1983 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 1983, 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). In 1983, the NRC dropped the fish impingement studies from the ETS program of required sampling at BVPS along with non-radiological water quality requirements.

A. SCOPE AND OBJECTIVES OF THE PROGRAM

The objectives of the 1983 environmental program were:

(1) to comply with Nuclear Regulatory Commission requirements regarding the soil sampling program

(2) 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.

(3) to provide a long and short range sampling program for establishing a continuing data base.

B. 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 relation to the principal population centers. Population density in the

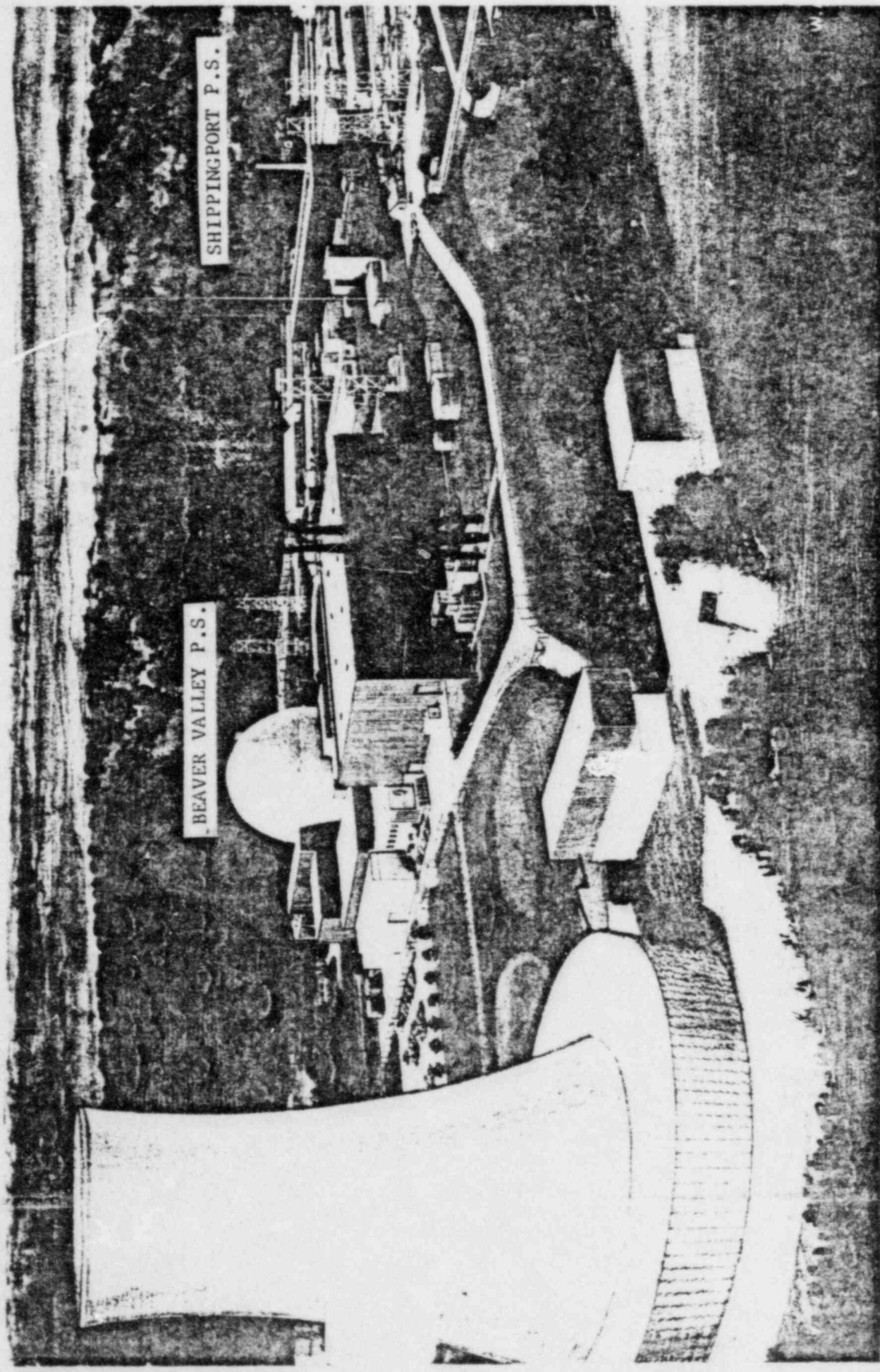


FIGURE 1.1

VIEW OF THE BEAVER VALLEY AND SHIPPINGPORT POWER STATIONS

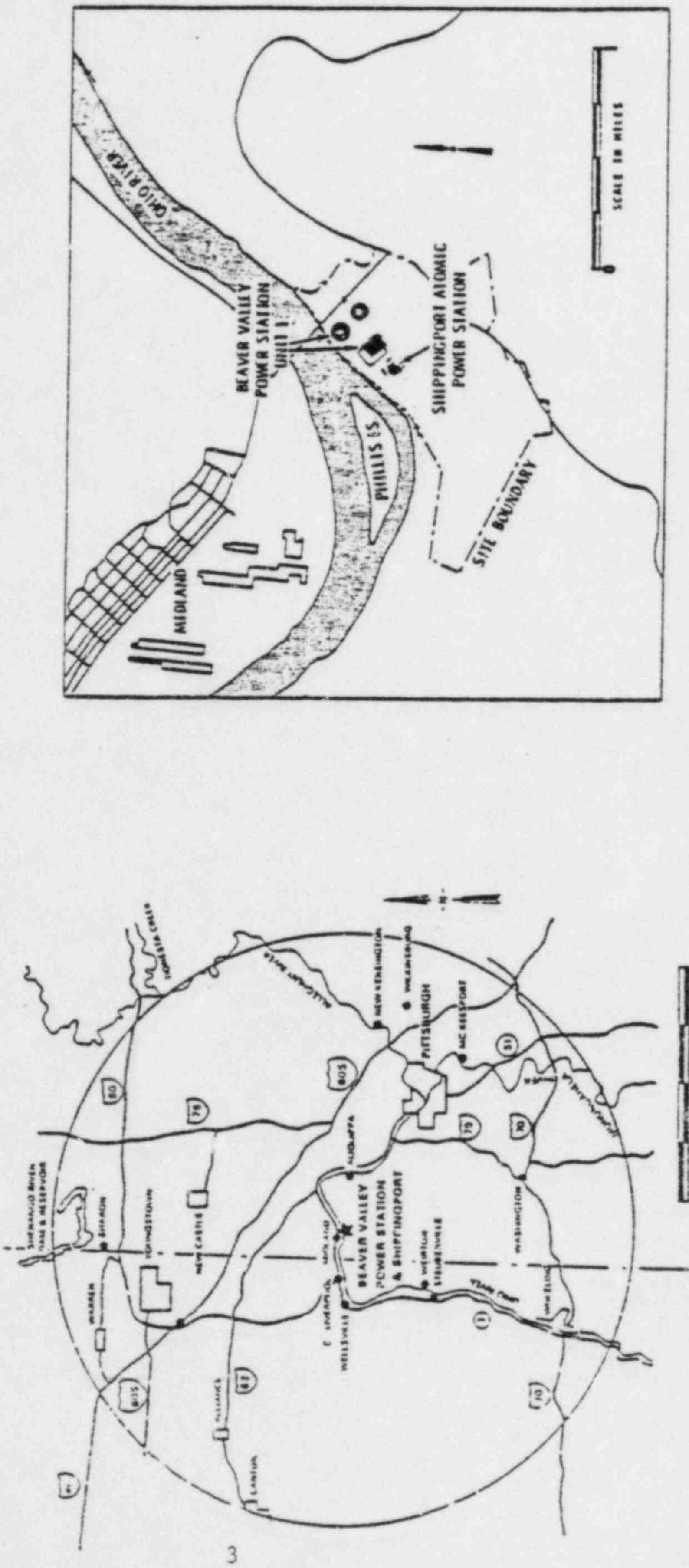


FIGURE I-2

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

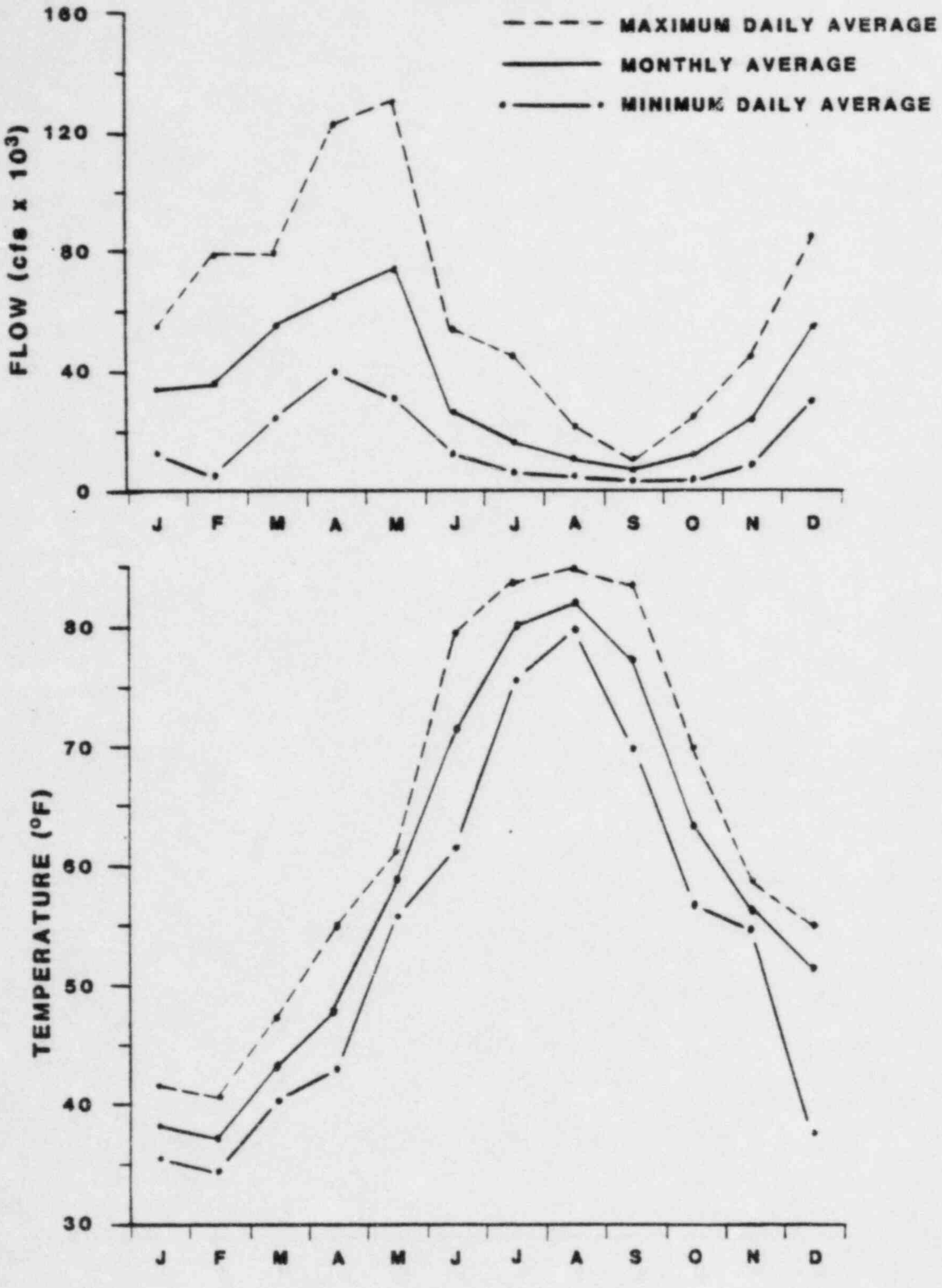
immediate vicinity of the site in relatively low. There are no residents within a 0.5 mile (0.8 km) radius of either plant. The population within a 5 mile (8 km) radius of the plant is approximately 18,000 and the only area of concentrated population is the Borough of Midland, Pennsylvania, which has 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 1983 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 1983, minimum temperatures were observed in February and maximum temperatures in August (Figure I-3) (Table I-1).

BVPS has a thermal rating of 2,660 megawatts (Mw) and an electrical rating of 835 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.



1983

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), 1983

TABLE I-1

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)
1983

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow (cfs x 10^3)												
Maximum Daily Average	55.0	79.6	79.8	122.5	131.8	55.0	45.7	22.0	10.7	24.5	45.5	85.2
Monthly Average	32.9	34.8	56.8	67.9	72.5	28.1	16.0	10.7	7.3	11.4	23.0	57.3
Minimum Daily Average	12.1	6.6	24.0	40.8	36.2	12.4	7.8	6.4	6.0	5.8	9.3	38.8
Temperature (°F)												
Maximum Daily Value	41.3	40.8	47.0	55.1	61.2	78.5	83.1	83.9	83.3	70.1	58.9	55.1
Monthly Average	38.6	37.6	43.7	48.4	59.0	71.8	80.1	82.3	77.5	63.7	56.4	51.5
Minimum Daily Value	35.4	34.6	40.8	43.8	55.9	61.3	75.7	80.0	70.0	56.9	54.8	38.0

II. SUMMARY AND CONCLUSIONS

The 1983 BVPS Unit 1 non-radiological environmental monitoring program included surveillance and field sampling of Ohio River aquatic life and a study of possible changes to soil pH and conductivity in the vicinity of the power plant. This is the eighth year of operational monitoring and, as in the previous operational monitoring years, no evidence of adverse environmental impact to the aquatic life in the Ohio River near BVPS was observed with the exception of a gizzard shad die-off which occurred during the winter of 1983.

During February 1983, there was an unplanned shut-down of the plant which inturn resulted in a rapid drop in temperature of the power plant discharge. This rapid drop in water temperature caused a die-off of large numbers of gizzard shad (Dorosoma cepedianum) in the BVPS discharge. A follow-up study was conducted to document the causes and affects of this unplanned shut-down on fish in the vicinity of the discharge and a full report was submitted to the Pennsylvania Fish Commission by Duquesne Light. A copy of this report is included in Appendix A of this report.

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 1983 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 1983 was similar to that observed during other operational years (1976 through 1982) and preoperational years (1973 through 1975). Oligochaetes have been the most numerous organisms in the community each year and they comprised 71.2% by numbers of the community in 1983. A similar oligochaete assemblage has been reported each year. Chironomids and mollusks comprised the remaining fraction (28.7%) of the

macroinvertebrate community. Common genera of oligochaetes were Limnodrilus, Paranais, and Nais. 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 macroinvertebrates were borrowing 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 and 1982 collections and were collected in the 1983 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 lower than normal flows and favorable weather conditions that occurred during the early spring of 1983.

Zooplankton. Zooplankton densities throughout 1983 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 eight operating years (1976 through 1983) 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 11-year period from 1973 to 1983. 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 1983, collected a total of 1,949 fish, representing 40 fish species. Three species were collected for the first time in 1983. Collection methods included: electrofishing, gill nets, and minnow traps. The majority of fish (1,508) were captured by electrofishing. Approximately 77.8% of the electrofishing catch consisted of emerald shiners.

Spotted bass (55 fish) and carp (28 fish) comprised the majority of the (160) gill netted fish. Two hundred and eighty one fish were collected in minnow traps. Of these, shiners, including the emerald, spotfin and sand shiners were the most common.

Variations in annual total numbers of fish caught during preoperational and operational years 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 1983. 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 1983.

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. Shiners (Notropis sp.) accounted for 54.3% of the 232 larvae collected. Only 2 juveniles were collected.

Data collected from 1973 through 1983 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 1983. A total of 216 fish weighing 3.38 kg (7.5 lbs) was collected. Gizzard shad (16.7%), channel catfish (18.0%), bluegill (17.6%) and freshwater drum (14.4%) comprised 66.7% of the annual catch. Of the 216 fish collected, 111 (51.4%) were alive and returned via the discharge pipe to the Ohio River. The majority of fish were less than 100 mm in length. The 1983 annual impingement catch was less than 1982 (227 fish), 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 1983 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.

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). In 1983, the NRC deleted the requirement for additional impingement studies. However, in the interest of providing a non-disruptive data base between the start-up of BVPS Unit 1 and that of Unit 2, DLCo is continuing the aquatic monitoring studies.

IV. MONITORING NON-RADIOLOGICAL EFFLUENTS

A. MONITORING CHEMICAL EFFLUENTS

The Environmental Technical Specifications (ETS) that were developed and included as part of the licensing agreement for the Beaver Valley Power Station, required that certain non-radiological chemicals and the temperature of the discharges be monitored and if limits were exceeded they had to be reported to the NRC. During 1983, the NRC (Amendment No. 64) deleted these water quality requirements. The basis for this deletion is that the reporting requirements would be administered under the NPDES permit. However, the NRC requested that if any NPDES permit requirements were exceeded, that a copy of the violation be forwarded to the Director, of the Office of Nuclear Reactor Regulation. A copy of the letter from the NRC to Duquesne Light Company documenting the deletion of the monitoring of water quality criteria is included on the following pages.

B. HERBICIDES

Monitoring and reporting of herbicide used for weed control during 1983, is no longer required as stated in Amendment No. 64; thus, this information is not included in this report.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 11, 1983

Docket No. 50-334

Mr. J. J. Carey, Vice President
Duquesne Light Company
Nuclear Division
Post Office Box 4
Shippingport, Pennsylvania 15077

Dear Mr. Carey:

The Commission has issued the enclosed Amendment No. 64 to Facility Operating License No. DPR-66 for the Beaver Valley Power Station, Unit No. 1. This amendment consists of changes to the Technical Specifications in response to your application dated February 9, 1983, and subsequent discussions between the NRC staff and your staff.

This amendment deletes the Appendix B Environmental Technical Specifications (ETS) which pertain to non-radiological water quality-related requirements, as required by the Federal Water Pollution Control Act Amendments of 1972.

Your basis for the requested deletion of water quality limits and monitoring programs is that these aquatic requirements are now under the jurisdiction of the U.S. Environmental Protection Agency (EPA) as established by the Federal Water Pollution Control Act Amendments of 1972. Therefore, water quality conditions in existing reactor operating licenses should be removed as a matter of law where the licensee holds, as you do, an effective National Pollutant Discharge Elimination System (NPDES) permit.

We concur in the deletion of the aquatic requirements and will rely on the NPDES permit system which is administered by EPA for regulation and protection of the aquatic environment. However, the NRC staff still wishes to remain informed about any changes in your NPDES permit and any violations of this permit. Accordingly, as discussed with your staff, you have agreed to provide NRC with a copy of any changes to the NPDES discharge permit and any permit violations requiring notification to the permitting agency at the time this information is reported to or received from the permitting agency. This information is to be submitted to the appropriate Regional Administrator with a copy to the Director, Office of Nuclear Reactor Regulation.

Please confirm this commitment in writing within 30 days of receipt of this letter.

RECEIVED
VICE PRESIDENT
NUCLEAR DIVISION

We have determined that the deletion of these water quality requirements is a ministerial action required as a matter of law and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and pursuant to 10 CFR 51.5(d)(4) that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

Since the amendment applies only to deletion of water quality requirements, we have concluded that: (1) because the amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated, does not create the possibility of an accident of a type different from any evaluated previously, and does not involve a significant reduction in a margin of safety, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

A copy of the Notice of Issuance is also enclosed.

Sincerely,

Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing

Enclosures:
1. Amendment No. 64 to DPR-66
2. Notice of Issuance

cc w/enclosures:
See next page

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 nearly 1 mile (15.2 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.

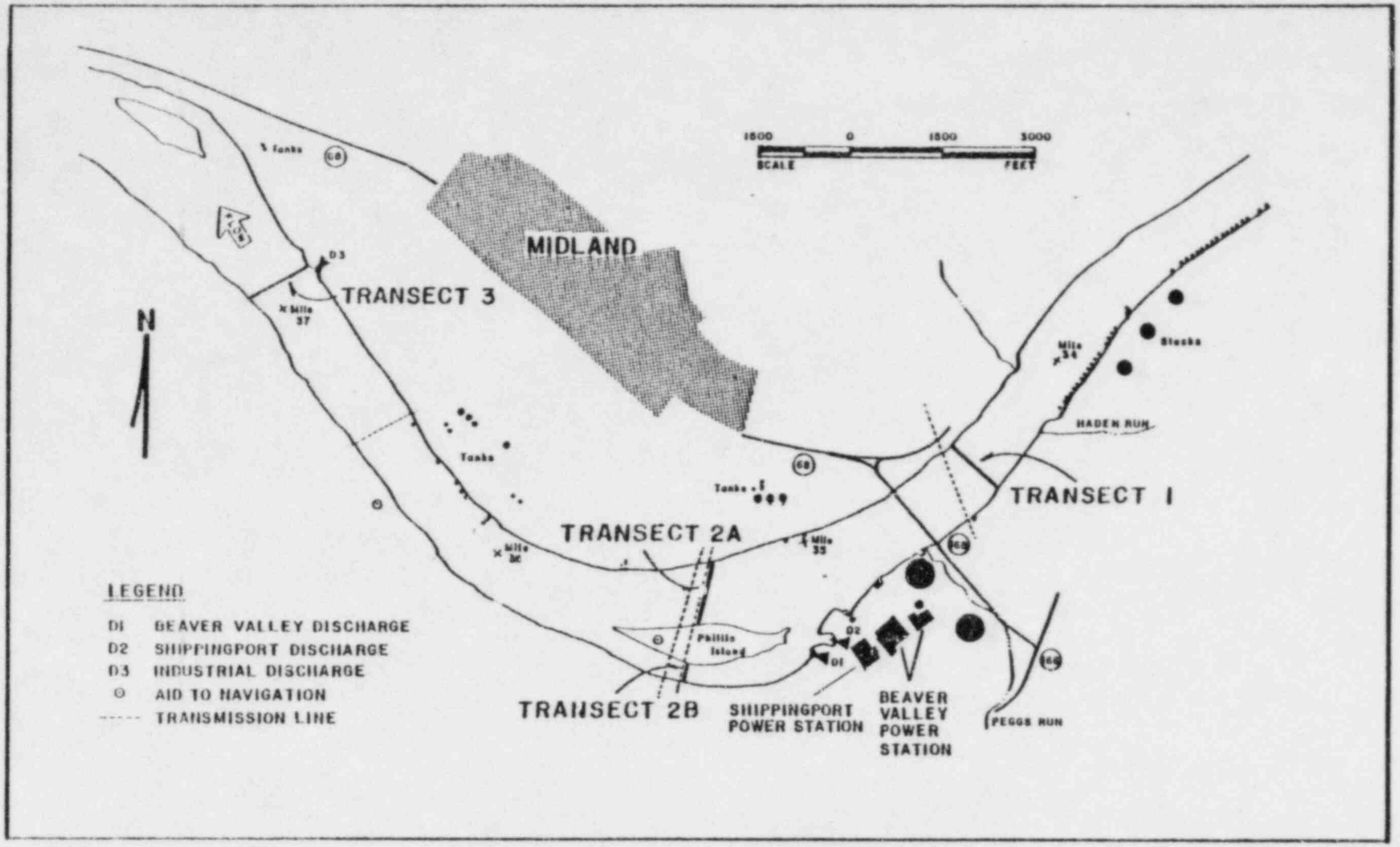


FIGURE V-A-1

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

TABLE V-A-1

AQUATIC MONITORING PROGRAM SAMPLING DATES
1983 BVPS

Month	Benthos	Fish	Impingement	Ichthyoplankton	Phyto- and Zooplankton
January			9, 14, 23, 28		14
February			4, 11, 18, 25		11
March			4, 11, 18, 25		11
April			1, 8, 15, 22, 29	13	15
May	11	11, 12	6, 13, 20, 27	11	13
June			3, 10, 17, 25	14	17
July		12, 13	1, 8, 15, 22, 29	12	15
August			5, 12, 19, 26		12
September	13	13, 23, 29	2, 9, 16, 23, 28		16
October			7, 14, 21, 28		14
November		22, 23	4, 11, 18, 25		18
December			2, 9, 16, 23, 30		16

B. BENTHOS

Objectives

The Ohio River was sampled at four transects in 1983 to determine if the power plant was affecting benthos populations near the BVPS.

Methods

Benthic surveys were performed in May and September, 1983. Benthos samples were collected at Transects 1, 2A, 2B and 3 (Figure V-B-1), using a Ponar grab sampler. Duplicate samples were taken off the south shore at Transects 1, 2A and 3. Sampling at Transect 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 Transect 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.

