1982 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 non-radiological environmental data collected by Duquesne Light Company (DLCo) during calendar year 1982, for the Beaver Valley Power Station (BVPS) Unit 1, Operating License No. DPR-66. This study was initiated in the interest of providing a non-disruptive data base between the start up of BVPS Unit 1 and that of Unit 2. This is primarily an optional program, since the Nuclear Regulatory Commission (NRC) on February 26, 1980, granted DLCo's request to delete all the aquatic monitoring program, with the exception of fish impingement (Amendment No. 25), from the Environmental Technical Specifications (ETS). This report contains the requirements for the ETS (Reference 3.1.3.7) fish impingement and all the river data collected in 1982.

SCOPE AND OBJECTIVES OF THE PROGRAM

The objectives of the 1982 environmental program were:

(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 of plant operation (including impingement and entrainment) on the plankton, benthos, fish and ichthyoplankton communities in the Ohio River

(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) 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

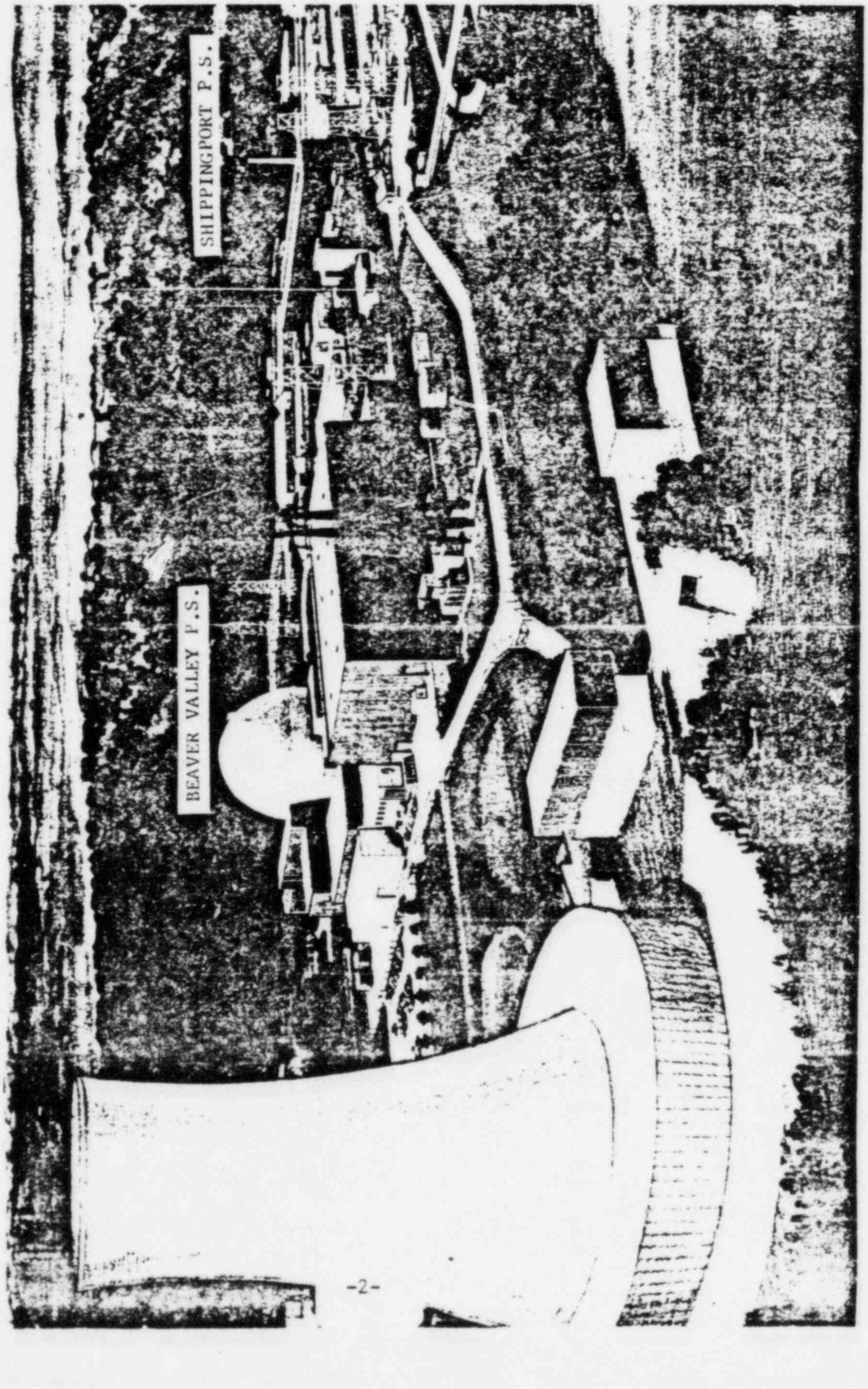


FIGURE I-1

VIEW OF THE BEAVER VALLEY AND SHIPPINGPORT POWER STATIONS

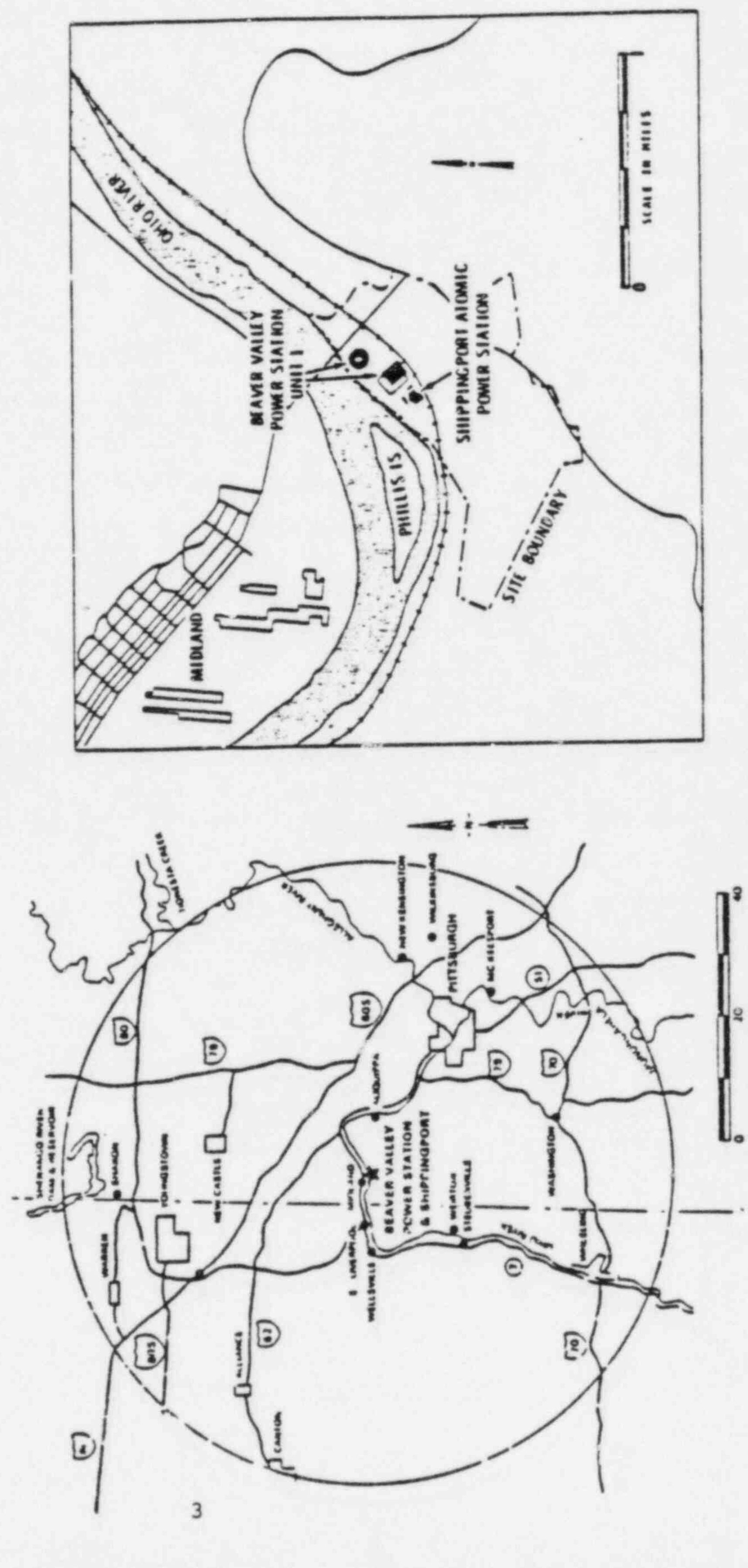


FIGURE I-2
LOCATION OF STUDY AREA, BEAVER VALLEY POWER STATION, SHIPPINGPORT, PENNSYLVANIA

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 4,300.

The site lies along the Ohio River in a valley which has a gradual slope extending from the river (elevation 665 ft (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 1982 is shown in Figure I-3 (Table I-1).

Ohio River water temperatures generally vary from 32 to 82°F (0 to 28°C). Minimum and maximum temperatures generally occur in January and July/August, respectively. During 1982, minimum temperatures were observed in January and maximum temperatures in July (Figure I-3) (Table I-1).

BVPS has a thermal rating of 2,660 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.

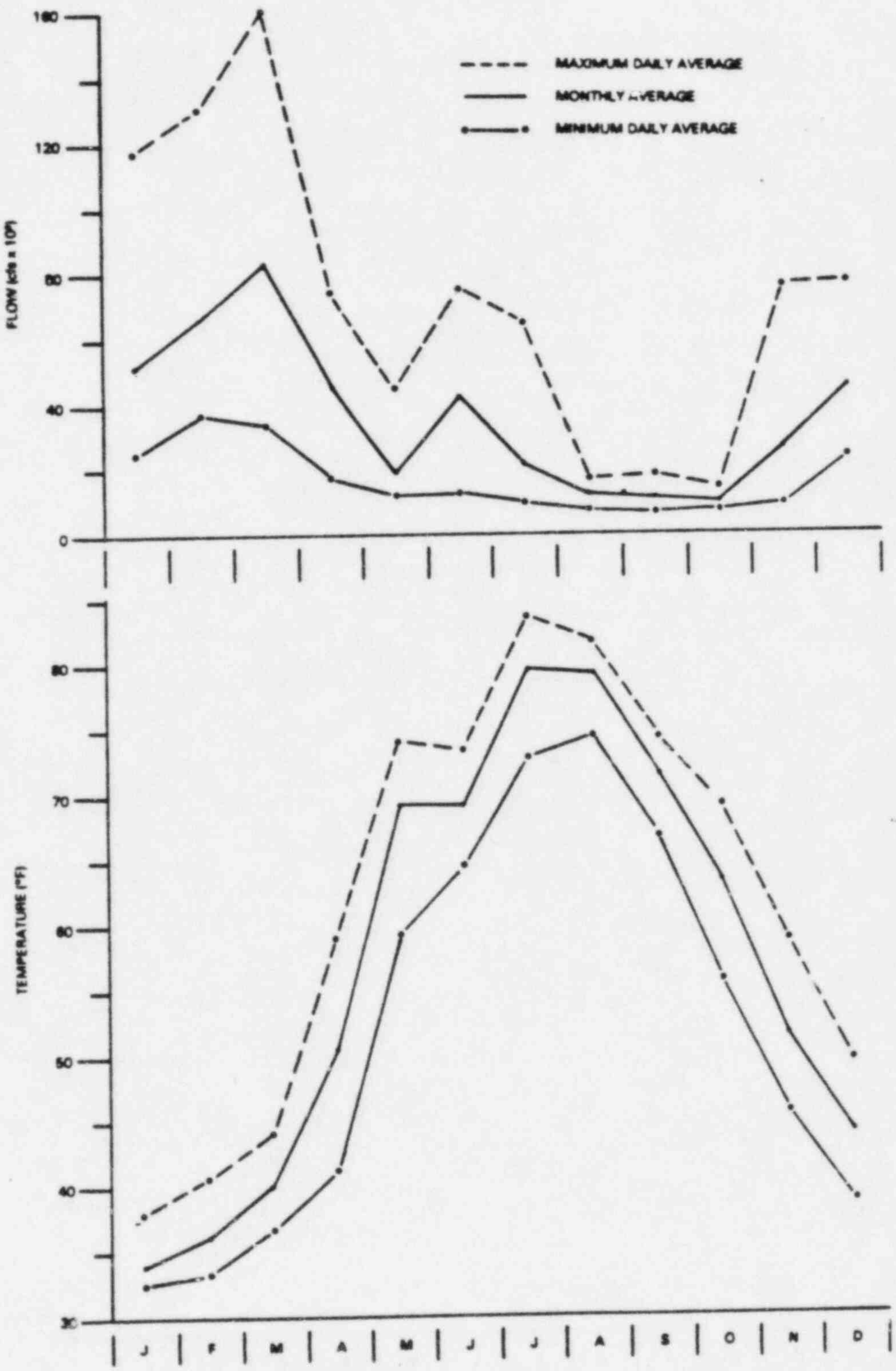


FIGURE I-3

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), 1982

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)
1982

Month	J	F	M	A	M	J	J	A	S	O	N	D
Flow (cfs x 10^3)												
Maximum Daily Average	119.5	131.1	160.2	74.2	46.0	77.6	65.7	17.5	18.1	14.3	76.5	78.3
Monthly Average	50.6	68.2	83.8	47.3	19.6	42.0	21.0	10.7	10.3	9.0	25.8	46.6
Minimum Daily Average	25.0	37.8	33.8	18.1	10.8	12.3	9.0	7.7	6.1	7.2	9.2	23.1
Temperature (^{O}F)												
Maximum Daily Value	37.8	40.4	44.3	58.2	73.7	73.4	83.7	82.1	74.9	69.2	58.9	49.2
Monthly Average	33.9	36.2	40.2	50.4	68.5	69.1	79.5	79.1	71.6	63.2	51.3	43.7
Minimum Daily Value	32.5	33.3	37.3	40.9	58.8	64.9	72.6	74.8	67.2	56.2	45.5	38.7

II. SUMMARY AND CONCLUSIONS

The 1982 BVPS Unit 1 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 seventh year of operational monitoring and, as in the previous operational monitoring years, no evidence of adverse environmental impact to the Ohio River or the surrounding vegetation was observed.

Thermal and chemical effluent monitoring included measurement of temperature and free available chlorine at the outfall, pH at the chemical waste sump and chromates at the low level waste drain tank.

The aquatic environmental monitoring program included studies of: benthos, fish, ichthyoplankton, impingement and plankton entrainment. Sampling was conducted for benthos and fish upstream and downstream of the plant during 1982 to assess potential impacts of BVPS discharges. These data were also compared to preoperational and other operational data to assess long term trends. Impingement and entrainment data were examined to determine the impact of withdrawing river water for in-plant use. The following paragraphs summarize these findings.

Benthos. The structure of the benthic macroinvertebrate community during 1982 was similar to that observed during other operational years (1976 through 1981) and preoperational years (1973 through 1975). Oligochaetes have been the most numerous organisms in the community each year and they comprised 81% by numbers of the community in 1982. A similar oligochaete assemblage has been reported each year. Chironomids and mollusks comprised the remaining fraction (19.0%) of the macroinvertebrate community. Common genera of oligochaetes were Limnodrilus, Nais, and Paranais. Substrate composition was probably the most important factor controlling the benthic macroinvertebrate community of the Ohio River near BVPS. Soft muck-type substrates along the shoreline were conducive to worm and midge proliferation, while limiting macroinvertebrates that require a more stable bottom. The predominant macroinverte brates were burrowing taxa typical of soft substrates. 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. Corbicula were present in the 1981 collections and were collected in the 1982 benthic surveys. Analysis of data for Control and Non-control Stations found no evidence to indicate that thermal and chemical effluents released from BVPS were adversely affecting the Ohio River benthos.

Phytoplankton. 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. Diversity indices of phytoplankton were as high or higher than those previously observed near BVPS. This was probably due to decreased precipitation and favorable weather conditions that occurred during 1982.

Zooplankton. Zooplankton densities throughout 1982 were typical of a temperate zooplankton community found in large river habitats. Total densities were slightly higher than those reported in previous years. Based on the data collected during the seven operating years (1976 through 1982) and the three preoperating years (1973 through 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 10-year period from 1973 to 1982. No evidence of appreciable harm to the river phytoplankton and zooplankton from BVPS Unit 1 operation was found.

Fish. Fish surveys, conducted during May, July, September and November 1982, collected a total of 1,248 fish, representing 32 fish species. Two species, spottail shiner and flathead catfish, had not been collected previously. Collection methods included: electrofishing, gill nets, and minnow traps. The majority of fish (643) were captured by electrofishing. Approximately 37.3% of the electrofishing catch consisted of emerald shiners.

Carp (21 fish) comprised the majority of the (126) gill netted fish. Gizzard shad, walleye, and channel catfish were the other species representing the next highest numbers of fish netted. Minnow traps collected 479 fish, the majority of which were bluntnose minnows (35.9%).

Variations in annual total numbers of fish caught occurred during preoperational and operational years. These variations are due primarily to fluctuations in numbers of small species (principally minnows and shiners). Larger fish (carp, channel catfish, smallmouth bass, yellow perch, walleye and sauger) have remained common species near BVPS. Members of the pike family (northern pike and muskellunge) not collected during preoperational years were collected 1977 through 1982. 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.

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 the fish community near BVPS has been adversely affected by BVPS operation. No fish classified as endangered or threatened by the Commonwealth of Pennsylvania or the U.S. Fish and Wildlife Service were collected during 1982.

Ichthyoplankton. 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 92.5% of the 94 larvae collected. Only 7 eggs were collected.

Data collected from 1973 through 1982 in the back channel of Phillis Island, the channel receiving the majority of discharges from BVPS, indicated that this channel was not used any more extensively for spawning purposes than main channel areas. No evidence was found to indicate BVPS operation was adversely affecting the ichthyoplankton of the Ohio River.

Impingement. Impingement surveys were conducted for one 24-hour period per week in 1982. A total of 227 fish weighing 0.596 kg (1.32 lbs) was collected. Emerald shiner (30.0%), channel catfish (26.0%), and unidentified *Notropis* spp. (9.7%) comprised 65.6% of the annual catch. Of the 227 fish collected, 71 (31.3%) were alive and returned via the discharge pipe to the Ohio River. The majority of fish were less than 100 mm in length. The 1982 annual impingement catch was less than 1979 (262 fish), 1978 (654 fish), 1977 (10,322 fish) and 1976 (9,102 fish). However, it was slightly more than the 1980 (108 fish) and 1981 (141 fish) collections.

Entrainment. Entrainment studies were performed to investigate the impact on the ichthyoplankton of withdrawing river water for in-plant use. 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 (92.9%). Assuming actual entrainment rates were similar to those found in 1976 through 1979, river abundance of ichthyoplankton indicate no substantial entrainment losses should have occurred in 1982 due to the operation of BVPS. Assessment of monthly phytoplankton and zooplankton data of past years indicated that under worst-case conditions of minimum low river flow (5000 cfs), about 1.25% of the phytoplankton and zooplankton passing the intake would be withdrawn by the BVPS circulating water system. This is considered as a negligible loss of phytoplankton and zooplankton relative to river populations.

Vegetation. During the summer and fall of 1982, stress on terrestrial vegetation was monitored in the vicinity of the Beaver Valley Power Station cooling tower as part of an Ecological Monitoring Program. Color infrared (CIR) aerial photography, photointerpretation of the imagery, and field observations were used to detect stressed or damaged vegetation and to determine probable causes.

Based on interpretation of the CIR aerial photography and field verification, there is no evidence to suggest that the BVPS cooling tower is causing vegetation stress.

III. ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE

In accordance with BVPS Unit 1 ETS, Appendix B to Operating License No. DPR-66, significant environmental change analyses were required on benthos, phytoplankton, and zooplankton data. 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 report deals with fish impingement and the optional programs initiated by DLCo in the interest of providing a non-disruptive data base between the start-up of BVPS Unit 1 and that of Unit 2.

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
2. Free Available Chlorine at the outfall
3. pH at the chemical waste sump
4. Chromates at the low level waste drain tank

In addition, the amounts of chemicals released to the environment are noted in the BVPS, Unit 1 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 1982.

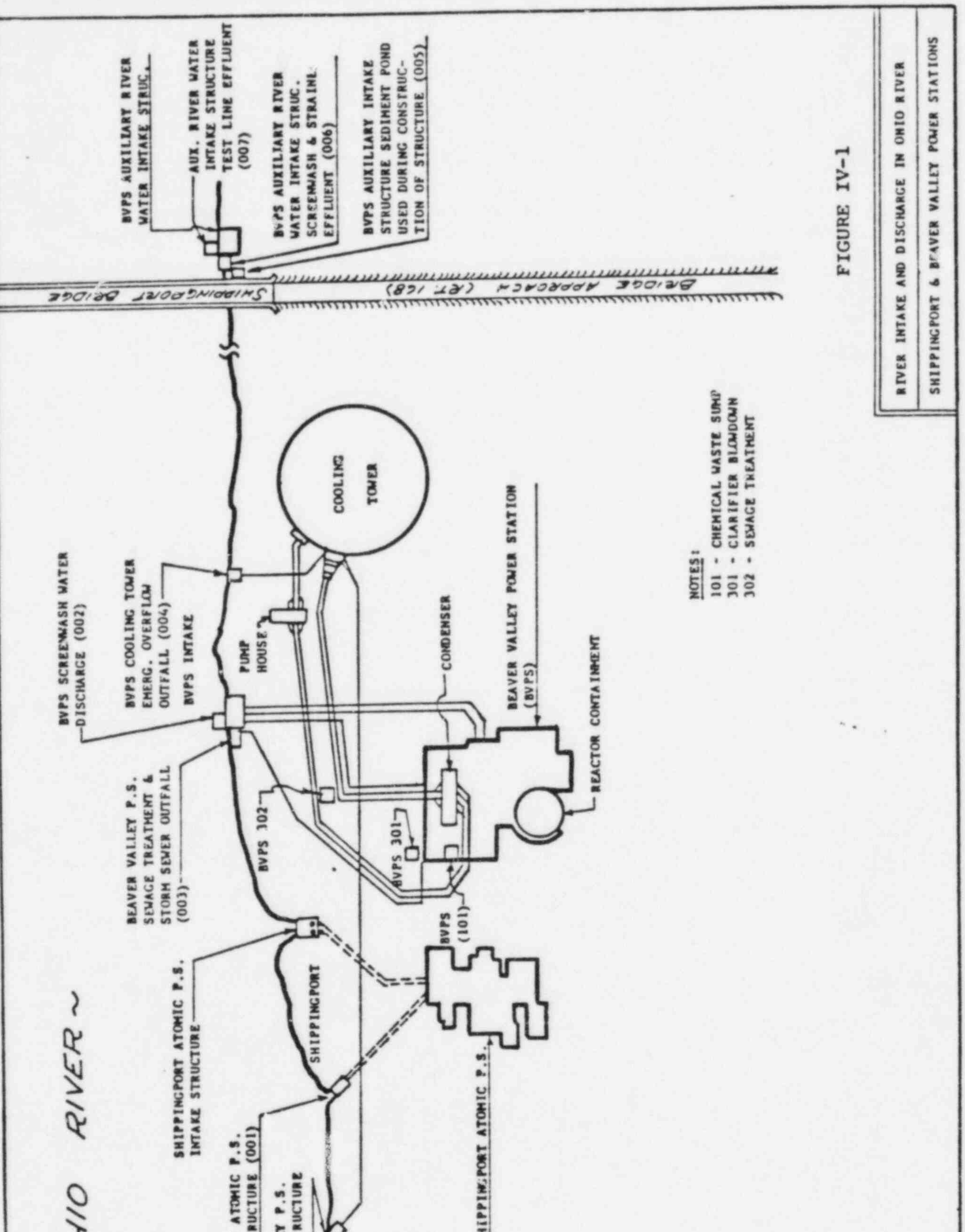

~ OHIO RIVER ~
BVPS AUXILIARY RIVER WATER INTAKE STRUC.
AUX. RIVER WATER INTAKE STRUCTURE TEST LINE EFFLUENT (007)
BVPS AUXILIARY RIVER WATER INTAKE STRUC. SCREENWASH & STRAINER EFFLUENT (006)
BVPS AUXILIARY INTAKE STRUCTURE SEDIMENT POND USED DURING CONSTRUCTION OF STRUCTURE (005)
SHIPPINGPORT BRIDGE
BRIDGE APPROACH (RT. 168)
COOLING TOWER
BVPS SCREENWASH WATER DISCHARGE (002)
BVPS COOLING TOWER EMERG. OVERFLOW OUTFALL (004)
BVPS INTAKE
PUMP HOUSE
CONDENSER
BEAVER VALLEY POWER STATION (BVPS)
REACTOR CONTAINMENT
BEAVER VALLEY P.S. SEWAGE TREATMENT & STORM SEWER OUTFALL (003)
BVPS 302
BVPS 301
BVPS (101)
SHIPPINGPORT ATOMIC P.S. INTAKE STRUCTURE
SHIPPINGPORT
SHIPPINGPORT ATOMIC P.S.
SHIPPINGPORT ATOMIC P.S. DISCHARGE STRUCTURE (001)
BEAVER VALLEY P.S. DISCHARGE STRUCTURE (001)
NOTES:
101 - CHEMICAL WASTE SUMP
301 - CLARIFIER BLOWDOWN
302 - SEWAGE TREATMENT
RIVER INTAKE AND DISCHARGE IN OHIO RIVER
SHIPPINGPORT & BEAVER VALLEY POWER STATIONS

