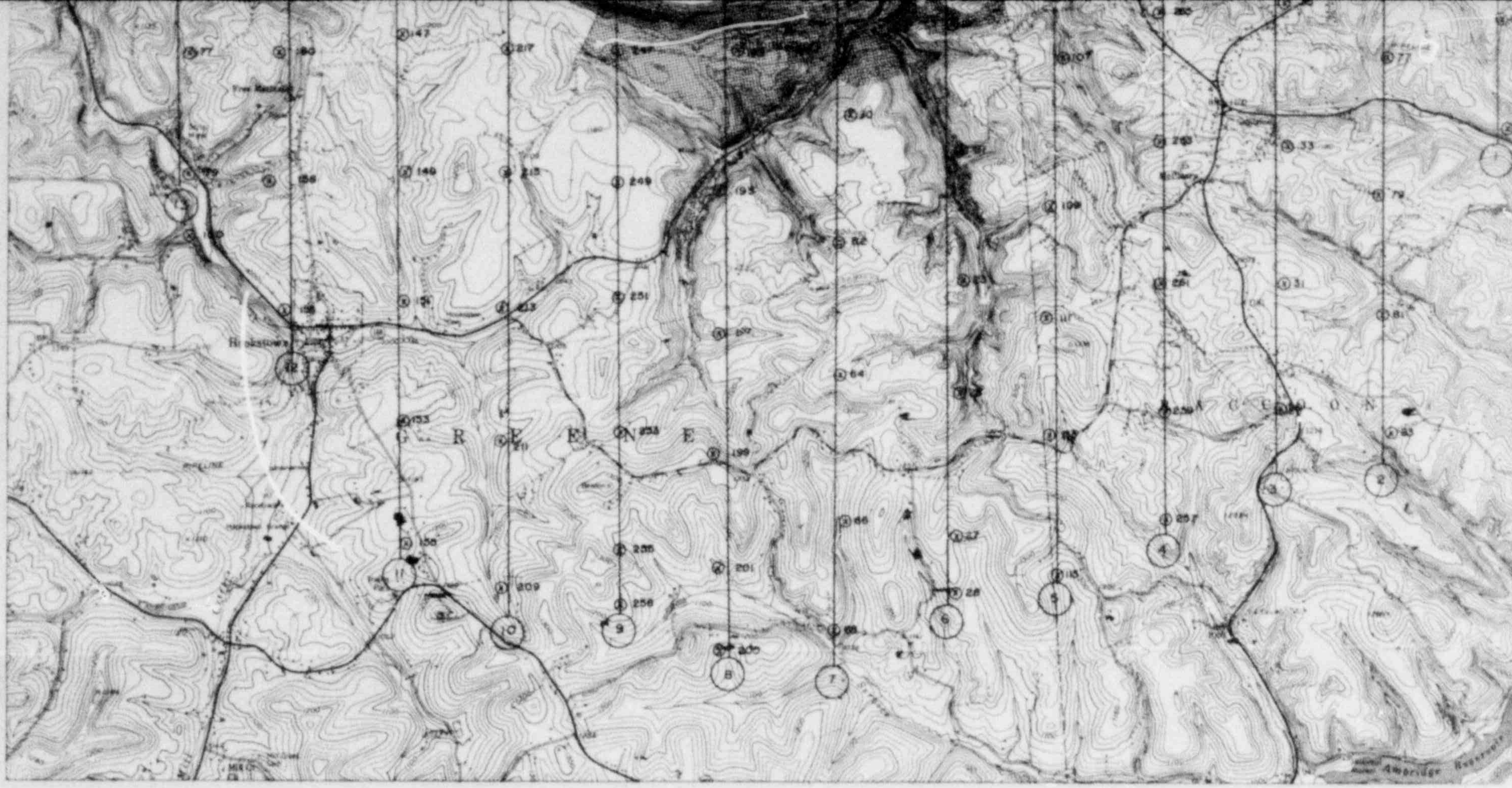
Obvious changes in color tone, pattern, or texture which might have indicated possible vegetation stress were delineated, and areas with the greatest and least potential for being affected by cooling tower drift were designated for ground truthing.