Forty-three macroinvertebrate taxa were identified during the 1983 monitoring program (Table V-B-1). Species composition during 1983 was

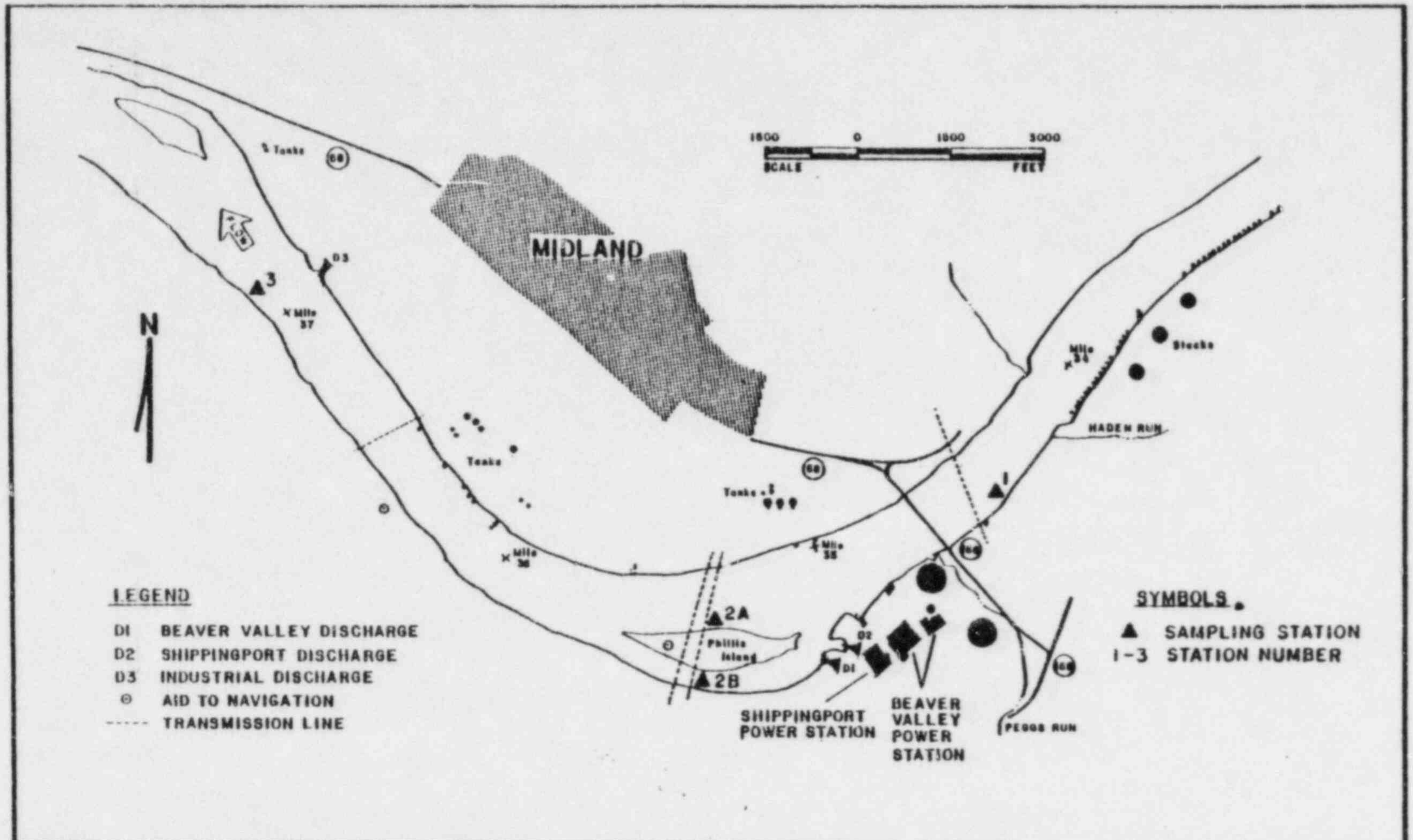


FIGURE V-B-1

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	1983
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	X
Nematoda	X	X	X	X	X	X	X	X	X	X	X
Entoprocta											
Urnatella gracilis	X	X	X	X	X	X	X	X	X	X	X
Ectoprocta											
Federicella sp.					X	X					
Paludicella articulata					X		X				
Pectinatella sp.	X										
Plumatella sp.	X										
Annelida											
Oligochaeta											
Aeolosomatidae			X	X	X			X			
Enchytraeidae		X		X	X	X	X	X	X	X	X
Naididae											
Amphichaeta leydigii						X					
Amphichaeta sp.							X				
Arcteonais lomondi					X			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	
Nais barbata						X					
N. bretscheri	X	X			X	X				X	
N. communis	X					X					
N. elinguis						X					

TABLE V-B-1
(Continued)

	Preoperational			Operational							
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
N. variabilis						X					
Nais sp.	X	X	X	X	X		X	X	X	X	X
Ophidonais serpentina								X		X	
Paranais frici	X	X		X	X	X	X	X	X	X	X
Paranais sp.							X				
Pristina osborni				X			X				
P. sima				X						X	X
Pristina sp.				X							
Slavina appendiculata					X						
Stephensoniana trivandrana				X	X	X			X	X	
Stylaria lacustris				X						X	
Uncinais uncinata			X								
Vejdovskyella intermedia											X
Tubificidae											
Aulodrilus limnobius	X	X	X	X	X	X	X	X	X		
A. pigueti	X		X	X	X	X	X	X	X	X	X
A. pluriseta	X			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	X
Ilyodrilus templetoni	X	X	X	X	X	X	X	X	X	X	
Limnodrilus cervix	X			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	X
L. hoffmeisteri	X	X	X	X	X	X	X	X	X	X	X
L. spiralis		X	X			X					
L. udekemianus	X	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	X
Potamothrix moldaviensis	X								X	X	
P. vejdovskyi											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	X
without hair chaetae	X	X	X	X	X	X	X	X	X	X	X
Lumbriculidae							X				
H[illegible]inea											
[illegible]ossiphoniidae											
[illegible]elobdella elongata										X	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	1983
Arthropoda											
Acarina				X		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	X
Decapoda							X				
Collembolla		X									
Ephemeroptera											
Heptageniidae	X		X								
Stenacron sp.				X							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	X
Coleoptera		X									
Hydrophilidae						X					
Elmidae											
Ancyronyx variegatus						X					
Dubiraphia sp.	X	X				X					
Helichus sp.	X										

TABLE V-B-1
(Continued)

	Preoperational			Operational							
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Stenelmis sp.	X				X	X					
Psephenidae											
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		
Simuliidae											
Similium sp.				X							
Chironomidae											
Chironominae							X				
Chironominae pupa							X			X	X
Chironomus sp.		X	X	X		X	X	X	X	X	X
Cladopelma sp.											X
Cryptochironomus sp.	X	X	X	X	X	X	X	X	X	X	X
Dicrotendipes nervosus	X										
Dicrotendipes sp.	X	X		X							X
Glyptotendipes sp.						X	X				X
Harnischia sp.		X	X	X		X	X	X	X	X	X
Micropsectra sp.				X							
Microtendipes sp.						X					
Parachironomus sp.		X									
Polypedilum (s.s.) *convictum* type						X					
P. (s.s.) *simulans* type						X					
Polypedilum sp.	X	X					X			X	X
Rheotanytarsus sp.	X				X	X	X		X		X
Stenochironomus sp.		X			X	X		X			
Stictochironomus sp.				X							
Tanytarsus sp.			X			X	X			X	X
Tanypodinae											
Ablabesmyia sp.	X	X		X							
Coelotanypus scapularis		X	X	X		X			X	X	X
Procladius (*Procladius*)							X	X			
Procladius sp.	X	X	X	X	X	X	X	X	X	X	X
Thienemannimyia group	X		X		X	X	X				
Zavrelimyia sp.						X					
Orthocladiinae							X				
Orthocladiinae pupae											X
Cricotopus bicinctus						X					
C. (s.s.) *trifascia*						X					
Cricotopus (*Isocladius*) *sylvestris* Group							X				
C. (*Isocladius*) sp.						X					

TABLE V-B-1
(Continued)

	Preoperational			Operational							
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cricotopus (s.s.) sp.	X	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				
Orthocladius sp.	X	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	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											
Ferrissia sp.	X	X			X	X					
Planorbidae							X				
Valvatidae											
Valvata perdepressa											
Pelecypoda							X				
Corbiculidae											
*Corbicula manilensis**		X	X	X	X	X			X	X	X
Sphaeriidae							X	X	X		
Pisidium sp.	X			X							
Sphaerium sp.	X			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*.

similar to that observed during previous preoperational (1973 through 1975) and operational (1976 through 1982) years. The macroinvertebrate assemblage during 1983 was composed primarily of burrowing 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 Polypedilum, Procladius, Coelotanypus, and Chrionomus. The Asiatic clam (Corbicula), which was collected from 1974 through 1978, has been collected in 1981, 1982 and 1983. None were collected during 1979 or 1980 surveys.

No ecologically important additions of species were encountered during 1983 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 (Figure V-B-2). Oligochaetes accounted for a greater percentage of the macroinvertebrate community at all four Stations in May as compared to September, when chironomidae and mollusca were more common at Transects 2A and 2B.

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 1983 was lowest at Transect 2A and higher at Transects 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 Transect 2A was probably related to substrate conditions (clay and sand) along the north shore of Phillis Island.

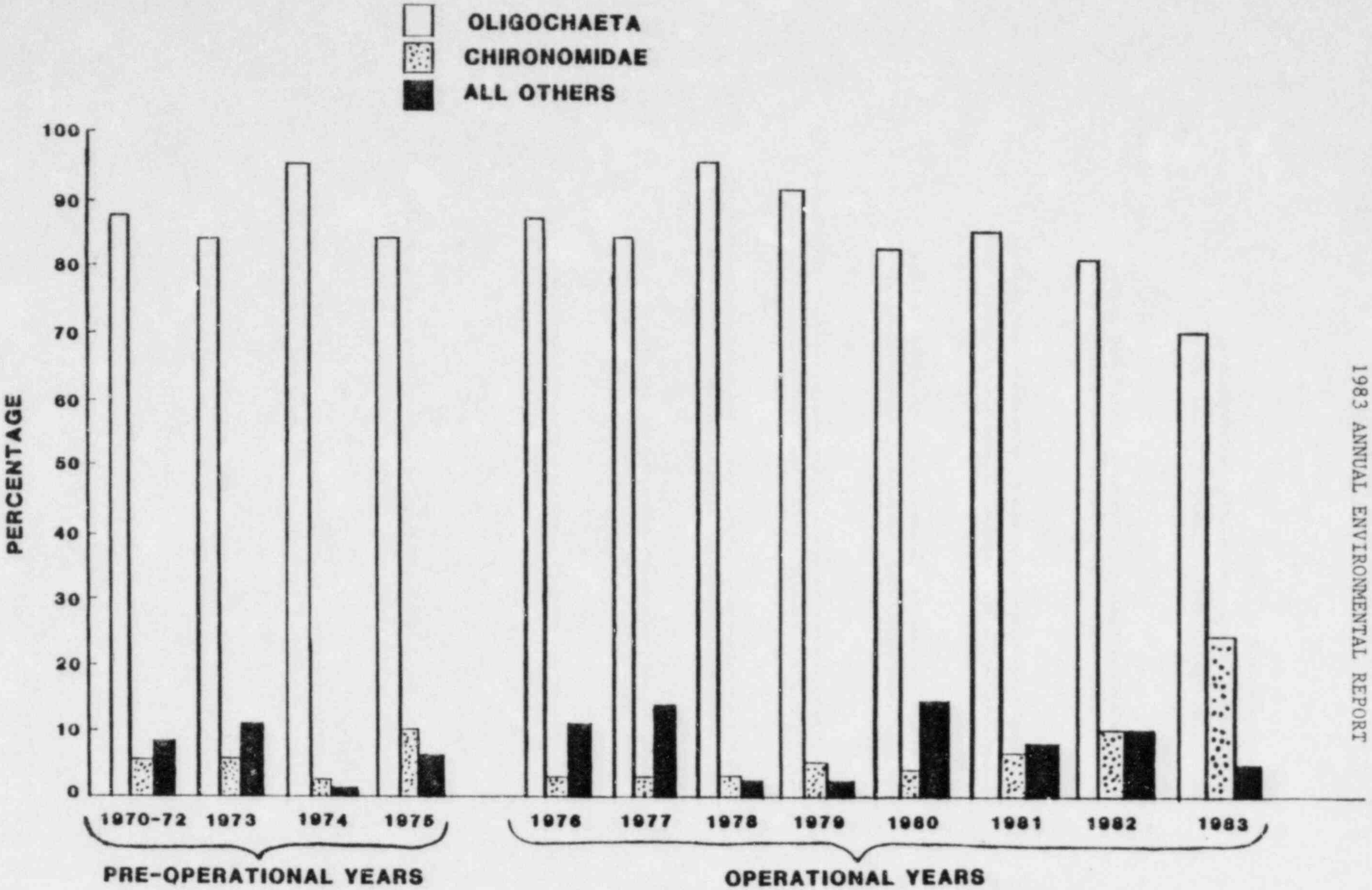


FIGURE V-B-2
MEAN PERCENT COMPOSITION OF THE BENTHOS COMMUNITY IN THE OHIO RIVER NEAR BVPS DURING PREOPERATIONAL AND OPERATIONAL YEARS .

TABLE V-B-2

MEAN NUMBER OF MACROINVERTEBRATES (Number/m^2) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA AND OTHER ORGANISMS, 1983
BVPS

	STATION							
	1		2A		2B		3	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
May 11								
Oligochaeta	3,164	88	70	88	1,041	79	1,118	59
Chironomidae	366	10			119	9	751	39
Mollusca	20	<1			99	8		
Others	40	1	10	12	55	4	40	2
Totals	3,590	100	80	100	1,314	100	1,909	100
September 13								
Oligochaeta	3,132	75	50	16	1,695	40	3,509	94
Chironomidae	981	24	198	62	2,008	48	189	5
Mollusca	59	1	60	19	475	11	40	1
Others			10	3	35	1	10	<1
Totals	4,172	100	318	100	4,213	100	3,748	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 11, 1983
BVPS

Taxa	STATION			
	1	2A	2B	3
Nemertea			7	
Nematoda	30			20
Entoprocta				
Urnatella gracilis	+		+	+
Annelida				
Oligochaeta eggs	+		+	+
Enchytraeidae				40
Arcteonais lomondi				50
Nais sp.	50		26	40
Paranais frici	158		13	40
Pristina sima			7	
Vejdovskyella intermedia	30			
Aulodrilus pigueti	10			
A. pluriseta	10			
Branchiura sowerbyi			13	10
Limnodrilus cervix				20
L. claparedeianus	10			
L. hoffmeisteri	316	40	79	79
L. udekemianus	40	10	46	
Peloscolex multisetosus	10			
Potamothrix vejdovskyi	60			
Immatures w/o capilliform chaetae	2,312	20	817	760
Immatures w/ capilliform chaetae	158		40	79
Arthropoda				
Acarina			7	
Amphipoda				
Gammarus sp.		10	7	
Ephemeroptera				
Stenacron sp.			7	
Trichoptera				
Oecetis sp.			20	
Diptera				
Chironomini	10			
Chironomus sp.	20		59	69
Cryptochironomus sp.	10		7	
Harnischia sp.	60		7	10
Polypedilum sp.			13	
Coelotanypus scapularis	40		13	20
Procladius sp.	216		13	632

TABLE V-B-3
(Continued)

Taxa	STATION 1	2A	2B	3
Cricotopus sp.	10			20
Orthocladius sp.			7	
Ceratopogonidae			7	20
Terrestrial insect	10			
Mollusca				
*Corbicula manilensis**	20			
Sphaerium sp.			99	
Total	3,590	80	1,314	1,909

+Indicates organisms present.
*Recent literature (1979) relegated all North American *Corbicula* to *Corbicula fluminea*

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 13, 1983
BVPS

Taxa	STATION 1	2A	2B	3
Entoprocta				
Urnatella gracilis	+		+	
Annelida				
Oligochaeta eggs	+			
Enchytraeidae	10			
Nais sp.	266		138	79
Paranais frici	20			
Aulodrilus pigueti			20	
A. pluriseta	89		86	10
Branchiura sowerbyi	89		86	
Limnodrilus cervix	10		33	60
L. claparedeianus			7	
L. hoffmeisteri	405	10	86	938
L. udekemianus	20		20	30
Potamothrix vejdovskyi			20	
Immatures w/o capilliform chaetae	1,808	40	916	2,332
Immatures w/ capilliform chaetae	415		283	60
Hirudinea				
Helobdella elongata			7	
Arthropoda				
Terrestrial spider (Arachnida)			7	
Acarina			7	
Amphipoda				
Gammarus sp.		10		
Trichoptera				
Oecetis sp.			7	
Terrestrial beetle (Coleoptera)			7	
Diptera				
Chironomini pupae			26	
Cladopelma sp.			40	
Chironomus sp.	148		105	40
Cryptochironomus sp.	179	10	26	
Dicrotendipes sp.		138	26	
Glyptotendipes sp.			7	
Harnischia sp.	30		20	10
Polypedilum sp.	80	30	1,021	89
Rheotanytarsus sp.	10		13	
Tanytarsus sp.	20		151	
Coelotanypus scapularis	228		171	10

TABLE V-B-4
(Continued)

Taxa	STATION 1	2A	2B	3
Procladius	286		395	40
Orthocladinae pupae			7	
Cricotopus sp.		20		
Terrestrial fly (Diptera)				10
Mollusca				
Corbicula manilensis*	59	20	251	40
Sphaerium sp.		40	224	
Total	4,172	318	4,213	3,748

+Indicates organisms present.
*Recent literature (1979) relegated all North American Corbicula to Corbicula fluminea

Comparison of Control and Non-Control Stations

No adverse impact to the benthic community was observed during 1983. This conclusion is based on a comparison of data collected at Transect 1 (Control) and 2B (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). Abundant taxa at Transects 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 Paranais frici and Limnodrilus hoffmeisteri. In September, the oligochaetes Limnodrilus hoffmeisteri and Nais sp. and the midges Procladius, Coelotanypus scapularis and Polypedilum were the common organisms collected at both stations.

In previous surveys, a greater variety of organisms have been found at Transect 2B than at Transect 1. This usually results in a slightly higher Shannon-Weiner diversity and evenness at Transect 2B (Table V-B-5). In 1983, a greater diversity of organisms was collected at stations, however, 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 Transect 1 (Control) and 2B (Non-Control) and between other stations could be related to differences in habitat. None of the differences can be attributed 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 approximately 71% of the individuals collected in 1983 (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

TABLE V-B-5

MEAN DIVERSITY VALUES FOR BENTHIC MACROINVERTEBRATES
COLLECTED IN THE OHIO RIVER, 1983
BVPS

	STATION			
	1	2A	2B	3
DATE: May 11				
No. of Taxa	17	2	8	14
Shannon-Weiner Index	2.18	1.26	1.32	2.61
Evenness	0.53	0.79	0.39	0.69
DATE: September 13				
No. of Taxa	18	5	16	11
Shannon-Weiner Index	2.95	1.81	2.90	1.64
Evenness	0.71	0.78	0.82	0.47

through 1976, but declined in number during 1977. Since 1981, Corbicula have been collected in the benthic surveys including 1983.

Total macroinvertebrate densities for Transect 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-up) until the current study year, 1983. Mean densities were frequently higher in the back channel of Phillis Island (Non-Control) as compared to densities at Transect 1 (Control). In years such as 1983 (also 1981, 1980, 1979) when mean densities were lower at Transect 2B than at Transect 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 (Transect 2B) as compared to Transect 1 was probably due to the morphology of the river. Mud, silt sediments and slow current were predominant at Transect 2B creating conditions more favorable for burrowing macroinvertebrates in comparison to Transect 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 71% of the macrobenthos collected, while Mollusca and Chironomidae each accounted for about 23.8 and 4.9% respectively.

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

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					
	1973		1974		1975	
	1	2B	1	2B	1	2B
January						
February	205	0	703	311		
March						
April						
May	248	508	1,116	2,197		
June	5	40	507	686		
July	653	119	421	440		
August	99	244	143	541	1,017	1,126
September			175	92		
October	256	239				
November	149	292	318	263	75	617
December						
Mean	231	206	483	643	546	871

	Operational Years															
	1976		1977		1978		1979		1980		1981		1982		1983	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
January																
February	358	200	312	1,100	1,499	2,545			1,029	1,296						
March							425	457								
April																
May	927	3,660	674	848	351	126	1,004	840	1,041	747	209	456	3,490	3,026	3,590	1,314
June																
July																
August	851	785	591	3,474	601	1,896	1,185	588								
September									1,523	448	2,185	912	2,956	3,364	4,172	4,233
October																
November	388	1,295	108	931	386	1,543	812	806								
December																
Mean	631	1,485	421	1,588	709	1,528	856	673	1,198	830	1,197	684	3,223	3,272	3,881	2,764

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 resulting from the operation of Unit 1.

Methods

One entrainment sample was collected monthly. Each sample was a one-gallon sample taken from below the skimmer wall 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 identified 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 diatoms.

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

Total cell densities of phytoplankton from stations on the Ohio River and in the intake samples have been similar during the past years (Annual Environmental Reports 1976-1979) . Species composition has also been similar in entrainment samples and those from the Ohio River (DLCo 1980).

Therefore, samples collected from the intake bays should provide an adequate characterization of the phytoplankton community in the Ohio River.

During 1983, January and March collections had the fewest phytoplankton present in the samples with mean densities of 872 and 898 cells/ml, respectively (Table V-C-1). The annual maximum occurred in February (84,176 cells/ml) (Figure V-C-1); however, this was due to a unicellular green algae (1 to 3 µm in diameter) not usually observed during winter. Total mean densities increased monthly from March through July, decreased in August, and increased again to a peak in October (Table V-C-1). Densities decreased after October to a low of 2,600 cells/ml observed in December (Figure V-C-2).

Diatoms (Chrysophyta) and green algae (Chlorophyta) were usually the most abundant groups of the phytoplankton during 1983 (Table V-C-1 and Figure V-C-2). The relative abundance for the group microflagellates was highest in May making up 16% of the total numbers observed in this month. Relative density of blue-greens (Cyanophyta) were highest during January (20%) and April (17%) (Table V-C-1).

Diversity indices for the phytoplankton during 1983 are presented in Table V-C-2. Shannon-Weiner indices ranged from 3.51 to 4.74, evenness values from 0.64 to 0.83, and richness values from 2.98 to 7.35. High diversity values occurred in 11 of the 12 months. The lowest value for Shannon-Weiner Index occurred in October; however, the lowest number of species occurred in May when small centric diatoms were predominant. Highest number of taxa (52) occurred in April and December.