FIGURE IV-1

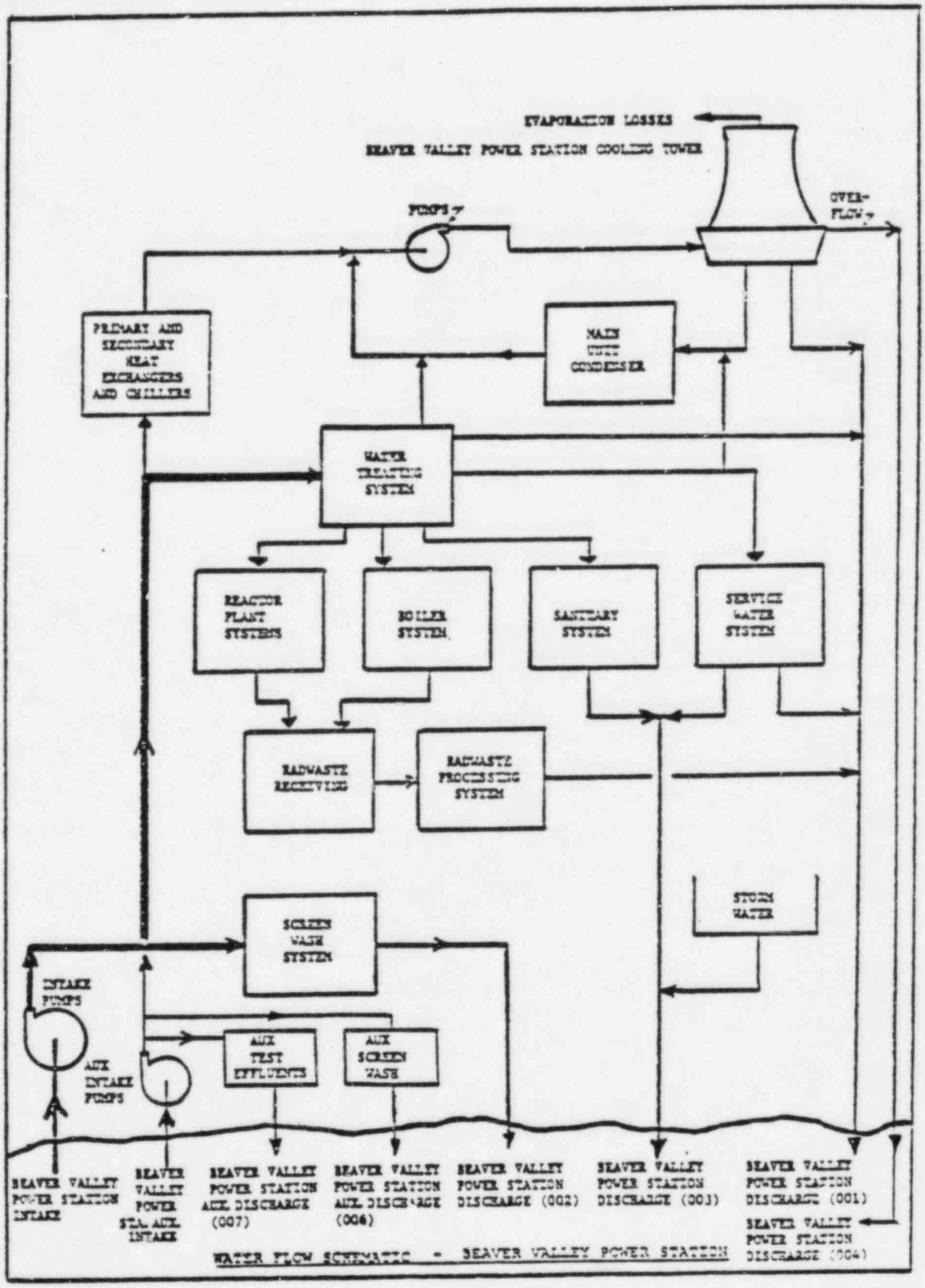

EVAPORATION LOSSES
BEAVER VALLEY POWER STATION COOLING TOWER
PUMPS
OVER-FLOW
PRIMARY AND SECONDARY HEAT EXCHANGERS AND CHILLERS
MAIN UNIT CONDENSER
WATER TREATING SYSTEM
REACTOR PLANT SYSTEMS
BOILER SYSTEM
SANITARY SYSTEM
SERVICE WATER SYSTEM
RADWASTE RECEIVING
RADWASTE PROCESSING SYSTEM
STORM WATER
SCREEN WASH SYSTEM
INTAKE PUMPS
AUX INTAKE PUMPS
AUX TEST EFFLUENTS
AUX SCREEN WASH
BEAVER VALLEY POWER STATION INTAKE
BEAVER VALLEY POWER STA. AUX. INTAKE
BEAVER VALLEY POWER STATION AUX. DISCHARGE (007)
BEAVER VALLEY POWER STATION AUX. DISCHARGE (006)
BEAVER VALLEY POWER STATION DISCHARGE (002)
BEAVER VALLEY POWER STATION DISCHARGE (003)
BEAVER VALLEY POWER STATION DISCHARGE (001)
BEAVER VALLEY POWER STATION DISCHARGE (004)
WATER FLOW SCHEMATIC - BEAVER VALLEY POWER STATION

FIGURE IV-2

Results

Limiting Conditions for Operation

The range observed during 1982 for each of the four parameters monitored in liquid effluents which have specified limits are as follows:

Parameter	Limits	Range of Values Discharged in 1982
Temperature at the outfall	94°F (4 hrs.)	35 to 92°F
Free Available Chlorine at the outfall	0.5 mg/l	0.0 to 0.45 mg/l
pH at the chemical waste sump	6.0 to 9.0	6.0 to 9.0
Chromates at the low level waste drain tank	0.05 mg/l	less than 0.05 mg/l

During 1982, the maximum allowable daily chlorination time limit of two hours for Free Available Chlorine was exceeded. Explanation is as follows:

1. Free Available Chlorine

On September 23, 1982, the main unit condenser chlorination limit of 2 hours per day was exceeded by five hours. This was due to an oversight during a time when other plant transients were occurring. The chlorination system will be placed in the AUTO mode of operation in order to prevent reoccurrence. Grab sampling verified that the daily maximum allowable limit of 0.5 mg/l was not exceeded. The environmental impact on the river ecosystem should have been minimal as the free available chlorine measured remained below the daily maximum limit.

Chemicals Released

Source	Estimated Amount Released (lb/yr)	*Actual Amount Released (lb/yr)
Cation - Anion Neutralized Waste (Sodium Sulfate)	20,000	245,700
Mixed Bed Neutralized Waste (Sodium Sulfate)	5,000	9,800

Water Softener Waste (Sodium Chloride)	15,000	39,750
Cooling Water Biocide (Chlorine)	2,380	179.3
Reactivity Control (Boric Acid)	20,000**	15,428
Corrosion Control	4.5	less than 1

*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 1982 was somewhat lower than that experienced during years of similar power production. Although the amount of sodium sulfate exceeded original estimates, adverse effects to the ecosystem were not suspected. 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 affects 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 in the expected proportion to that of the cation - anion neutralized waste. 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 (Appendix "B").

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 should not have harmed the ecosystem. A special assessment (study) 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 average free available chlorine concentration is limited to 0.2 mg/l over a 2 hour period per day. Based on actual analyses and blowdown flow, the total chlorine released during 1982 was 179 pounds. This amount was well below original estimates.

Reactivity Control

The amount of boric acid use during 1982 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 1982 was obtained using chemical analyses of all reactor plant discharges. The maximum chromate discharged, based on total liquid radwaste discharged in 1982 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 during 1982. Areas specifically designated for protection and restriction from herbicide application have not been sprayed. No accidental spills of herbicides occurred during the year.

Table IV-1 summarizes the usage of herbicides at the BVPS, 1982.

TABLE IV-1

BEAVER VALLEY POWER STATION - HERBICIDES USED
1982

Location Used	Herbicide Type	Concentration of Active Materials	Rate of Application	Method and Frequency of Application	Wind Conditions	Aerial Application	Date Applied
BVPS Substation Yard Slag Area	Ureabor Switchyard	Sodium Metaborate Tetrahydrate - 66.5% Boron Trioxide-Sodium Chlorate 30% Bromacil 1.5% Inert Ingred. 2%	App. 2 lbs. per 100 sq. ft.	Cyclone Whirlybird Dry Type Spreader Yearly App.	Normal Approx. 5 to 10 mph	No	5-28-82 6-1-82 6-2-82 9-7-82 Touchup
BV-1 Site North Fence 20 ft. boundary	Non-selective Herb. #3	1 gal. to 10 water - 5 applications	1000 sq. ft. per that rate	Spray	0-5 mph	No	8-5-82 8-9-82
Collier (314) N. Fayette Twp. Findley Twp.	Garlon 3A Tordon 101 Lo-DRIFT Spray Additive	½ gal. Garlon 3A ¼ gal. Tordon 101 1 pt. Lo-DRIFT with 100 gal. of water mixture	5 to 25 gal. per acre	Foliage spray approx. every 4 years	Less than 5 miles	Tank truck	6-82 7-82 8-82
Collier (314) Indp. Twp.	Krenite	1½ gal. per 100 gal. water	1½ to 3 gals per acre	"	"	"	9-82

V. AQUATIC MONITORING PROGRAM

A. INTRODUCTION

The environmental 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 Transect. 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 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.

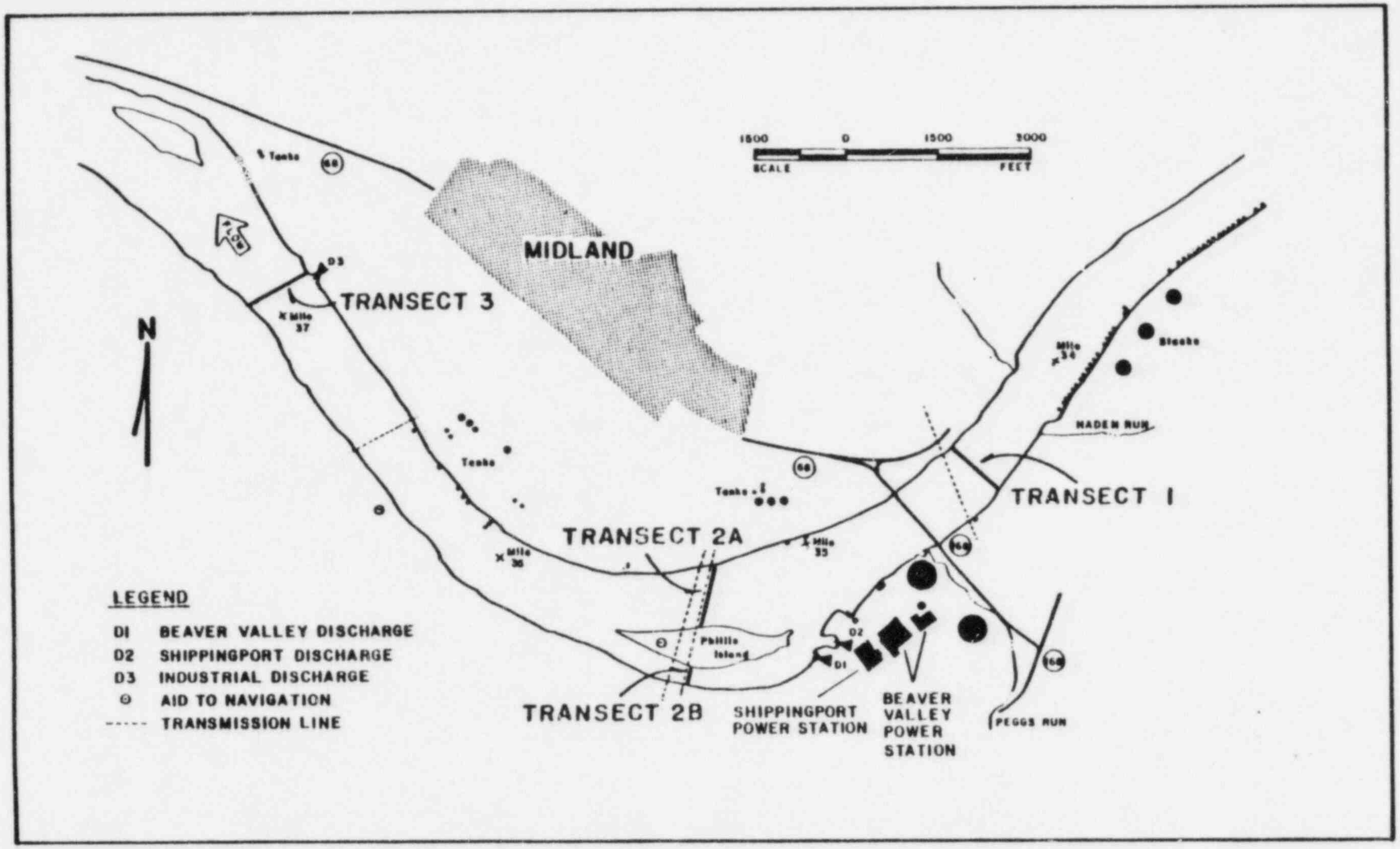


FIGURE V-A-1

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

TABLE V-A-1

AQUATIC PROGRAM MONITORING SAMPLING DATES
1982, BVPS

Month	Benthos	Fish	Impingement	Ichthyoplankton	Entrainment Plankton (Phyto and Zoo)
JAN			8, 15, 22, 29		22
FEB			7, 15, 19, 26		19
MAR			5, 12, 19, 26		19
APR			2, 9, 16, 23, 30	19	23
MAY	18	18, 19	7, 14, 21, 28	18	21
JUN			4, 11, 18, 25	21	18
JUL		20, 21	2, 9, 16, 23, 30	20	16
AUG			6, 13, 20, 27		20
SEP	23	22, 23, 29	3, 10, 17, 24		17
OCT			1, 8, 15, 22, 29		22
NOV		9, 10	5, 12, 19, 27		19
DEC			3, 10, 17, 24, 31		10

B. BENTHOS

Objectives

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

Methods

Benthic surveys were performed in May and September, 1982. Benthos samples were collected at Stations 1, 2A, 2B and 3 (Figure V-B-1), using a Ponar grab sampler. Duplicate samples were taken off the south shore at Stations 1, 2A and 3. Sampling at Station 2B, in the back channel of Phillis Island, consisted of a single ponar grab at the south, middle and north side of the channel.

Each grab was washed within a U.S. Standard No. 30 sieve and the remains placed in a bottle and preserved with 10% 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 two replicates and three back channel samples. Three species diversity indices were calculated: Shannon-Weiner and Evenness indices (Pielou 1969), and the number of species (taxa).

Habitats

Substrate type was an important factor in determining the composition of the benthic community. Two distinct benthic habitats exist in the Ohio River near BVPS. These habitats were the result of damming, channelization, and river traffic. Shoreline habitats were generally soft muck substrates composed of sand, silt and detritus. An exception occurs along the north shoreline of Phillis Island at Station 2A where clay and sand predominate. The other distinct habitat, hard substrate, is located at midriver. The hard substrate may have been initially caused by channelization and scoured by river currents and turbulence from commercial boat traffic.

Fifty-one macroinvertebrate taxa were identified during the 1982 monitoring program (Table V-B-1). Species composition during 1982 was similar to that

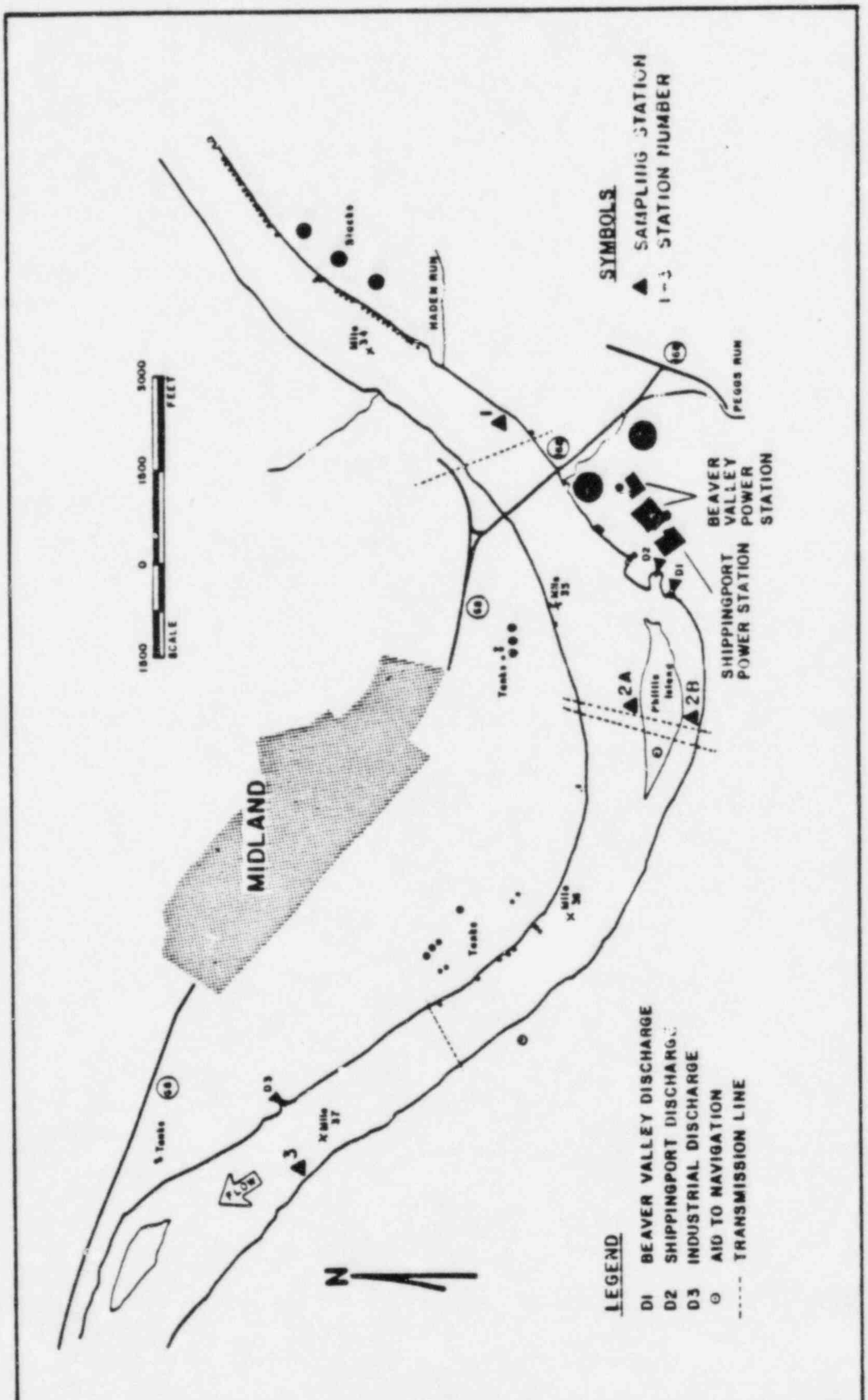


FIGURE V-B-1
BENTHOS SAMPLING STATIONS, BVPS

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	1981	1982
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		X	
Platyhelminthes										
Tricladida		X		X	X	X				X
Rhabdocoela				X	X	X				
Nemertea							X	X	X	X
Nematoda	X	X	X	X	X	X	X	X	X	X
Entroprocta										
Urnatella gracilis	X	X	X	X	X	X	X	X	X	X
Ectoprocta										
Fredericella 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	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		X
Dero digitata	X		X			X				
D. nivea	X					X				
Dero sp.	X	X		X	X	X	X	X	X	X

TABLE V-B-1 (Continued)

	Preoperational			Operational						
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Nais barbata						X				
N. bretscheri	X	X			X	X				X
N. communis	X					X				
N. elinguis						X				
N. variabilis						X				
Nais sp.	X	X	X	X	X		X	X	X	X
Ophidonais serpentina								X		X
Paranais frici	X	X		X	X	X	X	X	X	X
Paranais sp.							X			
Pristina osborni				X			X			
P. sima				X						X
Pristina sp.				X						
Slavina appendiculata					X					
Stephensoniana trivandrana				X	X	X			X	X
Stylaria lacustris				X						X
Uncinais uncinata			X							
Tubificidae										
Aulodrilus limnobius	X	X	X	X	X	X	X	X	X	
A. pigueti	X		X	X	X	X	X	X	X	X
A. pluriseta	X			X	X	X	X	X		X
Borthrioneurum vejdovskyanum				X	X	X	X	X		X
Branchiura sowerbyi		X		X	X	X	X	X	X	X
Ilyodrilus templetoni	X	X	X	X	X	X	X	X	X	X
Limnodrilus cervix	X			X	X	X	X	X	X	X
L. cervix (variant)	X	X	X	X		X		X	X	X
L. claparedeianus	X	X		X	X	X	X	X	X	X
L. hoffmeisteri	X	X	X	X	X	X	X	X	X	X
L. spiralis		X	X			X				X
L. udekemianus	X	X	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	X	X
Potamothrix moldaviensis	X								X	X
Psammoryctides curvisetosus		X								
Tubifex tubifex	X	X			X	X	X	X		
Unidentified immature forms:										
with hair chaetae	X	X	X	X	X	X	X	X	X	X
without hair chaetae	X	X	X	X	X	X	X	X	X	X
Lumbriculidae							X			X
Hirudinea										
Glossiphoniidae										
Helobdella elongata										X
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	1981	1982
Arthropoda										
Acarina				X		X		X		X
Ostracoda				X	X	X				
Amphipoda										
Talitridae										
Hyallela azteca						X	X			
Gammaridae										
Crangonyx pseudogracilis		X								
Crangonyx sp.		X								
Gammarus fasciatus						X		X		X
Gammarus sp.	X	X		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										
Psychomyidae										
Polycentropus sp.						X				
Hydropsychidae							X			
Cheumatopsyche sp.	X			X						
Hydropsyche sp.						X				
Hydroptilidae										
Hydroptila sp.						X				
Oxyethira sp.	X									
Leptoceridae										
Oecetis sp.		X		X						X
Coleoptera		X								
Hydrophilidae						X				
Elmidae										
Ancyronyx variegatus						X				
Dubiraphia sp.	X	X				X				
Helichus sp.	X									
Stenelmis sp.	X				X	X				

TABLE V-B-1 (Continued)

	Preoperational			Operational						
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
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		X	
Simulidae										
Similium sp.				X						
Chironomidae										
Chironominae							X			
Chironominae pupa							X			X
Chironomus sp.		X	X	X		X	X	X	X	X
Cryptochironomus sp.	X	X	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	X	X
Micropsectra sp.				X						
Microtendipes sp.						X				X
Parachironomus sp.		X								
Polypedilum (s.s.) *convictum* type						X				
P. (s.s.) *simulans* type						X				
Polypedilum sp.	X	X					X			X
Rheotanytarsus sp.	X				X	X	X		X	
Stenochironomus sp.		X			X	X		X		
Stictochironomus sp.				X						
Tanytarsus sp.			X			X	X			X
Tanypodinae										
Ablabesmyia sp.	X	X		X						
Coelotanypus scapularis		X	X	X		X			X	X
Procladius (*Procladius*)							X	X		
Procladius sp.	X	X	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			X	
Nannocladius sp.							X			

TABLE V-B-1 (Continued)

	Preoperational			Operational						
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Orthocladius sp.	X	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				X
Dolichopodidae					X	X				
Empididae		X		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										
Perrissia sp.	X	X			X	X				
Planorbidae							X			
Valvatidae										
Valvata perdepressa										
Pelecypoda						X				
Corbiculidae										
Corbicula manilensis*		X	X	X	X	X			X	X
Sphaeridae							X	X	X	
Pisidium sp.	X			X						
Sphaerium sp.	X			X	X	X	X			X
Unidentified immature Sphaeriidae				X	X	X				X
Unionidae										
Anadonta grandis						X				
Elliptio sp.						X				
Unidentified immature Unionidae	X				X	X			X	X

*Recent literature relegated all North American Corbicula to be Corbicula fluminea.

observed during previous preoperational (1973 through 1975) and operational (1976 through 1982) years. The macroinvertebrate assemblage during 1982 was composed primarily of borrowing organisms typical of soft unconsolidated substrates. Oligochaetes (worms) and chironomid (midge) larvae were abundant (Tables V-B-2, V-B-3, and V-B-4). Common genera of oligochaetes were Limnodrilus, Nais, and Paranais. Common genera of chironomids were Procladius, Coelotanypus, Chrionomus, and Cryptochironomus. The Asiatic clam (Corbicula), which was collected from 1974 through 1978, was also present in the 1981 and 1982 collections. None were collected during 1979 or 1980.

No ecologically important additions of species were encountered during 1982 nor were any threatened or endangered species collected.

Community Structure and Spatial Distribution

Oligochaetes accounted for the highest percentages of the macroinvertebrates at all sampling stations (Table V-B-2). Oligochaetes accounted for a greater percentage of the macroinvertebrate community at Stations 1 and 3 as compared to Stations 2A and 2B where chironomidae and mollusca were usually common.

Density and species composition variations observed within the BVPS study area were due primarily to habitat differences and the tendency of certain types of macroinvertebrates (e.g., oligochaetes) to cluster. Overall, abundance and species composition throughout the study area were similar.

In general, the density of macroinvertebrates during 1982 was lowest at Station 2A and higher at Stations 1, 2B, and 3 where substrates near the shore were composed of soft mud or various combinations of sand and silt. The lower abundance at Station 2A was probably related to substrate conditions (clay and sand) along the north shore of Phillis Island.