(3) Field Reconnaissance

A terrestrial survey was conducted October 13-15, 1980 in the vicinity of the BVPS to verify the photointerpretation of possible stressed vegetation. The 9" x 9" CIR prints were used in conjunction with the photoindex (Figure VI-1) to construct

POOR ORIGINAL





LEGEND

⊗ PHOTOGRAPHY FRAME CENTER POINT LOCATION
SEPTEMBER 4, 1980 (7-276)
OCTOBER 8, 1980 (2-5)

▭ BEAVER VALLEY POWER STATION SITE

POOR ORIGINAL

FIGURE VI-1
INDEX TO PHOTOGRAPHY
BEAVER VALLEY POWER STATION SITE
AND VICINITY, 1980

0 1 mile

TABLE VI-1

SUMMARY OF THE 1980 AERIAL PHOTOMISSION FLOWN
IN THE VICINITY OF THE BVPS

SCHEDULE

Date	September 4 and October 8, 1980
Time	1025 to 1149 Hours (EST)

EQUIPMENT/SETTINGS

Camera	Zeiss RMK-A 15/23 (#119016)
Lens	Zeiss Pleogon A4 (#123614)
Nominal Focal Length	153.086 mm
Filter	KL (minus blue)
Film	Kodak Aerochrome 2443-1
F-stop	f5.6-8
Shutter Speed	1/400
Scale	1 in. = 400 ft
Aircraft	C-310
Altitude	3420 ft ASL

ATMOSPHERIC CONDITIONS

Visibility	4-7 miles (smoke, haze; cloud layer at 25,000 ft)
Wind	Light and variable

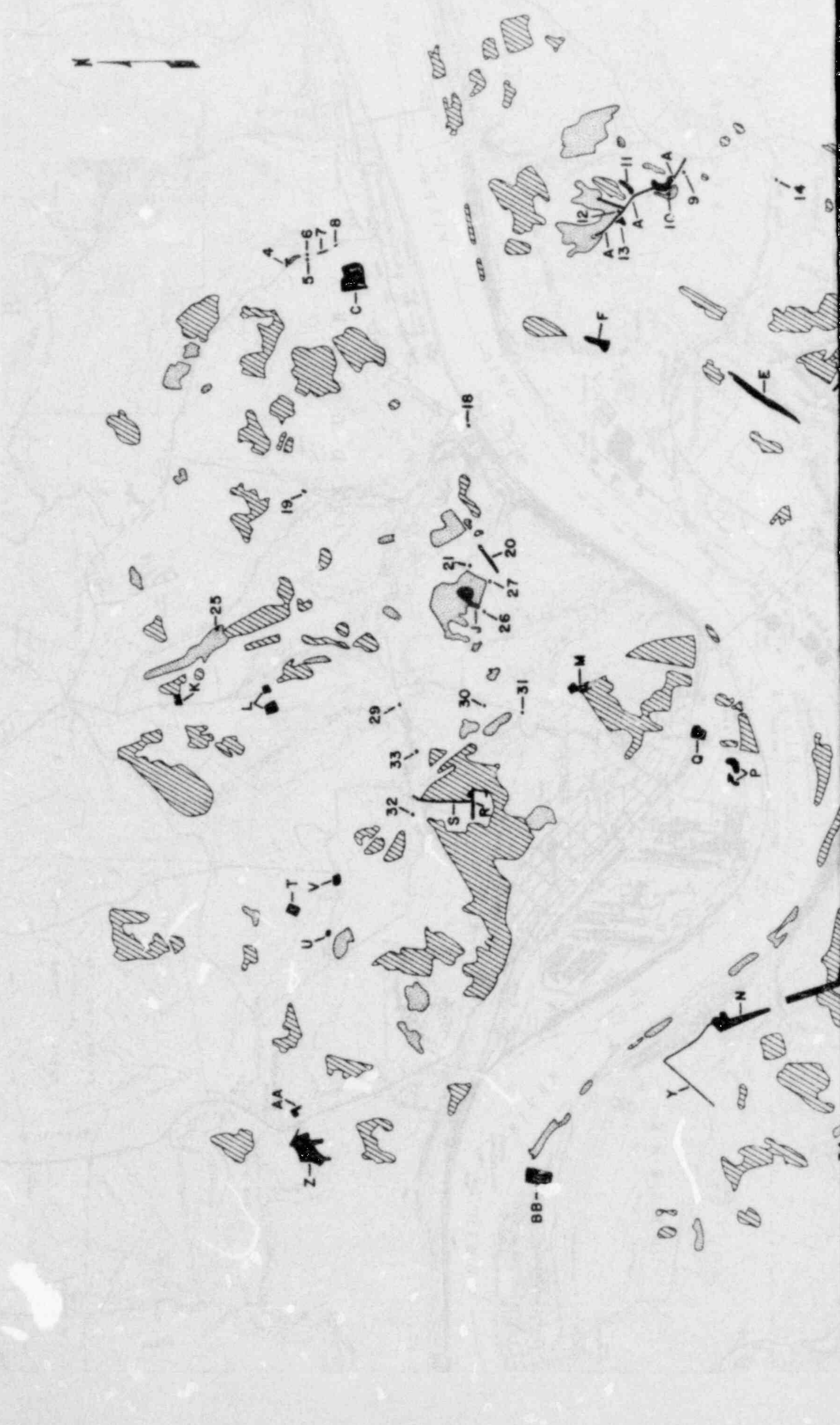
preliminary base maps and to locate suspected stressed vegetation. Where possible, vegetation was examined at close range to determine the cause of stress. If vegetation was on private property, binoculars were used to identify vegetation and the cause of stress. During the field survey, the location, extent, and severity of stressed areas were documented.