Phytoplankton communities were generally dominated by different taxa each season. Most abundant taxa during winter (January through March) were Chlorophyta I and Schizothrix (Table V-C-3). Generally, the group Chlorophyta I were small (5 to 15 µm), unicellular, green algae which were probably separated from a colony and were very difficult to positively identify. Small centric diatoms that were present in all phytoplankton samples were the most common organisms in the spring, and

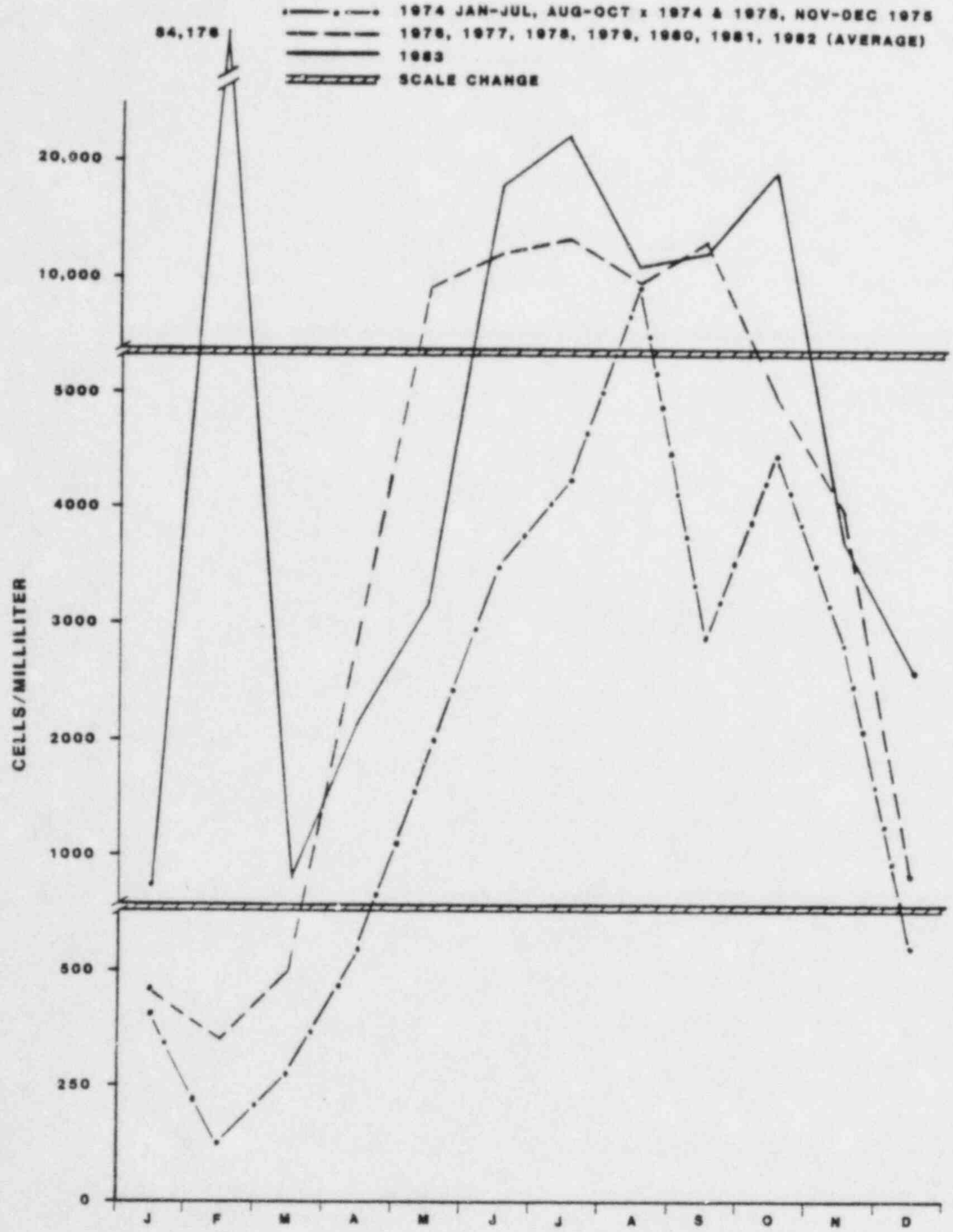


FIGURE V-C-1

SEASONAL PATTERN OF PHYTOPLANKTON DENSITIES IN THE OHIO RIVER DURING PREOPERATIONAL (1974-1975) AND OPERATIONAL (1976-1983) YEARS

BVPS

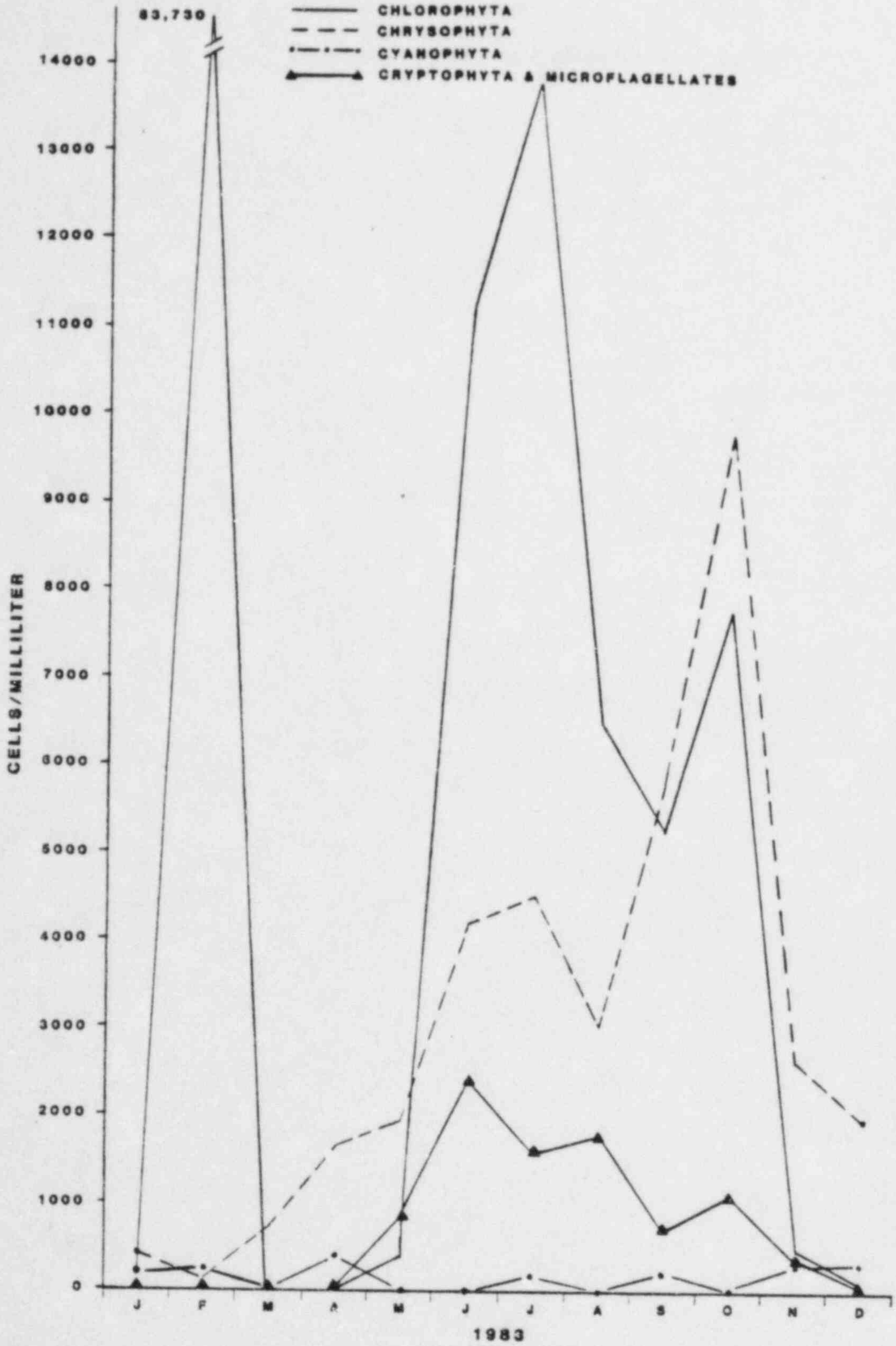


FIGURE V-C-2
PHYTOPLANKTON GROUP DENSITIES FOR ENTRAINMENT SAMPLES, 1983
BVPS

TABLE V-C-1

MONTHLY PHYTOPLANKTON GROUP DENSITIES (Number/ml) AND PERCENT COMPOSITION
FROM ENTRAINMENT SAMPLES, 1983
BVPS

Group	Jan		Feb		Mar		Apr		May		Jun	
	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
Chlorophyta	148	17	83,730	99	76	8	64	3	380	12	11,240	63
Chrysophyta	388	44	172	<1	682	76	1632	75	1920	60	4,240	24
Cyanophyta	172	20	228	<1	56	6	376	17	20	1	0	0
Cryptophyta	80	9	12	<1	12	1	24	1	360	11	1,520	8
Microflagellates	80	9	32	<1	70	8	88	4	500	16	920	5
Other Groups	4	<1	2	<1	2	<1	0	0	0	0	40	<1
Total	872	100	84,176	100	898	100	2.184	100	3,180	100	17,960	100

Group	Jul		Aug		Sep		Oct		Nov		Dec	
	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
Chlorophyta	13,760	68	6,480	57	5,220	43	7,880	41	480	13	150	6
Chrysophyta	4,560	22	3,080	27	5,780	48	9,780	51	2,660	72	1,970	76
Cyanophyta	200	1	80	<1	220	2	80	<1	280	8	310	12
Cryptophyta	680	3	520	4	580	5	540	3	0	0	30	1
Microflagellates	960	5	1,240	11	320	3	780	4	300	8	140	5
Other Groups	80	<1	40	<1	40	<1	20	<1	0	0	0	0
Total	20,240	100	11,440	100	12,160	100	19,080	100	3,720	100	2,600	100

TABLE V-C-2

PHYTOPLANKTON DIVERSITY INDICES BY MONTH FOR ENTRAINMENT SAMPLES, 1983
BVPS

	Jan	Feb *	Mar	Apr	May	Jun
No. of Species	36	42	51	52	25	42
Shannon-Weiner Index	4.27	4.01	4.60	4.74	3.67	4.41
Evenness	0.82	0.74	0.81	0.83	0.79	0.82
Richness	5.17	6.45	7.35	6.64	2.98	4.18

	Jul	Aug	Sep	Oct	Nov	Dec	$\overline{X}$
No. of Species	37	40	37	45	37	52	41
Shannon-Weiner Index	4.16	4.28	3.56	3.51	4.17	4.72	4.18
Evenness	0.80	0.80	0.68	0.64	0.80	0.83	0.78
Richness	3.63	4.17	3.83	4.46	4.38	6.48	4.98

*Diversity calculations for February without Chlorophyta I (83,600 cells/ml, unidentifiable unicellular greens). Diversity values with Chlorophyta I: Shannon - 0.09, Evenness - 0.02, Richness - 3.70.

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 1983
BVPS

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CYANOPHYTA												
Schizothrix calcicola	172	86	52	320	20		160		60	80	280	310
Schizothrix sp.		142										
CHLOROPHYTA												
Ankistrodesmus convolutus	12		2			1,440	1,320	360	200	620	40	20
Ankistrodesmus falcatus	36	18	6	16	80	680	200	280	160	260	20	
Coelastrum microporum							320			320		
Crucigenia tetrapedia	4						320	480		80		
Dictyosphaerium pulchellum					80	480	600	120		80		
Kirchneriella obesa						640	40		220	60		
Micractinium pusillum			10			920	120		40	100		
Pediastrum duplex						40	480					
Scenedesmus acuminatus		6				160	720	320		260		
Scenedesmus bicellularis	8	16	4			1,640	4,040	1,840	1,340	2,280	180	40
Scenedesmus quadricauda	8				20	1,880	1,760	480	800	1,000	160	
Selenastrum minutum	4	4	4	8	40	360	480	440	1,020	540	40	20
Selenastrum westii						360	680	880	100	500		
Sphaerocystis schroeteri								320				
Testrastrum staurogeniaeforme									160			
Chlorophyta I	60	83,678	40	32	120	1,600	1,440	440	760	1,000	40	40
CHRYS[illegible]												
Dinobr[illegible]tularia	4				140						80	
Synur[illegible]		2	44	48	20	80				20	60	
Achn[illegible]ssima	4	14	20	40	20						40	90
Aste[illegible]mosa	72	6	66	104	260	320		40			20	10
Cymbella ventricosa		6		64						20	20	30
Diatoma tenue		24	80	80		40				20	20	
Diatoma vulgare	8		2	24							20	60
Fragilaria crotonensis	32		6									
Fragilaria vaucheriae		2	10	40	40	40	40					80
Gomphonema parvulum	16	8	8	56							100	40
Melosira ambigua	24		14	24	100	400	1,760	40	200	160	320	
Melosira distans			4	8				160	580	1,180	40	20
Melosira granulata	68		46	48	180	560	760	240	260	120	40	20
Melosira varians	8		10	48							40	160
Navicula cryptocephala	24	28	50	.208	80	80	40	40	20	100	160	270

TABLE V-C-3
(Continued)

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Navicula viridula	16	12	40	268	60	40		40			60	140
Nitzschia holsetica								240		120		
Nitzschia palea	28	10	34	136	40		40	120	40	60	160	140
Synedra filiformis	4	8	12	16	40	320				100	100	30
Synedra ulna	4	2	16	24		40		40			40	60
Small Centrics	36	2	134	96	860	2,000	1,800	1,720	4,440	7,720	980	330
CRYPTOPHYTA												
Cryptomonas erosa	24	4	8	8	40	320	80	80	140	220		20
Rhodomonas minuta	56	8	4	16	320	1,200	600	440	440	300		10
MICROFLAGELLATES	80	32	70	88	500	920	960	1,240	320	780	300	140
TOTAL PHYTOPLANKTON	872	84,176	898	2,184	3,180	17,960	20,240	11,440	12,160	19,080	3,720	2,600
TOTAL OF MOST ABUNDANT TAXA	812	84,118	796	1,800	3,060	16,560	18,760	10,400	11,300	18,100	3,360	2,080
PERCENT COMPOSITION OF MOST ABUNDANT PHYTOPLANKTON	93	100	89	82	96	92	93	91	93	95	90	80

included several small (4 to 12 µm 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. ast:aea. The most abundant organisms in the summer surveys included Scenedesmus bicellularis (green algae) and small centrics. Small centrics were also the most abundant organisms collected in October, November and December.

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 1983.

Comparison of Preoperational 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 1983 (Figure V-C-2).

In general, the phytoplankton community in 1983 was similar to those of preoperational and operational years. No major change in species composition or community structure was observed during 1983. The small differences in the phytoplankton community between 1983 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 1983 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 1983, evenness ranged from 0.56 to 0.83. 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 3VPS. This was probably due to decreased precipitation and favorable weather conditions that occurred during early spring of 1983.

TABLE V-C-4

PHYTOPLANKTON DIVERSITY INDICES (MEAN OF ALL SAMPLES 1973 TO 1983)
NEW CUMBERLAND POOL OF THE OHIO RIVER
BVPS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	$\bar{X}$
1973													
No. of Species	7	2	No Sample	13	24	27	28	30	No Sample	24	17	16	19
Shannon Index	1.55	0.54		0.63	1.64	2.28	3.55	3.72		3.37	3.25	3.27	2.38
Evenness	0.33	0.15		0.11	0.25	0.35	0.55	0.52		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	No Sample		34
Shannon Index	2.96	2.23	3.18	3.50	4.89	4.40	4.03	4.25	3.85	5.02			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	No Sample							52	34	43	32	40	40
Shannon Index								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	46	43	38	33	35	38	39
Shannon Index	3.98	4.36	3.90	4.25	4.14	4.27	4.28	4.30	3.93	4.16	4.24	4.45	4.19
Evenness	0.80	0.85	0.78	0.81	0.75	0.76	0.78	0.80	0.75	0.83	0.83	0.85	0.80
Richness	5.15	5.89	4.92	4.70	4.68	4.79	4.72	4.34	3.85	4.17	4.95	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
1978													
No. of Species	37	29	32	42	28	42	36	37	35	37	34	32	35
Shannon Index	4.08	3.68	3.77	4.67	3.30	4.16	3.95	4.17	3.81	3.99	3.80	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

TABLE V-C-4
(Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	X̄
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	32	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	49	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
1983													
No. of Species	36	42	51	52	25	42	37	40	37	45	37	52	41
Shannon Index	4.27	4.01	4.60	4.74	3.67	4.41	4.16	4.28	3.56	3.51	4.17	4.72	4.18
Evenness	0.82	0.74	0.81	0.83	0.79	0.82	0.80	0.80	0.68	0.64	0.80	0.83	0.78
Richness	5.17	6.45	7.35	6.64	2.98	4.18	3.63	4.17	3.83	4.46	4.38	6.48	4.98

(a) No data
[]Data represent single entrainment sample 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, in Part C 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 hours. 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 collected below the skimmer wall from one operating intake bay of Unit 1.

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 1983, protozoans and rotifers accounted for 92% or more of all zooplankton on all samples dates (Table V-D-1). Total organism densities during January through February were less than 330/liter (Figure V-D-1, Table V-D-1). Total organism densities increased in March, decreased in April and May and peaked (8,220/liter) in June. 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). Below average precipitation during early 1983 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 1983 were between 250 and 320/liter (Table V-D-1). Protozoans gradually increased in April, decreased in May and peaked in June (6,940/liter). Protozoans progressively decreased in November to densities of 490/liter in December. Vorticella sp., Codonella cratera and Strobilidium sp. occurred fairly consistently through out the year. Nuclearia simplex exhibited a high density in June accounting for over 50% of the zooplankton observed in that month. These taxa have been a main part of the protozoan assemblage of the Ohio River near BVPS since the studies were initiated in 1972.

The rotifer assemblage in 1983 (Figure V-D-2) displayed a typical pattern of rotifer populations in temperate inland waters (Hutchinson

TABLE V-D-1

MONTHLY ZOOPLANKTON GROUP DENSITIES (Number/liter) AND PERCENT COMPOSITION
FROM ENTRAINMENT SAMPLES, 1983
BVPS

	Jan		Feb		Mar		Apr		May		Jun	
Group	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
Protozoa	250	88	320	97	315	22	500	93	390	81	6,940	84
Rotifera	30	10	10	3	1,100	78	40	7	90	19	1,270	15
Crustacea	5	2	0	0	0	0	0	0	0	0	10	<1
Total	285	100	330	100	1,415	100	540	100	480	100	8,220	100

	Jul		Aug		Sep		Oct		Nov		Dec	
Group	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%	#/ml	%
Protozoa	1,320	28	5,030	84	1,100	33	1,670	58	890	94	490	88
Rotifera	3,440	72	880	15	1,930	59	1,190	41	60	6	70	12
Crustacea	20	<1	100	1	250	8	20	1	0	0	0	0
Total	4,780	100	6,010	100	3,280	100	2,880	100	950	100	560	100

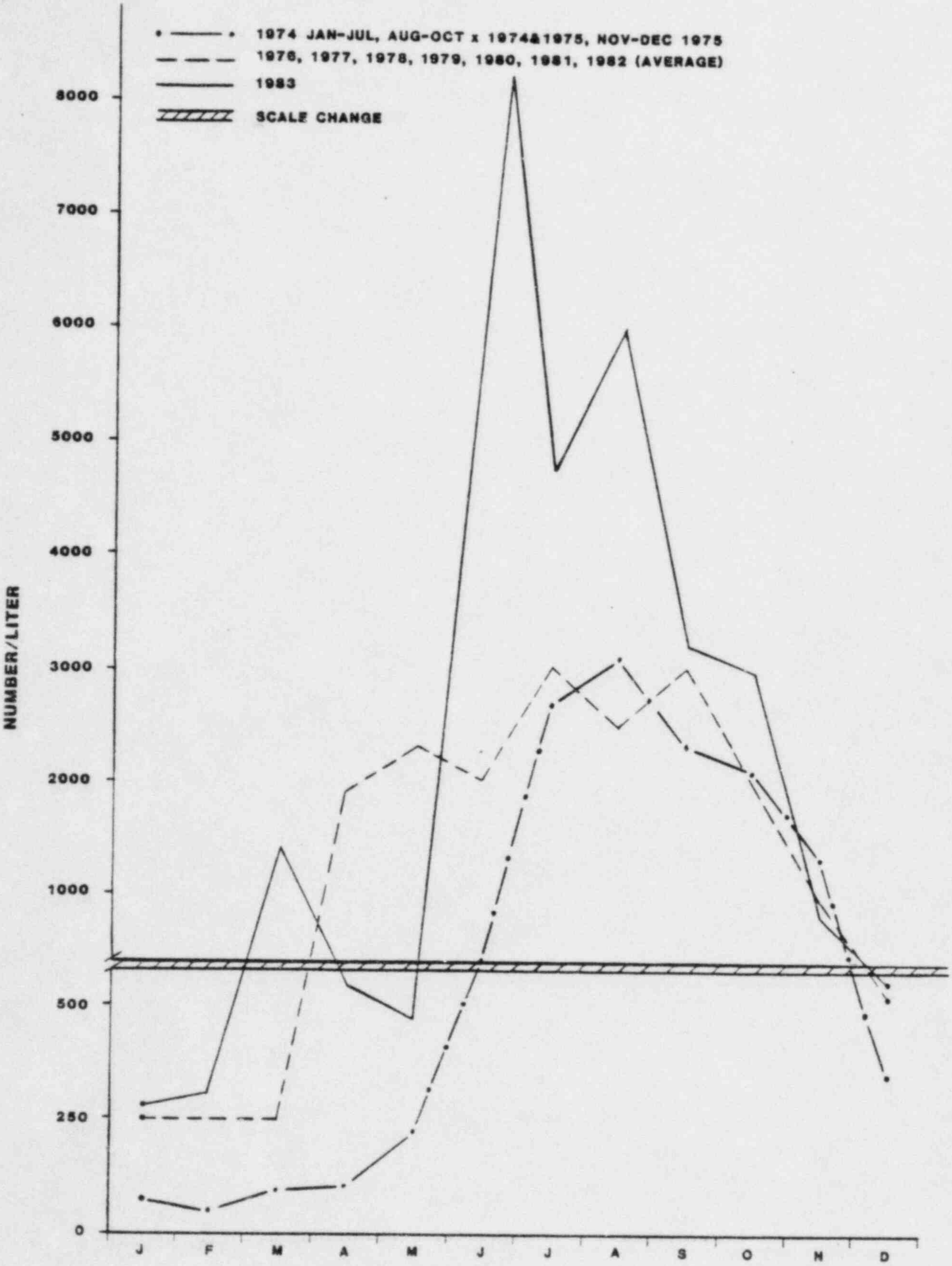


FIGURE V-D-1
SEASONAL PATTERNS OF ZOOPLANKTON DENSITIES IN THE OHIO RIVER DURING PREOPERATIONAL (1974-1975) AND OPERATIONAL (1976-1983) YEARS
BVPS

TABLE V-D-2

MEAN ZOOPLANKTON DENSITIES (Number/liter) BY MONTH FROM 1973 THROUGH 1983, OHIO RIVER AND BVPS

Total Zooplankton	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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	2,276	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
1983	285	330	1,415	540	480	8,220	4,780	6,010	3,280	2,880	950	560
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	1,560	1,590	4,850	2,060	980
1983	250	320	315	500	390	6,940	1,320	5,030	1,100	1,670	890	490
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
1983	30	10	1,100	40	90	1,270	3,440	880	1,930	1,190	60	70

TABLE V-D-2
(Continued)

Crustacea	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973	-	1	-	1	3	12	29	9	-	3	2	2
1974	2	2	3	3	6	3	14	85	7	6	-	-
1975	-	-	-	-	-	-	-	51	12	6	3	6
1976	2	1	5	4	10	141	43	23	69	3	2	8
1977	-	-	2	5	13	96	7	17	50	5	1	6
1978	4	6	3	2	6	48	12	27	75	9	5	5
1979	1	0	3	3	2	4	78	44	17	2	2	2
1980	3	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
1983	5	0	0	0	0	10	20	100	250	20	0	0

[a] No sample collected.

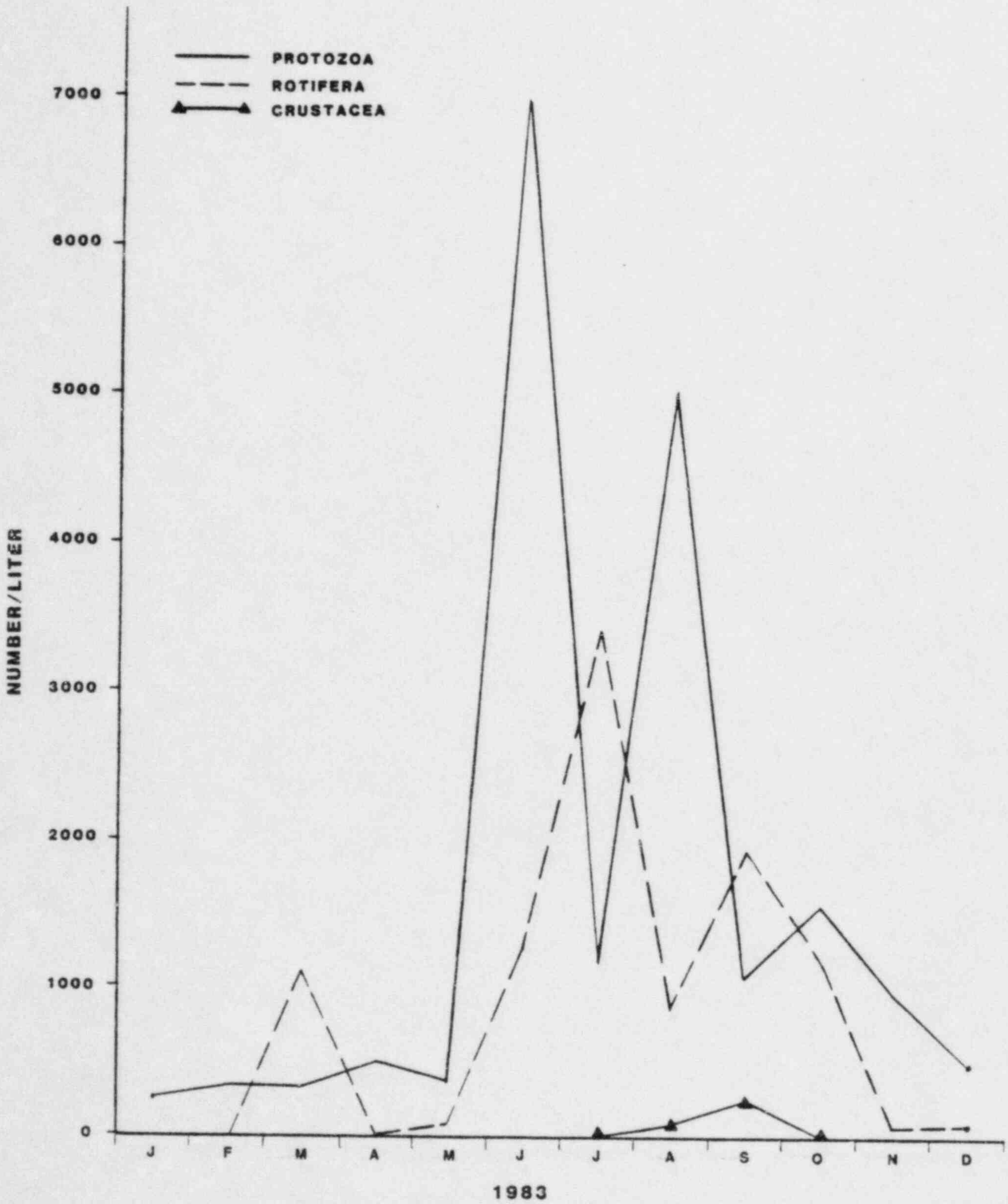


FIGURE V-D-2
ZOOPLANKTON GROUP DENSITIES FOR ENTRAINMENT SAMPLES, 1983
BVPS

1967). Rotifer densities increased from a minimum of 10/liter in February to a maximum of 3,440/liter in July (Table V-D-2). Rotifer populations generally decreased after July to densities of 70/liter in December. During March, July and September rotifers were the dominant zooplankters. Keratella cochlearis, Polyarthra spp. and Trichocerca pusilla were the most abundant rotifers during most of the year (Table V-D-3).