Comparison of Control and Non-Control Stations

No adverse impact to the benthic community was observed during 1982. This conclusion is based on a comparison of data collected at Stations 1 (Control) and 2B

TABLE V-B-2

MEAN NUMBER OF MACROINVERTEBRATES (Number/m^2) AND PERCENT COMPOSITION
OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA AND OTHER ORGANISMS, 1982
BVPS

	Station							
	1		2A		2B		3	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
May 18								
Oligochaeta	3,470	99	1,206	96	2,694	89	3,853	98
Chironomidae			30	2	60	2	10	1
Mollusca			10	1	47	2		
Others	20	1	10	1	225	7	50	1
Totals	3,490	100	1,256	100	3,026	100	3,913	99
September 23								
Oligochaeta	2,757	93	593	34	1,670	50	4,865	90
Chironomidae	189	6	356	20	1,277	38	387	7
Mollusca	10	1	445	25	343	10	10	1
Others			376	21	67	2	158	3
Totals	2,956	99	1,770	100	3,357	100	5,420	100

TABLE V-B-3

BENTHIC MACROINVERTEBRATE DENSITIES (INDIVIDUALS/M^2), MEAN OF TRIPLICATE FOR BACK CHANNEL AND DUPLICATE SAMPLES COLLECTED IN THE MAIN CHANNEL
OHIO RIVER, May 18, 1982
BVPS

Taxa	Station 1	2A	2B	3
Nemertea	10	10	198	30
Nematoda	10		20	10
Bryozoa				
Urnatella gracilis	+			
Annelida				
Oligochaeta eggs			+	+
Achaeta				59
Enchytraeidae				40
Lumbriculidae				10
Chaetogaster diastrophus			7	
Nais bretscheri		89	13	
Nais sp.	158	810	323	50
Ophidonais serpentina	10			
Paranais frici	978	188	310	376
Pristina sigma	20			
Stephensoniana trivandrana	10		224	
Stylaria lacustris	10			
Aulodrilus pigueti				20
A. pluriseta				10
Borthrioneurum vejdovskyanum				10
Branchiura sowerbyi	20		7	
Ilyodrilus templetoni	70		26	
Limnodrilus cervix	20			20
L. cervix (variant)	20			
L. claparedeianus	30		39	30
L. hoffmeisteri	118		165	346
L. spiralis	20			30
L. udekemianus	30		26	30
Pelescolex multisetosus	20			40
Potamothrix moldavensis				20
Immatures w/o capilliform chaetae	1,482	99	1,304	2,164
Immatures w/ capilliform chaetae	454	20	250	598
Arthropoda				
Gammarus sp.			7	
Diptera				
Chironomus sp.			13	10
Cryptochironomus sp.			7	
Procladius sp.			40	
Orthocladiinae pupae		10		
Orthocladius sp.		20		
Ceratopogonidae				10
Mollusca				
Sphaerium sp.		10	40	
Unidentified immature Unionidae			7	
Total	3,490	1,256	3,026	3,913

+ Indicates organisms present

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, SEPTEMBER 23, 1982
BVPS

Taxa	Station 1	2A	2B	3
Platyhelminthes				
Tricladia			7	
Nemertea		10		
Nematoda				10
Bryozoa				
Urnatella gracilis			+	+
Annelida				
Oligochaeta eggs	+		+	+
Lumbriculidae				10
Dero sp.	20			10
Nais sp.		118	20	50
Paranais frici			7	20
Aulodrilus pigueti			7	
Borthrioneurum vejdovskyanum	10			
Branchiura sowerbyi			7	
Ilyodrilus templetoni	10			
Limnodrilus cervix	10			50
L. claparedeianus				70
L. hoffmeisteri	306	50	72	277
L. spiralis	10		7	
L. udekemianus	148	30	13	99
Immature w/o capilliform chaetae	2,203	385	1,472	4,180
Immature w/ capilliform chaetae	40	10	72	99
Hirudinea				
Helobdella elongata				10
Arthropoda				
Terrestrial spider				10
Acarina			7	
Amphipoda				
Gammarus fasciatus		10		
Gammarus sp.		346	53	118
Trichoptera				
Oecetis sp.		10		
Diptera				
Chironominae pupae			13	
Chironomus sp.	109	108	586	227
Cryptochironomus sp.	10	20	99	40
Harnischia sp.			27	20
Microtendipes sp.		20	26	
Polypedilum sp.			13	20
Tanytarsus sp.	20			

TABLE V-B-4 (Continued)

Taxa	Station 1	2A	2B	3
Coelotanypus scapularis			118	10
Procladius sp.	50	30	395	70
Orthocladius sp.		178		
Empididae				10
Mollusca				
*Corbicula manilensis**		10		
Sphaerium sp.	10	346	303	10
Unidentified immature Sphaeriidae		89	40	
Total	2,956	1,770	3,364	5,420

+ Indicates organisms present.
* Recent literature relegated all North American *Corbicula* to *Corbicula fluminea*.

(Non-Control) and on analyses of species composition and densities.

Data indicate that oligochaetes were usually predominant throughout the study area (Figure V-B-2). The most abundant taxa at Stations 1 and 2B in both May and September were immature tubificids without capilliform chaetae (Tables V-B-3 and V-B-4). In May, the oligochaetes which were common or abundant at both stations were Nais sp., Paranais frici, and Limnodrilus hoffmeisteri. In September, the oligochaetes Limnodrilus hoffmeisteri, L. udekemianus and the midges Chironomus and Procladius were the dominant organisms collected at both stations.

Frequently, a greater variety of organisms was found at Station 2B than at Station 1. This usually results in a slightly higher Shannon-Weiner diversity and evenness at Station 2B (Table V-B-5). The mean number of taxa and Shannon-Weiner indices for the back channel were within the range of values observed for other stations in the study area. Differences observed between Station 1 (Control) and 2B (Non-Control) and between other stations could be related to differences in habitat. None of the differences were related to BVPS operation.

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 been the predominant macroinvertebrate in the community each year and they comprised 81% of the individuals collected in 1982 (Figure V-B-2). A similar oligochaete assemblage has been reported each year. Chironomids and mollusks have composed the remaining 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. Corbicula were presented in 1981 collections and one was collected during 1979 or 1980. One Corbicula was collected in the 1982 benthic surveys.

Total macroinvertebrate densities for Station 1 (Control) and 2B (Non-Control) for each year since 1973 are presented in Table V-B-6. Mean densities of macroinvertebrates have gradually increased from 1973 through 1976 (BVPS Unit 1 start-

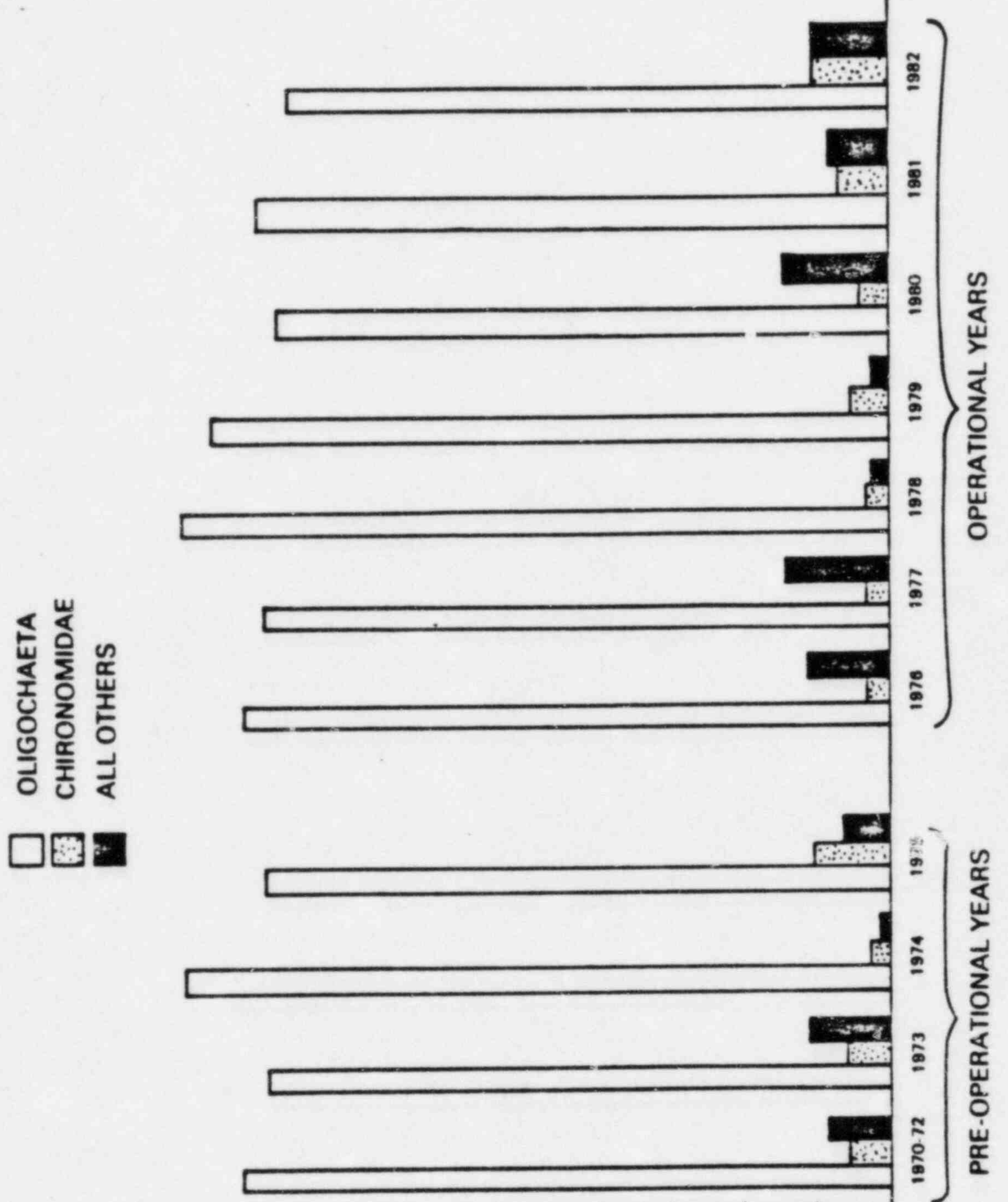


FIGURE V-B-2

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

TABLE V-B-5

MEAN DIVERSITY VALUES FOR BENTHIC MACROINVERTEBRATES
COLLECTED IN THE OHIO RIVER, 1982
BVPS

Date	Station			
	1	2A	2B	3
May 18				
No. of Taxa	19	9	20	21
Shannon-Weiner Index	2.40	1.73	2.85	2.29
Evenness	0.56	0.54	0.66	0.52
September 23				
No. of Taxa	14	17	22	21
Shannon-Weiner Index	1.49	3.16	2.72	1.58
Evenness	0.39	0.77	0.61	0.36

TABLE V-B-6

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

	Preoperational Years						Operational Years							
	1973		1974		1975		1976		1977		1978		1979	
	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		
March													425	457
April														
May	248	508	1,116	2,197			927	3,660	674	848	351	126	1,004	840
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										
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

TABLE V-B-6 (Continued)

	Preoperational Years						Operational Years					
	1973		1974		1975		1980		1981		1982	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
January												
February	205	0	703	311			1,029	1,296				
March												
April												
May	248	508	1,116	2,197			1,041	747	209	456	3,490	3,026
June	5	40	507	686								
July	653	119	421	410								
August	99	244	143	541	1,017	1,124						
September			175	92			1,523	448	2,185	912	2,956	3,364
October	256	239										
November	149	292	318	263	75	617						
December												
Mean	231	206	483	643	546	871	1,198	830	1,197	684	3,223	3,272

up) until the current study year, 1982. Mean densities were frequently higher in the back channel of Phillis Island (Non-Control) as compared to densities at Station 1 (Control). In years when mean densities were lower at Station 2B than at Station 1 the differences were negligible. These differences could be related to substrate, variability, and randomness of sample grabs. Higher total densities of macroinvertebrates in the back channel (Station 2B) as compared to Station 1 was probably due to the morphology of the river. Mud, silt sediments and slow current were predominant at Station 2B creating conditions more favorable for burrowing macroinvertebrates in comparison to Station 1, which has little protection from river currents and turbulence caused commercial boat traffic.

Summary and Conclusions

Substrate was probably the most important factor controlling the distribution and abundance of the benthic macroinvertebrates in the Ohio River near BVPS. Soft muck-type substrates along the shoreline were conducive to worm and midge proliferation, while limiting macroinvertebrates which require a more stable bottom. At the shoreline stations, Oligochaeta accounted for 81% of the macrobenthos collected, while Mollusca and Chironomidae each accounted for about 9.5% of the total.

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

C. PHYTOPLANKTON

Objectives

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

Methods

One entrainment sample was collected monthly. Each sample was a one-gallon composite of equal volumes of surface and bottom water taken from one operating intake bay of Unit 1. This one-gallon sample was preserved with Lugol's solution and was used for the analyses of both phytoplankton and zooplankton.

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. A minimum of 200 cells were identifed and counted in each sample. For each collection date, volume of the final concentrate was adjusted depending on cell density, however the same area of the Palmer cell was examined for all samples. A Hyrax diatom slide was also prepared monthly from each sample. This slide was examined at 1000X magnification in order to make positive identification of the diatom.

Densities (cells/ml), Shannon-Weiner and Evenness diversity indices (Pielou 1969), and Richness index (Dahlberg and Odum 1970) were calculated for each monthly sample.

Seasonal Distribution

During the first quarter of 1982 few phytoplankton were present in the samples. Total monthly mean densities were between 504 and 1,072 cells/ml (Table V-C-1). Total cell densities of phytoplankton from stations on the Ohio River and in the intake samples have been similar during the past four years. Data from past Annual Environmental Reports also indicate that the species composition has been similar in entrainment samples and those from the Ohio River (DLCo 1980).

TABLE V-C-1

MONTHLY PHYTOPLANKTON GROUP DENSITIES (NUMBER/ML) AND PERCENT COMPOSITION
FROM ENTRAINMENT SAMPLES, 1982
BVPS

Group	Jan		Feb		Mar		Apr		May		Jun	
	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
Chlorophyta	64	6	16	3	28	4	760	11	2,240	34	2,000	28
Chrysophyta	772	72	448	89	628	90	5,720	79	3,730	57	3,980	56
Cyanophyta	212	20	24	5	16	2	40	<1	200	3	200	3
Cryptophyta	0	0	0	0	0	0	240	3	210	3	260	4
Microflagellates	24	2	12	2	24	3	460	6	120	2	620	9
Other Groups	0	0	4	<1	0	0	0	0	20	<1	40	<1
Total	1,072	100	504	99	696	99	7,220	99	6,520	99	7,100	100

Group	Jul		Aug		Sep		Oct		Nov		Dec	
	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
Chlorophyta	12,120	69	13,300	64	10,240	50	5,920	50	940	10	540	24
Chrysophyta	3,860	22	5,980	29	7,660	37	5060	43	6,740	72	1,180	53
Cyanophyta	380	2	660	3	1,380	7	80	<1	480	5	40	2
Cryptophyta	640	4	500	2	600	3	580	1	240	3	40	2
Microflagellates	580	3	400	2	740	3	600	5	920	10	380	17
Other Groups	40	<1	60	<1	40	<1	0	0	40	<1	30	1
Total	17,620	100	20,900	100	20,660	100	12,240	99	9,360	100	2,220	99

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 April to 7,220 cells/ml, which represented the spring peak in phytoplankton abundance (Table V-C-1). Populations decreased slightly in May and June and then doubled in July. The annual maximum occurred in August and September (20,660-20,900 cells/ml) (Figure V-C-1). Densities decreased after September to a low of 2,210 cells/ml observed in December (Figure V-C-2). The two-peaked cycle of phytoplankton density is common in many large rivers and lakes in north temperate climates (Hutchinson 1967, Hynes 1970).

Diatoms (Chrysophyta) and green algae (Chlorophyta) were usually the most abundant groups of the phytoplankton during 1982 (Table V-C-1 and Figure V-C-2). The group microflagellates was common in March, November, and December, making up from 10 to 24% of the total numbers observed in those months. Blue-greens (Cyanophyta) were common (20%) during January (Table V-C-1). The overall increase of phytoplankton densities during the year was probably due to decreased flow and turbidity which were caused by below average precipitation during 1982.

Diversity indices for the phytoplankton during 1982 are presented in Table V-C-2. Shannon-Weiner indices ranged from 1.88 to 4.96, evenness values from 0.42 to 0.90, and richness values from 2.36 to 7.17. High diversity values occurred in 11 months. The lowest value for Shannon-Weiner Index and lowest number of species occurred in April when small centric diatoms were predominant during the spring peak. Highest number of taxa (66) occurred in July.

Phytoplankton communities were generally dominated by different taxa each season. Most abundant taxa during winter (January through March) were Chlorophyta I, Navicula spp., and Nitzschia spp.; the two latter were chrysophyte diatoms (Table V-C-3). The group Chlorophyta I were small (5 to 15), unicellular, green algae which were probably separated from a colony and were very difficult to positively identify. During the spring, small centric diatoms were

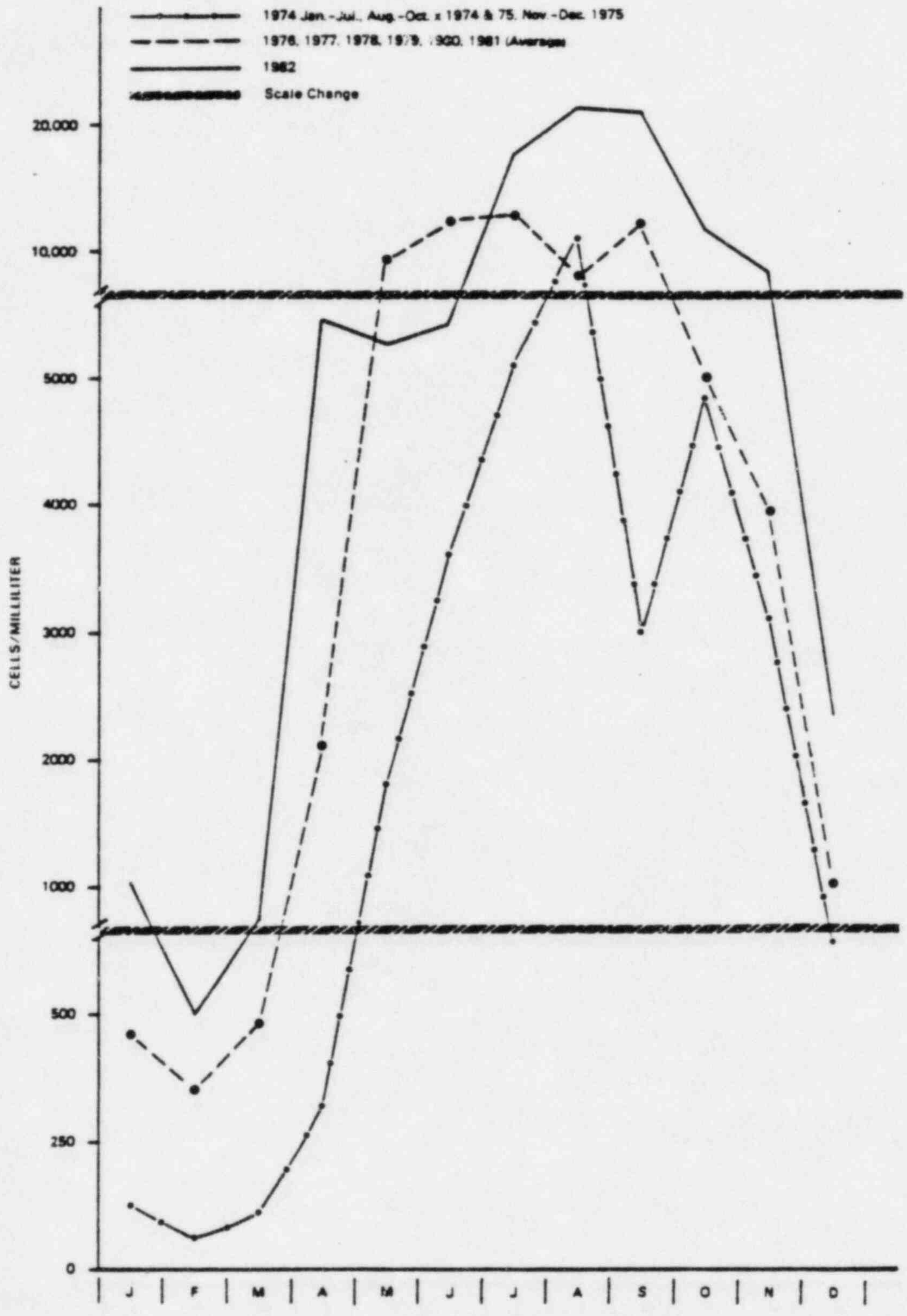


FIGURE V-C-1
SEASONAL PATTERN OF PHYTOPLANKTON DENSITIES IN THE OHIO RIVER
DURING PREOPERATIONAL (1974-1975) AND OPERATIONAL (1976-1982) YEARS
BVPS

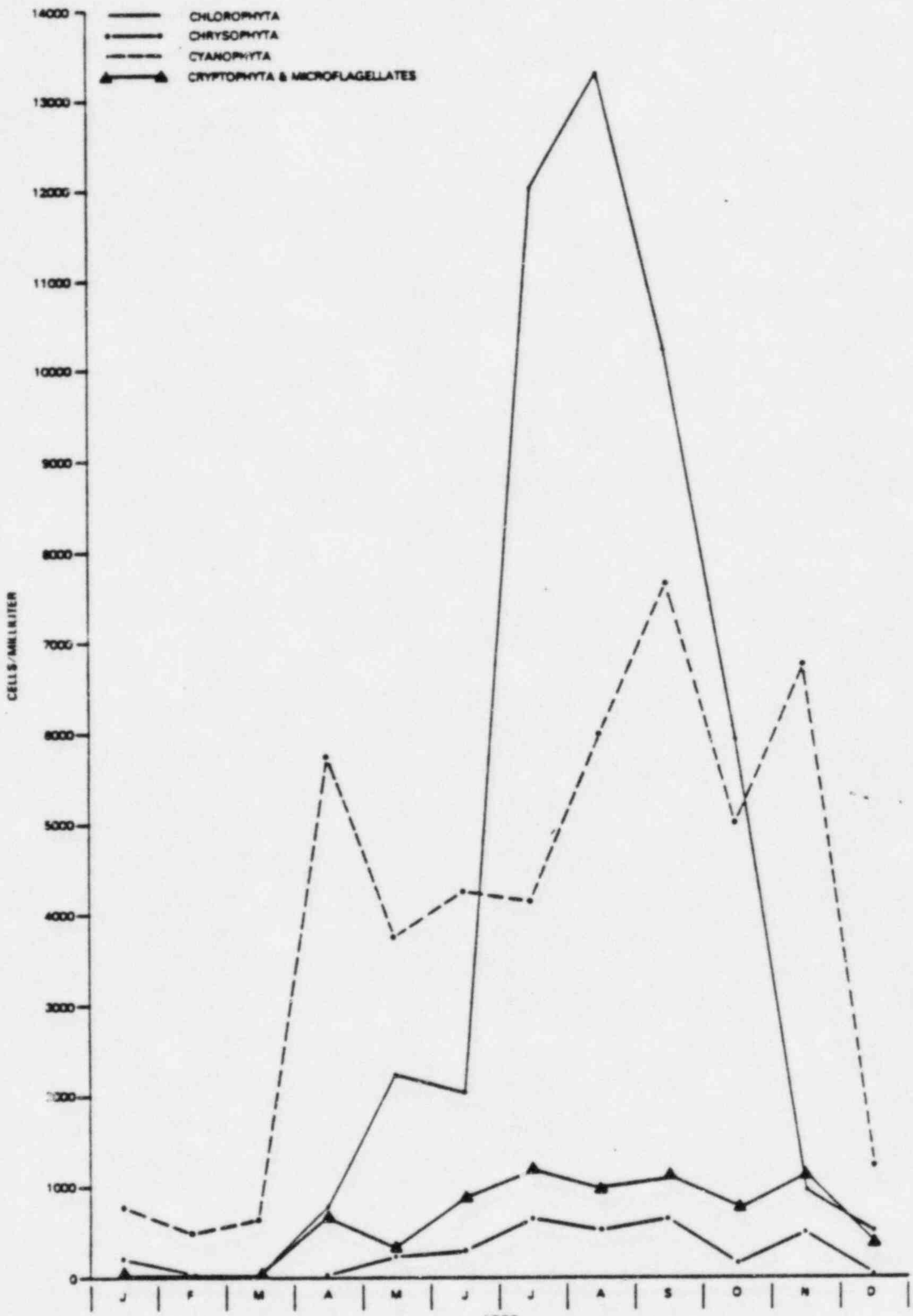


FIGURE V-C-2
PHYTOPLANKTON GROUP DENSITIES FOR ENTRAINMENT SAMPLES. 1982
BVPS

TABLE V-C-2

PHYTOPLANKTON DIVERSITY INDICES BY MONTH FOR ENTRAINMENT SAMPLES, 1982
BVPS

Date	Jan	Feb	Mar	Apr	May	Jun
No. of Species	51	41	46	22	55	45
Shannon-Weiner Index	4.68	4.80	4.96	1.88	4.79	4.33
Evenness	0.82	0.90	0.90	0.42	0.83	0.79
Richness	7.17	6.43	6.88	2.36	6.15	4.96

Date	Jul	Aug	Sep	Oct	Nov	Dec	$\bar{x}$
No. of Species	66	54	53	35	50	49	47
Shannon-Weiner Index	4.72	4.54	4.22	3.97	4.09	4.66	4.30
Evenness	0.78	0.79	0.74	0.77	0.72	0.83	0.77
Richness	6.65	5.33	5.23	3.61	5.36	6.23	5.53

Data represents single entrainment sample collected monthly.