Results

As warranted in the Environmental Technical Specifications, an area within three miles (28.3 square miles) of the BVPS cooling tower was covered during the 1980 aerial photomission. This represents a decrease in coverage of approximately 22 square miles from photography flown in 1976 and 1978 when a 50 square mile rectangle was covered. Records indicate that the extra coverage in previous years was the result of photography taken in a rectangular instead of a circular pattern, hence, a surplus of photographs. Studies have shown that photo coverage beyond a 2 kilometer radius (1.24 mile radius or 4.8 square miles) from a cooling tower source is unnecessary given the evidence that most drift-caused vegetation damage occurs well within that radius (Shipley et al. 1980). Thus, the decreased coverage in 1980 did not impair the detection of potential vegetation damage from BVPS tower emissions.

The photomission was flown on September 4 during the active growing season and before senescence (the change in leaf color in autumn) to ensure maximum contrast between stressed and normal vegetation. Because of processing malfunctions, frames 2-5 had to be reflown on October 8. The small size of the area that was photographed at the later date did not affect the overall results.

The 1980 photography, which had a slightly bluish tint, was more underexposed than the 1978 photography. Relatively heavy smoke and haze and a thin cloud layer at 25,000 feet (above the aircraft) contributed to the blueness. Nevertheless, enough contrast was available to discern a number of vegetated areas with evidence of stress. These areas are delineated in Figure VI-2, which shows the extent of distressed vegetation in the vicinity of the BVPS. On Figure VI-2, areas which had been disturbed due to the construction of roads, transmission lines, housing, and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LEGEND

FIELD OBSERVATION POINTS (1-37)
PHOTO OBSERVED VEGETATION DISTURBANCES (A-BB)

LOCUST LEAF MINER

AREAS OF UNIDENTIFIED VEGETATION STRESS

Areas identified by letters indicate vegetation stress due to construction of roads, transmission lines, housing, and other facilities.

Areas identified by numbers represent field observation points used to verify vegetative stress.

FIGURE VI-2

DISTRIBUTION OF VEGETATION STRESS IN THE VICINITY OF THE BEAVER VALLEY POWER STATION SITE, 1980

0 1 mile

other facilities, are indicated by letters. These areas were identified primarily by photointerpretation, and detailed descriptions of the activities are provided in Table VI-2. Areas indicated by numerals represent field observation points used to verify vegetative stress and identify possible causes. Major causal factors of stress (e.g., disease, insect damage, poor drainage, herbicide kill, highway runoff, SO_2 and ozone) are described in Table VI-3.

Photointerpretation of the aerial photography revealed that the majority of human-caused vegetation disturbance was attributed to new construction and related activities such as road building. Of the 28 areas identified (Table VI-2), 20 showed evidence of new construction. Excavation or land clearing for new developments or industrial expansion were present in five areas, whereas maintenance of existing right-of-ways, particularly transmission lines, was evident at two locations. Mining activity occurred in one area. With the exception of the widening of the transmission line corridor (location N), none of the vegetation damaging activities outlined on Figure VI-2 and Table VI-2 were attributable to on-site construction.

The majority of stressed vegetation in the vicinity of the BVPS was the result of natural causes. Over 300 acres of vegetation were affected by locust leaf miner (Xenochalepus dorsalis). These areas occurred primarily along the crests of hills and in flat areas which had historically been farmed or mined. After the areas were revegetated, black locust became the dominant canopy species.