Crustacean densities were low (0 to 20/liter) from January through July (Table V-D-1). Densities of crustaceans during 1983 reached their peak of 250/liter in September (Figure V-D-2). No crustaceans were collected in November and December. Crustacean densities never exceeded protozoan or rotifer densities and constituted from 0 to 8% of the total zooplankton density each month (Table V-D-1). Copepod nauplii were the only crustaceans collected during 1983. 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 below average precipitation during early 1983. Crustaceans are rarely numerous in the open waters of rivers and many are eliminated by silt and turbulent water (Hynes 1970).

The highest Shannon-Weiner diversity value of 3.92 and the maximum number of species (37) occurred in September (Table V-D-4). Evenness ranged from 0.51 in June to 0.86 in May. Richness varied from 1.55 in February to a maximum of 4.45 in September. The number of species ranged from 10 in February to 37 in September. Low diversity indices in February reflect the dominance of Vorticella whereas the low density in June was due to a dominance of Codonella cratera.

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-3

DENSITIES (Number/liter) OF MOST ABUNDANT ZOOPLANKTON TAXA
(Greater than 2% on any date)
COLLECTED FROM ENTRAINMENT SAMPLES
JANUARY THROUGH DECEMBER 1983
BVPS

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PROTOZOA												
Arcella sp.	10	10	10	40		10			10	10	270	100
Askenasia sp.	15	70	15							30		
Centropyxis aculeata				20								
Codonella cratera	35	10	50	100	130	20	380	40	40	60	130	110
Cyclotrichium sp.	5	20										20
Cyphoderia ampulla	5		15	100	10				10	30	110	30
Difflugia acuminata		20	5		10		20		70	20	90	30
Difflugia sp.	5	10	5	30	20		20		10	20		30
Dileptus sp.					10		70	20	80	20		
Euglypha compressa				20			10		10		10	10
Nuclearia simplex					10	4,450	90	100	50	20	20	
Opercularia sp.	10										80	10
Phascolodon vorticella										60		
Strobilidium gyrans					10	110	30	40	270		20	
Strobilidium sp.	25	10	55	10	50	20	60	2,440	170	560	10	
Tintinnidium fluviatile					40		110	2,010	120	450		10
Turaniella vitrea								30	90	10		
Vorticella sp.	110	160	50	150	40	1,500	130	100	40	110	90	100
Holophyrid ciliate	10	10	5		50	500	280	60	60	60		10
Ciliate Unidentified	5		20	20	10	40	40	80	20	20	30	20
ROTIFERA												
Branchionus calciflorus						80	110		10			
Colurella colurus			150		10					10		
Conochilus unicornis	5							10	100			
Hexarthra mira									140	10		
Keratella cochlearis	5		5		10	320	1,190	150	790	800	40	10
Keratella quadrata				10			120	130	10			
Lecane sp.			75	10						20		
Lepadella patella			850	10								
Polyarthra dolichoptera				10		580	990	230	530	260		
Polyarthra vulgaris						10	70	90	270			
Synchaeta sp.					20	160	120	20		30		20
Trichocerca pusilla	5			10			660	140	50	10		10
Bdelloidea		10	5		20							10
Rotifer Unidentified	10				30	50	20	10		20	10	20

TABLE V-D-3
(Continued)

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CRUSTACEA												
Nauplii	5					10	10	80	140	10		
Total Zooplankton	285	330	1,415	540	480	8,220	4,780	6,010	3,280	2,880	950	560
Total of Most Abundant Taxa	265	330	1,315	540	480	7,860	4,530	5,780	3,090	2,650	910	550
Percentage Composition of Most Abundant Zooplankton	93	100	93	100	100	96	95	96	94	92	96	98

TABLE V-D-4

ZOOPLANKTON DIVERSITY INDICES BY MONTH FOR ENTRAINMENT SAMPLES, 1983
BVPS

	Jan	Feb	Mar	Apr	May	Jun
No. of Species	18	10	23	14	17	24
Shannon-Weiner Index	3.20	2.39	2.41	3.09	3.54	2.36
Evenness	0.76	0.71	0.53	0.81	0.86	0.51
Richness	3.03	1.55	3.03	2.07	2.59	2.55

	Jul	Aug	Sep	Oct	Nov	Dec	$\bar{X}$
No. of Species	34	30	37	33	17	18	23
Shannon-Weiner Index	3.56	2.65	3.92	3.43	3.28	3.54	3.11
Evenness	0.70	0.54	0.75	0.68	0.80	0.85	0.71
Richness	3.90	3.33	4.45	4.02	2.33	2.69	2.96

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 1983 were frequently higher than those of preoperational years (1973 through 1975) and operational years (1976 through 1982) (Figure V-D-1). This was due primarily to below average river flow and precipitation which occurred during most of 1983.

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, 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 1983, the diversity indice and species numbers were relatively low in February which was typical for months of winter and early spring. Shannon-Wiener diversity indices in 1983 ranged from 2.36 to 3.92 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 1983 (0.51 to 0.86) was at the upper portion of the range reported from 1973 to 1982 (0.21 to 0.93).

TABLE V-D-5

MEAN ZOOPLANKTON DIVERSITY INDICES BY MONTH FROM 1973 THROUGH 1983 IN THE OHIO RIVER NEAR BVPS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973												
Number of Species	[1]	8.44		15.29	21.28	25.07	21.96	22.86		16.33	14.40	14.30
Shannon Index[2]		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	4.00	10.00	12.00	13.31	21.00	25.62	22.88	25.50	36.75	16.88	20.31	15.31
Shannon Index	1.53	2.59	3.01	2.98	3.15	3.45	3.32	3.60	3.71	3.35	3.42	3.42
Evenness	0.78	0.79	0.87	0.81	0.72	0.74	0.73	0.77	0.71	0.82	0.79	0.86
1978												
Number of Species	0.12	7.12	4.31	5.12	7.62	6.25	10.25	11.25	12.50	0.25	10.88	10.38
Shannon Index	2.48	2.41	1.53	1.70	1.53	1.33	2.50	2.44	2.53	2.28	2.15	2.00
Evenness	0.83	0.85	0.74	0.71	0.52	0.50	0.76	0.70	0.70	0.73	0.62	0.83
1979												
Number of Species	10.62	6.00	10.25	15.88	17.25	14.25	16.88	21.50	18.12	12.00	14.62	14.00
Shannon Index	2.51	2.52	3.05	3.42	2.36	3.02	2.42	3.30	3.36	2.99	2.84	3.10
Evenness	0.74	0.93	0.90	0.86	0.58	0.80	0.60	0.74	0.80	0.84	0.74	0.83
1980												
Number of Species	11.62	11.00	12.50	10.00	8.00	15.00	21.00	15.00	18.00	22.00	18.00	18.00
Shannon Index	2.51	2.70	3.03	2.41	2.00	2.91	3.63	2.79	3.23	2.88	3.26	3.36
Evenness	0.70	0.78	0.84	0.72	0.66	0.74	0.82	0.71	0.77	0.64	0.78	0.80
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

TABLE V-D-5
(Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982												
Number of Species	10.00	9.00	11.00	22.00	27.00	20.00	37.00	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
1983												
Number of Species	18.00	10.00	23.00	14.00	17.00	24.00	34.00	30.00	37.00	33.00	17.00	18.00
Shannon Index	3.20	2.39	2.41	3.09	3.54	2.36	3.56	2.65	3.92	3.43	3.28	3.54
Evenness	0.76	0.71	0.53	0.81	0.86	0.51	0.70	0.54	0.75	0.68	0.80	0.85

[1]Blanks represent periods when no collections were made.
[2]Shannon-Weiner Index

Summary and Conclusions

Zooplankton densities throughout 1983 were typical of a temperate zooplankton community found in large river habitats. Total densities were slightly higher than those reported in previous years. Populations during the fall of 1983 maintained high densities with the peak annual maximum occurring in September. Protozoans and rotifers were always predominant. Common and abundant taxa in 1983 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 preceding years. Based on the data collected during the eight operating years (1976 through 1983) 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 eleven year period from 1973 to 1983. 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 1983. During each survey, fish were collected at the three study transects (Figure V-E-1), using gill nets, electrofishing and minnow traps.

Gill nets, consisted of five, 25-ft. panels of 1.0, 2.0, 2.5, 3.0 and 3.5 inch square mesh. Two nets were positioned close to shore at each transect, with the small mesh inshore. As Transect 2 is divided by Phillis 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 transect 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. Non-game fish were counted and a batch weight obtained for the entire sample. The length range was determined by visual inspection and measurement 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 camouflage design and were set for 24 hours. All captured fish were preserved and processed in the laboratory in the manner described for electrofishing.

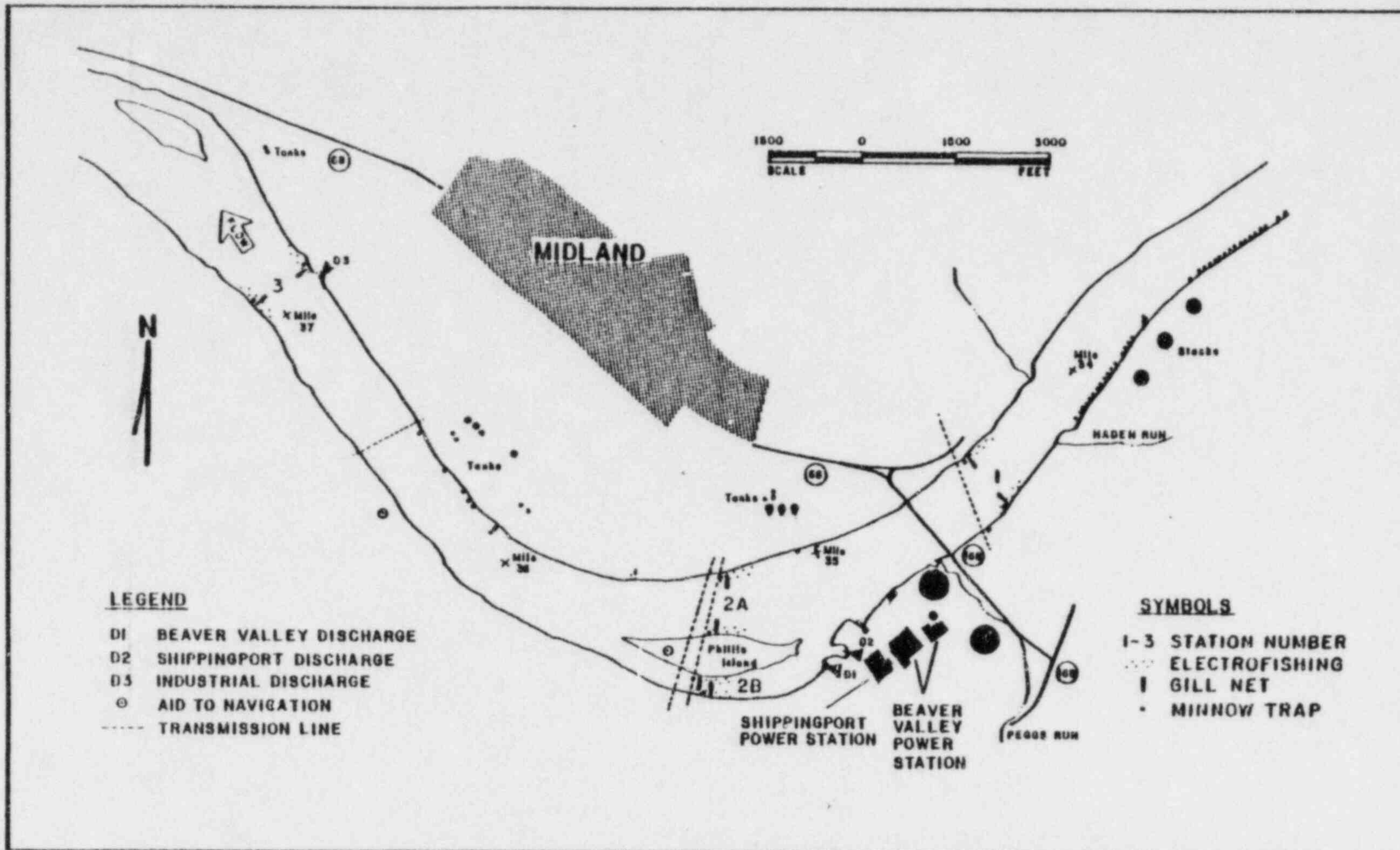


FIGURE V-E-1

FISH SAMPLING STATIONS, BVPS

Results

Fish population studies have been conducted in the Ohio River near BVPS from 1970 through 1983. These surveys have collected 61 fish species and two hybrids (Table V-E-1). In 1983, 40 fish species were collected, including three species (river chub, river carpsucker and brook silverside) that had not been captured previously. A combined total of 1,949 individuals were collected in 1983 by gill netting, electrofishing, and minnow traps (Table V-E-2).

A total of 1,508 fish, representing 24 species was collected by electrofishing (Table V-E-3). Emerald shiners dominated the catch numerically, accounting for 77.8% of the total electrofishing catch. Collectively, the minnow family accounted for 90.5% of the total electrofishing catch in 1983. Gizzard shad, also a forage species, represented 5.6% of the catch. Each of the other taxa accounted for less than 1% of the total. Most of fish sampled by electrofishing were collected in May (73.3%). The fewest fish were collected in July (2.7%).

The gill net results varied by month with the highest catch in the month of September (103 fish). July was the next highest month with 37 fish. May and November catches resulted in 16 fish and 4 fish, respectively. Gill net sampling typically results in catching more fish in warmer weather when fish are usually more active (Table V-E-4). The high number of fish collected in September was mainly spotted bass and common carp caught near the shore.

A total of 281 fish were captured using minnow traps in 1983 (Table V-E-2). This gear was most effective in May and July when 80.1% of the fish were caught. Most of these fish (shiners) were collected from Transect 3 (206 fish).

The most common species (i.e., contributed more than 1% to the annual total catch) collected through the use of gill nets, electrofishing and minnow traps included the following: gizzard shad; common carp; emerald, spotfin and sandshiners; bluntnose minnows; and spotted bass. The remaining 34 species accounted for 1% or less of the total.

TABLE V-E-1

(SCIENTIFIC AND COMMON NAME)[1]
FAMILIES AND SPECIES OF FISH COLLECTED IN THE NEW CUMBERLAND
POOL OF THE OHIO RIVER, 1970-1983
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
Ericymba buccata	Silverjaw minnow
Nocomis micropogon	River chub
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner
N. chrysocephalus[2]	Striped shiner[2]
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 carpio	River carpsucker
Carpiodes cyprinus	Quillback
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hog sucker
Ictiobus bubalus	Smallmouth buffalo
I. niger	Black buffalo
Moxostoma anisurum	Silver redhorse
M. carinatum	River redhorse
M. duquesnei	Black redhorse
M. erythrurum	Golden redhorse
M. macrolepidotum	Shorthead redhorse
Ictaluridae (bullhead and catfishes)	
Ictalurus catus	White catfish

TABLE V-E-1
(Continued)

Family and Scientific Name	Common Name
I. melas	Black bullhead
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
Atherinidae (silversides)	
Labidesthes sicculus	Brook silverside
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 blennioides	Greenside darter
E. nigrum	Johnny darter
E. zonale	Banded darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
P. copelandi	Channel darter
Stizostedion canadense	Sauger
S. vitreum vitreum	Walleye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum

[1]Nomenclature follows Robins, *et al*. (1980).

[2]A former subspecies of *N. cornutus* (Gilbert, 1964) and previously reported as common shiner.

TABLE V-E-2

NUMBER OF FISH COLLECTED AT VARIOUS TRANSECTS BY GILL NET (G), ELECTROFISHING (E), AND MINNOW TRAP (M) IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1983
BVPS

Taxa	1			2A			2B			3			Grand Total			Annual Total	Percent Annual Total
	G	E	M	G	E	M	G	E	M	G	E	M	G	E	M		
Longnose gar		1					1						1	1		2	0.1
Gizzard shad	1	46		1	26			5		2	8		4	85		89	4.6
Northern pike							1						1			1	<0.1
Muskellunge				1						1			2			2	0.1
Tiger muskellunge	1						1						2			2	0.1
Common carp	6	20		6	3		1	1		15	2		28	26		54	2.8
River chub						1									1	1	<0.1
Golden shiner					1									1		1	<0.1
Emerald shiner		186	16		359	31		141	4		487	33		1,173	84	1,257	64.5
Striped shiner		1												1		1	<0.1
Spotfin shiner		3	1		6	4		2	5			65		11	75	86	4.4
Sand shiner		4			33	6		1	1		18	82		56	89	145	7.4
Mimic shiner					9			2	2		3	4		14	6	20	1.0
Bluntnose minnow		6	1		25	1		32	2		20	22		83	26	109	5.6
River carpsucker	1												1			1	<0.1
Quillback				1						3			4			4	0.2
White sucker					1					2			2	1		3	0.2
Northern hog sucker		1												1		1	<0.1
Silver redhorse		1												1		1	<0.1
Golden redhorse		1			3									4		4	0.2
Shorthead redhorse							1	1					1	1		2	0.1
Redhorse sp.							1						1			1	<0.1
Yellow bullhead	1												1			1	<0.1
Channel catfish	2			5			4	1		4			15	1		16	0.8
Flathead catfish										1			1			1	<0.1
Trout-perch					4			5			1			10		10	0.5
Brook silversides											6			6		6	0.3
White bass										2			2			2	0.1
Rock bass				1			1						2			2	0.1
Pumpkinseed		1												1		1	<0.1
Bluegill		1			3		1						1	4		5	0.3
Smallmouth bass		3			7			1						11		11	0.6
Spotted bass	13	3		16	3			2		26			55	8		63	3.2

TABLE V-E-2
(Continued)

Taxa	1			2A			2B			3			Grand Total			Annual Total	Percent Annual Total
	G	E	M	G	E	M	G	E	M	G	E	M	G	E	M		
Largemouth bass	1			1	5								2	5		7	0.4
White crappie	1			1						5			7			7	0.4
Black crappie		1		1						1			2	1		3	0.2
Yellow perch							1						1			1	<0.1
Logperch					2									2		2	0.1
Sauger	1			2			2			7			12			12	0.6
Walleye	4									2			6			6	0.3
Freshwater drum	2			2						2			6			6	0.3
TOTAL	34	279	18	38	490	43	15	194	14	73	545	206	160	1,508	281	1,949	

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, 1983
BVPS

Taxa	May			Jul			Sep			Nov			Grand Total			Annual Total	Percent Annual Total
	G	E	M	G	E	M	G	E	M	G	E	M	G	E	M		
Longnose gar		1					1						1	1		2	0.1
Gizzard shad		63		2	9		2	9			4		4	85		89	4.6
Northern pike	1												1			1	<0.1
Muskellunge	1			1									2			2	0.1
Tiger muskellunge				2									2			2	0.1
Common carp	2	1		5	1		20	2		1	22		28	26		54	2.8
River chub												1			1	1	<0.1
Golden shiner		1												1		1	<0.1
Emerald shiner		946	66		6	10		9			212	8		1,173	84	1,257	64.5
Striped shiner		1												1		1	<0.1
Spotfin shiner		4	23		7	43			2			7		11	75	86	4.4
Sand shiner		19	23		4	49		21			12	17		56	89	145	7.4
Mimic shiner		11	1			2					3	3		14	6	20	1.0
Bluntnose minnow		45	6			2		10			28	18		83	26	109	5.6
River carpsucker				1									1			1	<0.1
Quillback				1			3						4			4	0.2
White sucker	1	1								1			2	1		3	0.2
Northern hog sucker								1							1	1	<0.1
Silver redhorse		1												1		1	<0.1
Golden redhorse					3			1						4		4	0.[illegible]
Shorthead redhorse				1							1		1	1		2	0.1
Redhorse sp.				1									1			1	<0.1
Yellow bullhead							1						1			1	<0.1
Channel catfish	2	1		5			8						15	1		16	0.8
Flathead catfish							1						1			1	<0.1
Trout-perch		8									2			10		10	0.5
Brook silversides											6			6		6	0.3
White bass				2									2			2	0.1
Rock bass							2						2			2	0.1
Pumpkinseed											1			1		1	<0.1
Bluegill	1				1			2			1		1	4		5	0.3
Smallmouth bass		2			4			5						11		11	0.6
Spotted bass	2			3	4		50	1			3		55	8		63	3.2

TABLE V-E-3
(Continued)

Taxa	May			Jul			Sep			Nov			Grand Total			Annual Total	Percent Annual Total
	G	E	M	G	E	M	G	E	M	G	E	M	G	E	M		
Largemouth bass	1			1				5					2	5		7	0.4
White crappie				3			4						7			7	0.4
Black crappie		1		1			1						2	1		3	0.2
Yellow perch							1						1			1	<0.1
Logperch				2												2	0.1
Sauger	4			2			5						12			12	0.6
Walleye	1			4			1						6			6	0.3
Freshwater drum				2			3			1			6			6	0.3
TOTAL	16	1,106	119	37	41	106	103	66	2	4	295	54	160	1,508	281	1,949	

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, 1983
BVPS

	Transect					
Gill Net	1	2A	2B	3	Total	Average
May	1	3	4	8	16	4.0
July	8	10	4	15	37	9.2
September	25	25	7	46	103	25.8
November	0	0	0	4	4	1.0
Total	34	38	15	73	160	
Average	8.5	9.5	3.8	18.2		
Electrofishing						
May	231	392	166	317	1,106	276.5
July	3	21	10	7	41	10.2
September	6	56	3	1	66	16.5
November	39	21	21	214	295	73.8
Total	279	490	200	539	1,508	
Average	69.8	122.5	50.0	134.8		
Minnow Trap						
May	15	28	1	75	119	29.8
July	1	13	6	86*	106	30.3*
September	0	0	1	1	2	0.5
November	2	2	6	44	54	13.5
Total	18	43	14	206	281	
Average	4.5	10.8	3.5	58.9*		

*Gear at one station missing.