TABLE V-C-3

DENSITIES (NUMBER/ML) OF MOST ABUNDANT PHYTOPLANKTON TAXA (FIFTEEN MOST ABUNDANT ON ANY DATE)
COLLECTED FROM ENTRAINMENT SAMPLES
JANUARY THROUGH DECEMBER 1982
BVPS

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CYANOPHYTA												
Aphanocapsa delicatissima									640			
Schizothrix calcicola	212	24	16	40	170	200		240	120		480	40
CHLOROPHYTA												
Ankistrodesmus convolutus			4	20	370	120	1380	120	460	300	220	50
Ankistrodesmus falcatus	12		8	120	240	180	360	100	260	80	40	20
Chlamydomonas globosa	4			40	10	80	240	200	20	120	40	10
Coelastrum microporum						160	720	160				
Coronastrum aestivale							240	640				
Crucigenia apiculata									640			
Crucigenia quadrata				160								
Dictyosphaerium pulchellum							320	1940	360			
Kirchneriella obesa						60	160	1160				
Micractinim pusillum				220	190	220	2760	1700	1500	500	80	
Scenedesmus acuminatus					30	80	420	240	100			
Scenedesmus armatus					160		120	80	320			
Scenedesmus bicellularis	8				220	80	2240	940	2080	2520	40	100
Scenedesmus dimorphus						160						
Scenedesmus quadricauda	8				720	360	560	1600	1420	440	80	80
Schroederia setigera				40		20			80			
Selenastrum minutum						40	580	1480	380	720		
Selenastrum westii							160	1700	1040	640		
Chlorophyta I	20	16	16	160	60	160	320	260	240	400	140	60
CHRYSOPHYTA												
Achnanthes minutissima	20	20	32		40	60	40				40	30
Asterionella formosa	76			220	620	380	40	20		200	60	50
Cymbella ventricosa	16	16	16		20	40					60	10
Diatoma vulgare	32		16		30						20	
Fragilaria crotonensis	12	8	8		440	20	180	40			40	

TABLE V-C-3 (Continued)

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fragilaria vaucheriae	20	4	32	20	60	40	40	40			80	10
Gomphonema olivaceum	8	12	20		20		20				60	
Gomphonema parvulum	12	24	32		40	20	20				60	10
Melosira ambigua	12	32	4				100	80	260	460	1080	260
Melosira distans	24				20		560	520	360	80	280	150
Melosira granulata	16		20		60	380	760	2620	5660	1920	2600	140
Melosira varians	72	40	28		160					40	120	20
Microsiphona potamos				40			120	860	220	480	180	20
Navicula cryptocephala	88	44	76		220	80	60	20			200	60
Navicula viridula	32	52	68	60	190	100	20		20	60	40	10
Nitzschia agnewii										300		10
Nitzschia capitellata	4	12	12		40	160		20	20		100	10
Nitzschia dissipata	16	20	28	20	30	40	20			20	160	10
Nitzschia holsetica	4						180	480	100			
Nitzschia kutzingiana	28	8		20	30	20	20		20			10
Nitzschia palea	32	32	36		80	160	60	40	40	40	120	40
Synedra filiformis	48	8	4	60	450	140	40	80		40	100	40
Synedra ulna	36	8	28		180	120	40				60	
Small centrics	56	16	20	5200	590	2040	1400	860	920	1360	940	150
CRYPTOPHYTA												
Rhodomonas minuta				240	150	180	340	380	340	500	180	30
MICROFLAGELLATES	24	12	24	460	120	620	580	400	740	600	920	380
Total Phytoplankton	1072	504	696	7220	6520	7100	17620	20900	20660	12240	9360	2220
Total of most abundant Taxa	952	408	548	7140	5760	6520	15220	19020	18360	11820	8620	1810
Percent composition of most abundant Phytoplankton	89	81	79	99	88	92	86	91	89	97	92	82

dominant in April and June when the spring peak occurred. Small centric diatoms were present in all phytoplankton samples, and include several small (4 to 12 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, Stephanodiscus hantzschii, and S. astraea. The most abundant taxon in July was Scenedermus bicellularis (green algae). Dictyosphaerium pulchellum (green algae) and Melosira granulata (diatom) were co-dominant in August. Scenedesmus bicellularis and Melosira granulata were the dominant taxa in September. Melosira granulata was the most abundant taxon in October and November. The most abundant taxa in December were microflagellates and Melosira ambigua.

Comparison of Control and Non-Control Transects

Plankton samples were not collected at any river stations after April 1, 1980 due to a reduction in the scope of the aquatic sampling program, therefore, comparison of data was not possible in 1982.

Comparison of Preoperation and Operational Data

The seasonal succession of phytoplankton varied from year to year, but in general the phytoplankton taxa has remained generally consistent. Phytoplankton communities in running waters respond quickly to changes in water temperature, turbidity, nutrients, velocity and turbulence (Hynes 1970). The phytoplankton from the Ohio River near BVPS generally exhibited a bimodal pattern of annual abundance. During the preoperational year 1974, total densities peaked in August and October while in operational years of 1976 through 1979, mean peak densities occurred in June and September (DLCo 1980). Total phytoplankton densities also displayed a bimodal pattern in 1982 (Figure V-C-2).

In general, the phytoplankton community in 1982 was similar to those of preoperational and operational years. No major change in species composition or community structure was observed during 1982. The small differences in the

phytoplankton community between 1982 and the previous years are believed to be due to natural fluctuations and were not a result of BVPS operations.

Yearly mean Shannon-Weiner diversity indices from 1974 through 1982 were similar, ranging from a low of 3.57 in 1980 to a maximum of 4.36 in 1975 (Table V-C-4). Evenness values were also similar, except during 1973 and 1974 when values were lower. From 1975 through 1982, evenness ranged from 0.44 to 0.90. The maximum evenness diversity value is 1.0 and would occur when each species is represented by the same number of individuals. The mean number of taxa each year ranged from 19 in 1973 to 47 in 1982. The highest number of taxa (66 in July) ever observed in phytoplankton studies at BVPS occurred during the operational year 1982.

Summary and Conclusions

The phytoplankton community of the Ohio River near BVPS exhibited a seasonal pattern similar to that observed in previous years. This pattern is common to temperate, lotic environments. Total cell densities were within the range observed during previous years. Diversity indices of phytoplankton were as high or higher than those previously observed near BVPS. This was probably due to decreased precipitation and favorable weather conditions that occurred during 1982.

TABLE V-C-4

PHYTOPLANKTON DIVERSITY INDICES (MEAN OF ALL SAMPLES 1973 TO 1982)
NEW CUMBERLAND POOL OF THE OHIO RIVER
BVPS

1973	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	$\bar{x}$
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
Eveness	0.55	0.46	0.57	0.58	0.62	0.62	0.56	0.55	0.54	0.58			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	46	40
Shannon Index				No Sample				4.53	4.22	4.37	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	4.91
1976													
No. of Species	31	35	31	38	47	49	66	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	4.95	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	3.84

TABLE V-C-4 (Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	x̄
1978													
No. of Species	37	29	32	42	28	42	36	37	35	37	34	32	3[illegible]
Shannon Index	4.08	3.68	3.77	4.67	3.30	4.16	3.95	4.17	3.81	3.99	3.80	4.44	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	3.79	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	3.28	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	4.07	2.65	3.49	4.02	2.50	2.38	2.90	1.94	3.33	2.59	4.01	5.40]	3.15
1981													
No. of Species	[22	35	37	39	34	33	33	51	35	27	40	3[illegible]]	35
Shannon Index	3.92	4.39	4.39	2.29	3.66	4.56	4.13	4.59	4.07	3.90	4.00	4.32	3.95
Evenness	0.88	0.85	0.84	0.43	0.72	0.90	0.82	0.81	0.79	0.82	0.75	0.86	0.79
Richness	3.91	5.84	6.10	4.58	3.69	4.61	3.73	5.76	3.85	3.56	5.00	4.55]	4.60
1982													
No. of Species	[51	41	46	22	55	45	66	54	53	35	50	4[illegible]]	47
Shannon Index	4.68	4.80	4.96	1.88	4.79	4.33	4.72	4.54	4.22	3.97	4.09	4.66	4.30
Evenness	0.82	0.90	0.90	0.42	0.83	0.79	0.78	0.79	0.74	0.77	0.72	0.83	0.77
Richness	7.17	6.43	6.88	2.36	6.15	4.96	6.65	5.33	5.23	3.61	5.36	6.23]	5.53

(a) No data

[ ] Data represent single entrainment samples collected monthly.

D. ZOOPLANKTON

Objectives

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

Methods

The zooplankton analysis was performed on one liter aliquots taken from the preserved one-gallon samples obtained from the intake bay of Unit 1 (see Phytoplankton methods, above). 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 supernatent was withdrawn until 10 ml of concentrate remained. One ml of this thoroughly mixed concentrate was placed in a Sedgwick-Rafter cell and examined at 100X magnification. All zooplankters within the cell were identified to the lowest practicable taxon and counted. Total density (individuals/liter), Shannon-Weiner and Evenness diversity indices (Pielou 1969), and Richness index (Dahlberg and Odum 1970) were calculated based upon one sample which was a composite from a surface and a bottom water sample.

Seasonal Distribution

The zooplankton community of a river system is typically 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 composed primarily of protozoans and rotifers.

Total organism density and species composition of zooplankton from the Ohio River and entrainment samples were similar during 1976, 1977, 1978, and 1979 (DLCo 1980). Samples collected from intake bays are usually representative of the zooplankton populations of the Ohio River.

During 1982, protozoans and rotifers accounted for 98% or more of all zooplankton on all sampling dates (Table V-D-1). Total organism densities during the winter

TABLE V-D-1

MONTHLY ZOOPLANKTON GROUP DENSITIES (Number/liter) AND PERCENT COMPOSITION
FROM ENTRAINMENT SAMPLES, 1982
BVPS

Group	Jan		Feb		Mar		Apr		May		Jun	
	#/l	%	#/l	%	#/l	%	#/l	%	#/l	%	#/l	%
Protozoa	350	88	310	97	310	91	820	93	1300	28	870	85
Rotifera	50	12	10	3	30	9	50	6	3340	72	130	13
Crustacea	0	0	0	0	0	0	10	1	10	<1	20	2
Total	400	100	320	100	340	100	880	100	4650	100	1020	100

Group	Jul		Aug		Sep		Oct		Nov		Dec	
	#/l	%	#/l	%	#/l	%	#/l	%	#/l	%	#/l	%
Protozoa	2360	42	3560	69	1590	29	4850	76	2060	90	980	95
Rotifera	3250	58	1550	30	3840	70	1520	24	240	10	40	4
Crustacea	20	<1	60	1	90	1	40	<1	0	0	10	1
Total	5630	100	5170	100	5520	100	6410	100	2300	100	1030	100

and early spring (January through March) were less than 401/liter. Lowest total density during 1982 was 320/liter which occurred in February (Figure V-D-1, Table V-D-1). Total organism densities increased slightly in April. The spring peak (4,650/liter) occurred in May. The annual peak density (6,410/liter) occurred in October. 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 it is sometimes delayed until summer or early fall (Table V-D-2; Figure V-D-2). Lower than average precipitation during 1982 allowed zooplankton populations to maintain high densities during the summer and early autumn. The effect of a dry year and low river discharges was noted by Hynes (1970) to favor plankton populations.

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 due primarily 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 this period.

Densities of protozoans during January through March of 1982 were between 310 and 350/liter (Table V-D-1). Protozoans gradually increased in April and May. The densities peaked in September at 4,850/liter. Protozoans progressively decreased in October, November and December to densities of 980/liter. The most common protozoan during 1982 was Vorticella which dominated the protozoan assemblage during seven months (Table V-D-3). The most abundant protozoans in the other months were Codonella cratera (March, May, June, and July) and Cyphodera ampulla (November). These taxa have been a main part of the protozoan assemblage of the Ohio River near BVPS since 1972.

The rotifer assemblage in 1982 (Figure V-D-2) displayed a typical pattern of rotifer populations in temperate inland waters (Hutchinson 1967). Rotifer densities increased from a minimum of 10/liter in February to a maximum of 3,840/liter

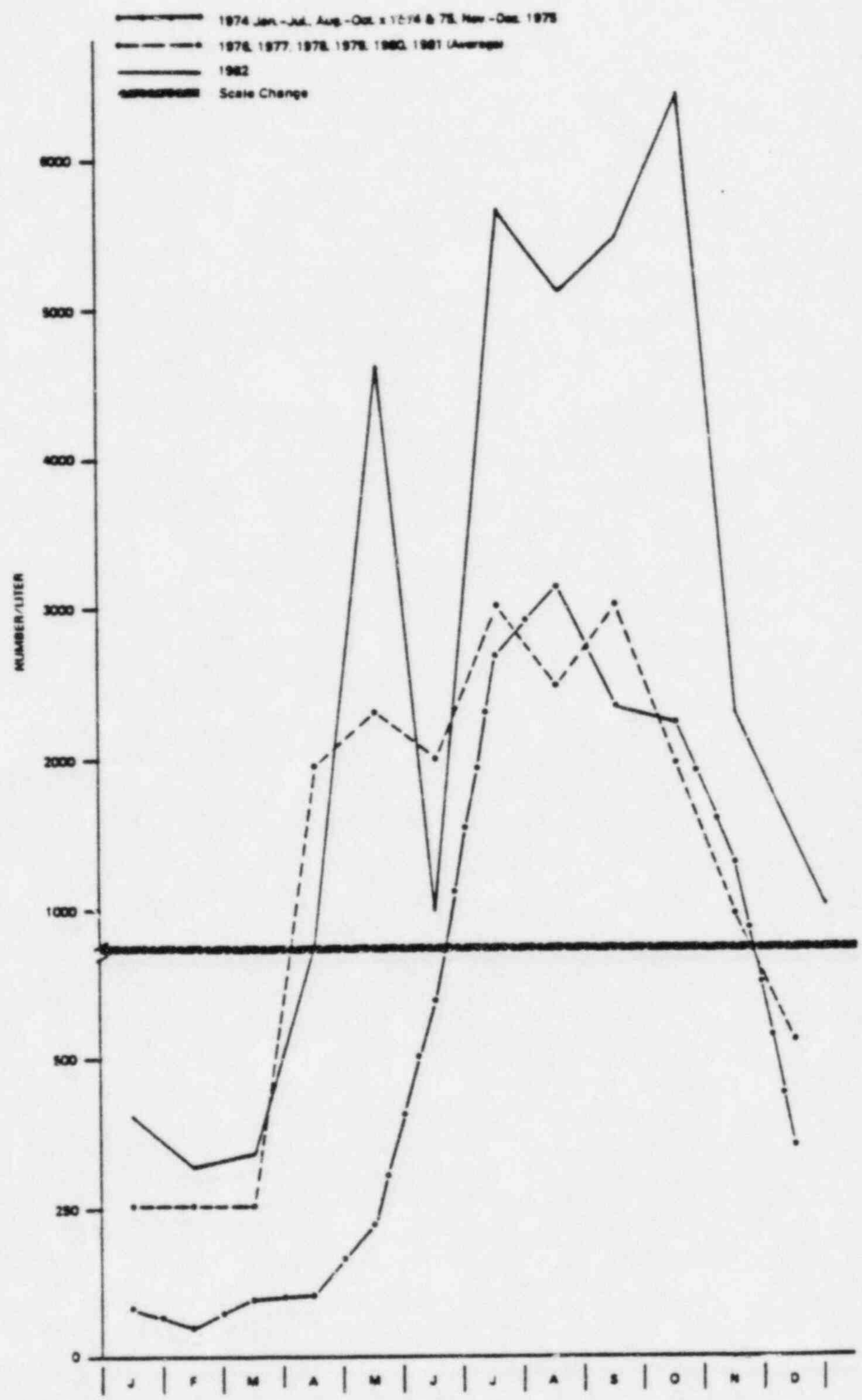


FIGURE V-D-1

SEASONAL PATTERNS OF ZOOPLANKTON DENSITIES IN THE OHIO RIVER DURING PREOPERATIONAL (1974-1975) AND OPERATIONAL (1976-1982) YEARS

BVPS

TABLE V-D-2

MEAN ZOOPLANKTON DENSITIES (Number/liter) BY MONTH FROM 1973 THROUGH 1982, 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	320	265	389	270	530	420	3,110	490	2,020	3,820	1,030	700
1981	190	360	220	580	840	310	3,800	1,940	4,490	1,850	760	370
1982	400	320	340	880	4,650	1,020	5,630	5,170	5,520	6,410	2,300	1,030
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	244	250	354	190	390	370	1,620	380	1,180	3,010	760	640
1981	130	310	180	510	480	230	730	1,250	4,020	1,580	550	330
1982	350	310	310	820	1,300	870	2,360	3,560	1,590	4,850	2,060	980
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	72	14	33	80	140	50	1,470	110	790	780	260	50
1981	40	50	40	70	340	80	2,800	630	470	260	210	40
1982	50	10	30	50	3,340	130	3,250	1,550	3,840	1,520	240	40
Crustacea												
1973	-	1	-	1	3	12	29	9	-	3	2	2
1974	2	2	3	3	6	3	14	95	7	6	-	-
1975	-	-	-	-	-	-	-	[illegible]	12	6	3	6
1976	2	1	5	4	10	141	43	[illegible]	69	3	2	8
1977	-	-	2	5	11	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	1	1	0	0	0	20	0	50	30	10	10
1981	20	0	0	0	20	0	270	60	0	10	0	0
1982	0	0	0	10	10	20	20	60	90	40	0	10

[a]No sample collected.

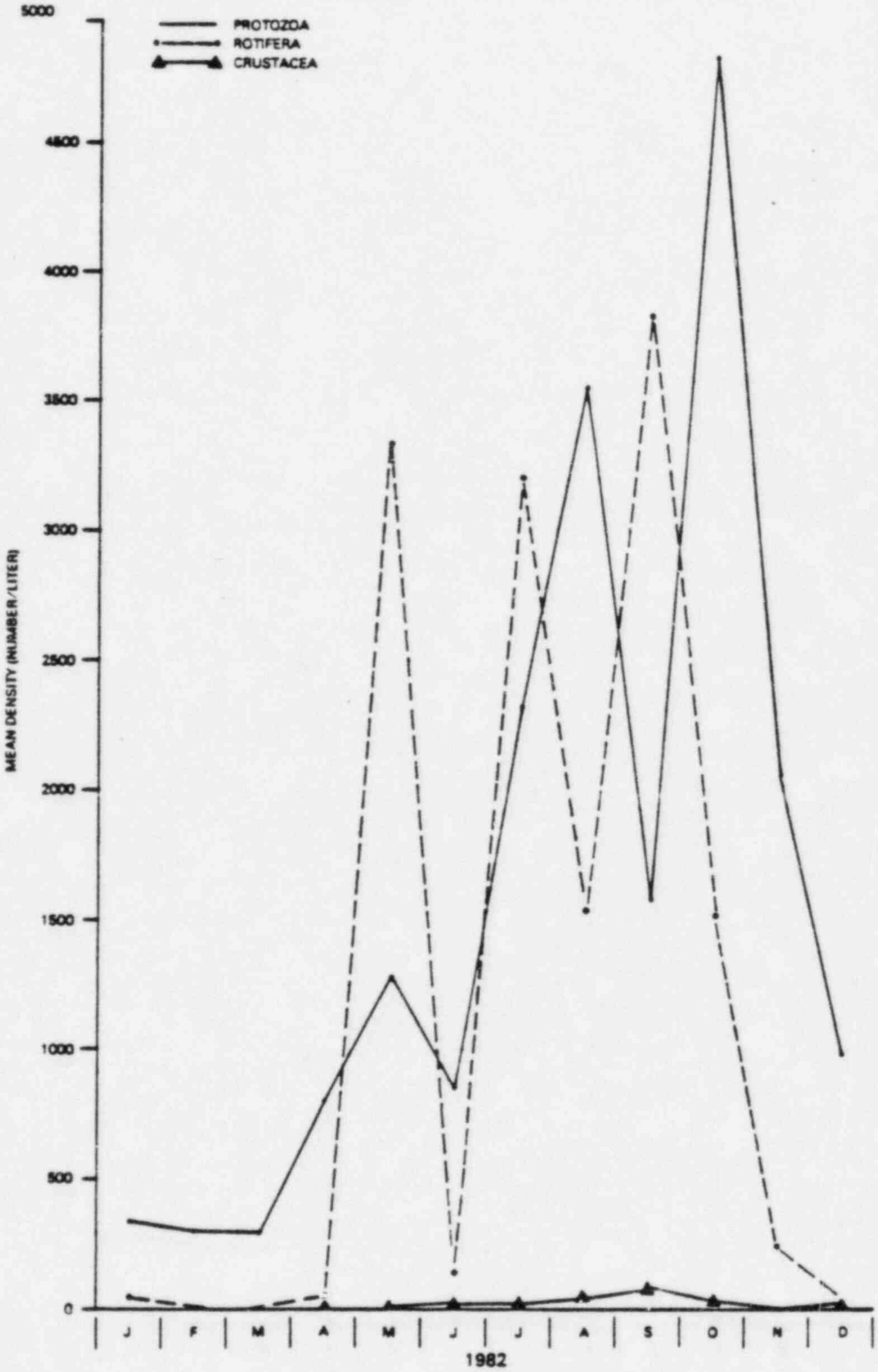


FIGURE V-D-2

ZOOPLANKTON GROUP DENSITIES FOR ENTRAINMENT SAMPLES, 1982

BVPS

TABLE V-D-3

DENSITIES (NUMBER/LITER) OF MOST ABUNDANT ZOOPLANKTON TAXA (GREATER THAN 2% ON ANY DATE)
COLLECTED FROM ENTRAINMENT SAMPLES
JANUARY THROUGH DECEMBER 1982
BVPS

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PROTOZOA												
Acropisthium sp.								120	10			
Arcella sp.				20	30	30		50	10	10	100	30
Askenasia sp.				40	20		10	150	60	120		10
Centropyxis sp.	80	20	70	40	60	20	10				140	20
Chlamydophora sp.							170		70	10		
Condonella cratera	40	60	90	10	680	350	470	620	280	60	380	170
Colpidium sp.			10	20			30					10
Cyclotrichium sp.	10		30	20	20		10					10
Cyphoderia ampulla	50	20	10	10	60	10	10			10	500	50
Difflugia acuminata	30			20	50	10	10	20	30	20	60	40
Difflugia sp.	30	10	10		40						80	
Euglypha compressa			10	10	20	10					20	
Paramecium sp.		10										
Strobilidium gyrans				50	40		430	250	100	290		
Strobilidium sp.		10		160	10	80	40	480	10	390	260	200
Tintinnidium fluviatile					10	80	80	370	140	380		60
Turaniella vitrea					110		400	100	80	70		
Vorticella sp.	100	170	70	200	100	220	80	790	300	2880	240	310
Holophyrid ciliate				150	10	30	260	120	210	250	20	30
Ciliate unidentified	10	10	10		30	10	110	100	40	110	120	30
ROTIFERA												
Branchionus calyciflours					40		270	40				
Conochilus unicornis							20	250	320	40		
Keratella cochlearis	30		10		2540	30	690	370	790	910	160	
Polyarthra dolichoptera				10	600	20	260	220	1460	270	40	30
Polyarthra vulgaris							30	310	290	20		

TABLE V-D-3 (Continued)

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Synchaeta sp.				10		30	990	50	570	150	20	
Trichocerca pusilla					20	20	930	160	210	50		
Rotifers-unidentified	20	10	20	10	50	20	10	60	30	10	20	10
Total Zooplankton	400	320	340	880	4650	1020	5630	5170	5520	6410	2300	1030
Total of most abundant zooplankton	400	320	340	780	4550	970	5320	4630	5010	6070	2160	1010
Percentage composition of most abundant zooplankton	100	100	100	89	98	95	94	90	91	95	94	98

in September (Table V-D-1). Rotifer populations progressively decreased after July to densities of 40/liter in December. Except during May, July, and September when rotifers were dominant, rotifers were always the second most abundant group during 1982. Keratella cochlearis, Polyarthra spp. and Synchaeta were the most abundant rotifers during most of the year (Table V-D-3). Trichocerca pusilla, Keratella, and Synchaeta were abundant in July.

Crustacean densities were low (0 to 20/liter) from January through July (Table V-D-1). Densities of crustaceans during 1982 reached their peak of 90/liter in September (Figure V-D-2). Populations decreased from October through December. Crustacean densities never exceeded protozoan or rotifer densities and constituted from 0 to 2% of the total zooplankton density each month (Table V-D-1). Copepod nauplii were the most numerous crustaceans during 1982. Other crustacean taxa occasionally present in low numbers were cyclopoid copepodites, Cyclops bicuspidatus thomasi, and Bosmina longirostris. Crustacean populations did not develop high densities despite favorable river conditions of low flow due to below average precipitation during 1982. Crustaceans are rarely numerous in the open waters of rivers and many are eliminated by silt and turbulent water (Hynes 1970).

Highest Shannon-Weiner diversity value was 4.28 which occurred in August whereas the maximum number of species (40) occurred in September (Table V-D-4). Evenness ranged from 0.52 in May to 0.90 in January. Richness varied from 1.39 in February to a maximum of 4.53 in September. The number of species ranged from 9 in February to 40 in September. Low diversity indices in February reflect low number of species and abundance of only Vorticella.

Comparison of Control and Non-Control Transects

Zooplankton samples were not collected from stations on the Ohio River after April 1, 1980; therefore, comparison of Control and Non-Control Transects was not possible.

TABLE V-D-4

ZOOPLANKTON DIVERSITY INDICES BY MONTH FOR ENTRAINMENT SAMPLES, 1982
BVPS

Date	Jan	Feb	Mar	Apr	May	Jun
No. of Species	10	9	11	22	27	20
Shannon-Weiner Index	2.99	2.22	2.89	3.59	2.46	3.20
Evenness	0.90	0.70	0.83	0.80	0.52	0.74
Richness	1.50	1.39	1.72	3.10	3.08	2.74

Date	Jul	Aug	Sep	Oct	Nov	Dec	$\bar{x}$
No. of Species	37	36	40	34	19	17	24
Shannon-Weiner Index	3.82	4.28	3.86	3.09	3.54	3.14	3.26
Evenness	0.73	0.83	0.72	0.61	0.83	0.77	0.75
Richness	4.17	4.09	4.53	3.76	2.32	2.31	2.89

Comparison of Preoperational and Operational Data

Population dynamics of the zooplankton community during the seasons of preoperational and operational years are displayed in Figure V-D-1. 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. Total densities of zooplankton during 1982 were frequently higher than those of preoperational years (1973 through 1975) and operational years (1976 through 1981) (Figure V-D-1). This was due primarily to reduced river flow and below average precipitation which occurred during 1982.

The species composition of zooplankton in the Ohio River near BVPS has remained stable during preoperational and operational years. The common or abundant protozoans during the past ten years have been Vorticella, Codonella, Difflugia, Strombilidium, Cyclotrichium, Strombilidium, Arcella and Centropyxis. The most numerous and frequently occurring rotifers have been Keratella, Polyarthra, Synchaeta, Branchionus and Trichocerca. Copepod nauplii have been the only crustacean taxa found consistently.