The locust leaf miner is a beetle approximately 6 mm long that hibernates in the winter. In the spring, the adults emerge and begin feeding on the developing foliage of locust, dogwood, elm, oak, beech, cherry, wisteria, and hawthorn (Johnson and Lyon 1976). Eggs are laid on the underside of black locust leaves, and after hatching, the larvae eat into the inner layer of leaf tissue, forming a mine. When stands of locust are attacked, they appear brownish as though dead, but late summer defoliation is usually not harmful (Hepting 1971). Outbreaks of locust leaf miner occur practically every year, and tens of thousands of acres are often defoliated (Baker 1972).

TABLE VI-2

SUMMARY OF THE 1980 VEGETATION DISTURBANCES OBSERVED ON AERIAL PHOTOGRAPHS TAKEN IN THE VICINITY OF THE BVPS

Type of Disturbance	Flight Line(s) & Photo Number(s)	Area Identification on Figure 2	Comments
Construction	2 - 73 & 3 - 39	Area A	Road & housing development (Forest Edge Estates)
Construction	2 - 81	Area B	New road & housing
Excavation/clearing	3 - 43	Area C	Dozer activity, possibly for housing development
Construction	5 - 107 & 5 - 105	Area D	New right-of-way corridor cleared
Maintenance	5 - 105	Area E	Sprayed herbicide to maintain transmission line corridor
Excavation/clearing	5 - 101	Area F	Possible expansion of laydown area for Bruce Mansfield Plant
Construction	6 - 27	Area G	New housing
Construction	6 - 28	Areas H & I	New buildings
Construction	7 - 52	Area J	New housing
Construction	8 - 183	Area K & L	New housing
Construction	8 - 189	Area M	New housing
Construction	8 - 193; 9 - 247; 10 - 217, & 219; 11 - 147 & 145	Area N	Transmission line corridor width increased from a 50' right-of-way to a 200' right-of-way.
Maintenance	9 - 247	Area O	Sprayed herbicide/mowed to maintain transmission line corridor.
Excavation/clearing	9 - 245	Area P	Dozer activity east of Crucible Steel Plant; possible dump or laydown area.
Excavation/clearing	9 - 243	Area Q	Dozer activity; most likely for industrial use.

TABLE VI-2 (Continued)

Type of Disturbance	Flight Line(s) & Photo Number(s)	Area Identification on Figure 2	Comments
Excavation/clearing	9 - 241	Area R	Possibly new roads for housing development
Construction	9 - 239	Area S	Width of old road increased
Construction	10 - 227	Area T	New building
Construction	10 - 227	Areas U & V	New housing
Construction	11 - 155	Areas W & X	New housing
Construction	11 - 145 & 143; 12 - 164	Area Y	New maintenance road for transmission line corridor Area N
Construction	12 - 170	Area Z	Extension of housing development
Construction	12 - 170	Area AA	New housing
Extraction	13 - 171	Area BB	Extension of mining activity east of Georgetown.

Note: Photos from the October 8, 1980 photomission showed widespread vegetation senescence not present during the September 4, 1980 photomission.

TABLE VI-3

SUMMARY OF THE 1980 FIELD OBSERVATIONS OF VEGETATION STRESS IN THE VICINITY OF THE BVPS

Type of Stress	Flight Line(s) & Photo Number(s)	Area Identification or Delineation on Figure 2	Comments
Locust Leaf Miner	1 - 92; 2 - 72 & 77; 3 - 28, 39 & 45; 4 - 261, 263, 265 & 275 5 - 95, 107, 109, 111 & 113; 6 - 13, 25, & 27; 7 - 46, 48, 50 & 52; 8 - 185, 187 & 199; 9 - 241, 247 & 253; 10 - 219 & 227; 11 - 139, 143 & 145; 12 - 158, 160, 166 & 168.	See appropriate stippling pattern	Areas stressed with locust leaf miner were detected on the photos as groups or scattered patches of mostly brownish colored crowns; over 300 acres of affected area were field verified; in addition, almost all of the areas delineated as "Areas of Unidentified Vegetation Stress" on Figure 2 are in all probability stressed by locust leaf miner.
Fall Webworm	1 - 85	Area 1	Approximately 20 trees affected; some tress having in excess of 50 webworm bag remnants; most trees were completely defoliated.
Herbicide Kill	1 - 85	Area 2	Pipeline sprayed, to kill woody vegetation, as a maintenance measure.
Flooding	2 - 77	Area 3	Riparian vegetation flooded.
Power Line Maintenance	3 - 43 & 45	-	Field crews were felling trees under the power lines that parallel Engle Road; cutting followed the overflight.
SO_2/Ozone/Roadway Runoff	3 - 45	Area 4	Necrotic pine needles; possible SO_2 or ozone injury, roadway runoff.
Fall Webworm	3 - 43	Area 5	Fall webworm bag remnants in shagbark hickory; affected tree was adjacent to a stand of blue spruce, hemlock and white pine.
Dutch Elm Disease	3 -43	Areas 6 & 7	Dead snags.
SO_2/Ozone/Roadway Runoff	3 -43	Area 8	Necrosis on scotch pine needles; possible SO_2 or ozone injury, roadway runoff; also, stand is overstocked, trees are crowding each other out, needs thinning.
SO_2/Ozone/Roadway Runoff	3 - 39	Area 9	Necrosis on pine needles; possibly SO_2 or ozone injury, roadway runoff.
Fall Webworm	3 - 39	Area 10	Fall webworm bag remnants in black cherry and apple trees; cherry trees were almost completely defoliated.