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 (Table V-E-5). 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. In addition, turbidity and current affects the collectors' ability to net the stunned 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 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 1983 gill net catch per unit effort (fish/24 hours) was the highest of any year to date, with 4.2 and 5.2 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 1983 are presented in Tables V-E-5 and V-E-6. These ten years represent two preoperational years (1974 and 1975) and eight operational years (1976 through 1983). Fish data for Transect 1 (Control Transect) and the averages 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 1970 to present, using several types of gear: electro-

TABLE V-E-5

ELECTROFISHING CATCH (FISH/HOUR) MEANS ($\bar{X}$) AT TRANSECTS IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1974-1983
BVPS

Species	Transect 1										Transects 2A, 2B, 3									
	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1981[d]	1982[d]	1983[d]	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1981[d]	1982[d]	1983[d]
Longnose gar	-	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	-	-	-	-	-
Gizzard shad	-	2.1	1.2	2.0	-	-	3.1	3.0	0.8	69.0	0.9	1.0	1.4	0.7	0.3	2.1	2.5	21.5	19.2	19.5
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	5.9	-	-	1.0	12.5	-	20.8	15.8	1.5	30.0	3.3	0.5	0.7	1.2	6.6	1.2	4.2	6.0	4.8	3.0
Golden shiner	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	0.2	0.5
Emerald shiner	42.0	441.7	18.7	57.0	22.8	58.4	51.5	151.5	114.8	279.0	67.7	239.9	13.1	33.8	23.9	53.7	37.0	163.5	21.8	493.5
Striped shiner	-	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	-	-	-	-	-
Spotfin shiner	0.9	-	4.8	7.0	0.5	-	-	-	3.0	4.5	4.3	2.0	6.1	4.9	0.5	0.5	1.0	0.8	1.0	4.0
Sand shiner	57.6	129.1	52.5	95.9	8.8	93.5	32.3	23.2	19.5	6.0	17.4	81.0	52.6	26.2	13.3	45.2	25.8	10.2	22.8	26.0
Mimic shiner	-	-	3.5	7.0	0.5	1.6	6.2	3.0	6.0	-	-	-	1.8	1.1	0.3	2.2	1.0	3.2	4.8	7.0
Bluntnose minnow	33.3	72.3	53.2	57.8	12.8	89.4	15.4	18.0	21.8	9.0	6.1	31.2	45.3	44.9	21.4	40.8	10.2	5.2	14.2	38.5
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	-	-	-	0.5
Northern hog sucker	0.7	-	-	1.0	0.3	-	-	-	-	1.5	-	-	-	0.3	0.3	0.3	0.2	0.8	-	-
Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-
Silver redhorse	-	-	-	-	-	-	-	-	0.0	1.5	-	-	-	-	0.3	-	-	0.2	0.2	-
Black redhorse	-	-	-	-	0.8	1.0	-	-	-	-	-	-	-	0.3	0.3	-	-	-	-	-
Golden redhorse	-	-	-	-	-	-	1.5	1.5	-	1.5	-	-	-	-	-	-	0.8	0.2	1.5	1.5
Shorthead redhorse	-	-	-	-	-	-	-	0.8	0.0	-	-	-	-	-	0.4	-	-	0.2	1.5	0.5
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	0.5
Trout-perch	-	-	-	-	-	-	1.5	-	0.8	-	-	-	-	-	0.1	0.5	0.2	-	0.2	5.0
Banded killifish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-
Brook silverside	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0
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	-	-	-	1.5	-	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	1.5	1.9	0.6	0.2	0.3	1.4	0.2	-	0.8	0.2	1.5
Smallmouth bass	0.9	-	2.3	3.0	0.3	0.5	4.6	3.0	3.8	4.5	0.8	-	0.6	1.0	0.3	0.9	2.8	6.5	5.8	4.0
Spotted bass	0.9	-	-	2.7	-	2.6	4.6	1.5	-	4.5	0.4	-	-	2.7	-	2.1	1.5	0.5	0.8	2.5
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	2.5
White crappie	-	-	-	-	-	-	1.5	-	-	-	-	-	-	-	0.1	-	0.8	-	-	-
Black crappie	-	-	-	-	-	-	-	-	-	1.5	0.5	-	0.3	-	-	0.2	-	-	-	-

TABLE V-E-5
(Continued)

Species	Transect 1										Transects 2A, 2B, 3									
	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1981[d]	1982[d]	1983[d]	1974[a]	1975[b]	1976[c]	1977[c]	1978[c]	1979[c]	1980[d]	1981[d]	1982[d]	1983[d]
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	1.0
Sauger	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.2	-	-
Walleye	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater drum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	-
Total	150.8	645.2	139.4	235.9	65.6	250.6	146.9	225.2	176.0	418.5	106.5	359.2	125.3	122.8	72.5	153.6	91.3	224.0	102.3	614.5

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

TABLE V-E-6

GILL NET CATCH (FISH/24 HOUR) MEANS ($\bar{X}$) AT TRANSECTS IN THE NEW CUMBERLAND POOL
THE OHIO RIVER, 1974-1983
BVPS

Species	Transect 1										Transects 2A, 2B, 3									
	1974[a]	1975[b]	1976[c]	1977[d]	1978[d]	1979[d]	1980[e]	1981[e]	1982[e]	1983[e]	1974[a]	1975[b]	1976[c]	1977[d]	1978[d]	1979[d]	1980[e]	1981[e]	1982[e]	1983[e]
Longnose gar	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1
Gizzard shad	-	-	-	-	-	-	0.1	-	0.4	0.1	0.2	0.1	-	0.1	-	<0.1	-	<0.1	0.7	0.1
Northern pike	-	-	-	0.1	-	-	-	-	-	-	-	-	-	0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1
Muskellunge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	<0.1	0.1
Tiger muskellunge	-	-	-	0.1	0.1	-	-	-	-	0.1	-	-	-	-	<0.1	-	<0.1	-	-	<0.1
Goldfish	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	0.1	-	-	<0.1	-	-	-
Carp	0.8	1.2	0.1	0.4	0.6	<0.1	-	0.4	-	0.8	0.9	0.3	0.2	0.6	0.3	0.3	0.2	0.3	0.9	0.9
Goldfish x Carp hybrid	-	-	-	-	-	-	-	-	-	-	-	0.1	-	0.1	-	-	-	-	-	-
River carpsucker	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
Quillback	-	-	0.1	0.2	-	-	-	0.1	0.1	-	-	-	<0.1	0.2	0.1	<0.1	<0.1	-	<0.1	0.2
White sucker	-	0.3	-	0.2	0.2	-	-	-	-	-	0.1	-	-	<0.1	-	<0.1	<0.1	-	-	0.1
Black redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	0.1	<0.1	-	-	-	-
Silver redhorse	-	-	-	-	-	<0.1	-	-	0.1	-	-	-	-	-	-	<0.1	-	-	<0.1	-
Golden redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	-
Shorthead redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1
Redhorse sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
Black bullhead	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-
Brown bullhead	0.4	-	-	-	0.1	-	-	-	-	-	0.2	-	<0.1	<0.1	-	-	-	-	..	-
Yellow bullhead	-	-	-	-	-	-	-	-	-	0.1	0.1	-	-	-	-	-	-	-	-	<0.1
White catfish	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-
Channel catfish	-	0.8	-	0.7	0.7	0.2	0.2	0.2	0.4	0.2	0.3	1.3	0.4	1.0	0.4	0.5	0.4	0.6	0.7	0.5
Flathead catfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1
White bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
Rock bass	-	0.3	-	0.2	0.1	0.2	-	-	-	-	-	0.1	-	<0.1	<0.1	<0.1	-	-	<0.1	0.1
Green sunfish	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	0.1	-	-	-	<0.1	-	-
Pumpkinseed	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	<0.1
Smallmouth bass	-	-	-	-	0.1	<0.1	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-
Largemouth bass	-	-	0.2	-	-	<0.1	-	-	0.1	0.1	0.2	0.1	0.1	<0.1	<0.1	-	-	-	<0.1	<0.1
Spotted bass	-	0.2	0.7	0.1	-	<0.1	-	-	0.5	1.6	-	-	0.2	0.1	<0.1	<0.1	0.1	<0.1	0.3	1.8
White crappie	-	-	-	-	0.1	-	-	-	-	0.1	-	-	<0.1	<0.1	-	0.1	0.1	-	<0.1	0.2
Black crappie	-	-	-	0.1	-	-	-	-	-	-	-	-	<0.1	0.1	-	<0.1	-	-	-	0.1
Yellow perch	0.4	0.6	0.5	0.8	0.3	0.2	-	-	-	-	-	0.7	0.5	0.7	0.1	0.1	-	<0.1	-	<0.1
Walleye	0.2	-	0.3	0.3	0.3	0.2	-	0.1	0.4	0.5	0.2	0.2	0.1	0.2	0.1	<0.1	0.2	0.1	0.7	0.1
Sauger	-	-	-	-	0.2	-	0.1	-	0.2	0.1	-	0.1	-	<0.1	0.2	0.3	<0.1	0.2	0.3	0.5
Freshwater drum	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-	-	-	-	0.1	0.3	0.2
Total	1.8	3.4	2.2	3.2	2.9	0.8-1.3	0.4	0.8	2.4	4.2	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	5.2

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

fishing, gill netting, and periodically 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 1970, 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 1970, 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 1983 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 habitat preferences of individual species. This habitat preference is probably the most influential factor that affects where the different species of fish are collected and in what relative abundance.

Data collected from 1970 through 1983 indicate that fish in the vicinity of the power plant have not been adversely affected by BVPS operation. In 1983, a gizzard shad die-off occured near the power plant discharge. This resulted from an unplanned shut-down of the power plant which in turn caused a rapid drop in discharge water temperature. This sudden drop in water temperature induced a stress condition in the fish which killed as estimated 20,100 gizzard shad. A detailed report of this incident is included in Appendix A of this report.

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 (13 April, 11 May, 14 June, and 12 July) were conducted during the spring and summer, which is the primary spawning season for most resident fish species. 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 24 eggs, 100 larvae, and two adults was collected in 1983 from 1010.3 m^3 of water sampled (Table V-F-1). Six taxa representing four families were identified. Gizzard shad (*Dorosoma cepedianum*) accounted for 49.2% (62 larvae) of the total catch. Freshwater drum (*Aplodinotus grunniens*) eggs represented 95.5% of the eggs collected in 1983. No juveniles were collected in 1983; however, two adult emerald shiners (*Notropis atherinoides*) were taken during the 11 May sampling.

On a seasonal basis, ichthyoplankton was most abundant and displayed the most diversity on 12 July when total daily density was 44.05 individuals

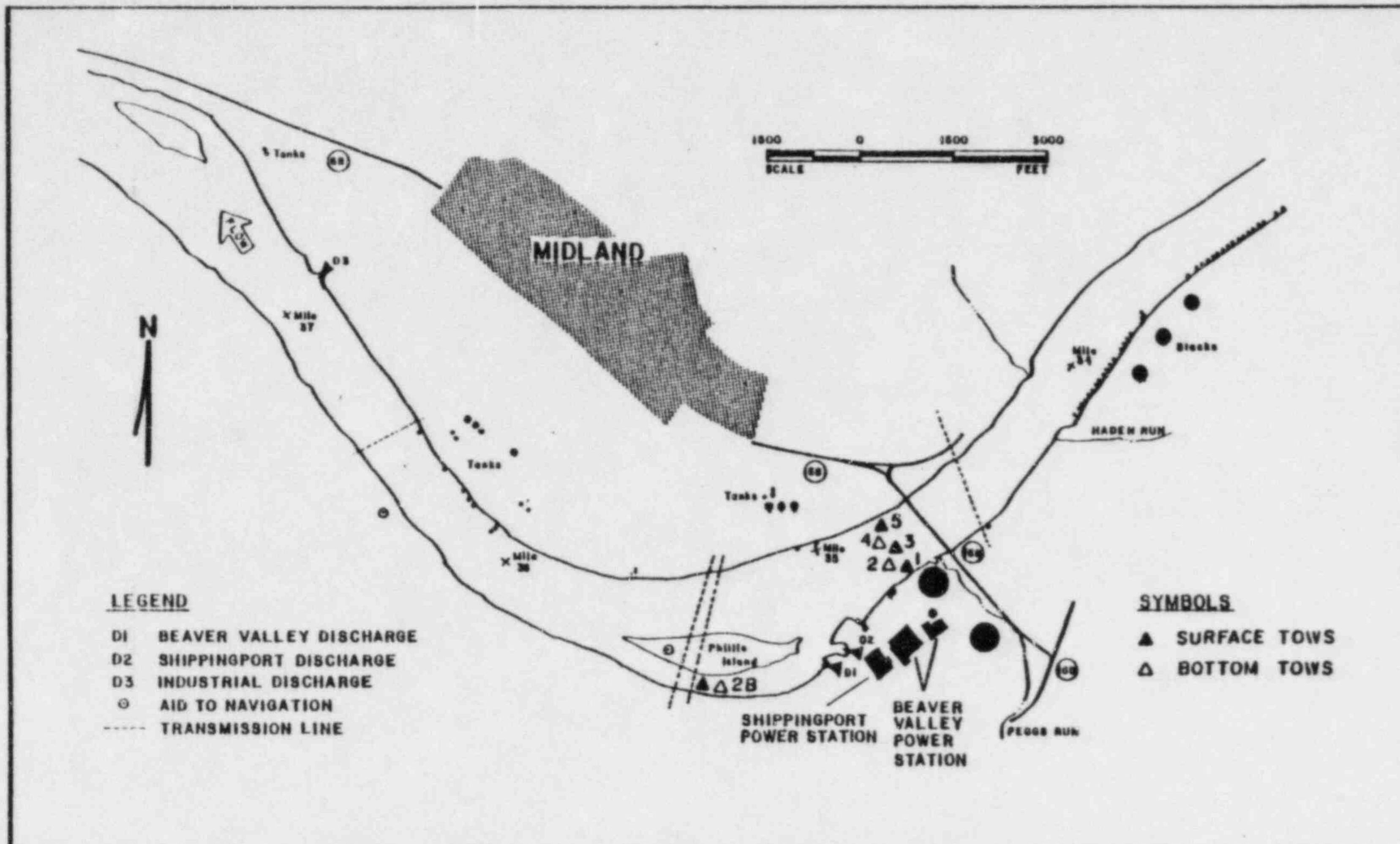


FIGURE V-F-1

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, 1983

	Depth of Collection		Total Collected and
	Surface	Bottom	Taxa Density
April 13			
Vol. water filtered (m^3)	114.3	89.0	203.3
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	0	0	0
Larvae	0	0	0
Total density (number collected)	0	0	0
May 11			
Vol. water filtered (m^3)	156.9	144.8	301.7
No. eggs collected	0	0	0
No. larvae collected	0	0	0
No. juveniles collected	0	0	0
No. adults collected	2	0	2
Density (number collected)			
Eggs	0	0	0
Larvae	0	0	0
Adults			
Notropis atherinoides	1.27 (2)	0	0.66 (2)
Total density (number collected)	1.27 (2)	0	0.66 (2)

TABLE V-F-1
(Continued)

	Depth of Collection		Total Collected and
	Surface	Bottom	Taxa Density
June 14			
Vol. water filtered (m^3)	106.4	140.1	246.5
No. eggs collected	1	0	1
No. larvae collected	1	9	10
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Cyprinidae spp.	0.94 (1)	0	0.41 (1)
Larvae			
Dorosoma cepedianum (YL)	0	2.86 (4)	1.62 (4)
Cyprinus carpio (YL)	0.94 (1)	0	0.41 (1)
Cyprinidae (YL)	0	2.86 (4)	1.62 (4)
Etheostoma spp. (EL)	0	0.71 (1)	0.41 (1)
Total density (number collected)	1.88 (2)	6.42 (9)	4.46 (11)
July 12			
Vol. water filtered (m^3)	125.9	132.6	258.8
No. eggs collected	0	23	23
No. larvae collected	8	83	91
No. juveniles collected	0	0	0
No. adults collected	0	0	0
Density (number collected)			
Eggs			
Aplodinotus grunniens	0	17.35 (23)	8.89 (23)
Larvae			
Dorosoma cepedianum (YL)	1.59 (2)	28.66 (38)	15.46 (40)
Dorosoma cepedianum (EL)	0	14.33 (19)	7.34 (19)
Notropis spp. (YL)	1.59 (2)	4.52 (6)	3.09 (8)
Notropis spp. (EL)	3.18 (4)	14.33 (19)	8.89 (23)
Unidentifiable (L)	0	0.75 (1)	0.39 (1)
Total density (number collected)	6.35 (8)	79.94 (106)	44.05 (114)

TABLE V-F-1
(Continued)

Yearly Totals	Depth of Collection		Total Collected and Taxa Density
	Surface	Bottom	
Vol. water filtered (m^3)	503.5	506.5	1010.3
No. eggs collected	1	23	24
No. larvae collected	9	92	100
No. juveniles collected	0	0	0
No. adults collected	2	0	2
Density (number collected)			
Eggs			
Cyprinidae spp.	0.20 (1)	0	0.10 (1)
Aplodinotus grunniens	0	4.54 (23)	2.28 (23)
Larvae			
Dorosoma cepedianum (YL)	0.40 (2)	8.29 (42)	4.36 (44)
Dorosoma cepedianum (EL)	0	3.75 (19)	1.88 (19)
Cyprinus carpio (YL)	0.20 (1)	0	0.10 (1)
Cyprinidae (YL)	0	0.79 (4)	0.40 (4)
Notropis spp. (YL)	0.40 (2)	1.18 (6)	0.79 (8)
Notropis spp. (EL)	0.79 (4)	3.75 (19)	2.23 (23)
Etheostoma spp. (EL)	0	0.20 (1)	0.10 (1)
Unidentifiable (L)	0	0.20 (1)	0.10 (1)
Adults			
Notropis atherinoides	0.40 (2)	0	0.20 (2)
Total density (number collected)	2.38 (12)	22.70 (115)	12.57 (127)

[a] Developmental Stages

YL - Hatched specimens with yolk and/or oil globules present.

EL - Specimens with no yolk and/or oil globules and with no development of fin rays and/or spiny elements.

L - Specimens with undefinable larval stage due to deterioration.

per 100 m^3 of water filtered (Table V-F-2). Collections on 14 June yielded 4.46 individuals per 100 m^3 mostly cyprinidae eggs and larvae. Sampling on 13 April yielded no ichthyoplankton.

Comparison of Preoperational and Operational Data

Species abundance and composition was similar to that found in previous years. Gizzard shad and 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, 1976-1983, are presented in Table V-F-2.

Summary and Conclusions

Gizzard shad and cyprinids dominated the 1983 ichthyoplankton catch from the back channel of Phillis Island. Peak densities occurred 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/100 m^3) COLLECTED IN THE OHIO RIVER BACK CHANNEL OF PHILLIS ISLAND (STATION 2B) NEAR BVPS, 1973-1974, 1976-1983

Date	Density	Date	Density
1973		1979	
12 April	0	19 April	0
17 May	0	1 May	0
20 June	16.10	17 May	0.81
26 July	3.25	7 June	0.39
		20 June	11.69
		5 July	14.82
1974		1980	
16 April	0	23 April	0.42
24 May	0	21 May	0.53
13 June	6.98	19 June	9.68
26 June	9.25	22 July	107.04
16 July	59.59		
1 August	6.85		
1976		1981	
29 April	0.70	20 April	1.10
19 May	0	12 May	0
18 June	5.99	17 June	26.40
2 July	6.63	22 July	17.14
15 July	3.69		
29 July	4.05		
1977		1982	
14 April	0	19 April	0
11 May	0.90	18 May	3.77
9 June	24.22	21 June	7.54
22 June	3.44	20 July	31.66
7 July	3.31		
20 July	28.37		
1978		1983	
22 April	0	13 April	0
5 May	0	11 May	0.66
20 May	0.98	14 June	4.46
2 June	4.01	12 July	44.05
16 June	12.15		
2 July	13.32		

G. FISH IMPINGEMENT

Objective

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

Methods

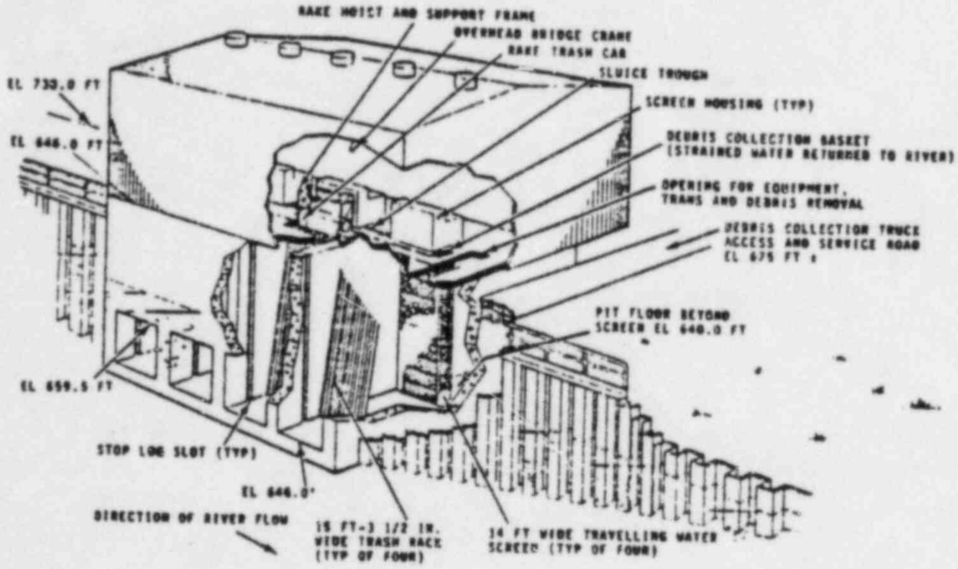
The surveys were conducted weekly throughout 1983 for a total of 52 weeks (Table V-A-1). Except when technical difficulties delayed the start of collections, weekly fish impingement sampling began on Thursday mornings when all four traveling screens were washed. A collection basket of 0.25 inch mesh 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 hour sampling period) and non-operating intake bays.

Results

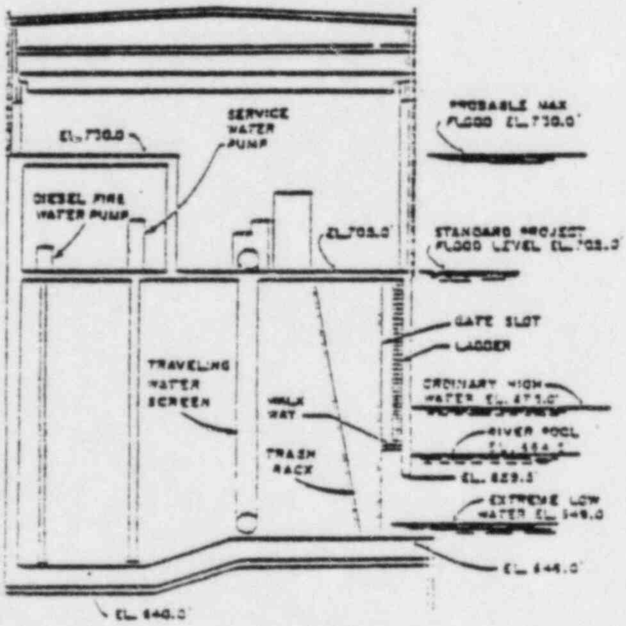
The BVPS impingement surveys of 1976 through 1983 have resulted in the collection of 34 species of fish representing nine families (Table V-G-1). A total of 216 fish, representing 22 species (24 taxa) was collected in 1983 (Table V-G-2). Channel catfish were the most numerous fish, comprising 18.0% of the total annual catch, followed by bluegill (17.6%), gizzard shad (16.7%) and freshwater drum (14.4%), with all other species represented by less than 20 specimens. Percina copelandi a channel darter, which had not been collected in previous years, was collected in 1983. All fishes ranged in size from 20 mm to 455 mm, with the majority under 120 mm. The total weight of fish collected in 1983 was 3.38 kg (7.5 lbs). Approximately 25% of the total weight of fish collected (both alive and dead) was due to one (1) large channel catfish which was collected on November 25. This fish exhibited a large cut on the top of the head probably due to a boat propeller and was undoubedly dead long before collection. It is believed that this fish simply

FIGURE V-G-1

INTAKE STRUCTURE
BVPS



(Three dimensional: Cutaway View)



(Two dimensional: Side View)

TABLE V-G-1

FISH COLLECTED DURING THE[(a)]
IMPINGEMENT SURVEYS, 1976-1983
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 and 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)

Percidae (perches)	
Etheostoma nigrum	Johnny darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
P. copelandi	Channel darter
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 1983
BVPS

				OPERATING INTAKE BAYS[a]				NON-OPERATING INTAKE BAYS[b]				
				Alive		Dead		Alive		Dead		
Taxa	Number	Percent Frequency Occurrence	Percent Composition	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)	Length Range (mm)
Gizzard shad	36	19.2	16.7			33	946			3	47	95-245
Common carp	1	1.9	0.5	1	4							75
Emerald shiner	18	21.2	8.3	2	2	13	16			3	3	25-73
Shiner (*Notropis* sp.)	1	1.9	0.5							1	1	38
Mimic shiner	1	1.9	0.5			1	2					53
Yellow bullhead	2	3.8	0.9	1	6					1	26	75-124
Brown bullhead	3	3.8	1.4	2	8			1	1			42-80
Channel catfish	39	42.8	18.0	14	97	17	928	7	275	1	1	62-455
Flathead catfish	1	1.9	0.5	1	10							94
Trout-perch	1	1.9	0.5			1	3					76
Rock bass	2	3.8	0.9	1	4			1	2			49-60
Green sunfish	11	17.3	5.1	6	44			5	30			47-93
Pumpkinseed	4	7.7	1.8	2	34			1	10	1	2	58-102
Bluegill	38	48.1	17.6	10	40	8	34	18	139	2	2	22-116
Sunfish (*Lepomis* sp.)	3	5.8	1.4							3	3	20-22
Smallmouth bass	1	1.9	0.5	1	25							123
Spotted bass	10	13.5	4.6	1	28	1	23	5	118	3	57	110-135
Largemouth bass	5	3.8	2.3	2	62	2	44			1	22	110-143
White crappie	2	3.8	0.9			2	42					97-123
Black crappie	1	1.9	0.5			1	11					97
Johnny darter	3	3.8	1.4	2	2	1	1					40-50
Logperch	1	1.9	0.5	1	6							95
Channel darter	1	1.9	0.5	1	1							35
Freshwater drum	31	25.0	14.4	14	98	4	25	11	75	2	17	52-118
Total	216			62	471	84	2,075	49	650	21	181	
Percent of Total				28.7	13.9	38.9	61.4	22.7	19.2	9.7	5.4	

(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

drifted into the bay after death. No endangered or threatened species were collected (Commonwealth of Pennsylvania, 1979).

Other organisms collected in the impingement surveys include 253 crayfish, 24 native clams, 12 dragonflies, 1 damselfly and 30 leeches (Tables V-G-6 and V-G-8). In addition, 965 Asiatic clams (Corbicula) were collected (Table V-G-7).