Community structure, as compared by diversity indices, has been similar during the past ten years (Table V-D-5). 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 1982, the diversity indices and species numbers were relatively low in January and March which was typical for months of winter and early spring. Shannon-Weiner diversity indices in 1982 ranged from 2.22 to 4.28 and were somewhat higher than the range of 1.80 to 3.28 that occurred during preoperational years from 1973 to 1975. The variation in evenness during 1982 (0.52 to 0.90) was at the upper portion of the range reported from 1973 to 1981 (0.21 to 0.93).

TABLE V-D-5

MEAN ZOOPLANKTON DIVERSITY INDICES BY MONTH FROM 1973 THROUGH 1982 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	22.86		16.33	14.60	14.30
Shannon Index[b]		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	17.56	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	8.00	10.00	17.00	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	0.79	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	2.06
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	3.36	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
1981												
Number of Species	8.00	12.00	7.00	11.00	19.00	12.00	23.00	24.00	20.00	21.00	17.00	10.00
Shannon Index	2.14	3.02	2.28	2.32	3.44	2.73	2.96	3.55	2.62	3.05	2.66	2.47
Evenness	0.71	0.84	0.81	0.67	0.81	0.76	0.65	0.77	0.60	0.69	0.65	0.74
1982												
Number of Species	10.00	9.00	11.00	22.00	27.00	20.00	17.00	36.00	40.00	34.00	19.00	17.00
Shannon Index	2.99	2.22	2.89	3.59	2.46	3.20	3.82	4.28	3.86	3.09	3.54	3.14
Evenness	0.90	0.70	0.83	0.80	0.52	0.74	0.73	0.83	0.72	0.61	0.83	0.77

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

[b]Shannon-Weiner Index.

Summary and Conclusions

Zooplankton densities throughout 1982 were typical of a temperate zooplankton community found in large river habitats. Total densities were slightly higher than those reported in previous years. The populations the summer of 1982 maintained high densities until the annual maximum occurred in October. Protozoans and rotifers were always predominant. Common and abundant taxa in 1982 were similar to those reported during preoperational and other operational years. Shannon-Weiner diversity, number of species and evenness were within the ranges or slightly greater than those of preceeding years. Based on the data collected during the seven operating years (1976 through 1982) and the three preoperating years (1973 through 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 ten year period from 1973 to 1982. 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

Fish sampling was conducted in order to detect any changes which might occur in fish populations in the Ohio River near BVPS.

Methods

Adult fish surveys were performed in May, July, September and November 1982. During each survey, fish were collected at the three study areas transects (Figure V-E-1), using gill nets, minnow traps, and electrofishing gear.

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 at each transect, with the small mesh inshore. As Transect 2 is divided by Phillips Island into two separate water bodies consisting of the main river channel (2A) and the back channel (2B), south of the island, a total of eight gill nets were set per sampling month. Nets were set for approximately 24 hours. All captured fish were identified, counted, measured for total length (mm) and weighed (g).

Electrofishing was conducted with a boat-mounted boom electroshocker. Direct current of 220 volts and two to four amps was 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 above 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 which contained 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 determined by visual inspection of the largest and smallest fish.

Minnow traps were baited with bread and placed next to the inshore side of each gill net on each sampling date. These traps were painted black and brown with a

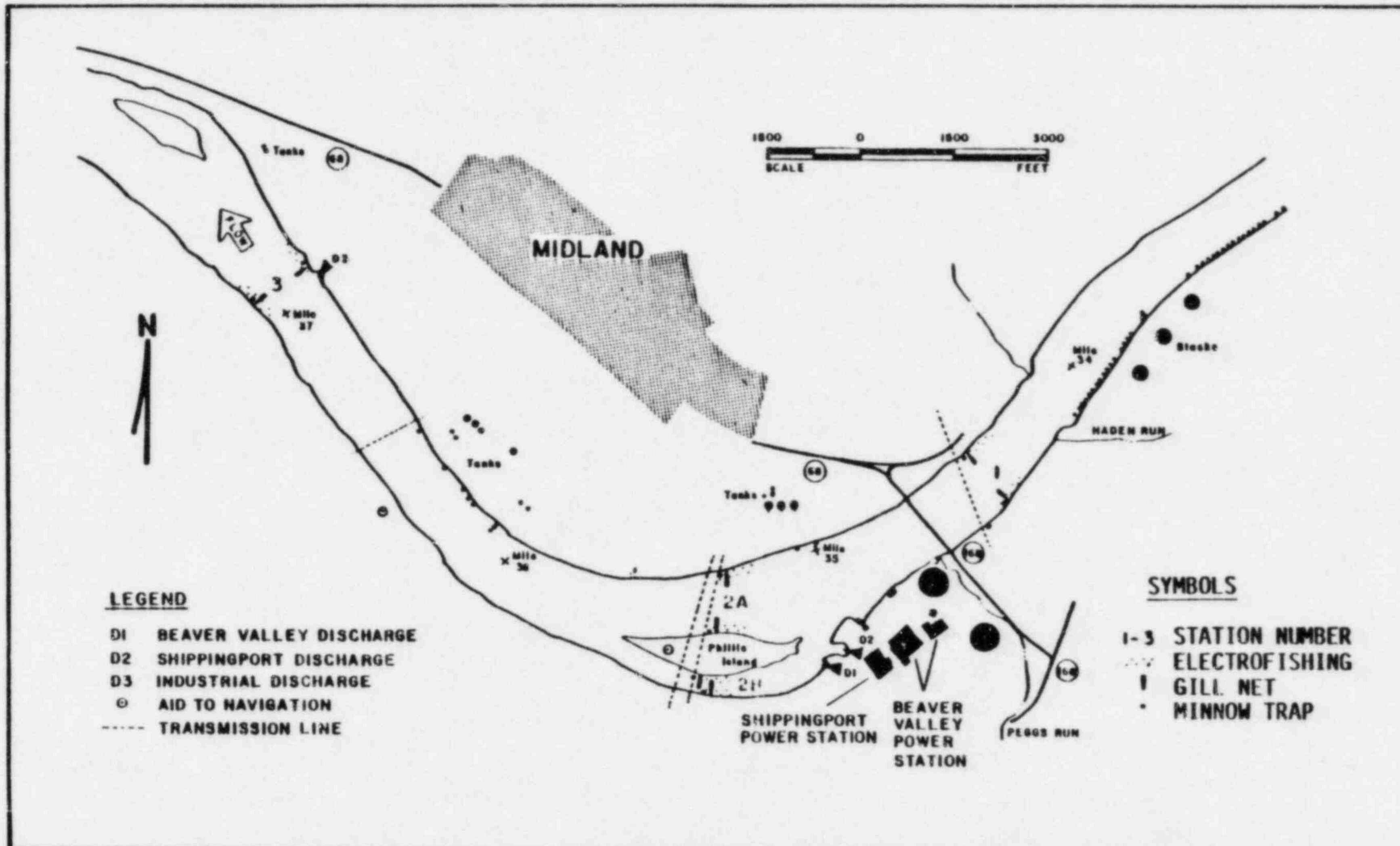


FIGURE V-E-1
FISH SAMPLING STATIONS, BVPS

camouflage design traps. Traps were set for 24 hours. 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 from 1974 through 1982. These surveys have collected 52 fish species (Table V-E-1). In 1982, 32 fish species were collected, including two species (spottail shiner and flathead catfish) that had not been captured previously. A combined total of 1,248 individuals were collected in 1982 by electrofishing, gill netting, and minnow traps (Table V-E-2).

A total of 643 fish, representing 21 species was collected by electrofishing (Table V-E-3). Emerald shiners dominated the catch numerically, accounting for 37.3% of the total electrofishing catch. Collectively, the minnow family accounted for 77.9% of the total electrofishing catch in 1982. Gizzard shad, also a forage species, represented 12.1% of the catch. The most abundant sport fish was smallmouth bass which comprised 4.4% of the electrofishing catch. Each of the other taxa accounted for less than 1% of the total. Most of fish were collected in November (46.8%). The fewest fish were collected in May (8.4%).

Common carp, walleye, channel catfish, and gizzard shad were the most abundant fishes caught, all represented by at least twenty (20) individuals (15.9%). Spotted bass and freshwater drum had twelve and ten specimens collected, respectively. Sauger was collected eight times, with all other species (longnose gar, northern pike, muskellunge, quillback, silver redhorse, golden redhorse, shorthead redhorse, flathead catfish, rock bass, largemouth bass, and white crappie) collected one or two times during 1982 (Table V-E-2).

The gill net results varied by month with the highest catch in the month of September (55 fish). May was the next highest month with 40 fish. July and November catches resulted in 13 fish and 18 fish, respectively. Gill nets typically catch more fish in warmer weather when fish are usually more active

TABLE V-E-1

(SCIENTIFIC AND COMMON NAME)[a]
FAMILIES AND SPECIES OF FISH COLLECTED IN THE NEW CUMBERLAND
POOL OF THE OHIO RIVER, 1970-1982
BVPS

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

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
Pylodictis olivaris	Flathead 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 Robins et al. (1980).

TABLE V-E-2

NUMBER OF FISH COLLECTED BY GILL NET (G), ELECTROFISHING (E), AND MINNOW TRAP (M)
AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1982
BVPS

	1			2A			2B			3			Grand Total			Annual	Percent Annual
	G	E	M	G	E	M	G	E	M	G	E	M	G	E	M	Total	Total
Longnose gar										1			1			1	0.1
Gizzard shad	3	1			42		2			15	35		20	78		98	7.9
Northern pike							1			1			2			2	0.2
Muskellunge										1			1			1	0.1
Goldfish		1												1		1	0.1
Common carp		2		2	4		9	14		10	1		21	21		42	3.4
Golden shiner								1						1		1	0.1
Emerald shiner		153	43		48	3		15	6		24	40		240	92	332	26.6
Spottail shiner												2			2	2	0.2
Spotfin shiner		4	12		2	2		2	2			61		8	77	85	6.8
Sand shiner		26	40		81	19		6	4		4	23		117	86	203	16.3
Mimic shiner		8	3		15	1			1		4	3		27	8	35	2.8
Bluntnose minnow		29	102		48	48		9	16			6		86	172	258	20.7
Quillback	1									1			2			2	0.2
Silver redhorse	1	1			1					1			2	2		4	0.3
Golden redhorse					5			1		1			1	6		7	0.6
Shorthead redhorse		1			2			4		1			1	7		8	0.6
Channel catfish	3		5	1		2	9	4		7		30	20	4	37	61	4.9
Flathead catfish										1			1			1	0.1
Trout-perch		1									1	1		2	1	3	0.2
Rock bass				1									1			1	0.1
Green sunfish					1			2						3		3	0.2
Pumpkinseed						1		1	2					1	3	4	0.3
Bluegill		1			1									2		2	0.2
Smallmouth bass		5			6			16			1			28		28	2.2
Spotted bass	4		1	2	2			1		6			12	3	1	16	1.3
Largemouth bass	1	1						2		1			2	3		5	0.4
White crappie										1			1			1	0.1
Logperch					3									3		3	0.2
Sauger	2			3						3			8			8	0.6
Walleye	3			4			7			6			20			20	1.6
Freshwater drum	2			4						4			10			10	0.8
Total	20	234	206	17	261	76	28	78	31	61	70	166	126	643	479	1248	

TABLE V-E-3

NUMBER OF FISH COLLECTED PER MONTH BY GILL NET (G), ELECTROFISHING (E), AND MINNOW TRAP (M)
IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1982
BVPS

	May			July			September			November			Grand Total			Annual	Percent Annual
	G	E	M	G	E	M	G	E	M	G	E	M	G	E	M	Total	Total
Longnose gar	1												1			1	0.1
Gizzard shad	1			4	41		15	37					20	78		98	7.9
Northern pike										2			2			2	0.2
Muskellunge	1												1			1	0.1
Goldfish		1												1		1	0.1
Common carp	11	10		2	2		6	5		2	4		21	21		42	3.4
Golden shiner		1												1		1	0.1
Emerald shiner		11	8		6			24			199	84		240	92	332	26.6
Spottail shiner												2			2	2	0.2
Spotfin shiner			1		2			2	2		4	74		8	77	85	6.8
Sand shiner		2	1		70	1		9	4		36	80		117	86	203	16.3
Mimic shiner		5			6			6	3		10	5		27	8	35	2.8
Bluntnose minnow		4			28	2		14	3		40	167		86	172	258	20.7
Quillback	1			1									2			2	0.2
Silver redhorse	1	2		1									2	2		4	0.3
Golden redhorse		4			1		1	1					1	6		7	0.6
Shorthead redhorse	1	2			1			4					1	7		8	0.6
Channel catfish	5	3		1			14	1	6			31	20	4	37	61	4.9
Flathead catfish							1						1			1	0.1
Trout-perch								1	1		1			2	1	3	0.2
Rock bass							1						1			1	0.1
Green sunfish					1			2						3		3	0.2
Pumpkinseed		1				1			1			1		1	3	4	0.3
Bluegill											2			2		2	0.2
Smallmouth bass		8			6			10			4			28		28	2.2
Spotted bass	9		1				3	2			1		12	3	1	16	1.3
Largemouth bass								3		2			2	3		5	0.4
White crappie													1			1	0.1
Logperch					1			2						3		3	0.2
Sauger	5						3						8			8	0.6
Walleye				1			7			12			20			20	1.6
Freshwater drum	4			3			3						10			10	0.8
Total	40	54	11	13	165	4	55	123	20	18	301	444	126	643	479	1246	

(Table V-E-4). The high number of fish collected in May was attributed to schools of common carp caught near the shore, probably in preparation for spawning.

A total of 479 fish were captured using minnow traps in 1982 (Table V-E-2). This gear was most effective in November when 92.7% of the fish were caught. Most of there fish were collected from Transect 1 (206 fish). Young-of-the-year channel catfish (30 fish) were collected at Station 3.

Comparison of Control and Non-Control Transects

Comparisons of the data obtained from the Control Transect (1) with that from the Non-Control Transects indicate that the fish populations have fluctuated slightly since 1974. However, comparisons between years include many natural variables and can be misleading. Fluctuations in catches occur with changes in the physical and chemical properties of the river's ambient water quality. Since electrofishing efficiency depends largely on the water's conductivity, any sampling conducted during extremes in this parameter will affect catch-per-unit effort. Also turbidity and current affects the collectors' ability to net stunned the fish. Direct sunlight also influences where fishes congregate, thus determining their susceptibility to being shocked. Electrofishing collects mostly small forage species (minnows and shad) and their highly fluctuating annual populations were reflected in differences in per unit effort from year to year and station to station. However, gill nets catch mostly large game species and are more indicative of true changes in fish abundance. When comparing gill net data (Table V-E-6), little change is noticed either between Control and Non-Control Transects or between pre-operational and operational years. The 1982 gill net catch per unit effort (fish/24 hours) was the highest of any year to date, with 2.4 and 4.4 for the Control and Non-Control Transects, respectively.

Comparison of Preoperational and Operational Data

Electrofishing and gill net data, expressed as catch-per-unit-effort, for the years 1974 through 1982 are presented in Tables V-E-5 and V-E-6. These nine years represent two preoperational years (1974 and 1975) and seven operational years (1976 through 1982). Fish data for Transect 1 (Control Transect) and the averages

TABLE V-E-4

NUMBER OF FISH COLLECTED BY GILL NET, ELECTROFISHING, AND MINNOW TRAP AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1982
BVPS

	Transect					
Gill Net	1	2A	2B	3	Total	Average
May	8	8	9	15	40	10.0
July	4	2	2	5	13	3.2
September	5	6	12	32	55	13.8
November	3	1	5	9*	18	5.1
Total	20	17	28	61	126	
Average	5.0	4.2	7.0	17.4		
Electrofishing						
May	8	7	25	14	54	13.5
July	9	144	10	2	165	41.2
September	16	47	20	40	123	30.8
November	201	63	23	14	301	75.2
Total	234	261	78	70	643	
Average	58.5	65.2	19.5	17.5		
Minnow Trap						
May	1	1*		9	11	3.2
July		2	1	1	4	1.0
September	7	10	2	1	20	5.0
November	198	63	28	155	444	111.0
Total	206	76	31	166	479	
Average	51.5	21.7	7.8	41.5		

* Gear at one station missing

TABLE V-E-5

ELECTROFISHING CATCH (FISH/HOUR) MEANS (x̄) AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1974-1982

BVPS

Species	Transect 1									Transect 2A, 2B, 3								
	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1981[d]	1982[d]	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1981[d]	1982[d]
Gizzard shad	-	5.1	1.2	2.0	-	-	3.1	3.0	0.8	0.9	1.0	1.4	0.7	0.3	2.1	2.5	21.5	19.2
Tiger muskellunge	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-
Muskellunge	-	-	-	-	-	0.5	-	-	-	-	-	-	-	-	0.3	-	-	-
Northern pike	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.2	-
Goldfish	-	-	0.7	-	-	-	2.3	-	0.8	-	-	-	-	-	-	0.8	-	-
Carp	[illegible]	-	-	1.0	12.5	-	20.8	15.0	1.5	3.3	0.5	0.7	1.2	6.6	1.2	4.2	6.0	4.8
Golden shiner	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	0.2
Emerald shiner	42.0	441.7	10.7	57.0	22.0	50.4	51.5	151.5	114.0	67.7	239.9	13.3	33.8	23.9	53.7	37.0	163.5	21.0
Spotfin shiner	0.9	-	4.0	7.6	0.5	-	-	-	3.0	4.3	2.0	6.1	4.9	0.5	0.5	1.0	0.8	1.0
Sand shiner	57.6	129.1	52.5	95.9	0.8	93.6	32.3	23.3	19.5	17.4	81.0	52.6	26.2	13.3	45.2	25.0	10.2	22.0
Mimic shiner	-	-	3.5	7.0	0.5	1.6	6.2	3.0	6.0	-	-	1.0	1.1	0.3	2.3	1.0	3.2	4.0
Bluntnose minnow	33.3	72.3	53.2	57.0	12.0	89.4	15.4	18.0	21.0	6.1	31.2	45.3	44.9	21.4	40.8	10.2	5.2	14.2
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	0.8	-
Redhorse spp.	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-
Silver redhorse	-	-	-	-	-	-	-	-	0.8	-	-	-	-	0.3	-	-	0.2	0.2
Black redhorse	-	-	-	-	0.8	1.0	-	-	-	-	-	-	0.3	0.3	-	-	-	-
Golden redhorse	-	-	-	-	-	-	1.5	1.5	-	-	-	-	-	-	-	0.8	0.2	1.5
Shorthead redhorse	-	-	-	-	-	-	-	0.8	0.8	-	-	-	-	0.4	-	-	0.2	1.5
Yellow bullhead	-	-	-	-	-	-	-	-	-	0.4	-	0.2	-	0.2	-	-	-	-
Brown bullhead	-	-	-	-	-	-	-	-	-	0.4	-	0.2	-	0.1	-	-	0.1	-
Channel catfish	-	-	-	-	0.3	-	-	0.8	-	-	1.0	0.2	1.1	0.3	0.7	0.5	1.2	1.0
Trout-perch	-	-	-	-	-	-	1.5	-	0.8	-	-	-	-	0.1	0.5	0.2	-	0.2
Banded killifish	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-
White bass	-	-	-	-	0.5	-	-	-	-	-	-	-	-	0.1	-	0.5	-	-
Rock bass	-	-	-	-	-	-	-	-	-	-	-	0.4	-	0.1	-	-	0.5	-
Sunfish (Lepomis) hybrid	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	0.2	-
Green sunfish	-	-	-	-	0.3	0.5	-	-	-	-	-	-	1.4	0.3	0.5	0.2	0.2	0.8
Pumpkinseed	-	-	-	-	0.3	0.5	-	-	-	-	0.5	0.7	1.0	0.5	-	-	0.2	0.2
Bluegill	6.6	-	1.5	-	3.0	0.5	-	1.5	0.8	1.9	0.6	0.2	0.3	1.4	0.2	-	0.8	0.2
Smallmouth bass	0.9	-	2.3	3.0	0.3	0.5	4.6	3.0	3.0	0.8	-	0.6	1.0	0.3	0.9	2.0	6.5	5.0
Spotted bass	0.9	-	-	2.7	-	2.6	4.6	1.5	-	0.4	-	-	2.7	-	2.1	1.5	0.5	0.8
Largemouth bass	1.1	-	-	1.0	1.0	-	0.8	-	0.8	1.4	-	1.1	0.7	0.7	0.3	0.2	0.8	0.5
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	-	0.8	-	-	-	-	-	0.1	0.2	0.2	-	-
Logperch	-	-	-	-	0.3	0.5	-	-	-	-	-	-	0.3	-	0.7	0.2	0.8	0.8
Sauger	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.2	-
Walleye	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater drum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-
Total	150.0	645.2	139.4	235.9	65.6	250.6	146.9	225.2	176.0	106.5	359.2	125.7	122.0	72.5	153.6	91.3	224.0	102.3

[a] MAY-JUL
[b] AUG, NOV
[c] MAY-SEP, NOV
[d] MAY, JUL, SEP AND NOV

TABLE V-8-6

GILL NET CATCH (FISH/24 HOUR) MEANS ($\bar{x}$) AT TRANSECTS IN THE NEW CUMBERLAND POOL
OF THE OHIO RIVER, 1974-1982
BVPS

Transect 1

Species	1974[a]	1975[b]	1976[c]	1977[d]	1978[d]	1979[d]	1980[e]	1981[e]	1982[e]
Longnose gar	-	-	0.2	-	-	-	-	-	-
Gizzard shad	-	-	-	-	-	-	0.1	-	0.4
Northern pike	-	-	-	0.1	-	-	-	-	-
Muskellunge	-	-	-	-	-	-	-	-	-
Tiger muskellunge	-	-	-	0.1	0.1	-	-	-	-
Goldfish	-	-	-	-	-	-	-	-	-
Carp	0.8	1.2	0.1	0.4	0.6	<0.1	-	0.4	-
Goldfish x Carp hybrid	-	-	-	-	-	-	-	-	-
Quillback	-	-	0.1	0.2	-	-	-	0.1	0.1
White sucker	-	0.3	-	0.2	0.2	-	-	-	-
Black redhorse	-	-	-	-	-	-	-	-	-
Silver redhorse	-	-	-	-	-	<0.1	-	-	0.1
Golden redhorse	-	-	-	-	-	-	-	-	-
Shorthead redhorse	-	-	-	-	-	-	-	-	-
Black bullhead	-	-	-	-	-	-	-	-	-
Brown bullhead	0.4	-	-	-	0.1	-	-	-	-
Yellow bullhead	-	-	-	-	-	-	-	-	-
White catfish	-	-	-	-	-	-	-	-	-
Channel catfish	-	0.8	-	0.7	0.7	0.2	0.2	0.2	0.4
Flathead catfish	-	-	-	-	-	-	-	-	-
Rock bass	-	0.3	-	0.2	0.1	0.2	-	-	-
Green sunfish	-	-	0.1	-	0.1	-	-	-	-
Pumpkinseed	-	-	-	-	-		-	-	-
Bluegill	-	-	-	-	-		-	-	-
Smallmouth bass	-	-	-	-	0.1	<0.1	-	-	-
Largemouth bass	-	-	0.2	-	-	<0.1	-	-	0.1
Spotted bass	-	0.2	0.7	0.1	-	<0.1	-	-	0.5
White crappie	-	-	-	-	0.1	-	-	-	-
Black crappie	-	-	-	0.1	-	-	-	-	-
Yellow perch	0.4	0.6	0.5	0.8	0.3	0.2	-	-	-
Walleye	0.2	-	0.3	0.3	0.3	0.2	-	0.1	0.4
Sauger	-	-	-	-	0.2	-	0.1	-	0.2
Freshwater drum	-	-	-	-	-	-	-	-	0.2
Total	1.8	3.4	2.2	3.2	2.9	0.8-1.3	0.4	0.8	2.4

Transect 2A, 2B, 3

Species	1974[a]	1975[b]	1976[c]	1977[d]	1978[d]	1979[d]	1980[e]	1981[e]	1982[e]
Longnose gar	-	-	-	-	-	-	-	-	<0.1
Gizzard shad	0.2	0.1	-	0.1	-	<0.1	-	<0.1	0.7
Northern pike	-	-	-	0.1	<0.1	-	<0.1	<0.1	<0.1
Muskellunge	-	-	-	-	<0.1	-	-	-	<0.1
Tiger muskellunge	-	-	-	-	<0.1	-	<0.1	-	-
Goldfish	-	-	<0.1	0.1	-	-	<0.1	-	-
Carp	0.9	0.3	0.2	0.6	0.3	0.3	0.2	0.3	0.9
Goldfish x Carp hybrid	-	0.1	-	0.1	-	-	-	-	-
Quillback	-	-	<0.1	0.2	0.1	<0.1	<0.1	-	<0.1
White sucker	0.1	-	-	<0.1	-	<0.1	<0.1	-	-
Black redhorse	-	-	-	<0.1	0.1	<0.1	-	-	-
Silver redhorse	-	-	-	-	-	<0.1	-	-	<0.1
Golden redhorse	-	-	-	-	-	-	-	-	<0.1
Shorthead redhorse	-	-	-	-	-	-	-	-	<0.1
Black bullhead	-	0.1	-	-	-	-	-	-	-
Brown bullhead	0.2	-	<0.1	<0.1	-	-	-	-	-
Yellow bullhead	0.1	-	-	-	-	-	-	-	-
White catfish	-	-	<0.1	-	-	-	-	-	-
Channel catfish	0.3	1.3	0.4	1.0	0.4	0.5	0.4	0.6	0.7
Flathead catfish	-	-	-	-	-	-	-	-	<0.1
Rock bass	-	0.1	-	<0.1	<0.1	<0.1	-	-	<0.1
Green sunfish	-	-	-	0.1	-	-	-	<0.1	-
Pumpkinseed	-	-	-	0.1	-	-	-	-	-
Bluegill	-	-	-	0.1	-	-	-	-	-
Smallmouth bass	-	-	<0.1	-	-	-	-	-	-
Largemouth bass	0.2	0.1	0.1	<0.1	<0.1	-	-	-	<0.1
Spotted bass	-	-	0.2	0.1	<0.1	<0.1	0.1	<0.1	0.3
White crappie	-	-	<0.1	<0.1	-	0.1	0.1	-	<0.1
Black crappie	-	-	<0.1	0.1	-	<0.1	-	-	-
Yellow perch	-	0.7	0.5	0.7	0.1	0.1	-	<0.1	-
Walleye	0.2	0.2	0.1	0.2	0.1	<0.1	0.2	0.1	0.7
Sauger	-	0.1	-	<0.1	0.2	0.3	<0.1	0.2	0.3
Freshwater drum	-	-	-	-	-	-	-	0.1	0.3
Total	2.2	3.1	1.5-2.2	3.6-4.3	1.3-1.9	1.3-1.9	1.2-1.6	1.5	4.4

[a] MAY, SEP, NOV
[b] AUG, SEP, NOV
[c] MAY-SEP
[d] MAY-SEP, NOV
[e] MAY, JUL, SEP, NOV

of Transects 2A, 2B and 3 (Non-Control Transects) are tabulated separately. These data indicate that new species are inhabiting the study area and that, in general, the water quality of the Ohio River is steadily improving.