TABLE VI-3 (Continued)

Type of Stress	Flight Line(s) & Photo Number(s)	Area Identification or Delineation on Figure 2	Comments
Dutch Elm Disease	3-39	Area 11	Numerous dead elm snags in drainage area; also, a few black locust snags.
Fall Webworm	3-39	Area 12	Black cherry trees with webworm bag remnants.
Fall Webworm	3-39	Area 13	Defoliated black cherry with webworm bag remnants.
Fall Webworm	3-37	Area 14	Black cherry with webworm bag remnants; also, some black cherry snags.
SO_2/Ozone/Roadway Runoff	3-35	Area 15	Three stands of scotch pine in Raccoon Township Municipal Park all of which contain individuals with necrotic needles; possible SO_2 or ozone injury, roadway runoff.
Flooding	4-259	Area 16	Numerous dead or dying black cherry trees within periodically flooded area.
SO_2/Ozone/Roadway Runoff	4-259	Area 17	Necrosis on red pine needles; possible SO_2 or ozone injury, roadway runoff.
Fall Webworm	5-99	Area 18	Black cherry with webworm bag remnants.
SO_2/Ozone/Roadway Runoff	6-09	Area 19	White pine with necrotic needles; possible SO_2 or ozone injury, roadway runoff.
Herbicide Kill	6-13	Area 20	Recently sprayed transmission line corridor; evident on ground, however, not evident on aerial photography because of shadowing; minor overspray.
Fall Webworm	6-13	Area 21	American elm and black cherry with webworm bag remnants.
Fall Webworm	6-19	Area 22	Black cherry with webworm bag remnants.
Fall Webworm	6-21	Area 23	American elm, black cherry, bigtooth aspen, and black locust with webworm bag remnants.
Fall Webworm	6-27	Area 24	Black locust with webworm bag remnants; also, some locust leaf miner.
Fall Webworm	7-48	Area 25	Black cherry with webworm bag remnants; also, some nearby elm snages.

TABLE VI-3 (Continued)

Type of Stress	Flight Line(s) & Photo Number(s)	Area Identification or Delineation on Figure 2	Comments
Fall Webworm	7-52	Area 26	Black cherry, white ash and black locust with webworm bag remnants.
Fall Webworm	7-52	Area 27	Black cherry and black locust with webworm bag remnants.
SO_2/Ozone/Roadway Runoff	7-66	Area 28	Necrotic white pine needles; possible SO_2 or ozone injury, roadway runoff.
Fall Webworm	8-185	Area 29	Black cherry and white ash with webworm bag remnants; cherry trees almost completely defoliated.
SO_2/Ozone/Roadway Runoff	8-187	Area 30	Necrotic white pine needles; possible SO_2 or ozone injury, roadway runoff.
Fall Webworm	8-187	Area 31	Black walnut with webworm bag remnants.
Fall Webworm	9-239	Area 32	Hickory with webworm bag remnants.
Fall Webworm	9-239	Area 33	Black cherry with webworm bag remnants
Fall Webworm	12-160	Areas 34, 35 & 36	Black cherry with webworm bag remnants.
Fall Webworm	13-180	Area 37	Black cherry with webworm bag remnants.