The temporal distribution of the 1983 impingement catch closely follows the pattern of catches of previous years (1976 to 1982) (Tables V-G-3 and V-G-4). During each year, generally the largest numbers of fish have been collected in the winter months (December-February) and then the catch has gradually decreased until the late summer 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. Of the 44 species collected, 18 were observed in both locations, 4 species were collected only in the impingement surveys, while 22 species were taken exclusively in the river. The major difference in species composition between the two type of collections is the absence of large species in the impingement collections. Six species of suckers and/or redhorses, and four species of sport fish (muskellunge, northern pike, walleye, and sauger) were collected in the river studies, but were not collected in the impingement surveys. 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 216 fish collected during the 1983 impingement studies, 146 (67.6%) were collected from operating intake bays and 70 (32.4%) from non-operating intake bays (Table V-G-2). However, due to differences between the number of operating (99) and non-operating (89) screens washed in 1983, the impingement data were computed with catch expressed

TABLE V-G-3

SUMMARY OF IMPINGEMENT SURVEY DATA FOR 1983
BVPS

Date		Number of Fish	Percent	Operating Intake Bays[a]		Non-Operating Intake Bays[b]		Intake Bays Operating				Intake Water	River Elevation Above Mean
Month	Day	Collected	Annual Total	Alive	Dead	Alive	Dead	A	B	C	D	Temp °F	Sea Level
January	9	0	0.0						X	X	X	41.0	666.8
	14	2	0.9		2			X	X	X		41.8	666.7
	23	3	1.4		3			X	X	X		38.5	666.4
	28	4	1.8		4			X		X		40.0	666.3
February	4	4	1.8	2	1		1	X		X		41.2	669.8
	11	4	1.8		4			X		X		38.5	666.7
	18	2	0.9	1	1			X		X		40.2	666.9
	25	1	0.5		1			X		X		42.8	666.2
March	4	1	0.5			1		X		X		45.2	666.5
	11	3	1.4		1		2			X	X	50.0	666.9
	18	1	0.5		1					X	X	49.0	666.8
	25	5	2.3	3			2			X	X	44.2	669.5
April	1	4	1.8	2	1	1				X	X	45.8	668.2
	8	2	0.9	1		1		X		X		50.2	667.4
	15	1	0.5		1			X		X		51.8	670.5
	22	3	1.4		2	1		X		X		48.0	668.0
	29	8	3.7		4	1	3	X		X		56.8	667.2
March	6	8	3.7		7		1	X		X		58.2	671.8
	13	2	0.9	2				X	X	X		61.0	666.8
	20	5	2.3		5			X	X			62.0	668.6
	27	4	1.8	1	1	2		X		X		62.5	669.8
June	3	3	1.4			2	1	X	X			64.8	666.2
	10	2	0.9	1		1		X	X			69.0	666.0
	17	3	1.4	1		2			X	X		76.8	666.0
	25	1	0.5	1				X		X		77.4	666.2
July	1	0	0					X		X		76.0	667.5
	8	0	0							X		76.2	665.8
	15	1	0.5			1				X		80.0	665.0
	22	2	0.9	1		1				X		83.0	666.2
	29	1	0.5				1			X		82.5	666.0
August	5	0	0					X		X		82.0	666.5
	12	1	0.5	1				X				82.0	666.2
	19	3	1.4	1			2	X				77.4	664.8
	26	3	1.4			1	2	X				81.0	666.5

TABLE V-G-3
(Continued)

Date		Number of Fish	Percent	Operating Intake Bays[a]		Non-Operating Intake Bays[b]		Intake Bays Operating				Intake Water	River Elevation Above Mean
Month	Day	Collected	Annual Total	Alive	Dead	Alive	Dead	A	B	C	D	Temp °F	Sea Level
September	2	6	2.8	5	1			X	X			81.0	666.5
	9	11	5.1	5		5	1	X	X			78.6	666.3
	16	2	0.9			2		X		X		75.2	666.2
	23	3	1.4	3				X		X	X	65.0	666.5
	28	7	3.2	2		5			X		X	62.5	666.5
October	7	6	2.8	5		1			X			61.5	666.0
	14	6	2.8	3		2	1			X	X	58.2	666.0
	21	8	3.7	3	3	2				X	X	55.4	665.6
	28	3	1.4	1		2				X	X	51.5	666.0
November	4	2	0.9	2				X			X	49.5	666.5
	11	4	1.8			4		X			X	46.5	666.5
	18	7	3.2	4	1	1	1	X	X		X	38.5	667.8
	25	5	2.3		2	3			X		X	40.0	666.8
December	2	5	2.3	3	2				X		X	37.8	668.0
	9	8	3.7	3	3	2			X		X	35.0	670.8
	16	10	4.6	1	4	2	3		X		X	36.5	670.0
	23	8	3.7		6	2			X		X	29.5	670.5
	30	28	13.0	4	23	1			X		X	26.0	671.5
TOTAL		216		62	84	49	21						

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

TABLE V-G-4

SUMMARY OF FISH COLLECTED IN IMPINGEMENT SURVEYS, 1976-1983
BVPS

Number of Fish Collected

Month	1976 Operating Intake Bays[1]	1976 Non-operating Intake Bays[2]	1976 Total	1977 Operating Intake Bays	1977 Non-operating Intake Bays	1977 Total	1978 Operating Intake Bays	1978 Non-operating Intake Bays	1978 Total	1979 Operating Intake Bays	1979 Non-operating Intake Bays	1979 Total
January	3,792	2,021	5,813	1,136	2,869	4,005	186	41	227	66	16	82
February	1,087	1,034	2,121	3,622	2,039	5,661	99	73	172	9	8	17
March	260	128	388	314	72	386	36	113	149	15	10	25
April	19	11	30	7	3	10	3	1	4	1	0	1
May	5	2	7	3	0	3	-	-	-	3	1	4
June	4	1	5	4	3	7	2	4	6	2	0	2
July	20	12	32	27	5	32	9	3	12	5	2	7
August	27	10	37	6	1	7	6	12	18	20	34	54
September	8	6	14	1	4	5	7	15	22	9	9	19
October	35	8	43	8	3	11	4	14	18	21	6	[illegible]
November	15	4	19	9	0	9	1	2	3	7	6	13
December	374	219	593	174	12	186	20	3	23	8	4	12
Total	5,646	3,456	9,102	5,311	5,011	10,322	373	281	654	162	100	262

Number of Fish Collected

Month	1980 Operating Intake Bays[1]	1980 Non-operating Intake Bays[2]	1980 Total	1981 Operating Intake Bays	1981 Non-operating Intake Bays	1981 Total	1982 Operating Intake Bays	1982 Non-operating Intake Bays	1982 Total	1983 Operating Intake Bays	1983 Non-operating Intake Bays	1983 Total
January	5	0	5	5	1	6	[illegible]	16	44	9	0	9
February	5	7	12	21	1	22	[illegible]	42	66	10	1	11
March	16	13	29	4	2	6	[illegible]	7	11	5	5	10
April	0	11	11	8	0	8	[illegible]	6	9	11	7	18
May	0	2	2	7	2	9	1	1	2	16	3	19
June	0	4	4	3	0	3	0	2	2	3	6	9
July	3	10	13	5	2	7	4	5	9	1	3	4
August	10	4	14	12	1	13	14	0	14	2	5	7
September	4	0	4	15	4	19	13	3	16	16	13	29
October	2	2	4	10	2	12	7	12	19	15	8	23
November	3	1	4	4	0	4	4	4	8	9	9	18
December	6	0	6	28	4	32	16	9	25	49	10	59
Total	54	54	108	122	19	141	120	107	227	146	70	216

[1] Intake bays that had pumps operating in the 24 hr sampling period.
[2] 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, 1983
BVPS

Species[a]	Total Number of Fish Collected		Percent of Annual Total	
	Impingement	River	Impingement	River
Longnose gar	0	2	0	0.1
Gizzard shad	36	89	16.7	4.6
Northern pike	0	1	0	<0.1
Muskellunge	0	2	0	0.1
Tiger muskellunge	0	2	0	0.1
Common carp	1	54	0.5	2.8
River chub	0	1	0	<0.1
Golden shiner	0	1	0	<0.1
Emerald shiner	18	1,257	8.3	64.5
Striped shiner	0	1	0	<0.1
Spotfin shiner	0	86	0	4.4
Sand shiner	0	145	0	7.4
Mimic shiner	1	20	0.5	1.0
Bluntnose minnow	0	109	0	5.6
River carpsucker	0	1	0	<0.1
Quillback	0	4	0	0.2
White sucker	0	3	0	0.2
Northern hog sucker	0	1	0	<0.1
Silver redhorse	0	1	0	<0.1
Golden redhorse	0	4	0	0.2
Shorthead redhorse	0	2	0	0.1
Yellow bullhead	2	1	0.9	<0.1
Brown bullhead	3	0	1.4	0
Channel catfish	39	16	18.0	0.8
Flathead catfish	1	1	0.5	<0.1
Trout-perch	1	10	0.5	0.5
Brook silverside	0	6	0	0.3
White bass	0	2	0	0.1
Rock bass	2	2	0.9	0.1
Green sunfish	11	0	5.1	0
Pumpkinseed	4	1	1.8	<0.1
Bluegill	38	5	17.6	0.3
Smallmouth bass	1	11	0.5	0.6
Spotted bass	10	63	4.6	3.2
Largemouth bass	5	7	2.3	0.4
White crappie	2	7	0.9	0.4
Black crappie	1	3	0.5	0.2
Johnny darter	3	0	1.4	0
Yellow perch	0	1	0	<0.1

TABLE V-G-5
(Continued)

Species[a]	Total Number of Fish Collected		Percent of Annual Total	
	Impingement	River	Impingement	River
Logperch	1	2	0.5	0.1
Channel darter	1	0	0.5	0
Sauger	0	12	0	0.6
Walleye	0	6	0	0.3
Freshwater drum	31	6	14.4	0.3
Total	212	1,948		

[a] Includes only those specimens identified to species or stocked hybrids.

TABLE V-G-6

SUMMARY OF CRAYFISH COLLECTED IN IMPINGEMENT SURVEYS
CONDUCTED FOR ONE 24-HOUR PERIOD PER WEEK, 1983
BVPS

Date		Number Collected			
		Operating Intake Bays		Non-Operating Intake Bays	
Month	Day	Alive	Dead	Alive	Dead
January	9	5	1	2	1
	14	4			1
	23	1			
	28	2		2	
February	4	1	1		
	11	2		2	
	18	4		3	1
	25	8	1	1	
March	4	5		3	
	11	7	3	7	
	18	4	1	1	2
	25	1		6	1
April	1	2	3	2	1
	8	7	1	2	1
	15	6	1	2	1
	22	3			
	29	1	2	2	1
May	6			2	2
	13	1	1		
	20	1			1
	27				
June	3	1			
	10				
	17			1	1
	25	4	1		1
July	1	1	3	1	1
	8	1		2	
	15	1		2	
	22				1
	29	1	1	1	3
August	5	2		9	2
	12	2	1		
	19	1	1	1	
	26	1			1
September	2	2	2		
	9				
	16			1	
	23		1		
	28				1
October	7				
	14	1	1		
	21			2	1
	28				

TABLE V-G-6
(Continued)

Date		Number Collected			
		Operating Intake Bays		Non-Operating Intake Bays	
Month	Day	Alive	Dead	Alive	Dead
November	4		1		
	11				1
	18		3		
	25			1	2
December	2	5		3	
	9	5		4	1
	16	12	1	7	1
	23	2		9	
	30			2	2
Total		107	31	83	32

TABLE V-G-7

SUMMARY OF *Corbicula* COLLECTED IN IMPINGEMENT
SURVEYS FOR ONE 24-HOUR PERIOD PER WEEK, 1983
BVPS

Date		Number Collected			
		Operating Intake Bays		Non-Operating Intake Bays	
Month	Day	Alive	Dead	Alive	Dead
January	9	5	2		
	14		1	5	1
	23	1	1		
	28				
February	4		1		
	11			1	1
	18		2		
	25		1		
March	4		1		
	11	2		1	3
	18				
	25		10	1	
April	1		4		5
	8		1		
	15				5
	22				1
	29				14
May	6			2	4
	13	1	5		3
	20				4
	27		1		1
June	3			2	1
	10				1
	17		1		2
	25	6		1	5
July	1		9	1	2
	8		1		2
	15		3		24
	22	1	2	1	5
	29		2		7
August	5		1		1
	12	1	1		
	19			1	3
	26	5	7		9
September	2	6	14	1	7
	9	32	23	8	1
	16	11	32	41	4
	23		19		
	28	4	3	50	45
October	7	3	4	20	13
	14	3	9	71	45
	21	1	3	5	7
	28		3	10	6

TABLE V-G-7
(Continued)

Date		Number Collected			
		Operating Intake Bays		Non-Operating Intake Bays	
Month	Day	Alive	Dead	Alive	Dead
November	4	6	5	1	1
	11	2	3	1	1
	18		4		1
	25	1		3	2
December	2		4	3	8
	9			17	3
	16		5	43	14
	23			39	13
	30	5	3	62	12
Total		96	191	391	287

TABLE V-G-8

SUMMARY OF MISCELLANEOUS INVERTEBRATES COLLECTED
IN IMPINGEMENT SURVEYS CONDUCTED FOR ONE 24-HOUR
PERIOD PER WEEK, 1983
BVPS

Date		Number of Organisms in all Bays		
Month	Day	Mollusks[(a)]	Dragonflies	Leeches
January	9			
	14	1		
	23			
	28			
February	4	1	1	
	11	1		
	18			
	25			
March	4			
	11	2		
	18			
	25	2		
April	1	1		
	8			
	15		1	
	22		1	
	29	1		2
May	6		2	4
	13		1	2
	20			2
	27			
June	3			3
	10		1	
	17		1[(b)]	
	25			2
July	1	1		4
	8		1	
	15			3
	22			4
	29			2
August	5	1		1
	12			
	19			
	26			
September	2		1	
	9	1		
	16	2	1	
	23			
	28		1	
October	7	1		
	14			
	21			
	28	1		

TABLE V-G-8
(Continued)

Date		Number of Organisms in all Bays		
Month	Day	Mollusks[a]	Dragonflies	Leeches
November	4			
	11			
	18	1		
	25			
December	2	1	1	
	9	3		1
	16	3		
	23			
	30			
Total		24	13	30

(a) Other than Corbicula
(b) Damselfly

as fish per 1000 m^2 of screen surface area washed. These results showed 8.3 and 4.4 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.

Of the 253 crayfish collected in the 1983 impingement studies, 138 (54.5%) were collected from operating bays and 115 (45.5%) 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 7.8 and 7.2 crayfish for operating and non-operating screens, respectively. On the otherhand, Corbicula collected in the 1983 studies included 287 (29.7%) in the operating bays and 678 (70.3%) in the non-operating bays. Again, adjusting these data for the screen surface area washed (Corbicula per 1000 m^2) the results show 16.2 and 42.7 Corbicula for operating and non-operating screens, respectively.

Summary and Conclusions

The results of the 1983 impingement surveys indicate that withdrawal of river water at the BVPS intake for cooling purposes has little or no effect on the fish populations. Two hundred sixteen fish were collected, which is the third fewest collected since initial operation of BVPS in 1976. Of the 216 fish collected, 111 (51.4%) were alive and returned via the discharge pipe to the Ohio River.

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 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, from 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 dengal 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 42 eggs, 232 larvae, 2 juveniles and 688 adults representing seven taxa of four families was collected from 2059.9 m^3 of water filtered during sampling along the river entrainment transects (Table V-H-1). Minnows (Cyprinidae spp.) were the most common taxa, representing 91% of the total catch (66.7% of the eggs, 81% of the larvae, 50% of the juveniles and 100% of the adults). Early larvae shiners (Notropis sp.) were the most abundant larval life stage collected (103

TABLE V-H-1

NUMBER AND DENSITY OF FISH EGGS, LARVAE, JUVENILES, AND ADULTS
(Number/100 m^3) COLLECTED WITH A 0.5 m PLANKTON NET
AT THE ENTRAINMENT RIVER TRANSECT IN THE OHIO RIVER NEAR BVPS, 1983

April 13	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
Vol. water filtered (m^3)	94.0	88.6	115.3	96.8	101.8	496.5
No. eggs collected	1	2	0	1	0	4
No. larvae collected	0	0	0	0	0	0
No. juveniles collected	0	0	0	0	0	0
No. adults collected	684	0	0	0	1	685
Density (number collected)						
Eggs						
Percidae	1.06 (1)	2.26 (2)	0	1.03 (1)	0	0.81 (4)
Adults						
Notropis atherinoides	727.66 (684)	0	0	0	0.98 (1)	137.97 (685)
Total Station Density (number collected)	728.72 (685)	2.26 (2)	0	1.03 (1)	0.98 (1)	138.77 (689)

May 11	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
Vol. water filtered (m^3)	79.8	121.5	142.9	121.6	89.0	554.8
No. eggs collected	0	0	0	0	0	0
No. larvae collected	0	1	0	0	0	1
No. juveniles collected	0	0	0	0	0	0
No. adults collected	1	0	0	1	1	3
Density (number collected)						
Eggs						
Larvae						
Stizostedion sp. (YL)	0	0.82 (1)	0	0	0	0.18 (1)
Adults						
Notropis atherinoides	1.25 (1)	0	0	0.82 (1)	1.12 (1)	0.54 (3)
Total Station Density (number collected)	1.25 (1)	0.82 (1)	0	0.82 (1)	1.12 (1)	0.72 (4)

June 14	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
Vol. water filtered (m^3)	75.0	106.2	104.1	84.3	96.1	465.7
No. eggs collected	0	7	2	10	0	19
No. larvae collected	1	26	1	16	0	44
No. juveniles collected	0	0	0	0	0	0
No. adults collected	0	0	0	0	0	0
Density (number collected)						
Eggs						
Cyprinidae	0	4.71 (5)	0.96 (1)	10.68 (9)	0	3.22 (15)
Aplodinotus grunniens	0	1.88 (2)	0.96 (1)	1.19 (1)	0	0.86 (4)

TABLE V-H-1
(Continued)

	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
Larvae						
Dorosoma cepedianum (YL)	0	6.59 (7)	0	0	0	1.50 (7)
Dorosoma cepedianum (EL)	0	0	0	2.37 (2)	0	0.43 (2)
Cyprinus carpio (YL)	0	8.47 (9)	0.96 (1)	9.49 (8)	0	3.87 (18)
Pimephales sp. (YL)	0	0.94 (1)	0	0	0	0.21 (1)
Notropis spp. (EL)	1.33 (1)	0	0	0	0	0.21 (1)
Cyprinidae (YL)	0	8.47 (9)	0	7.12 (6)	0	3.22 (15)
Total Station Density (number collected)	1.33 (1)	31.07 (33)	2.88 (3)	30.84 (26)	0	13.53 (63)
July 12						
Vol. water filtered (m³)	97.1	116.1	127.2	105.3	97.2	542.9
No. eggs collected	0	3	2	14	0	19
No. larvae collected	65	35	4	78	5	187
No. juveniles collected	1	1	0	0	0	2
No. adults collected	0	0	0	0	0	0
Density (number collected)						
Eggs						
Cyprinidae	0	0.86 (1)	0	11.40 (12)	0	2.39 (13)
Aplodinotus grunniens	0	1.72 (2)	1.57 (2)	1.90 (2)	0	1.11 (6)
Larvae						
Dorosoma cepedianum (YL)	0	12.06 (14)	0.79 (1)	35.14 (37)	0	9.58 (52)
Dorosoma cepedianum (EL)	0	3.45 (4)	0	0	0	0.74 (4)
Notropis spp. (YL)	0	5.17 (6)	0	15.19 (16)	0	4.05 (22)
Notropis spp. (EL)	64.88 (63)	9.47 (11)	2.36 (3)	18.99 (20)	5.14 (5)	18.79 (102)
Notropis spp. (LL)	1.03 (1)	0	0	0	0	0.18 (1)
Aplodinotus grunniens (YL)	0	0	0	4.75 (5)	0	0.92 (5)
Unidentifiable (L)	1.03 (1)	0	0	0	0	0.18 (1)
Juveniles						
Pimephales notatus	1.03 (1)	0	0	0	0	0.18 (1)
Etheostoma sp.	0	0.86 (1)	0	0	0	0.18 (1)
Total Station Density (number collected)	67.97 (66)	33.59 (39)	4.72 (6)	87.37 (92)	5.14 (5)	38.31 (208)
Yearly Total						
Vol. water filtered (m³)	345.9	432.4	489.5	408.0	384.1	2059.9
No. eggs collected	1	12	4	25	0	42
No. larvae collected	66	62	5	94	5	232
No. juveniles collected	1	1	0	0	0	2
No. adults collected	685	0	0	1	2	688

TABLE V-H-1
(Continued)

	Station 1[a]	Station 2	Station 3	Station 4	Station 5	Total Collected and Taxa Density
Density (number collected)						
Eggs						
Cyprinidae	0	1.39 (6)	0.20 (1)	5.15 (21)	0	1.36 (28)
Percidae	0.29 (1)	0.46 (2)	0	0.25 (1)	0	0.19 (4)
Aplodinotus grunniens	0	0.93 (4)	0.61 (3)	0.74 (3)	0	0.49 (10)
Larvae						
Dorosoma cepedianum (YL)	0	4.86 (21)	0.20 (1)	9.07 (37)	0	2.86 (59)
Dorosoma cepedianum (EL)	0	0.93 (4)	0	0.49 (2)	0	0.29 (6)
Cyprinus carpio (YL)	0	2.08 (9)	0.20 (1)	1.96 (8)	0	0.87 (18)
Pimephales sp. (YL)	0	0.23 (1)	0	0	0	0.05 (1)
Notropis spp. (YL)	0	1.39 (6)	0	3.92 (16)	0	1.07 (22)
Notropis spp. (EL)	18.50 (64)	2.54 (11)	0.61 (3)	4.90 (20)	1.30 (5)	5.00 (103)
Notropis spp. (LL)	0.29 (1)	0	0	0	0	0.05 (1)
Cyprinidae (YL)	0	2.08 (9)	0	1.47 (6)	0	0.73 (15)
Stizostedion sp. (YL)	0	0.23 (1)	0	0	0	0.05 (1)
Aplodinotus grunniens (YL)	0	0	0	1.23 (5)	0	0.24 (5)
Unidentifiable (L)	0.29 (1)	0	0	0	0	0.05 (1)
Juveniles						
Pimephales notatus	0.29 (1)	0	0	0	0	0.05 (1)
Etheostoma sp.	0	0.23 (1)	0	0	0	0.05 (1)
Adults						
Notropis atherinoides	197.75 (684)	0	0	0.25 (1)	0.52 (2)	33.35 (687)
Total Station Density (number collected)	217.40 (752)	17.35 (75)	1.84 (9)	29.41 (120)	1.82 (7)	46.75 (963)

[a]Station 1 - South Shoreline; Station 3 - Mid-channel, Station 5 - North Shoreline.

YL - Hatched specimens with yolk and/or oil globules present.
EL - Specimens with no yolk and/or oil globules and with no development of fin rays and/or spiny elements.
LL - Specimens with developed fin rays and/or spiry elements and evidence of a fin fold.

individuals; total yearly density = 5.00/100 m^3). Gizzard shad (Dorosoma cepedianum) yolk-sac larvae were the second most abundant stage, numbering 59 individuals (2.86/100 m^3).

The remaining larval taxa collected included sauger/walleye (Stizostedion spp.), common carp (Cyprinus carpio), minnow (Pimephales sp.), and freshwater drum (Aplodinotus grunniens); all numbered less than 18 individuals.

Seasonal Distribution

A large number of emerald shiner adults (684 individuals) were collected during the April ichthyoplankton sampling at Station 1. During the same survey, one egg was collected each at Stations 1 and 4 and two eggs were collected at Station 2. No larvae or juveniles were collected (Table V-H-1).

Samples taken in May yielded no eggs, only one larva (0.18/100 m^3) and three adults (0.54/100 m^3). Fifteen of the 19 eggs collected in June were minnows, and 35 of 44 larvae collected were minnows. Samples taken in July included 19 eggs (68.5% in the minnow family), 187 larvae (66.8% in the minnow family) and 2 juveniles.

Spatial Distribution

Eggs were more abundant at Stations 2 and 4 where deep tows were made than at Stations 1, 3 and 5 (Table V-H-1). Larvae were generally more abundant at Stations 1, 2 and 4. Nearly all larvae collected at Station 1 (N=64; 18.50/100 m^3), the station nearest to the BVPS intake structure, were minnows taken during a single sampling effort in July. Larval catch at Station 2 (N=62) and Station 4 (N=94) exhibited the greatest diversity of taxa; however, most (45.5%) were minnows. Mid-channel Station 3 and the north shore Station 5 yielded only 5 larvae each. All except one were minnows. Larval densities increased somewhat at Station 4 (N=94; 23.04/100 m^3) and included the highest abundance of freshwater drum larvae (N=5; 1.23/100 m^3) found along the transect; however, most larvae (53.2%) were minnows. All of the larvae collected at Station 5 were minnows.

Summary and Conclusions

The similarity of species composition and relative abundance of ichthyoplankton taken in 1983 along the river transect to those of 1979-1982, 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 1983.

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 1 gal taken from below the skimmer wall from one operating intake bay of Unit 1.

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 1983 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 and zooplankters were counted. For the 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 1 gal taken from below the skimmer wall from one operating intake bay of Unit 1.

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 1983 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. SOIL CHEMISTRY (ETS References 3.1.3.10)

Objectives

Conductivity and pH of soils were studied as part of a program to monitor the impact of cooling tower drift on the terrestrial ecosystem.

Methods

pH

Soil samples were collected in June, 1983 and analyzed for pH and soluble salt concentrations.

Statistical analyses of pH and soluble salt concentrations indicate that a minimum of ten (10) samples are required from each soil series to detect statistically significant changes at the 0.05 level of probability. Fifteen (15) samples are obtained per sampling point and the arithmetic mean and standard deviation are calculated and compared to prior sampling periods.

Ten (10) permanent sampling locations (see Figure VI-1) representing points of projected low and high salt deposition from cooling tower drift have been established. Using a soil test auger, soil samples were collected at ten (10) locations.