Summary and Conclusions

The fish community of the Ohio River in the vicinity of BVPS has been sampled from 1974 to present, using several types of gear: electrofishing, gill netting, minnow traps, and seines. The results of these fish surveys show normal community structure based on species composition and relative abundance. In all the surveys since 1974, forage species (minnows and shiners) were collected in the highest numbers. This indicates a normal fish community, since sport species and predators rely heavily on this forage base for their survival. Variations in total annual 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 (competition, food availability, cover, and water quality) with large changes in population size. These fluctuations are naturally occurring and take place in the vicinity of BVPS.

Although 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. Since 1978, sauger has become a common sport species to this area.

Differences in the 1982 electrofishing and gill net catches, between the Control and Non-Control Transects were similar to previous years (both operational and pre-operational) and were probably caused by the habitat preferences of individual species. This habitat preference is probably the most influential factor that effects where the different species of fish are collected and in what relative abundance.

Data collected from 1974 through 1982 show no evidence that the fish community in the study area has been adversely affected by BVPS operation.

F. ICHTHYOPLANKTON

Objective

Ichthyoplankton sampling was performed in order 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 spring and summer, which is the primary spawning season for most resident species (19 April, 18 May, 21 June, and 20 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 conical 505 micron mesh plankton net with a 0.5 m mouth diameter. 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 the field using 5% buffered formalin containing rose bengal dye.

In the laboratory, ichthyoplankton was sorted from the sample and enumerated. Each specimen was identified as to its stage of development (egg, yolk-sac, larvae, early larvae, juvenile, or adult) and to the lowest possible taxon. Densities of ichthyoplankton (numbers/100 m^3) were calculated for each sample using flowmeter data.

Results

A total of 7 eggs, 94 larvae, and one adult was collected in 1982 from 909.7m^3 of water sampled (Table V-F-1). Six taxa representing four families were identified. Cyprinidae spp. (minnows and carp) accounted for 87.3% (1 egg, 87 larvae, 1 juvenile) of the total catch.

Minnow (Cyprinidae spp.), representing 57.1% of the eggs taken, was the only identifiable egg taxon collected in 1982 (Table V-F-1). Minnows also dominated the larval catch (88.3% of the total yearly catch). Other larval taxa collected included

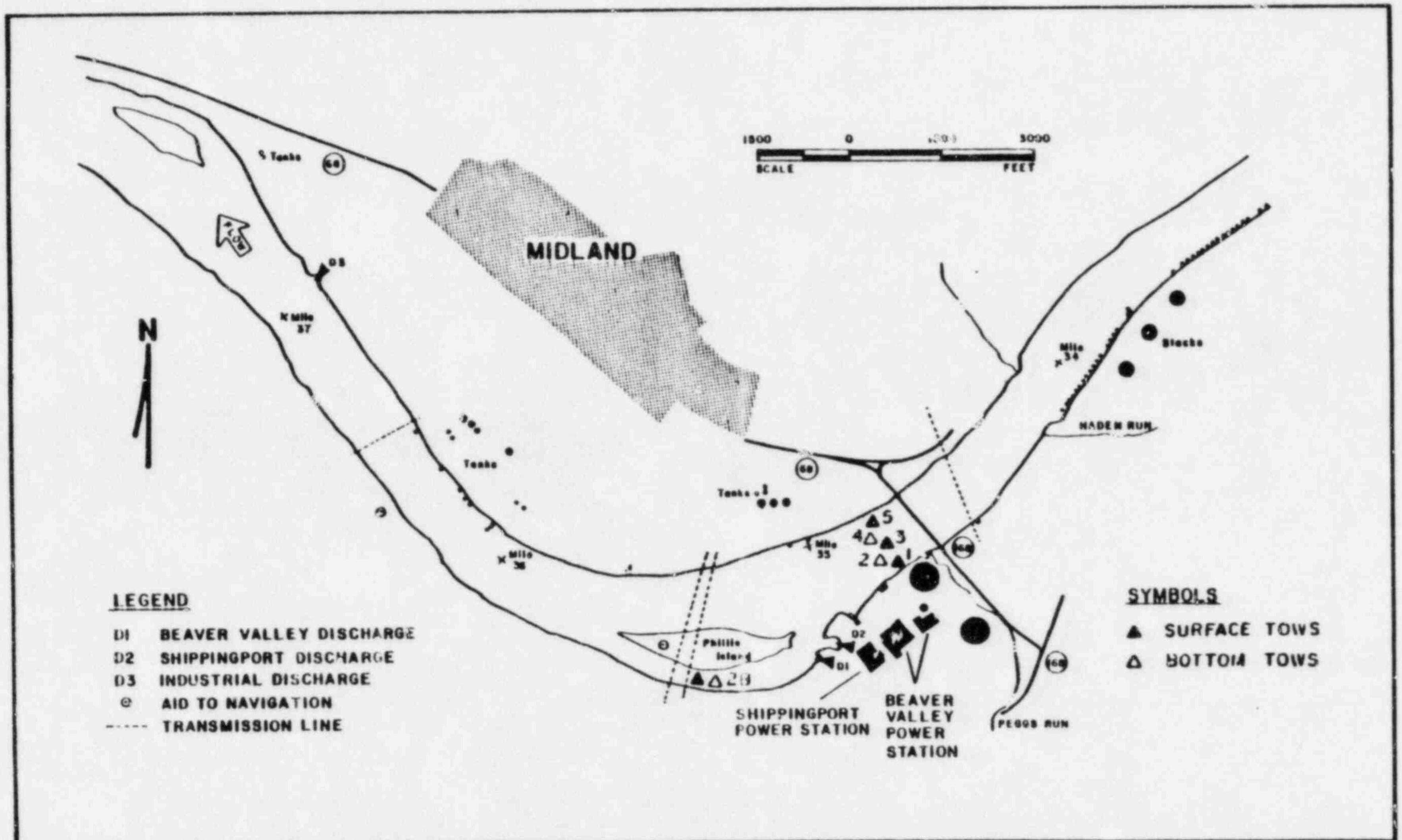


FIGURE V-F-1

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, 1982

Date	Depth of Collection		Total Collected and
19 April	Surface	Bottom	Taxa Density
Vol. water filtered (m^3)	112.6	116.2	228.8
No. eggs collected	0	0	0
No. larvae collected	0	0	0
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Unidentifiable	0	0	0
Total density (number collected)	0	0	0
18 May			
Vol. water filtered (m^3)	125.0	87.1	212.1
No. eggs collected	0	1	1
No. larvae collected	1	6	7
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Unidentifiable	0	1.15(1)	0.47(1)
Larvae			
Dorosoma cepedianum (YL)	0	3.44(3)	1.41(3)
Cyprinus carpio (YL)	0.80(1)	0	0.47(1)
Cyprinidae sp. (YL)	0	1.15(1)	0.47(1)
Perca flavescens (EL)	0	2.30(2)	0.94(2)
Total density (number collected)	0.80(1)	8.04(7)	3.77(8)

TABLE V-F-1 (Continued)

Date	Depth of Collection		Total Collected and
21 June	Surface	Bottom	Taxa Density
Vol. water filtered (m^3)	126.6	99.0	225.6
No. eggs collected	2	2	4
No. larvae collected	2	10	12
No. juveniles collected	0	0	0
No. adults collected	1	0	1
Density (number collected)			
Eggs			
Cyprinidae spp.	1.58(2)	2.02(2)	1.77(4)
Larvae			
Cyprinidae spp. (YL)	0	6.06(6)	2.66(6)
Cyprinidae spp. (EL)	1.58(2)	2.02(2)	1.77(4)
Unidentifiable (L)	0	2.02(2)	0.89(2)
Adults			
Notropis atherinoides	0.79(1)	0	0.44(1)
Total density (number collected)	3.95(5)	12.12(12)	7.54(17)
20 July			
Vol. water filtered (m^3)	103.3	139.9	243.2
No. eggs collected	0	2	2
No. larvae collected	39	36	75
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Unidentifiable	0	1.94(2)	0.82(2)
Larvae			
Cyprinidae spp. (YL)	4.29(6)	1.94(2)	3.29(8)
Cyprinidae spp. (EL)	23.59(33)	30.01(31)	25.32(64)
Aplodinotus grunniens (EL)	0	1.94(2)	0.82(2)
Unidentifiable (YL)	0	0.97(1)	0.41(1)
Total density (number collected)	37.75(39)	27.16(38)	31.66(77)

TABLE V-F-1 (Continued)

Yearly Totals	Depth of Collection Surface	Bottom	Total Collected and Taxa Density
Vol. water filtered (m^3)	467.5	442.2	909.7
No. eggs collected	2	5	7
No. larvae collected	42	52	94
No. juveniles collected	0	0	0
No. adults collected	1	0	1
Density (number collected)			
Eggs			
Cyprinidae spp.	0.43(2)	0.45(2)	0.44(4)
Unidentifiable	0	0.68(3)	0.33(3)
Larvae			
Dorosoma cepedianum (YL)	0	0.68(3)	0.33(3)
Cyprinus carpio (YL)	0.21(1)	0	0.11(1)
Cyprinidae spp. (YL)	1.28(6)	2.04(9)	1.65(15)
Cyprinidae spp. (EL)	7.49(35)	7.46(33)	7.47(68)
Perca flavescens (EL)	0	0.45(2)	0.22(2)
Aplodinotus grunniens (EL)	0	0.45(2)	0.22(2)
Unidentifiable (YL)	0	0.23(1)	0.11(1)
Unidentifiable (L)	0	0.45(2)	0.22(2)
Adults			
Notropis altherinoides	0.21(1)	0	0.11(1)
Total density (number collected)	9.63(45)	12.89(57)	11.21(102)

[a]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 no fin rays and/or spiny elements have developed.

L - Specimens whose larval stage is undefinable due to body deterioration.

gizzard shad (Dorosoma cepedianum; 3.2% of the total larval catch), yellow perch (Perca flavescens; 2.1%), and freshwater drum (Aplodinotus grunniens; 2.1%). No juveniles were collected in 1982; however, a single adult emerald shiner (Notropis atherinoides) was taken during 21 June sampling.

On a seasonal basis, ichthyoplankton was most abundant on 20 July when total daily density was 31.66 individuals per $100m^3$ of water filtered (Table V-F-1). All but two (97.3%) of the identifiable specimens were minnow larvae. The other identifiable larvae taxon collected on this date was freshwater drum. Collections on 21 June yielded 7.54 individuals per $100m^3$; most (82.4%) were minnow eggs and larvae. The greatest diversity of taxa for the year was found during 18 May sampling; however, total density of individuals was relatively low ($3.77/100m^3$). Four taxa of three families were collected on this date in nearly equal numbers. Sampling on 20 April yielded no ichthyoplanton.

Comparison of Preoperational and Operational Data

Species abundance and composition was similar to that found in previous years. As in previous years, minnows dominated the catch with other taxa represented by only a few individuals. Densities of ichthyoplankton collected in the backchannel (Station 2B) from 1973-1974, 1976-1982, are presented in Table V-F-2.

Summary and Conclusions

As in previous years, cyprinids dominated the 1982 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 or no spawning was noted in April and May. 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, 1976-1982

Date	Density
1973	
12 April	0
17 May	0
20 June	16.10
26 July	3.25
1974	
16 April	0
24 May	0
13 June	6.98
26 June	9.25
16 July	59.59
1 August	6.85
1975	
29 April	0.70
19 May	0
18 June	5.99
2 July	6.63
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
1978	
22 April	0
5 May	0
20 May	0.98
2 June	4.01
16 June	12.15
2 July	13.32
1979	
19 April	0
1 May	0
17 May	0.81
7 June	0.39
20 June	11.69
5 July	14.82
1980	
23 April	0.42
21 May	0.53
19 June	9.68
22 July	107.04
1981	
20 April	1.10
12 May	0
17 June	26.40
22 July	17.14
1982	
19 April	0
18 May	3.77
21 June	7.54
20 July	31.66

G. FISH IMPINGEMENT (ETS Reference 3.1.3.7)

Objective

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

Methods

The surveys were conducted weekly throughout 1982 for a total of 52 (Table V-A-1). Except when technical difficulties delayed the start of collections, weekly fish impingement sampling began on Thursday mornings when all four traveling screens were washed. 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 were summarized according to operating intake bays (bays that had pumps operating in the 24 hr sampling period) and non-operating intake bays.

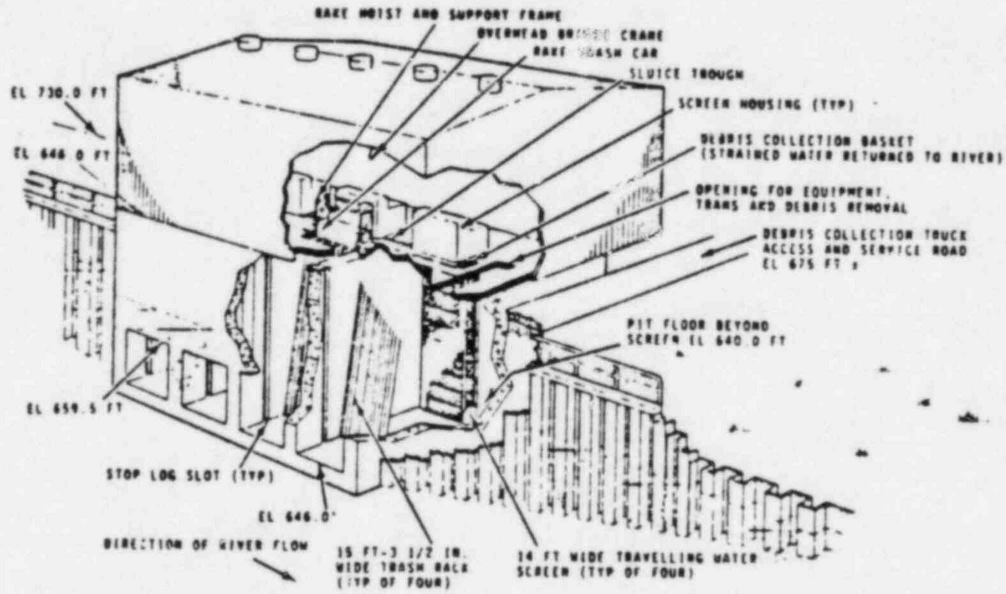
Results

The BVPS impingement surveys of 1976 through 1982 have resulted in the collection of 33 species of fish representing nine families (Table V-G-1). A total of 227 fish, representing 22 species (24 taxa) was collected in 1982 (Table V-G-2). Emerald shiner were the most numerous fish, comprising 30.0% of the total annual catch, followed by channel catfish (26.0%) and gizzard shad (12.0%). Bluegill (19 specimens) accounted for 8.4% with all other species represented by less than ten specimens. No endangered or threatened species were collected (Commonwealth of Pennsylvania 1981). In addition, 293 crayfish, 20 native clams (Lampsilus), and 16 dragonflies were collected on the traveling screens in 1982. In addition, 299 Asiatic clams (Corbicula) were collected.

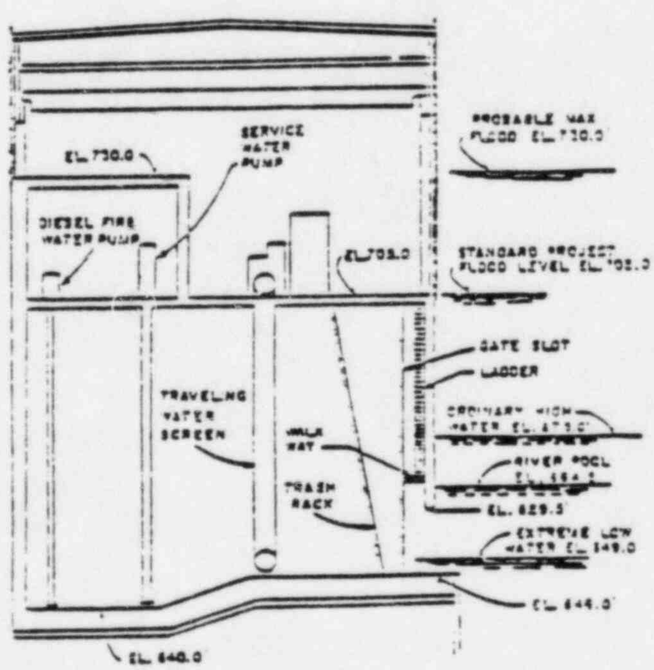
Two flathead catfish, a species not collected in previous years, were collected in 1982. All fishes ranged in size from 24 mm to 182 mm, with the majority under 100 mm. The total weight of fish collected in 1982 was 0.596 kg (1.32 lbs) (Table V-G-2).

FIGURE V-G-1

INTAKE STRUCTURE
BVPS



(Three dimensional: Cutaway View)



(Two dimensional: Side View)

TABLE V-G-1

(SCIENTIFIC AND COMMON NAME)[a]
FAMILIES AND SPECIES OF FISH COLLECTED DURING THE
IMPINGEMENT SURVEYS, 1976-1982
BVPS

Family and Scientific Name	Common Name
Clupeidae (herrings)	
Dorosoma cepedianum	Gizzard shad
Cyprinidae (minnows and carps)	
Cyprinus carpio	Common carp
Notemigonus crysoleucas	Golden shiner
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 catus	White catfish
I. natalis	Yellow bullhead
I. nebulosus	Brown bullhead
I. punctatus	Channel catfish
Noturus flavus	Stonecat
Pylodictis olivaris	Flathead catfish
Percopsidae (trout-perches)	
Percopsis omiscomaycus	Trout-perch
Cyprinodontidae (killifishes)	
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. punctulatus	Spotted bass
M. salmoides	Largemouth 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 vitreum	Walleye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum

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

TABLE V-G-2

SUMMARY OF FISH COLLECTED IN IMPINGEMENT SURVEYS CONDUCTED FOR ONE 24 HOUR PERIOD
PER WEEK DURING 1982
BVPS

Taxa	Number	Percent Frequency of Occurrence	Percent Composition	Operating Intake Bays[a] Alive Number	Operating Intake Bays[a] Alive Weight (g)	Operating Intake Bays[a] Dead Number	Operating Intake Bays[a] Dead Weight (g)	Non-Operating Intake Bays[b] Alive Number	Non-Operating Intake Bays[b] Alive Weight (g)	Non-Operating Intake Bays[b] Dead Number	Non-Operating Intake Bays[b] Dead Weight (g)	Length Range (mm)
Gizzard shad	1	1.9	0.4			1	14					115
Goldfish	1	1.9	0.4							1	3	71
Common carp	1	1.9	0.4					1	2			50
Emerald shiner	68	36.5	30.0	4	3	33	12	4	4	27	21	25-72
Mimic shiner	7	7.7	3.1			3	4			4	4	30-55
Shiner (Notropis spp.)	22	11.5	9.7			7	7			15	12	30-50
Bluntnose minnow	5	5.8	2.2			4	3			1	1	32-46
Brown bullhead	1	1.9	0.4							1	1	38
Channel catfish	59	46.2	26.0	10	24	26	45	18	42	5	8	30-124
Flathead catfish	2	3.8	0.9	2	16							67-116
Trout-perch	2	1.9	0.9			1	1			1	1	38-43
Banded killifish	1	1.9	0.4					1	1			50
Rock bass	4	7.7	1.8	3	6	1	1					30-60
Green sunfish	1	1.9	0.4					1	1			47
Pumpkinseed	2	3.8	0.9			1	1	1	1			45
Bluegill	19	26.9	8.4	5	10	1	1	10	55	3	4	35-110
Sunfish (Lepomis spp.)	3	3.8	1.3			1	1			2	2	24-34
Smallmouth bass	3	3.8	1.3			2	12	1	15			49-97
Spotted bass	5	9.6	2.2	2	36	1	27	1	20	1	12	101-127
Largemouth bass	1	1.9	0.4	1	79							182
White crappie	3	3.8	1.3	1	2	2	30					45-125
Black crappie	2	1.9	0.9	1	3			1	2			48-57
Johnny darter	5	9.6	2.2			1	1	1	1	3	3	30-55
Freshwater drum	9	13.5	4.0			6	26	2	14	1	1	65-102
Total	227			29	179	91	186	42	158	65	73	
Percent of Total				12.8	30.0	40.1	31.2	18.5	26.5	28.3	12.2	

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

The temporal distribution of the 1982 impingement catch closely follows the pattern of catches of previous years (1976 to 1981) (Tables V-G-3 and V-G-4). During each year, the largest numbers of fish have been collected in the winter months (December-February) and then the catch has gradually decreased until the July-September period when another smaller peak has occurred.

Comparison of Impinged and River Fish

A comparison of the numbers of fish collected in the river and traveling screens is presented in Table V-G-5. Four fish species were collected only in the impingement surveys, while 14 species were taken exclusively in the river. The major difference in species composition between the two types of collections is the absence of many large species in the impingement collections. Four species of suckers and redhorses, and four species of sport fish (muskellunge, northern pike, walleye, and sauger) were not collected in the impingement surveys. Those sport fish which were collected on the traveling screens (channel catfish and bluegill) were smaller than individuals of those species collected by river sampling. Minnows and shiners constituted a large percentage of the river and impingement collections.

Comparison of Operating and Non-Operating Intake Bay Collections

Of the 227 fish collected during the 1982 impingement studies, 120 (52.9%) were collected from operating intake bays and 107 (47.1%) non-operating intake bays (Table V-G-2). However, due to differences between the number of operating (99) and non-operating (104) screens washed in 1982, the impingement data were computed with catch expressed as fish per 1000 m^2 of screen surface area washed. These results showed 6.8 and 5.8 fish for operating and non-operating screens, respectively. As in previous years, the numbers 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 1982
BVPS

Date		Number Fish Collected	Percent of Annual Total	Number of Fish Collected: Operating Intake Bays[a]		Number of Fish Collected: Non-Operating Intake Bays[b]		Intake Bays Operating				Intake Water Temp. °F	River Elevation Above Mean Sea Level
Month	Day			Alive	Dead	Alive	Dead	A	B	C	D		
January	8	3	1.3		2		1	X	X			31.9	669.0
	15	5	2.2	2	1	2			X			27.0	667.6
	22	5	2.2			2	3		X			27.5	667.0
	29	33	14.5	1	25	1	6		X			28.5	667.2
February	7	27	11.9	1	11	2	13		X			28.5	668.5
	15	10	4.4		2	1	7		X			29.0	667.0
	19	16	7.0	4	2	2	8		X			37.5	669.5
	26	13	5.7	2	2	2	7		X			38.0	667.5
March	5	1	0.4		1				X			38.7	667.3
	12	3	1.3	1		1	1	X				41.5	668.5
	19	4	1.8		1	1	2	X				44.5	672.5
	26	3	1.3		1		2	X				45.7	670.8
April	2	2	0.9		1	1			X			48.0	669.0
	9	4	1.8			3	1			X		43.6	668.2
	16	2	0.9		1	1				X		49.5	667.0
	23	0	0.0							X		56.3	666.3
	30	1	0.4		1					X		58.0	666.5
May	7	0	0.0							X		63.7	665.9
	14	0	0.0						X			67.5	665.6
	21	1	0.4			1				X		74.3	665.8
	28	1	0.4	1				X	X	X		72.0	666.2
June	4	0	0.0					X		X		72.5	666.2
	11	0	0.0					X	X			67.0	667.3
	18	1	0.4			1		X	X	X		69.5	668.0
	25	1	0.4			1		X				68.0	666.0

TABLE V-G-3 (Continued)

Date		Number Collected	Percent of Annual Total	Number of Fish Collected: Operating Intake Bays(a)		Number of Fish Collected: Non-Operating Intake Bays(b)		Intake Bays Operating				Intake Water Temp. °F	River Elevation Above Mean Sea Level
Month	Day			Alive	Dead	Alive	Dead	A	B	C	D		
July	2	1	0.4				1	X				73.5	666.0
	9	1	0.4		1			X	X		X	77.0	665.4
	16	3	1.3		2		1	X	X		X	80.2	665.5
	23	4	1.8		1		3	X		X	X	83.0	666.0
	30	0	0.0					X		X	X	82.9	666.2
August	6	3	1.3		3			X	X		X	82.0	665.7
	13	7	3.1		7			X	X		X	78.9	666.0
	20	1	0.4		1			X	X	X	X	78.6	666.4
	27	3	1.3		3			X	X	X	X	75.8	666.4
September	3	4	1.8		2	1	1	X			X	74.8	665.6
	10	4	1.8	2	2			X	X	X	X	74.7	665.9
	17	3	1.3		3			X	X		X	75.5	666.0
	24	5	2.2	2	2	1		X	X		X	70.3	666.2
October	1	4	1.8		2	1	1	X			X	67.9	666.4
	8	4	1.8			2	2	X			X	70.2	666.2
	15	1	0.4			1		X			X	67.0	666.0
	22	8	3.5	3	1	4		X		X		60.5	666.0
	29	2	0.9		1	1		X		X		56.2	665.6
November	5	2	0.9			2		X		X		57.5	666.3
	12	2	0.9	2				X	X		X	54.5	665.9
	19	3	1.3	1	1	1		X		X		49.0	665.8
	27	1	0.4			1		X	X			49.0	667.0
December	3	10	4.4	4	3	2	1	X	X			48.0	668.0
	10	1	0.4			1		X	X			48.3	66[illegible].0
	17	1	0.4			1			X		X	42.0	667.5
	24	3	1.3	3					X		X	41.0	667.8
	31	10	4.4	2	4	2	2		X		X	45.0	669.0
Total		227		29	91	42	65						

(a) Intake bays that had 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, 1976-1982
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	1981 Operating Intake Bays	1981 Non-operating Intake Bays	1981 Total
January	66	16	82	5	0	5	5	1	6
February	9	8	17	5	7	12	21	1	22
March	15	10	25	16	13	29	4	2	6
April	1	0	1	0	11	11	8	0	8
May	3	1	4	0	2	2	7	2	9
June	2	0	2	0	4	4	3	0	3
July	5	2	7	3	10	13	5	2	7
August	20	34	54	10	4	14	12	1	13
September	9	9	18	4	0	4	15	4	19
October	21	6	27	2	2	4	10	2	12
November	7	6	13	3	1	4	4	0	4
December	8	4	12	6	0	6	28	4	32
Total	162	100	262	54	54	108	122	19	141

(a) Intake bays that had 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 (Continued)

Month	Number of Fish Collected 1982		
	Operating Intake Bays[(a)]	Non-operating Intake Bays[(b)]	Total
January	30	16	46
February	24	42	66
March	4	7	11
April	3	6	9
May	1	1	2
June	0	2	2
July	4	5	9
August	14	0	14
September	13	3	16
October	7	12	19
November	4	4	8
December	16	9	25
Total	120	107	227

(a) Intake bays that had 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, 1982
BVPS

Species[a]	Total Number of Fish Collected		Percent of Annual Total	
	Impingement	River	Impingement	River
Longnose gar	0	1	0	0.1
Gizzard shad	1	98	0.5	7.9
Northern pike	0	2	0	0.2
Muskellunge	0	1	0	0.1
Goldfish	1	1	0.5	0.1
Common carp	1	42	0.5	3.4
Golden shiner	0	1	0	0.1
Emerald shiner	68	332	33.7	26.6
Spottail shiner	0	2	0	0.2
Spotfin shiner	0	85	0	6.8
Sand shiner	0	203	0	16.3
Mimic shiner	7	35	3.5	2.8
Bluntnose minnow	5	258	2.5	20.7
Quillback	0	2	0	0.2
Silver redhorse	0	4	0	0.3
Golden redhorse	0	7	0	0.6
Shorthead redhorse	0	8	0	0.6
Brown bullhead	1	0	0.5	0
Channel catfish	59	61	29.2	4.9
Flathead catfish	2	1	1.0	0.1
Trout-perch	2	3	1.0	0.2
Banded killifish	1	0	0.5	0
Rock bass	4	1	2.0	0.1
Green sunfish	1	3	0.5	0.2
Pumpkinseed	2	4	1.0	0.3
Bluegill	19	2	9.4	0.2
Smallmouth bass	3	28	1.5	2.2
Spotted bass	5	16	2.5	1.3
Largemouth bass	1	5	0.5	0.4
White crappie	3	1	1.5	0.1
Black crappie	2	0	1.0	0
Johnny darter	5	0	2.5	0
Logperch	0	3	0	0.2
Sauger	0	8	0	0.6
Walleye	0	20	0	1.6
Freshwater drum	9	10	4.5	0.8
Total	202	1248		

[a] Includes only those specimens identified to species.