TABLE VI-4

FLIGHT LOG OF THE 1980 AERIAL PHOTOMISSION FLOWN IN THE VICINITY OF THE BVPS

PHOTOGRAPHIC FLIGHT LOG

Project No. ______ Job Order No. 80-30
Date 9-4-80 Pilot Keddal
Aircraft C-310 Operator Cancella
Shippingport Power Plant Area

☐ RC-8 ☑ Zeiss
☐ RC-10 Focal Length 153.06
☐ Other ______

Film 2443 I.R.
Filter KL
F-Stop 5.6 - 8
Shutter Speed 1/400

PAGE —
Lab I.D. No. ______
Emulsion No. ______
Roll No. 1

Site	Line	Run	Altitude MSL	Heading	TIME Start	TIME Stop	FRAME COUNT Start	FRAME COUNT Stop	O.L. %	REMARKS
	1		3420	N-S	10:43	10:43:30	84	94	60%	
	2				10:40	10:42	69	83		
	3				10:30	10:31	29	45		
	4				11:47	11:49	257	276		
	5				10:49	10:52	95	115		
	6				10:25	10:27	7	28		
	7				10:33	10:35	46	68		
	8				11:19	11:21	181	202		
	9				11:42	11:45	235	256		
	10				11:29	11:31	209	230		
	11				11:01	11:02	137	155		
	12				11:09	11:10	156	170		
	13				11:13	11:14	171	180		

An addition 37 acres were also surveyed in the BVPS vicinity in order to identify causal factors of vegetative stress. Twenty areas contained trees infested by fall webworm (Hyphantria cunea). It has been documented that this lepidopteran has attacked as many as 88 species of shade, fruit, and ornamental trees (excluding conifers) in the United States (Johnson and Lyon 1976). Although its feeding habits very regionally, elm, maple, hickory, apple, ash, and black cherry are preferred in Western Appalachia and the Ohio Valley. During the field survey, it was observed that a large number of black cherries were completely defoliated by this pest.

The fall webworm is a small white moth which deposits its egg masses in the spring. The emerging larvae pass through as many as 11 stages of development in which they spin silk webs over foliage and skeletonize the leaves as they feed (Borror and White 1970). Damage is of minor importance in forestry, but infestation in ornamental plantings sometimes affects esthetic values enough to warrant control (Baker 1972).

Other insect-caused vegetative damage included evidence of Dutch elm disease in three locations.

Vegetation stressed by flooding and/or poor drainage in low areas was identified at two observation points, and it is certain that high water levels in other areas not surveyed contributed to widespread stress. Precipitation records from Pittsburgh International Airport indicated that rainfall accumulations during the 1980 growing season (April to September) were between 5 and 6 inches above normal for the region (NOAA 1980). Although vegetation in poorly-drained areas was stressed by the increased precipitation, it is probable that upland vegetation would benefit.

Evidence of possible air or water pollution damage was observed in 8 locations. In each of these areas, the needles of conifers were necrotic. Possible causal factors included runoff or spray containing road de-icing salts, or airborne SO_2 and ozone. Conifers are highly susceptible to these pollutants (Jacobson and Hill 1970, Moxley and Davidson 1973). The potential for a synergistic effect between cooling tower drift and industrial emissions in the area was pointed out in the final environmental impact statement for the BVPS, Unit 1 (USAEC 1973). Further study would be necessary to quantify this possible relationship.

Several instances of vegetation removal that did not show up on the aerial photography were noted during the field survey. Herbicide use was observed in two areas, and power line maintenance (tree cutting) was active at one location.

Summary and Conclusions

During the summer and fall of 1980, vegetation stress was monitored in the vicinity of the BVPS cooling tower. False color infrared aerial photography, photointerpretation of the imagery, and field observations were conducted to detect stressed or damaged vegetation and to identify probable causes.

Evidence from the photography and fieldwork indicated that the majority of vegetation damage was due to construction activities (particularly housing), whereas vegetation stress was primarily caused by insects (fall webworm and locust leaf miner), disease (Dutch elm disease), poor drainage in low areas (excess rainfall during the growing season), and herbicide spraying programs. Several coniferous species showed stress caused by possible air pollution (SO_2, ozone) or salt damage from adjacent public roadways. The actual cause and source of this damage would require further work for positive identification.

Based on interpretation of CIR aerial photography and field verification, there is no evidence to suggest that the BVPS cooling tower is causing vegetation stress. A combination of drift from the BVPS and Bruce Mansfield cooling towers, regional stack emissions, air pollution from other sources such as automobiles, and the local climate may contribute to vegetational stress in the region. The uncertainties of synergistic effects would make it difficult, although not impossible, to measure the actual contribution of the BVPS cooling tower drift to these effects.

It is also possible that the BVPS cooling tower is subtly affecting local microclimatic systems with its inputs of moisture and heat. Damaged vegetation from winter ice buildup would have been a diagnostic measure of this effect, but there was no evidence of heavy limb fall or structural damage in the photographs or field observations.

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