Three (3) equidistant radii (e.g., 0°, 120°, 240° azimuth) were established about the pin marking each permanent sampling point. Samples were collected to a depth of six inches at 2, 4, 6, 8, and 10 feet along each radius for a total of fifteen (15) samples per permanent sampling point. Samples were prepared by transferring each soil sample to a plate, and distributing the sample uniformly over the plate. The sample was dried overnight at 10-15°C above room temperature.

Using the hand grinder, the soil samples were crushed until a major portion passed a 10-mesh (U.S. No. 10) sieve. The crushed soil samples were then placed in jars and mixed for five (5) minutes on a mixing wheel. About 20 grams per sample were prepared for chemical analysis.

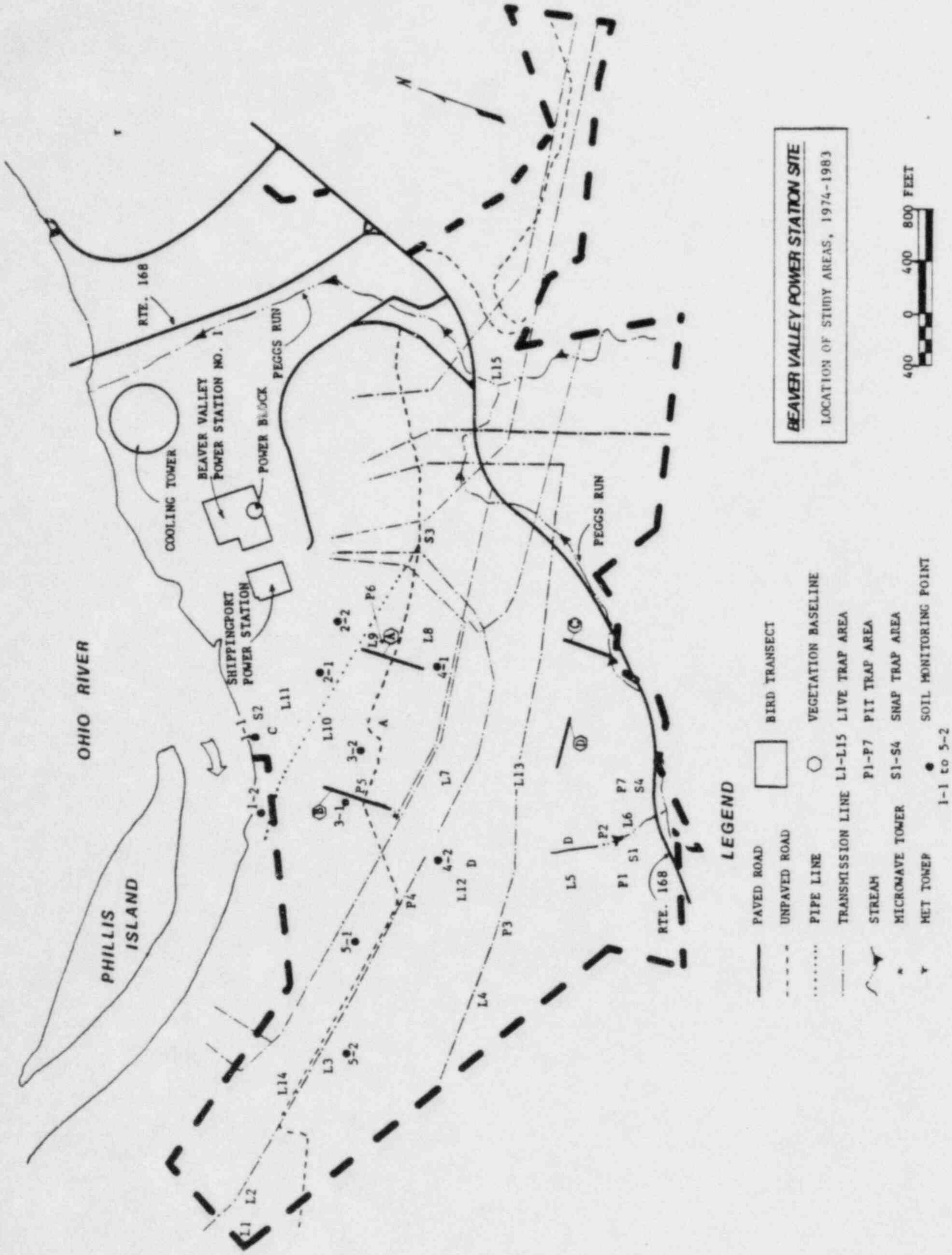

BEAVER VALLEY POWER STATION SITE
LOCATION OF STUDY AREAS, 1974-1983
400 0 400 800 FEET
OHIO RIVER
PHILLIS ISLAND
COOLING TOWER
BEAVER VALLEY POWER STATION NO. 1
POWER BLOCK
SHIPPINGPORT POWER STATION
RTE. 168
PEGGS RUN
LEGEND
PAVED ROAD
UNPAVED ROAD
PIPE LINE
TRANSMISSION LINE
STREAM
MICROWAVE TOWER
MET TOWER
BIRD TRANSECT
VEGETATION BASELINE
L1-L15 LIVE TRAP AREA
P1-P7 PIT TRAP AREA
S1-S4 SNAP TRAP AREA
1-1 to 5-2 SOIL MONITORING POINT

FIGURE VI-1

Specific Conductance (Soluble Salt Concentration)

Specific conductance is determined by using a conductivity bridge, a dip-type conductivity cell, and a thermometer.

When the conductivity value has been determined, the electrical conductivity is converted to approximate salt concentrations using the following formula:

- Salt concentration (mg/liter) equals 640 x electrical conductivity (mmhos/cm)

The arithmetic mean and standard deviation of pH and conductivity values are calculated for each of the ten (10) permanent sampling points.

A one-way analysis of variance is used to compare the values of this sampling period which values obtained for previous sampling period.

Results

No investigative levels for soil pH and/or conductivity were reached in this survey. The mean pH of the soils from the ten (10) sampling points stipulated in this program did, however, vary (see Table VI-1). The highest mean pH occurred at sampling point 1-1 (pH 6.76) and the lowest occurred at sampling point 3-2 (pH 4.11). Of the 150 soil samples analyzed, the range of pH values was from 3.85 to 7.15. The mean pH of all the samples was 4.83.

Specific conductance values varied from a low mean value of 0.11 mmhos/cm at sampling points 2-2 and 4-1 to a high mean value of 0.15 mmhos/cm at sampling point 1-1 (see Table VI-2). The lowest conductivity value of the 150 samples was 0.076 at sampling point 2-2. The highest individual conductivity value was 0.18 recorded at sampling points 1-1, 1-2, 4-2, and 5-1. Average of the mean specific conductance levels was 0.130 mmhos/cm.

TABLE VI-1

SUMMARY OF pH LEVELS
JUNE, 1983

Sample Point	Mean[1] pH	Standard Deviation	Standard Error	Range		Investigation[2] Levels	
				High	Low	High	Low
1-1	6.76	0.13	0.034	7.15	6.62	7.4	6.0
1-2	6.44	0.16	0.041	6.73	6.22	7.4	6.0
2-1	4.58	0.11	0.028	4.95	4.28	4.7	3.9
2-2	4.22	0.19	0.049	4.46	3.87	4.5	3.6
3-1	4.69	0.13	0.034	4.82	4.56	4.8	4.0
3-2	4.11	0.10	0.026	4.31	3.85	4.6	3.7
4-1	4.36	0.12	0.031	4.52	3.99	4.5	3.7
4-2	4.31	0.20	0.052	4.61	3.91	4.7	3.8
5-1	4.55	0.17	0.044	4.87	4.11	4.9	4.0
5-2	4.26	0.08	0.021	4.38	4.12	4.4	3.6

1. Mean values are the arithmetic averages of the fifteen soil samples obtained per sampling point. None of the ten sampling points exceeded the investigations levels.

2. The investigation levels are 10% of the mean pH from the first 75 samples (15 samples taken on 5 dates 12/74, 6/75, 2/76, 6/76 and 12/76) obtained at each point.

TABLE VI-2

SUMMARY OF SPECIFIC CONDUCTANCE VALUES
JUNE, 1983

Sample Point	Mean of Specific[1] Conductance Levels	Standard Deviation	Standard Error	Range High	Range Low	Investigation[2] Level
1-1	0.15	0.015	0.004	0.18	0.12	0.58
1-2	0.14	0.022	0.006	0.18	0.11	0.66
2-1	0.12	0.018	0.005	0.14	0.096	0.48
2-2	0.11	0.014	0.004	0.12	0.076	0.42
3-1	0.12	0.020	0.005	0.15	0.091	0.40
3-2	0.14	0.018	0.005	0.17	0.10	0.40
4-1	0.11	0.015	0.004	0.14	0.096	0.38
4-2	0.14	0.019	0.005	0.18	0.108	0.42
5-1	0.13	0.024	0.006	0.18	0.099	0.38
5-2	0.14	0.011	0.003	0.15	0.12	0.38

1. Mean values are the arithmetic averages of the fifteen soil samples obtained per sampling point. None of the ten sampling points exceeeded the investigation levels.

2. The investigation levels are based on a 100% increase in the mean specific conductance values obtained for the first 75 samples per point. (15 samples taken on 5 dates 12/74, 6/75, 2/76, 6/76 and 12/76).

Discussion of Results

pH

A one-way analysis of variance was used to compare the pH of June, 1983 samples with the pH of June and December, 1978 samples, (see Table VI-3). No significant differences between June, 1983 and June, 1978 were reported for all ten sample points. Sampling points 2-1, 3-1, and 3-2 were significantly different at the 1% level and sampling point 2-2 was significantly different at the 5% level for December, 1978.

The mean pH for all samples from June, 1983 was lower than those reported for June, 1975; June, 1978; and December, 1978 but higher than December, 1974; February, 1976; June, 1976; and December, 1976 values (Figure VI-2). The greatest change in mean pH between successive sampling periods occurred between December, 1976 and June, 1978. The mean pH of all points for June, 1983 decreased by 0.01 unit. At the individual sampling locations only sampling point 1-2 had a lower mean pH value than the average of the 75 baseline samples. Sample point 1-2 exhibited the greatest change from baseline samples with a decrease of 0.4 pH units. An examination of the data indicates the usual variance in both the mean pH of all 150 points and in the mean pH's at the 10 individual points. None of the pH values exceeded the investigation levels established by the original 75 baseline samples.

Conductivity

A comparison of the conductivity values between samples obtained during June, 1983 with those obtained during December, 1978 indicates significant differences at the 1% level occurred at five (5) locations (see Table VI-3). The values recorded at sampling point 2-1 were significantly different than those obtained for June, 1978 and December, 1978 at the 5% level. A difference at the 5% level was recorded for sampling point 2-2 between June, 1983, and June, 1978.

The mean conductivity value for all 150 samples from June, 1983 was lower than any value previously recorded except June, 1978 (Figure VI-3). Between successive sampling periods, the greatest change occurred between December, 1976 and June, 1978. The mean conductivity

TABLE VI-3

COMPARISON OF pH AND SPECIFIC CONDUCTANCE VALUES
JUNE 1983 VS JUNE 1978 AND DECEMBER 1978

Sampling Points	Soil Type	Expected Salt[a] Deposition	pH 6/83 Mean	pH 6/78 Mean	pH 12/78 Mean	pH Significantly[b] Different 6/78	pH Significantly[b] Different 12/78	Specific Conductance 6/83 Mean	Specific Conductance 6/78 Mean	Specific Conductance 12/78 Mean	Specific Conductance Significantly[b] Different 6/78	Specific Conductance Significantly[b] Different 12/78
1-1	Pope silt loam	Low	6.76	6.8	6.7	--	--	0.15	0.16	0.19	--	**
1-2	Pope silt loam	High	6.44	6.4	6.4	--	--	0.14	0.15	0.17	--	**
2-1	Wharton silt loam	Low	4.58	4.6	4.7	--	**	0.12	0.10	0.14	*	*
2-2	Wharton silt loam	High	4.22	4.3	4.3	--	*	0.11	0.10	0.15	*	**
3-1	Gilpin-Weikert shaly silt loam	High	4.69	4.7	4.6	--	**	0.12	0.12	0.11	--	--
3-2	Gilpin-Weikert shaly silt loam	Low	4.11	4.1	4.3	--	**	0.14	0.14	0.11	--	**
4-1	Gilpin channery silt loam	Low	4.36	4.4	4.4	--	--	0.11	0.10	0.12	--	--
4-2	Gilpin channery silt loam	High	4.31	4.3	4.3	--	--	0.14	0.13	0.15	--	--
5-1	Wellston silt loam	Low	4.55	4.5	4.5	--	--	0.13	0.12	0.13	--	--
5-2	Wellston silt	High	4.26	4.3	4.2	--	--	0.14	0.13	0.17	--	**

a - Expected low and high deposition levels are relative to each soil type
b - Significantly different: * at the 5% level ** at the 1% level

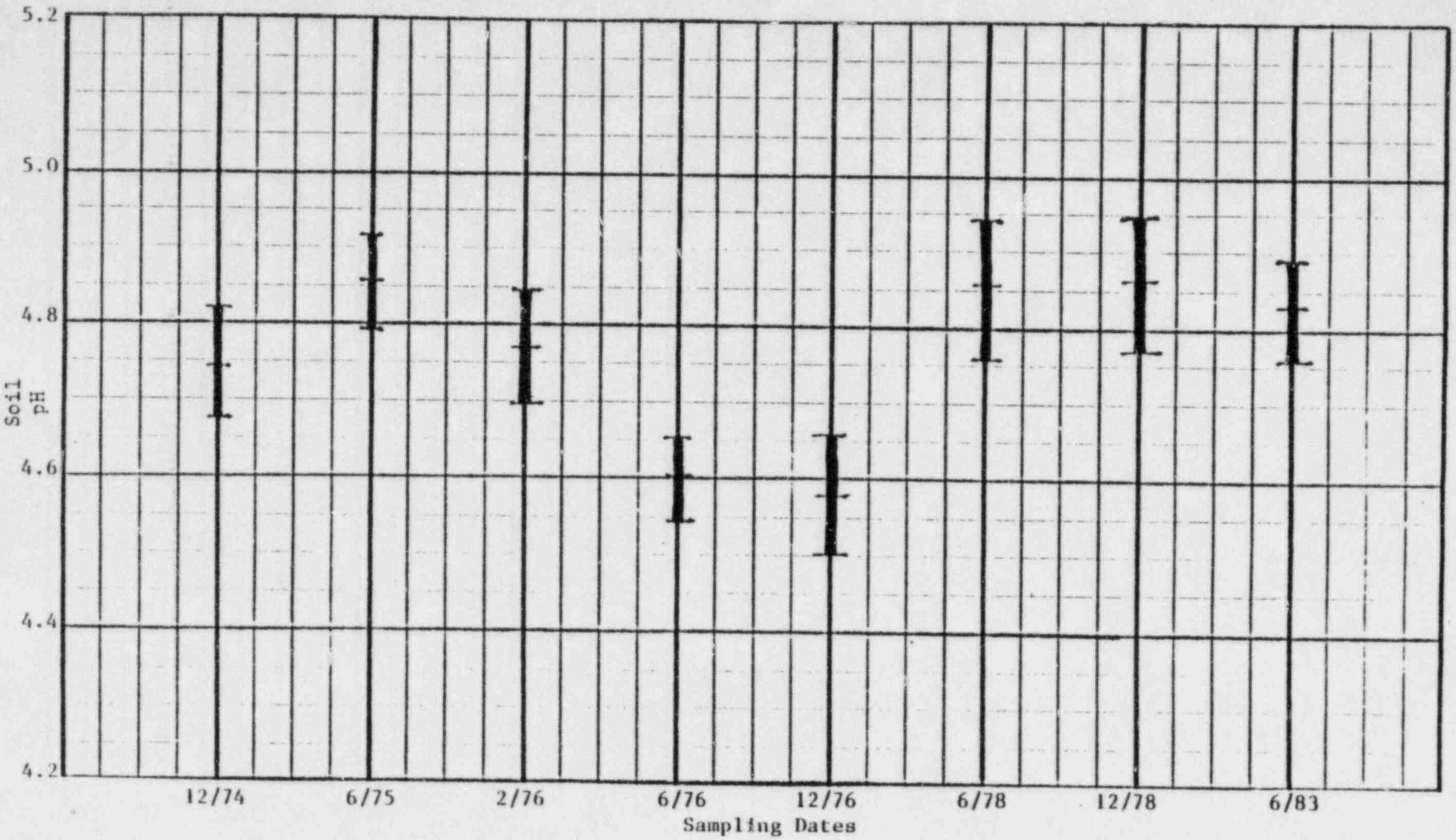


FIGURE VI-2

SOIL SURVEY MEAN AND 95% CONFIDENCE LIMITS OF SOIL pH FOR SAMPLES OBTAINED ON EACH OF 8 DATES

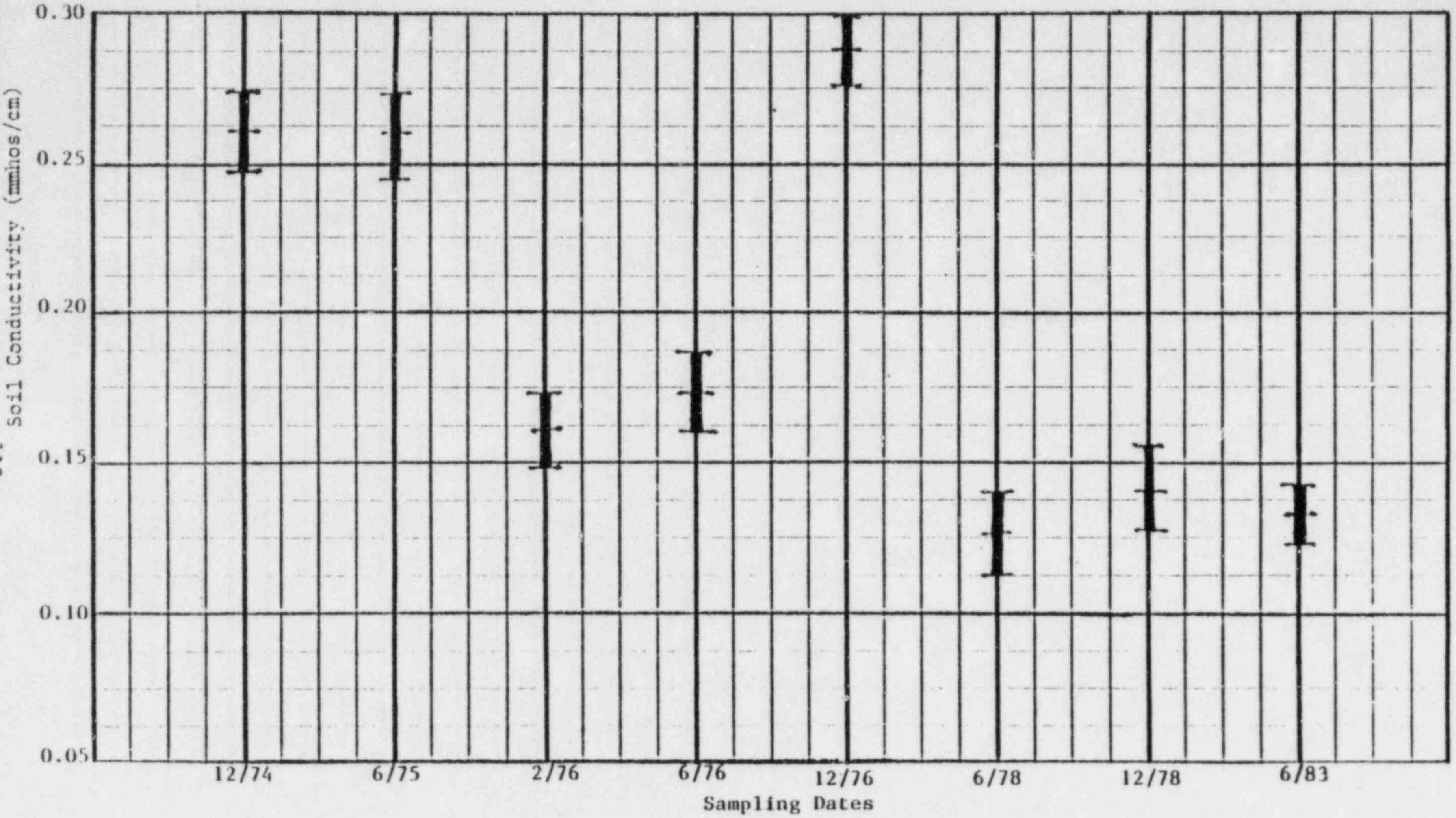


FIGURE VI-3

SOIL SURVEY MEAN AND 95% CONFIDENCE LIMITS OF SOIL CONDUCTIVITY FOR SAMPLES OBTAINED ON EACH OF 8 DATES

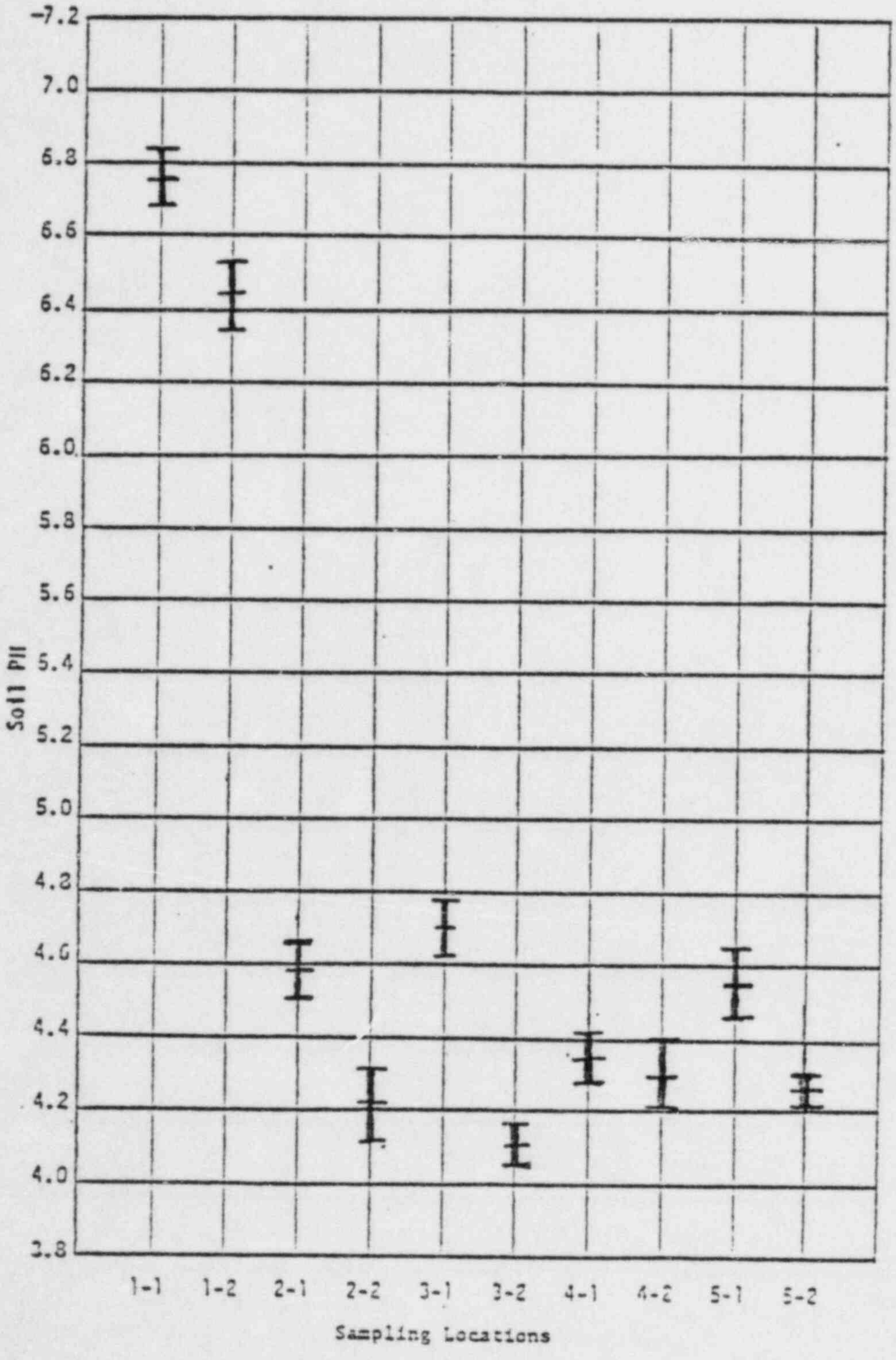


FIGURE VI-4

MEAN AND 95% CONFIDENCE LIMITS OF SOIL pH AT
EACH SAMPLING LOCATION FOR JUNE, 1983.
(DATA FOR EACH SAMPLING LOCATION BASED ON 15 SAMPLES)

decreased from 0.28 mmhos/cm to 0.125 mmhos/cm - a difference of 0.155 mmhos/cm. At the ten (10) individual sampling locations, all sampling points had lower mean conductance values than the average of the previous baseline 75 samples (Figure VI-5). The greatest change at an individual sampling location, between the June, 1983 samples and the original 75 samples, occurred at sampling point 1-2, a difference of 0.18 mmhos/cm. The variance in the conductivity data was similar to the variance in the pH data. The usual dispersion was observed for the mean of all samples and the individual sampling location means as compared to the five (5) previous sampling periods. None of the mean conductivity values exceeded the investigation levels established by the original samples.