Of the 293 crayfish collected in the 1982 impingement studies, 118 (40.3%) were collected from operating bays and 175 (59.7%) were collected from non-operating bays (Table V-G-6). Adjusting these data for screen surface area washed (crayfish per 1000 m^2) the results show 6.7 and 9.4 crayfish for operating and non-operating screens, respectively.

Summary and Conclusions

The results of the 1982 impingement surveys indicate that withdrawal of river water at the BVPS intake for cooling purposes has little or no effect on the fish populations. Only 227 fish were collected, which is the third fewest collected since initial operation of BVPS in 1976. Of the 227 fish collected, 71 (31.3%) were alive and returned via the discharge pipe to the Ohio River.

TABLE V-G-6

SUMMARY OF INVERTEBRATES COLLECTED IN IMPINGEMENT SURVEYS
CONDUCTED FOR ONE 24-HOUR PERIOD PER WEEK, 1982
BVPS

Date		Crayfish				All Bays Clams		All Bays	All Bays
		Operating Intake Bay		Non-Operating Intake Bay					
Month	Day	Alive	Dead	Alive	Dead	Corbicula	Lampsilus	Dragonflies	Leeches
January	8			4	1	2		1	
	15		1	6	1				
	22								
	29	1		3	2			2	
February	7	2		5	2	1			
	15		8						
	19	1		6					
	26	2	1	15	2				
March	5			9	2				
	12	3		3					
	19	1	3	1	1	2		1	
	26	9		6	2				
April	2		1	10	7			2	
	9		3	2	2			2	
	16		1		2				
	23							1	1
	30				1	4			
May	7					2			
	14								
	21							1	
	28					1			2
June	4				1	1			
	11	3				1		3	
	18	2				1			
	25								
July	2	1	1					1	
	9		1			1			1

TABLE V-G-6 (Continued)

Date		Crayfish				All Bays		All Bays	All Bays
		Operating Intake Bay		Non-Operating Intake Bay		Clams			
Month	Day	Alive	Dead	Alive	Dead	Corbicula	Lampsilus	Dragonflies	Leeches
July	16	1	1	1		1			
	23	1				1			
	30		1		1	1			1
August	6				1				1
	13		2	1		86	3		1
	20	6	1			51	3		
	27		1			18			1
September	3	1			1	12	3		1
	10		1			20	1	1	1
	17			1		15		1	
	24					12			
October	1	1			1	7			
	8		1	1	1	4			
	15	2			1	12			
	22		1			1			1
	29		1		1	1			
November	5	1			1	3			
	12	3	1		1	1			
	19	4				7			
	27	4		5					
December	3	10		7		8	8		
	10	10		9	1	4			
	17	3	1	15		2			
	24	7	3	8	1	1	1		
	31	10	2	10	2	15	1		
Total		89	29	136	39	299	20	16	11

H. PLANKTON ENTRAINMENT

1. Ichthyoplankton

Objective

The ichthyoplankton entrainment studies are designed to determine the species composition, relative abundance, and distribution of ichthyoplankton found in proximity to the BVPS intake structure.

Methods

Previous studies have demonstrated that species composition and relative abundance of ichthyoplankton samples collected in front of the intake structure were very similar to those of ichthyoplankton entrainment samples taken at BVPS (DLCo 1976, 1977, 1978, and 1979). Based on these results, a modified sampling program was utilized from 1980 through the current sampling season which sampled the Ohio River along a transect adjacent to the BVPS intake structure (Figure V-F-1). Samples were collected monthly, April through July, during daylight hours along a five station transect. Surface tows were made at Stations 1, 3, and 5 and bottom tows were taken at Stations 2 and 4 utilizing a 505 micron mesh plankton net with a 0.5 m diameter mouth. Sample volumes were measured by a General Oceanics Model 2030 digital flowmeter mounted centrically in the mouth of the net. Samples were preserved upon collection in 5% buffered formalin containing rose bengal dye.

In the laboratory, eggs, larvae, juveniles, and adults were sorted from the samples, identified to the lowest possible taxon and stage of development, and enumerated.

Densities of ichthyoplankton (number/100m^3) were calculated using appropriate flowmeter data.

Results

A total of 70 eggs and 156 larvae representing five taxa of four families was collected from 1837.5m^3 of water filtered during sampling along the river entrainment transects (Table V-H-1). Minnows (Cyprinidae spp.) were the most common taxa, representing 95.1% of the total catch (100% of the eggs, 92.9% of

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, 1982

Date	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
19 April						
Vol. water filtered (m^3)	72.7	99.0	117.8	108.8	64.2	462.5
No. eggs collected	0	0	0	0	0	0
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 (number collected)	0	0	0	0	0	0
Total Station Density (number collected)	0	0	0	0	0	0
18 May						
Vol. water filtered	77.6	92.1	90.4	67.2	84.1	411.4
No. eggs collected	0	0	4	7	0	11
No. larvae collected	1	7	0	5	0	12
No. juveniles collected	0	0	0	0	0	0
No. adults collected	0	0	0	0	0	0
Density (number collected)						
Eggs						
Cyprinidae spp.	0	0	4.42 (4)	10.42 (7)	0	2.67 (11)
Larvae						
Dorosoma cepedianum (YL)[b]	0	1.09(1)	0	0	0	0.24(1)
Dorosoma cepedianum (EL)	0	1.09(1)	0	0	0	0.24(1)
Cyprinus carpio (YL)	0	2.17(2)	0	0	0	0.49(2)
Cyprinidae spp. (YL)	0	2.17(2)	0	5.95(4)	0	1.46(6)
Perca flavescens (YL)	0	1.09(1)	0	0	0	0.24(1)
Unidentifiable (YL)	0	0	0	1.49(1)	0	0.24(1)
Total Station Density (number collected)	0	7.60(7)	4.42(4)	17.86(12)	0	5.59(23)

TABLE V-H-1 (Continued)

Date	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
21 June						
Vol. water filtered (m^3)	72.5	108.3	122.8	118.9	81.1	503.6
No. eggs collected	4	34	8	11	1	58
No. larvae collected	0	8	0	1	2	11
No. juveniles collected	0	0	0	0	0	0
No. adults collected	0	0	0	0	0	0
Density (number collected)						
Eggs						
Cyprinidae spp.	5.52(4)	31.39(34)	6.51(8)	9.25(11)	1.23(1)	11.52(58)
Larvae						
Cyprinidae spp. (YL)	0	6.46(7)	0	0.84(1)	0	1.59(8)
Cyprinidae spp. (EL)	0	0	0	0	2.47(2)	0.40(2)
Unidentifiable (YL)	0	0.92(1)	0	0	0	0.20(1)
Total Station Density (number collected)	5.52(4)	38.78(42)	6.51(8)	10.09(12)	3.70(3)	13.70(69)
20 July						
Vol. water filtered (m^3)	98.2	83.5	100.8	85.8	91.7	460.0
No. eggs collected	0	0	0	1	0	1
No. larvae collected	55	10	11	17	40	133
No. juveniles collected	0	0	0	0	0	0
No. adults	0	0	0	0	0	0
Density (number collected)						
Eggs						
Cyprinidae spp.	0	0	0	1.17(1)	0	0.22(1)
Larvae						
Cyprinidae spp. (YL)	0	2.40(2)	0.99(1)	6.99(6)	2.06(2)	2.39(11)
Cyprinidae spp. (EL)	56.01(55)	9.58(8)	9.92(10)	9.32(8)	38.11(37)	25.65(118)
Aplodinotus grunniens (EL)	0	0	0	3.50(3)	1.03(1)	0.87(4)
Total Station Density (number collected)	56.01(55)	11.98(10)	10.91(11)	20.98(8)	41.19(40)	29.13(134)

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)	321.0	382.9	431.8	380.7	321.1	1837.5
No. eggs collected	4	34	12	19	1	70
No. larvae collected	55	25	11	23	42	156
No. juveniles collected	0	0	0	0	0	0
No. adults collected	0	0	0	0	0	0
Density (number collected)						
Eggs						
Cyprinidae spp.	1.25(4)	8.88(34)	2.78(12)	4.99(19)	0.31(1)	3.81(70)
Larvae						
Dorosoma cepedianum (EL)	0	0.26(1)	0	0	0	0.05(1)
Dorosoma cepedianum (EL)	0	0.26(1)	0	0	0	0.05(1)
Cyprinus carpio (YL)	0	0.52(2)	0	0	0	0.11(2)
Cyprinidae spp. (YL)	0	2.87(11)	0.23(1)	2.89(11)	0.62(2)	1.36(25)
Cyprinidae spp. (EL)	17.13(55)	2.09(8)	2.32(10)	2.10(8)	12.15(39)	6.53(120)
Perca flavescens (YL)	0	0.26(1)	0	0	0	0.05(1)
Aplodinatus grunniens (EL)	0	0	0	0.79(3)	0.31(1)	0.22(4)
Unidentifiable (YL)	0	0.26(1)	0	0.26(1)	0	0.11(2)
Total Station Density (number collected)	18.38(59)	15.41(59)	5.33(23)	11.03(42)	13.39(43)	12.30(226)

[a]Station 1 - South Shoreline; Station 3 - Mid-channel; 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 developed.

the larvae). By taxa, minnow early larvae were the most abundant larval life stage collected (120 individuals; total yearly density = 6.53/100m^3). Minnow yolk-sac larvae were the second most abundant stage number 25 individuals (1.36/100m^3).

The remaining larval taxa collected included gizzard shad (Dorosoma cepedianum), common carp (Cyprinus carpio), yellow perch (Perca flavescens), and freshwater drum (Aplodinotus grunniens); all numbered less than 5 individuals (0.27/100m^3).

The greatest single sample densities of larvae by species and life stage are listed below. Gizzard shad yolk-sac and early larvae and yellow perch yolk-sac larvae were represented by single specimens (1.09/100m^3) collected at Station 2 on 18 May (Table V-H-1). Both common carp yolk-sac larvae (2.17/100m^3) were also taken at Station 2 on 18 May. Minnow yolk-sac larvae were most abundant (6.99/100m^3) on 20 July at Station 4, while early larvae were most numerous (56.01/100m^3) at Station 1 on 20 July. Freshwater drum early larvae were only collected on 20 July and were most abundant (3.50/100m^3) at Station 4.

Seasonal Distribution

No ichthyoplankton were collected during the first survey (19 April) (Table V-H-1).

Samples taken on 18 May yielded 11 eggs (2.67/100m^3) and 12 larvae (2.92/100m^3). All eggs collected were minnows; most (82.9%) were taken on 21 June. Greatest density per sample (31.39/100m^3) was recorded at Station 2 on this date.

Larval catch was comprised of four taxa and one unidentifiable specimen (Table V-H-1). Most (50.0%) specimens taken were minnow yolk-sac larvae (6 individuals; 1.46/100m^3). Common carp was represented by two yolk sac larvae (2.17/100m^3) taken at Station 2 on 18 May. Other taxa collected in May included gizzard shad (one yolk-sac and one early larva) and yellow perch (one yolk-sac larva).

The majority (82.9%) of the eggs collected in 1982 were taken on 21 June; all were minnows (Table V-H-1). All identifiable larvae taken in June were also minnows;

most (80.0%) were yolk-sac larvae. In addition, one unidentifiable yolk-sac larvae was collected in June.

Collections taken on 20 July resulted in the greatest density (28.70/100m^3) of larvae collected in 1982; nearly all (88.7%) were minnow early larvae (Table V-H-1). Eleven (2.39/100m^3) minnow yolk-sac larvae and four (0.87/100m^3) freshwater drum early larvae comprised the remaining larval catch. A single minnow egg represented the total eggs collected on 20 July.

Spatial Distribution

Eggs were more abundant at midchannel Stations 2, 3, and 4 than at nearshore Stations 1 and 5 (Table V-H-1). Larvae were generally more abundant at inshore stations. All larvae collected at Station 1 (N=55; 17.13/100m^3), the station nearest to the BVPS intake structure, were minnows taken during a single sampling effort on 20 July. Larval catch at Station 2 (N=25; 6.53/100m^3) exhibited the greatest diversity of taxa (4); however, most (76.0%) were minnows. Midchannel Station 3 yielded the fewest larvae (N=11; 2.55/100m^3) of the stations along the transect; all were minnows. Larval densities increased somewhat at Station 4 (N=23; 6.04/100m^3) and included the highest abundance of freshwater drum larvae (N=3; 0.79/100m^3) found along the transect; however, most larvae (82.6%) were minnows. Nearly all (97.6%) of the larvae collected at Station 5 were minnows. Freshwater drum, represented by a single early larva (0.31/100m^3), was the only other species taken at this station.

Summary and Conclusions

The similarity of species composition and relative abundance of ichthyoplankton taken in 1982 along the river transect to those of 1979-1981, combined with the close correlation between river sampling in front of the intake and actual entrainment sampling established in previous years (DLCo 1976, 1977, 1978, and 1979) suggests little change in ichthyoplankton entrainment impact by BVPS in 1982.

2. Phytoplankton

Objective

The phytoplankton entrainment study was designed to determine the composition and abundance of phytoplankton entrained in the intake water system.

Methods

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 obtained from one operating intake bay.

In the laboratory, phytoplankton analyses were performed in accordance with procedures described above in Section C, PHYTOPLANKTON. Total densities (cells/ml) were calculated for all taxa. However, only densities of the 15 most abundant taxa each month are presented in Section C of this report.

Comparison of Entrainment and River Samples

Plankton samples were not collected at any river stations after April 1, 1980 due to a reduction of the aquatic sampling program, therefore, comparison of entrainment and river samples was not possible for the 1982 phytoplankton program. Results of phytoplankton analyses for the entrainment sample collected monthly are presented in Section C, PHYTOPLANKTON.

During the years 1976 through 1979, phytoplankton densities of entrainment samples were usually slightly lower than those of mean total densities observed from river samples (DLCo 1980). However, species composition of phytoplankton in the river and entrainment samples was similar (DLCo 1976, 1977, 1979, 1980).

Studies from previous years indicate mean Shannon-Weiner indices, evenness and richness values of entrainment samples were very similar to the river samples (DLCo, 1979, 1980).

Summary and Conclusions

Past 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 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 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

The zooplankton entrainment studies were designed to determine the composition and abundance of zooplankton entrained in the intake water system.

Methods

Plankton entrainment samples were collected for counting phytoplankton and zooplankton. For zooplankton analyses, a well-mixed sample was taken and processed using the same procedures described in Section D, 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.

Total densities (number/liter) were calculated for all taxa, however, only taxa which comprised greater than 2% of the total are presented in Section D, ZOOPLANKTON.

Comparison of Entrainment and River Samples

Plankton samples were not collected at any river stations after April 1, 1980 due to a reduction of the aquatic sampling program, therefore, comparison of entrainment and river samples was not possible for the 1982 zooplankton program. Results of zooplankton analyses for the entrainment sample collected monthly are presented in Section D, ZOOPLANKTON.

During past years, composition of zooplankton was similar in entrainment and river samples (DLCo 1980). Protozoans and rotifers were predominant, whereas crustaceans were sparse. Densities of the four most abundant taxa for each month (DLCo, 1976, 1977, 1979, 1980) indicate the same taxa were present in both river and intake samples. In addition, they were present in similar quantities. Shannon-Weiner indices, evenness, and richness values for river and entrainment samples were also similar, further demonstrating similarity between entrained and river zooplankton.

Summary and Conclusions

Past results of monthly sampling of zooplankton in the Ohio River near BVPS and within the intake structure showed little difference 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. TERRESTRIAL MONITORING PROGRAM

A. INTRODUCTION

The 1982 terrestrial ecological survey at the Beaver Valley Power Station (BVPS) consisted of a program to detect potential vegetation stress using aerial color infrared (CIR) photography and subsequent field reconnaissance to determine the cause and extent of any stress.

Vegetation stress attributed to natural causes such as disease, insect infestations, weather variations and changes in moisture regimes, and human-caused impacts can be detected by experienced photointerpreters using either true color or CIR film. Healthy vegetation reflects light in the visible green (0.5-0.6 um) and invisible near infrared (0.7-1.0 um) portions of the electromagnetic spectrum (Hilborn, 1978). Because the reflectance of near infrared radiation from healthy green leaves is even higher than for green light, reductions in plant vigor will result in changes in reflectivity that are more readily apparent when using film sensitive to near infrared wavelengths (Shipley, et al., 1980).

The use of aerial CIR photography allows large areas of vegetation to be remotely sensed to delineate areas that have experienced potential stress. Interpretation of the photographs in the laboratory further reduces time and effort by directing field crews to specific locations where the causes of that stress can be determined (Hilborn, 1978). In addition, the use of yellow filters with CIR film decreases the absorption of blue wavelengths, thus reducing the effects of haze that often obscure detail and clarity in true color photography.

B. AERIAL INFRARED PHOTOGRAPHY

Objectives

The objective of this study was to use aerial CIR imagery and ground surveys to evaluate vegetation stress in the vicinity of the BVPS cooling tower and to determine if drift from the tower is adversely affecting vegetative communities of terrestrial ecosystems (Environmental Technical Specifications, Reference 3.1.3.9).

Methods

(1) Aerial Photography

As directed by the Environmental Technical Specifications, an area of 50 square miles comprising a rectangle approximately 7.1 miles on a side and centered on the BVPS cooling tower was photographed and ground-truthed during the 1982 terrestrial ecological monitoring program. The photomission was flown on July 21 during the active growing season to ensure maximum contrast between stressed and healthy vegetation.

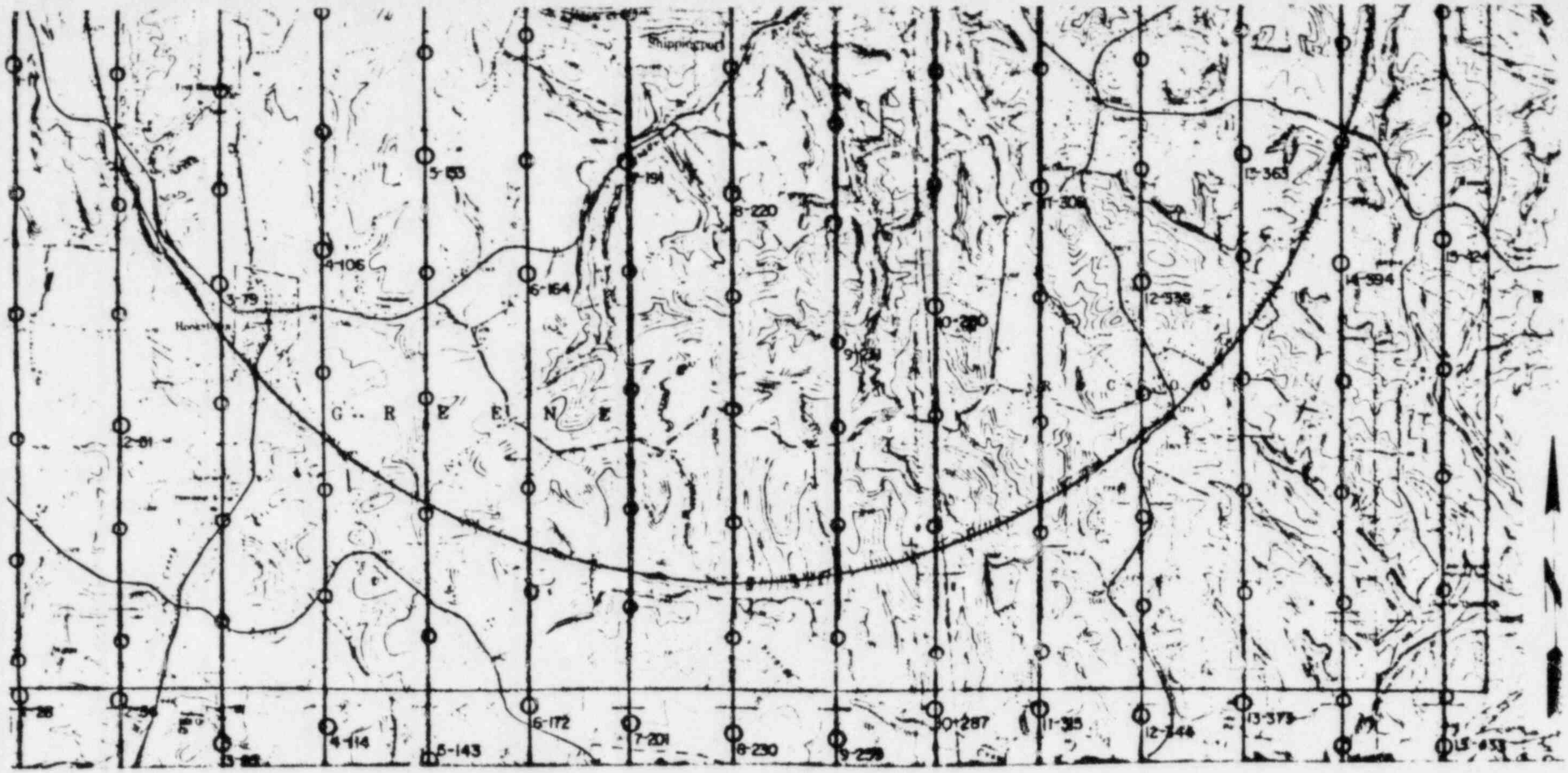
The flight was conducted on July 21 between 1017 and 1155 hours Eastern Standard Time at an altitude of 2400 feet above mean ground level. Flight lines were oriented in a north-south direction, and in order to provide stereo coverage, photos were taken with a 60% overlap in line of flight and a 30% sidelap between flight lines. Single-coverage prints were also obtained. The photomission index is shown in Figure VI-B-1. In addition, all photographs were free of cloud shadows, and processing methods and conditions were standardized throughout the project.

A flight log was kept in accordance with the Environmental Technical Specifications. The camera used was a Zeiss RMK 15/23, and film was Kodak Aerochrome 2443. Other information in the flight log included serial numbers of camera and lens, film and lot number, filter type, altitude, and date of flight (see Table VI-B-1). A copy of the flight log is provided as Exhibit VI-B-1.

(2) Airphoto Interpretation

Photographs were scanned in the laboratory for quality of color, resolution, scale, and clarity. Obvious changes in color tone, pattern, or texture that might have indicated possible vegetation stress were delineated and transferred to a base map. Areas with the greatest potential for being affected by cooling tower drift were designated for ground truthing. Equipment used included:

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



LEGEND

○ 1-433 PHOTOGRAPH FRAME NUMBER AND CENTER POINT LOCATIONS FOR INFRARED PHOTOS

2,000 0 2,000 4,000 6,000 FEET

INDEX TO PHOTOGRAPHY
BEAVER VALLEY POWER STATION
AND VICINITY
JULY 21, 1982

FIGURE VI-B-1

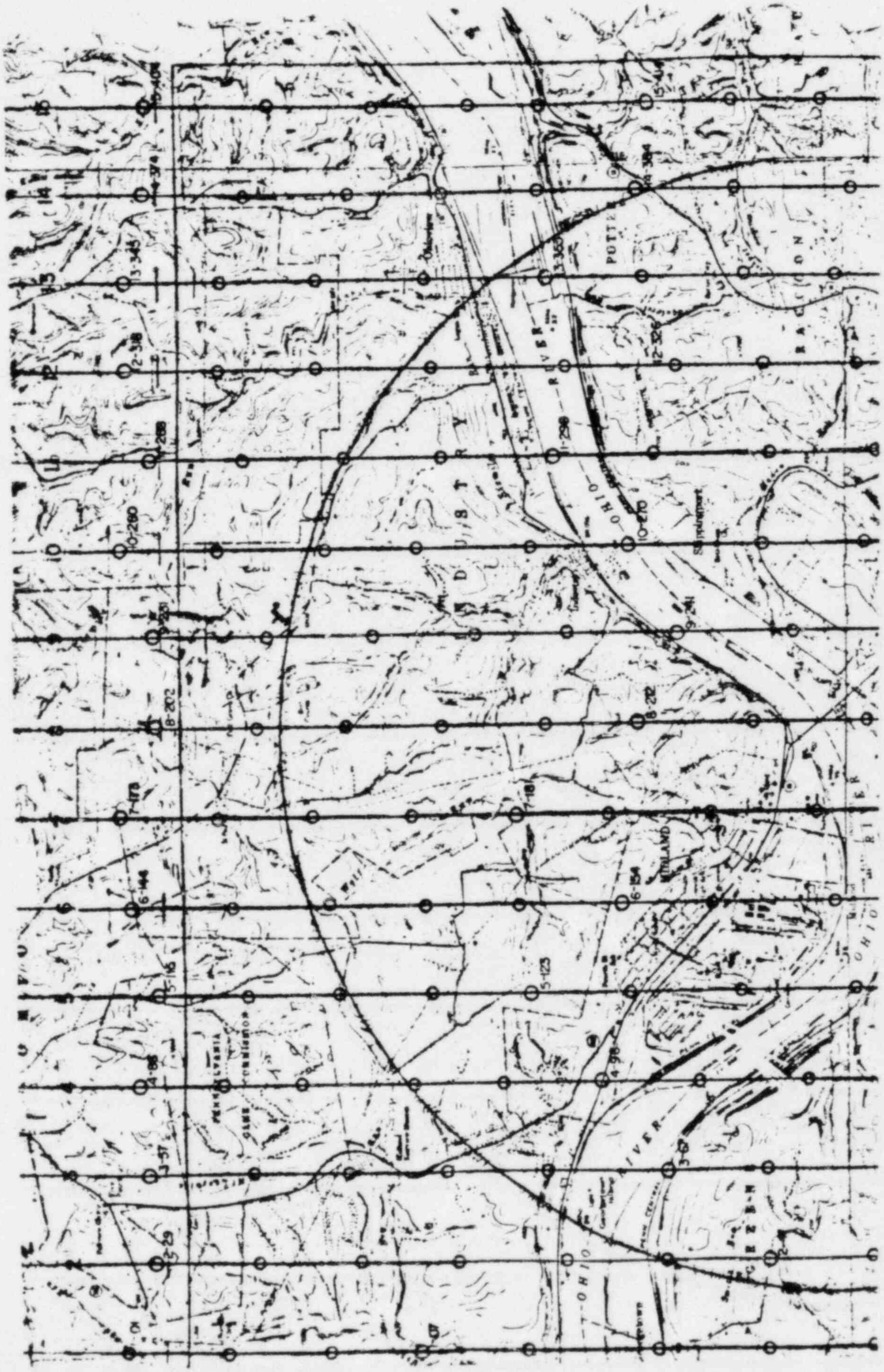


TABLE VI-B-1

SUMMARY OF THE 1982 AERIAL PHOTOMISSION
FLOWN IN THE VICINITY OF THE BVPS

Specifications

Camera: Zeiss RMK 15/23 SN 118992
Lens: Zeiss SN 118992
Focal Length: 153.09 mm
Magazine: 118802
Shutter Speed: 1/200 or 1/250 (see Flight Report)
f. Stop: 5.6
Filter: Minus Blue
Film Type: Kodak Aerochrome 2443
Film Lot Number: 2443-275-15
Scale: 1" = 400'

Photomission

Date: July 21, 1982
Time: 1017-1155 Eastern Standard Time
Altitude: 2400 feet above mean ground level for all lines
Weather: Thin cloud overcast at high altitude.
hazy sun, no cloud shadows

Time Lines were Flown:

Line	Start	End
1	1152 hrs.	1155 hrs.
2	1149	1151
3	1142	1145
4	1140	1142
5	1132	1134
6	1130	1132
7	1122	1125
8	1119	1121
9	1056	1059
10	1053	1055
11	1045	1047
12	1042	1044
13	1034	1037
14	1031	1033
15	1017	1020

EXHIBIT VI-B-1

KUCERA & ASSOCIATES

FLIGHT REPORT

CREW Bill / Pat DATE 7-21-82 ROLL# ______

Film Type 2443 Weather 0 Altitude ______

Shutter Speed 1/250 f. Stop 5.6 Filter M.B.

Camera ______ Magazine 118802 Lens ______ CFL ______

Developer ______ Time ______ By ______ Date ______

WORK ORDER	LOCATION	LINE	DIR.	EXPOSURES SHOT		EXPOSURES USED		TIME START	TIME STOP	REMARKS
				0	7					Run Off S½
17916		9	S	8	27	231	259			
		8	N	28	57	202	230			
		7	S	58	87	173	201			
		6	N	88	118	144	172			
		5	S	119	149	115	143			
		4	N	150	180	86	114			
		3	S	181	210	57	85			
		2	N	211	240	29	56			
		1	S	241	268	01	28			
				269	270					Sep.
				271	274			Test		

EXHIBIT VI-B-1 (continued)

KUCERA & ASSOCIATES

FLIGHT REPORT

CREW Bill / Pat DATE 7-21-82 ROLL#

Film Type 2443 Weather 0 Altitude

Shutter Speed 1/200 f. Stop 5.6 Filter M.B.

Camera 118992 Magazine 118802 Lens CFL 153.09

Developer Time By Date

WORK ORDER	LOCATION	LINE	DIR.	EXPOSURES SHOT		EXPOSURES USED		TIME START	TIME STOP	REMARKS
				0	8					Run-off
17916	Midland	15	S	9	22	Use North ½				
	PA	15	S	23	45	404	433			
		14	N	47	76	374	403			
		13	S	77	107	345	373			
		12	N	108	138	316	344			
		11	S	139	169	288	315			
		10	N	170	198	260	287			
					200					Test
		9	S	201	218	Out of Film				

(3) Field Reconnaissance

General observations of the BVPS and vicinity were conducted from September 20 through 23 and again on September 25 to verify the photointerpreted results that had indicated potentially stressed vegetation. The 9" x 9" CIR prints were used in conjunction with the photoindex (Figure VI-B-1) and standard USGS 7.5-minute topographic sheets to construct preliminary base maps and to locate areas suspected of containing stressed vegetation. Where possible, vegetation was closely examined to determine the cause of stress. When vegetation was inaccessible due to terrain difficulties or private property, binoculars were used to aid characterization. During the field survey, the location, extent, and severity of stressed areas were documented and, in some instances, photographed.

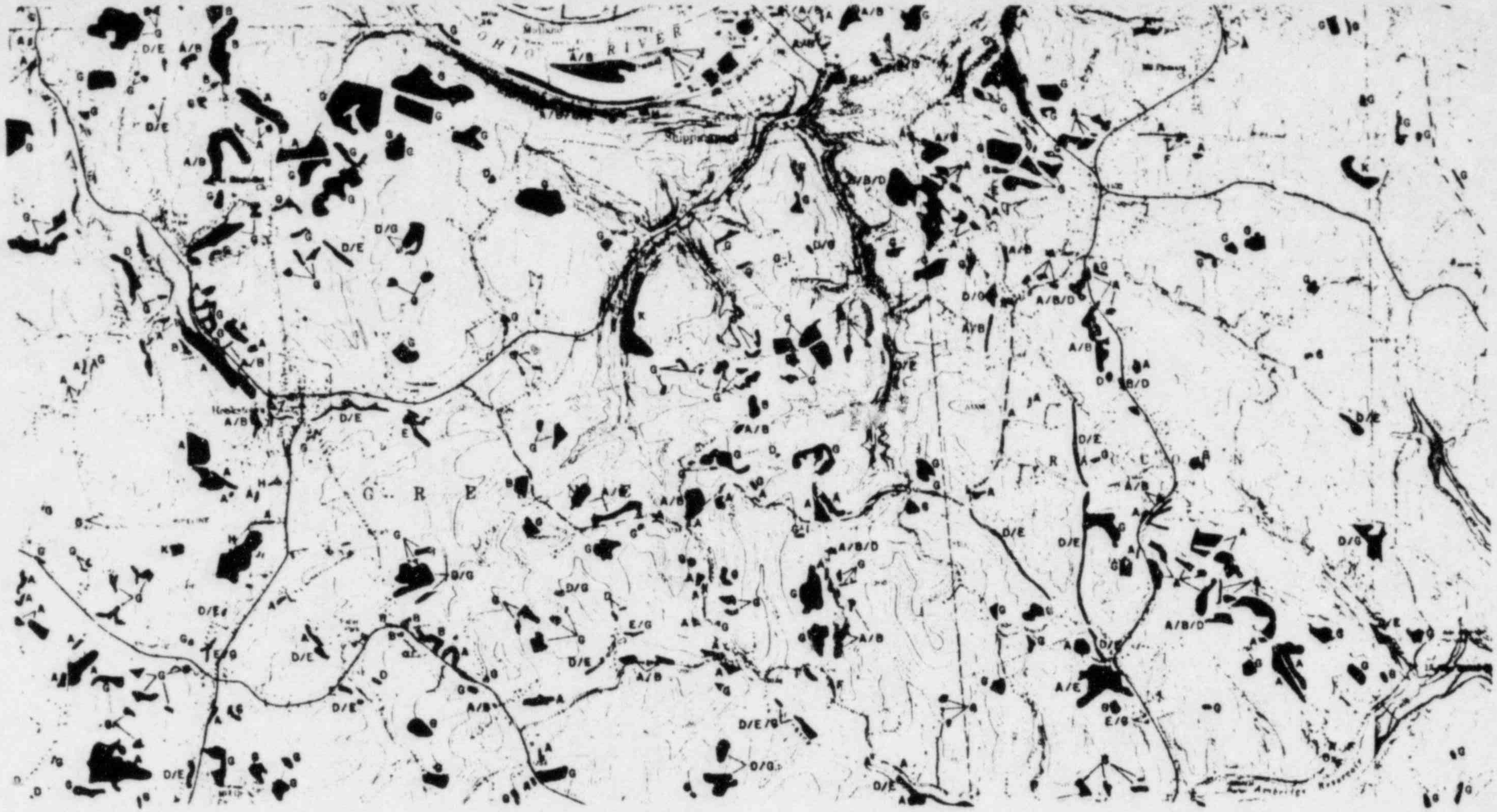
(4) Vegetation Mapping

A final map indicating the location and distribution of vegetation stress was constructed from the base maps and results of the field survey (Figure VI-B-2). This map can be compared with similar maps from previous BVPS vegetation monitoring results to note trends in type, location, and extent of vegetation stress.

Results

The 1982 photographs were better exposed than the results from 1980, which were slightly overexposed. Color saturation was generally good on all frames. Photos taken earlier in the morning showed somewhat greater shadowing due to the lower angle of the sun and the hilly terrain. Some overexposure occurred in photos taken near the end of the photomission due to the high reflectivity of the sun on objects such as highways, plowed or bare fields, and rooftops. Such effects were minor and did not alter the ability to detect stress.

As shown in Figure VI-B-2, a number of vegetated areas experienced some form of stress. These areas are identified by letters on the map, each letter representing a particular stress type. As indicated on the map, major causal factors of stress included insect damage, disease, overcrowding, poor drainage, erosion, herbicide kill, and construction. Due to inaccessibility, the stress in many areas had to be



LEGEND

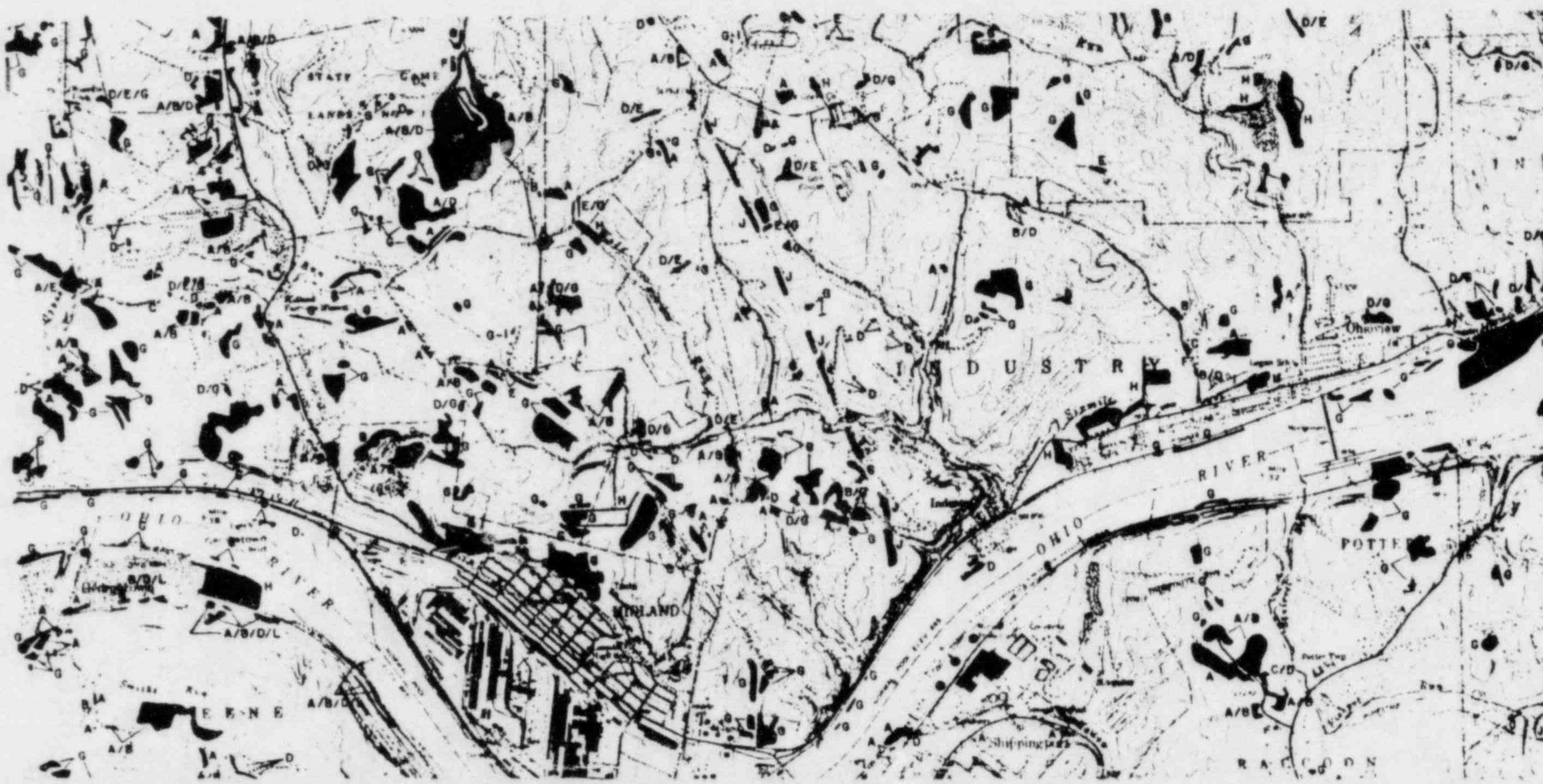
A FALL WEBWORM
B LOCUST LEAF MINER
C DUTCH ELM DISEASE
D DEAD/DECADENT/THIN CROWNED TREES
E POOR DRAINAGE/PERIODICALLY FLOODED
F NECROSIS
G UNIDENTIFIED DISTURBANCE (G-1: Orchard)
H HEAVY EQUIPMENT ACTIVITY
I EROSION
J UTILITY CORRIDOR MAINTENANCE
K LOGGING ACTIVITY
L OVER GROWN WOODLOT

N

DISTRIBUTION OF VEGETATION STRESS IN THE VICINITY OF THE BEAVER VALLEY POWER STATION, 1982

0 — 1 mile

FIGURE VI-B-2



INDUSTRY
OHIO RIVER
POTTER
MIDLAND
RACCOON

labelled unidentified. It is most likely that such stress followed the general trends of the region.

Twelve major stress types distributed over 819 individual areas were identified and observed in the field. A number of the larger areas also contained more than one type of stress, thus, the total number of occurrences of stress investigated was 982. These ranged in size from small clumps of trees less than an acre in extent to relatively large blocks of woodland from 20 to 60 acres. Numerous individual trees were probably stressed throughout the area under investigation, but in most cases, only larger groupings were delineated on the base map and visited in the field.

Natural Causes

Of the 962 occurrences of stress, 519 (or 53.85%) of the occurrences were identified as the result of natural causes (Table VI-B-2). These were divided into six categories discussed below: fall webworm, locust leaf miner, Dutch elm disease, poor drainage and/or periodic flooding, overage (overmature), and overcrowding. The letters in parentheses correspond to the map identifications.

Fall Webworm (A)

Two hundred forty-nine areas contained trees damaged by fall webworm (Hyphantria cunea). These areas were generally scattered throughout the region under investigation. Johnson and Lyon (1976) indicate that this lepidopteran has attacked as many as 88 species of shade, fruit, and ornamental trees (excluding conifers) in the United States. In the vicinity of the BVPS, fall webworm damage was most extensive in wild cherries (Prunus serotina and P. avium), hickories (Carya spp.), and to a lesser extent, American elm (Ulmus americana), sycamore (Platanus occidentalis), willow (Salix spp.), and black locust (Robinia pseudoacacia).

The fall webworm is a small white moth that deposits its egg masses in the spring. The emerging larvae pass through as many as 11 instars in which they spin silk webs over foliage on the ends of branches and skeletonize the leaves as they feed (Borror and White, 1970; USDA, 1979). Because defoliation occurs late in the growing

TABLE VI-B-2

TYPE AND FREQUENCY OF VEGETATION STRESS IN
THE VICINITY OF THE BEAVER VALLEY POWER STATION,
1982 ECOLOGICAL MONITORING PROGRAM

	Vegetation Stress	Cause	Occurrence	Percent
A	Fall Webworm	Natural	249	25.36
B	Locust Leaf Miner	Natural	89	9.06
C	Dutch Elm Disease	Natural	3	0.31
D	Dead/Decadent/Thin-crowned Trees	Unknown/Natural	123	12.53
E	Poor Drainage/Periodically Flooded	Natural	47	4.79
F	Necrosis	Unknown	11	1.12
G	Unidentified Disturbance	Unknown	412	41.96
H	Heavy Equipment Activity	Human	19	1.93
I	Erosion	Human	5	0.51
J	Utility Corridor Maintenance	Human	13	1.32
K	Logging Activity	Human	3	0.31
L	Overgrown Woodlot	Unknown/Natural	8	0.81
			982	100.00

Note: Refer to Figure VI-B-2.

season, damage is of minor importance in forestry because the tree is seldom killed; infestation in ornamental plantings sometimes affects aesthetic values enough to warrant control (Baker, 1972). Since the overflight took place in late July, vegetation stress was far more severe in the field than had appeared in the aerial photos.

Locus Leaf Miner (B)

In comparison with the 1980 vegetation stress survey, locust leaf miner (Xenochalepus dorsalis) was of minor importance. A total of 89 occurrences of stress caused by locus leaf miner was documented. This amounted to slightly more than 9% of the total occurrences of stressed vegetation. One large area approximately two miles north of Midland and another on Phyllis Island showed major damage. During previous years, whole ridges, hillsides, and woodlands were infested with this pest. Outbreaks of locust leaf miner occur practically every year in western Pennsylvania, and tens of thousands of acres are often defoliated (Baker, 1972; USDA, 1979).

The locus leaf miner is a beetle approximately 6 mm long that hibernates through the winter. In the spring, the adults emerge and begin to feed on the developing foliage of black locust, dogwood (Cornus sp.), elm (Ulmus spp.), oak (Quercus spp.), American beech (Fagus grandifolia), cherry (Prunus spp.), wisteria (Wisteria spp.), and hawthorn (Crataegus spp.). 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 infested, they appear brownish as though dead, but late summer defoliation is usually not harmful (Hepting, 1971).

Dutch Elm Disease (C)

Dutch elm disease, caused by a fungus (Ceratocystis ulmi) carried by the native elmbark beetle (Hylurgopinus rufipes) and the European elm bark beetle (Scolytus multistratus), was observed in three locations. This number was the same as that observed in the 1980 survey.

Poor Drainage/Periodically Flooded (E)

Evidence of stress caused by poor drainage or flooding occurred in 47 locations. These were primarily small areas along drainage courses or in the lower elevations of forested wetlands. According to Levitt (1972) excess water is not a stress in itself. Flooding, however, gives rise to two secondary stresses-turgor pressure stress and oxygen-deficient stress--and tertiary ionic stress from buildups of toxic manganous and ferrous ions. In addition, stressed vegetation may then become more susceptible to injurious insect and disease attacks (Treshow, 1975).

Dead/Decadent/Thin-crowned Trees and Overgrown Woodlots (D and L)

Stress attributed to decadent (overmature or overage), overcrowded, and overgrown conditions was observed in a total of 131 locations. This represents about 13% of the total aeas investigated. The loss of vigor due to inter- or intraspecific competition and the inability to tolerate changing conditions may have led to eventual death or to accelerated death from insect infestations or disease outbreaks enhanced by overcrowding.

Human Activities

Forty of the 982 (4.07%) occurrences of stress noted during the 1982 monitoring program were attributed to human activities. These consisted of heavy equipment activity, induced erosion, utility corridor maintenance, and logging.

Heavy Equipment Activity (H)

Activities using heavy equipment resulted in the stress or removal of vegetation in 19 locations. New road construction was occurring along Route 68 and in an undeveloped area about a half-mile north of Midland. Vegetation removal for mining was taking place in several locations from two to three miles north of Midland and about three miles southwest of the BVPS. One relatively large area along the Ohio River at Ohioview was being developed, resulting in extensive vegetation removal. Two areas, one just west of the BVPS and another one adjacent to the Hookstown Grange and Racetrack had been previously disturbed, but were being revegetated with grass.

Erosion (I)

Erosion due to construction activities was occurring in two locations in Ohioview, in one location along the Ohio River across from Ohioview, and in two locations in the vicinity of Midland. These areas were all relatively small in extent.

Utility Corridor Maintenance (J)

Herbicide use to maintain utility corridors occurred in two locations. The first was located approximately one mile east of Midland and extended about two and a half miles in a north-northwest direction. Ten individual plots had been treated. The second location, in which three plots had been treated, was a much smaller area about three miles east of the BVPS.

Logging Activity (K)

Three logging operations were identified during the survey. One large area of about 15 acres was located a mile south of the BVPS while the other, smaller areas were several miles east and southwest of the station.

Unidentified or Unknown Causes

The causes of vegetation stress could not be identified in 423 of the 982 instances of disturbance. This was due to a combination of factors including inaccessibility, budget limitations, or inability to adequately ascertain the cause or causes of stress.

Necrosis (F)

Evidence of coniferous necrosis was observed in 11 locations. Possible causal factors included overcrowding, airborne SO_2 and ozone, and/or runoff or spray containing road deicing salts. Conifers are highly susceptible to overcrowding and pollutants (Jacobson and Hill, 1970; Moxley and Davidson, 1973; Mudd and Kozlowski, 1975). The possibility of a combination of factors (Treshow, 1975) resulted in categorizing the cause of coniferous necrosis as unknown.

Unidentified Disturbance (G)

Nearly 42% of the occurrences of stress could not be accurately identified. However, due to their random distribution and variable sizes, it is most likely that the majority of the stressed areas were the result of insect infestations, particularly fall webworm and locust leaf miner.

One additional occurrence of unidentified stress, labelled G-1 on Figure VI-B-2, is represented in six orchards where individual trees have been stressed. No cause of this stress was apparent, although overmaturity may be a possible explanation.

Summary and Conclusions

During the summer and fall of 1982, vegetation stress was monitored in the vicinity of the Beaver Valley Power Station cooling tower as part of an Ecological Monitoring Program. Color infrared aerial photography, photointerpretation of the imagery, and field observations were used to detect stressed or damaged vegetation and to determine probable causes.

Evidence from the photography and fieldwork indicated that the majority of occurrences of vegetation stress was due to natural causes including insect infestation (fall webworm and locust leaf miner), disease (Dutch elm disease), poor drainage in low areas, overcrowding, and overmaturity. Extensive areas of unidentified stress were also delineated. Several coniferous species showed stress caused by possible air pollution (SO_2, ozone), salt damage from adjacent public roadways, and/or overcrowding. Human activities resulting in vegetation damage or stress included heavy construction, erosion, utility corridor maintenance, and logging.

Of the 982 identified and delineated occurrences of stress, over 52% were probably caused by natural factors. Forty-three percent of the occurrences were categorized as unknown; the majority of these areas could probably be assumed to be of natural causes. Less than 5% of the occurrences were attributed to human activities.

Based on interpretation of the 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 vegetation stress in the region. The uncertainties of such combinations and resultant synergistic effects would make it difficult, although not impossible, to measure the actual contribution of the BVPS cooling tower drift to the 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. Enhanced conditions for the propagation of insects or disease organisms might have been another result of microclimatic modification, but the study of such phenomena was beyond the scope of this program.

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