Summary of June, 1983 Results

As summarized in Table VI-3, the pH and specific conductance levels varied slightly. The fluctuations noted between years and seasons are a result of natural phenomena (i.e., flooding, soil moisture) to which terrestrial biota are adapted. The 1983 soluble salts concentrations are considerably below the point where vegetation would be adversely affected. Cooling tower drift did not affect either pH or conductivity in a measurable way.

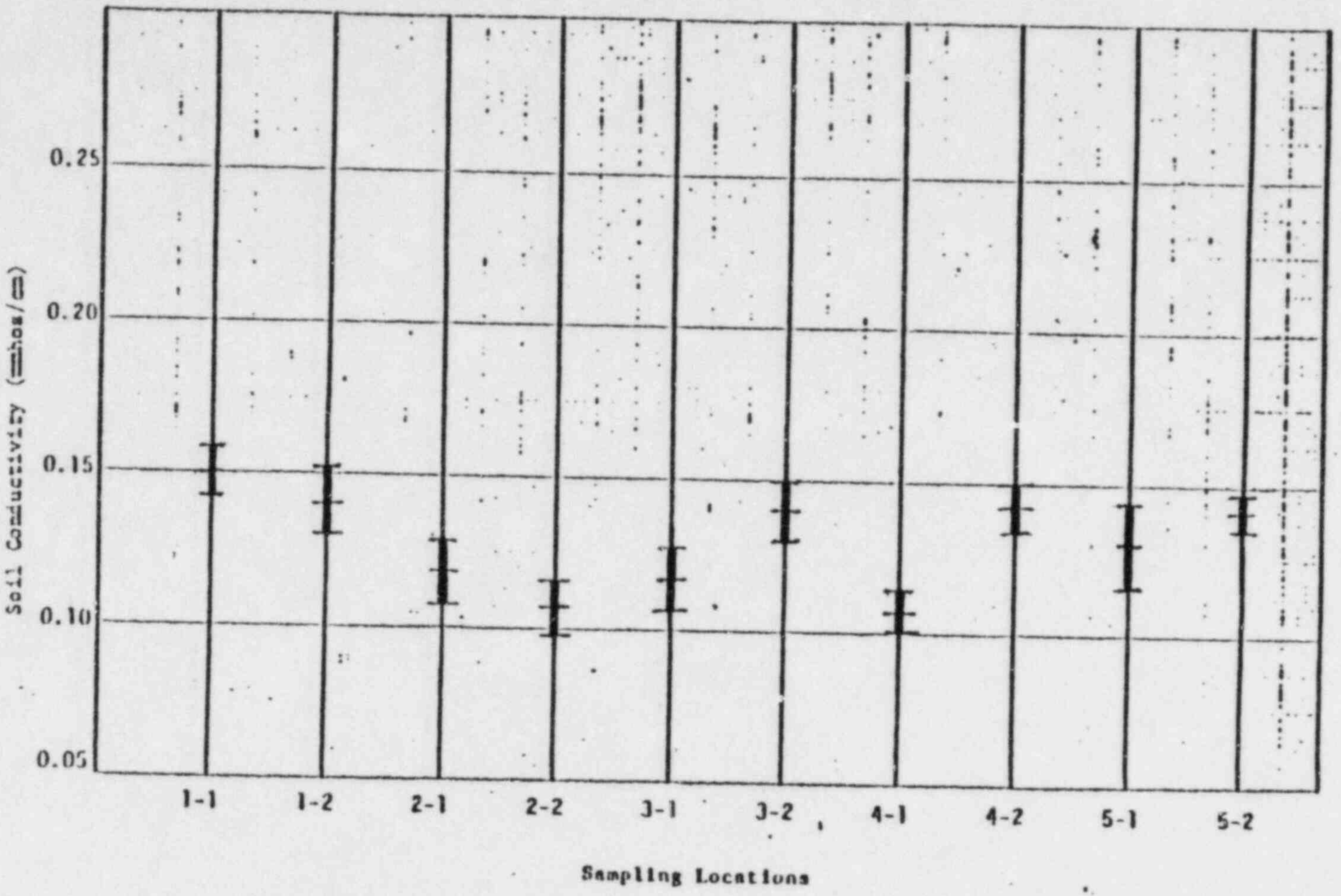


FIGURE VI-5

MEAN AND 95% CONFIDENCE LIMITS OF SOIL CONDUCTIVITY AT EACH SAMPLING LOCATION FOR JUNE, 1983. (DATA FOR EACH SAMPLING LOCATION BASED ON 15 SAMPLES)

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APPENDIX A

REPORT CONCERNING A FISH DIE-OFF, FEBRUARY 1983, AT THE BEAVER VALLEY POWER STATION UNIT NO. 1

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Introduction

On February 12, 1983 at 0930 hours, the Beaver Valley Power Station Unit No. 1 reactor shut-down. This unplanned shut-down resulted in a rapid drop in temperature of the power plant discharge which in turn, caused a die-off of a large number of gizzard shad (Dorosoma cepedianum). Reports of this fish die-off reached Duquesne Light Company's environmental staff on February 15. Subsequently, the same day, Duquesne Light notified Aquatic Systems Corporation (ASC) of the problem and requested that a follow-up study be conducted to document the cause of the fish die-off. On February 16, the staff of ASC initiated field and laboratory studies of the fish die-off. On February 17, a waterway patrolman from the Pennsylvania Fish Commission surveyed the area and on February 25, a meeting was held between representatives of the Fish Commission, Duquesne Light Company, Aquatic Systems Corporation and Baker Engineers to discuss the fish die-off. This report is a summary of the subsequent investigations and provides the following information.

(1) Summary of the events leading up to the fish die-off.

(2) Investigations conducted to determine the possible causes of the die-off.

(3) Findings of the subsequent investigations.

Background Information

The Beaver Valley Power Station Unit No. 1 (BVPS) and the Shippingport Power Station are located on a 486.8 acre tract of land along the south bank of the Ohio River in the Borough of Shippingport, Pennsylvania (Figure 1). Both power plants are operated by Duquesne Light Company.

The Shippingport Power Station began full operation in 1957 and BVPS began operation in 1976. However, in 1982 the Shippingport Power Station was shut-down for decommissioning. Thus, over a 6 year period from 1976 to mid-1982 both the Shippingport Power Station and BVPS have

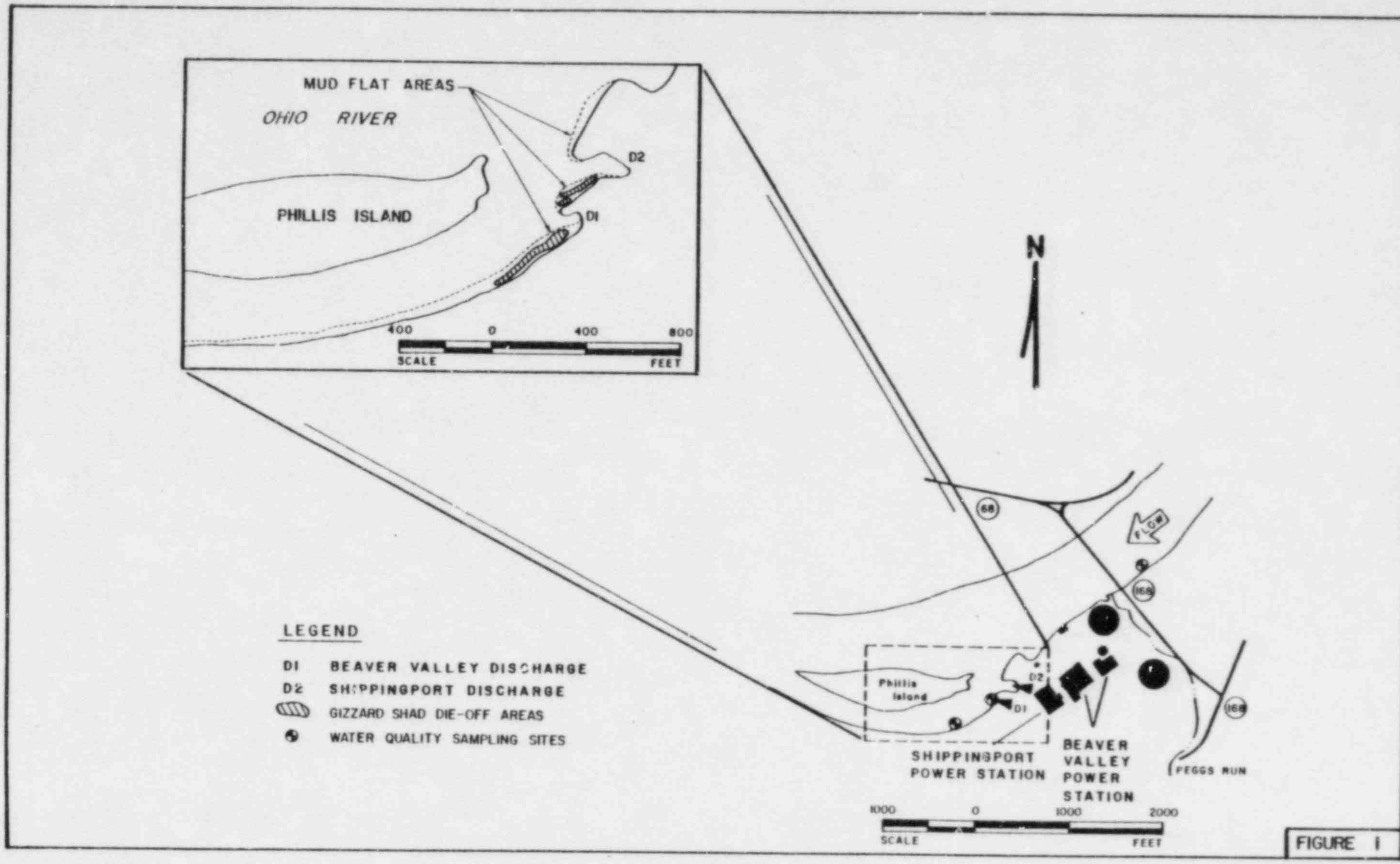

MUD FLAT AREAS
OHIO RIVER
PHILLIS ISLAND
D2
DI
400 0 400 800
SCALE FEET
N
68
FLOW
168
168
Phillis Island
D2
DI
SHIPPINGPORT POWER STATION
BEAVER VALLEY POWER STATION
PEGGS RUN
1000 0 1000 2000
SCALE FEET
LEGEND
DI BEAVER VALLEY DISCHARGE
D2 SHIPPINGPORT DISCHARGE
GIZZARD SHAD DIE-OFF AREAS
WATER QUALITY SAMPLING SITES

FIGURE 1

been discharging heated water into the Ohio River in the vicinity of the back channel of Phillis Island. The heated discharge from the two power plants which are approximately 500 feet apart, have created favorable habitat for gizzard shad, apparently providing moderating water temperatures and a food source (plankton), particularly during the winter months. When the Shippingport Power Station was shut-down in 1982, it eliminated a source of heated water, leaving only the BVPS discharge. Thus, the gizzard shad, which previously had stayed within the two discharge plumes, began congregating in the BVPS discharge in the winter of 1982-83. This was confirmed starting in January 1983, when large numbers of shad were observed congregating in the BVPS discharge. These observations (six times) were made during routine aquatic sampling surveys conducted at the BVPS.

Events possibly contributing to the fish die-off have been reconstructed by reviewing (1) internal power plant documentation concerning the timing of the reactor shut-down; (2) discharge temperature data; and (3) river elevation data. River and discharge temperature data obtained from continuous recording stations operated by Duquesne Light Company, is summarized as follows:

February 11 - Normal Operations - discharge temperature ranged from 58.5 to 66°F.

February 12 - Reactor Shut-Down - discharge temperature dropped 25°F (i.e., 61° to 36°F) within a 3.25 hour period. Eight hours later the discharge temperature was 45°F. (See Attachment 1)

February 14 - Normal Operations - discharge temperature was in the 60 to 68°F range.

During the same period (i.e., February 11 through February 14, water temperatures in the Ohio River ranged from 38 to 39°F (see Attachment 2). Information regarding the river elevation in the Cumberland Pool was also recorded (see Attachment 3).

Investigative Methods

On February 16, 1983 the ASC field team comprised of a fisheries biologist and an aquatic biologist conducted an investigation to estimate the extent of the fish die-off, collect specimens of dead shad and establish physico-chemical parameter conditions through field measurements and collection of water samples for laboratory analysis.

To estimate the number of shad on the shore, measurements of the length of shoreline containing dead fish was made. The areas where these measurements were taken (and dead fish observed) is shown on Figure 1. Due to the drop in river elevation during the time period in question, fish were present from the previous high water mark (at elevation ca. 667 feet msl) across an exposed mud flat to the water's edge (ca. 666 feet msl). Fish were then counted within one-foot wide transects that extended perpendicular from the shore beginning at the high water mark and extending across the mud, to the water line and also included fish floating off shore. A total of 11 transects were used to obtain an average density of fish per foot of shoreline. This average density was then multiplied by the length of shoreline containing fish to arrive at an estimate of shad. This estimate represents only those fish observed as of 1200 hours on February 16. In addition to the shad, two other species of dead fish were observed along the shore, channel catfish (Ictalurus punctatus) and common carp (Cyprinus carpio). Because few specimens of either species were present, they were directly counted rather than estimated.

In addition to making an estimate of the number of shad, each specimen counted was also segregated into three arbitrary sizes (small, medium or large). The percentage of each size was later used in making an estimate of the total biomass of fish that were on the shoreline. The average weight of fish in each of the three categories was determined from a 47 randomly selected specimens which were taken from the field and returned to the laboratory for examination.

Water samples and field measurements of water temperature and dissolved oxygen were taken at three locations on February 16. These stations, shown on Figure 1, were located: (1) approximately 2,000 feet upstream of the BVPS heated water discharge; (2) at the discharge; and (3) approximately 500 feet downstream of the discharge. The water samples were analyzed for ammonia (NH_4-N), 5-day BOD, nitrite, pH and specific conductance.

The 47 shad returned to the laboratory were examined to determine their age and growth. Fish are aged in a manner analogous to aging a tree by counting the rings. The scales provide a means of accurately predicting age since scales grow at a rate that is comparable to the overall growth of the fish. In the fall when the water temperature decreases, the growth of fish is also reduced as a result of a decline in the metabolic rate and active feeding. Concentric ridges are formed on the scales during all periods of active growth but when the growth rate decreases, the ridges form closer together. This crowding is referred to as annulus formation. In temperate waters, the number of annuli can be considered to correspond to the age of the fish in years.

The scales of the specimen shad were obtained from each fish from the area between the dorsal fin and the lateral line. The scales were treated with a bone stain to facilitate identification of annuli and then mounted on a microscope slide. Each scale was viewed using a Bausch and Lomb overhead slide projector and magnifying the scales until they were enlarged to greater than 12 inches in diameter. Several scales from each fish were examined three times in an independent fashion for determination of age. A subsample of 18 fish were also sexed.

On February 28, the site where the dead shad accumulated was revisited to collect additional specimens for age and growth analysis. A total of 57 gizzard shad were collected; each fish was selected on the basis of its length being greater than 225 mm (8.9 inches). The size criterion was used to confirm the age classes of fish involved in the die-off.

The final field task conducted by ASC for this study involved taking samples of the intake and discharge waters to examine them for the presence of phytoplankton. Gizzard shad are herbivores, feeding primarily on algae and phytoplankton (Scott and Crossman, 1973). Thus, the occurrence of plankton in the discharge could help explain the presence of shad in the vicinity of the outfall. The phytoplankton samples were counted in the laboratory using an inverted microscope at 1000X.

To determine if any radiological uptake had occurred in the fish, a fish sample was taken from the shoreline near the discharge on February 18, 1983. This sample was forwarded to Teledyne Isotopes of Westwood, New Jersey for analysis. At the laboratory, the sample was prepared in a standard 300 ml plastic bottle and scanned for gamma emitting nuclides with a gamma spectrometry system utilizing a Ge (Li) detector.

Results of the Investigation

Four areas of shoreline contained dead shad. Two of these sections were in the vicinity of the Shippingport Power Station, and measured 80 and 100 feet in length (Figure 1). The two areas near the BVPS discharge were 150 and 250 feet long. The average density of dead gizzard shad per foot of shoreline in the Shippingport area was 34.16, while the density near the BVPS discharge was 34.25 fish/foot of shoreline. In addition, a small patch of shad numbering 250 fish was observed next to the discharge. The combined total of fish estimated on the shoreline as a result of the shut-down was 20,100 shad. In addition, 20 channel catfish and one (1) common carp were counted. No other fish species were observed on the shoreline or floating off shore.

The estimated percentage for each of the three size classes were as follows:

1. Small shad made up 71.4 percent of the total and had an average weight of 40.0 grams (0.088 pounds),

2. Medium-sized shad comprised 23.8 percent of the total die-off and had an average weight of 112.8 g (0.249 pounds).

3. Large shad were found to be 4.8 percent of the total and have an average weight of 548.3 g (1.21 pounds).

By using 20,100 shad as the total estimated number of fish and the aforementioned distribution of size and weight, a total of 1642 kg (3,620 pounds) of shad were present along the shore. In addition, 18.1 kg (40 pounds) of channel catfish at an average weight of 0.9 kg (2 pounds) per fish and 2.3 kg (5 pounds) of carp (one fish estimated to weigh this amount) were also observed.

The original 47 gizzard shad specimens brought back for age and growth analysis were found to the predominately members of age class I (91 percent), that is, no annuli were present on the scales examined for 43 of the 47 individuals. Because of this unusual age distribution, 57 additional specimens were collected for age and growth evaluation, with the emphasis on acquiring larger fish to obtain a wider range of ages. The results of the scale analyses are presented in Table 1. The age distribution even including the second collection of large fish continued to be predominately age class I fish (85 percent).

A comparison of the upstream and downstream results indicates that organic matter decomposition resulting from the gizzard shad die-off was probably occurring on the date of collection below the discharge (Table 2). This conclusion is based on:

1. A drop in the dissolved oxygen concentration at the downstream sampling point.

2. Increases in the ammonia and nitrite concentrations below the discharge.

These effects cannot the attributed to the effluent quality of the BVPS discharge because, as can be seen from Table 2, the parameters in

TABLE 1

STATUS OF GIZZARD SHAD
COLLECTED FROM THE BVPS
DISCHARGE AREA
February 16 and 28, 1983

AGE-GROWTH

	YEAR CLASS					
	I	II	III	IV	V	VI
Number	88	2	0	9	3	1
Length Range (mm)	143-269	302-308	-	312-368	340-342	396
Mean Length (mm)	215	305	-	338	341	396

SEX	MALE	FEMALE
Number	8	10

Note: One of the specimens had regenerated scales and therefore no age determination could be made.

TABLE 2

PHYSICAL AND CHEMICAL MEASUREMENTS OF
WATER SAMPLES TAKEN FROM THE OHIO
RIVER AND BVPS DISCHARGE
February 16, 1983

PARAMETER	STATION		
	UPSTREAM[a]	DISCHARGE[b]	500' BELOW DISCHARGE[c]
Field Measurements			
Temperature °C	4.1	20.0	12.5
Dissolved Oxygen (mg/l)	15.4	10.4	8.7
Oxygen % Saturation	119.5	116.4	83.4
Laboratory Analyses			
Ammonia (N) (mg/l)	0.48	0.31	0.84
BOD, 5-day (mg/l)	5.5	2.1	5.7
Nitrite (mg/l)	0.08	0.15	0.64
pH	6.9	6.9	7.3
Specific Conductance µmhos/cm at 25°C	320	480	443

Notes: (Figure 1 shows the locations of the sampling stations described below)

(a) Upstream Sample: taken from the south shore of the Ohio River at BVPS Aquatic Monitoring Program: Transect 1.

(b) Discharge Sample: taken at river level immediately at the end of the sluiceway pilings.

(c) 500' Below Discharge Sample: taken from the south shore of the backchannel of Phillis Island.

question were not substantially different from the levels observed at the upstream station. Only the increase in temperature and specific conductance at the downstream site can be related directly to BVPS. A review of the plant NPDES sampling data from February 12, indicated that all physico-chemical parameters were within NPDES guidelines.

The phytoplankton analysis for the intake and discharge resulted in counts of 1389.5 and 1286.5 cells/ml respectively. These results show that food organisms for the shad are present in the discharge.

Results of the radiological studies conducted in conjunction with the fish die-off indicated that the only gamma emitter detected was the naturally occurring K-40. All of the gamma emitters analyzed for, were less than (L.T.) the lower limit of detection (Table 3). In addition, a review of the February Radiological Monitoring Program surface water and drinking water sample results downstream of the discharge showed no detectable increase in radioactivity in the Ohio River.

Observations and Discussion

Several factors may have combined to have caused the die-off of gizzard shad and other species in the time period of February 12 through February 15, 1983. There is no question that after the shut-down, a rapid decline in the discharge temperature occurred (25°F or 14°C in 3.25 hours). The area in the vicinity of the outfall is shallow and a one foot drop in the river elevation during the period would have further reduced the area available for the fish to congregate. It is, however, unlikely that the shad were killed outright by the drop in temperature (thermal shock). Studies performed for the Front Street Station in Erie, PA entitled "Field and Laboratory Assessment of Factors Affecting the Occurrence and Distribution of Gizzard Shad" (Penelec, 1977) revealed that sudden, 15-minute decreases in temperature resulted in high frequencies of stress in shad, but even a 15°C drop in temperature over 15-minutes did not cause mortality. Therefore, thermal shock is probably not the direct cause of death. A more plausible explanation is

TABLE 3

RADIOACTIVITY ANALYSIS RESULTS OF GIZZARD SHAD
COLLECTED IN THE VICINITY OF THE
BEAVER VALLEY POWER STATION
DISCHARGE ON FEBRUARY 18, 1983

NUCLIDE	ACTIVITY (pCi/gm WET)
BE-7	L.T. 4. E-02
K-40	8.02+-1.02E-01
CR-51	L.T. 4. E-02
MN-54	L.T. 4. E-03
CO-58	L.T. 4. E-03
FE-59	L.T. 8. E-03
CO-60	L.T. 5. E-03
ZN-65	L.T. 8. E-03
NB-95/ZR-95	L.T. 5. E-03
RU-103	L.T. 5. E-03
RU-106	L.T. 4. E-02
I-131	L.T. 9. E-03
CS-134	L.T. 5. E-03
CS-137	L.T. 5. E-03
LA-140/BA-140	L.T. 6. E-03
CE-141	L.T. 8. E-03
CE-144	L.T. 3. E-02
RA-226	L.T. 8. E-02
TH-228	L.T. 8. E-03

that the fish mortality resulted from oxygen depletion. The fish probably started to emigrate from the discharge when the temperature began to drop, seeking warmer water. The shallow shoreline area would have probably provided warmer temperatures because the substrate, which had originally absorbed heat from the discharge, would have been emitting heat for some time after the discharge began dropping in temperature. Thus, thousands of shad would have been congregating in the shallows, depleting oxygen levels in the area at a high rate because they were under stress from the thermal shock. The wind and wave action in these shallows would then have washed the fish onto the shore.

The actual number of fish that expired as a result of the reactor shut-down was undoubtedly greater than the estimated 20,100 shad plus several channel catfish and one common carp. The estimate does not take into account those fish consumed by predator fish, waterfowl or small mammals. It also does not include those fish which, as indicated by the results of the water quality analyses, were not washed up on shore and were in the process of decomposing on the bottom of the discharge area. Finally, the number of fish washed downstream and out of the study area could not be defined from this investigation.

In addition to identifing why the die-off took place, this investigation was also conducted to determine if the die-off was confined to any particular species, age class or sex. The latter two objectives have already been addressed with the results being that most of the shad were in age class I and seemed to be equally represented by both males and females. Also it has been noted that of the observed fish, gizzard shad were the predominate species affected. Based on field observations no gamefish species were involved in the die-off. During six observations made of fish congregating in the discharge area in 1983 prior to the die-off, no gamefish were noted although schools of shad were present. The shad were swimming gently into the current and they showed no signs of panic as if a predator was in chase. The reason for this may be that predator species such as northern pike (Esox lucius) or walleye (Stizostedion vitreum vitreum) generally prefer cooler water temperatures. Since shad suffering from disease or other stresses would tend to drift out of the

discharge plume, it is quite possible that predators could feed on those individuals and seldom have to enter the heated water to obtain food. Thus, these species would not have been subjected to thermal shock, which would account for their absence in the die-off.

The study of the shad scales did reveal some interesting facts concerning the past history of growth conditions for these fish. Since the patterns on the scale represent a permanent record of the fish's growth, the spacing between the ridges or annuli provide an indication of how favorable environmental factors were for a particular year. 1982 represented a very good year for shad because the Ohio River drainage experienced a mild winter, early spring and a warm summer. Also, no major floods occurred in the spring when the shad spawn. All of these factors contribute to ideal conditions for successful shad reproduction and growth. This is in contrast to the 1981 and 1980 growing seasons. Both of these years, based on the closely spaced annuli, showed very slow growth for the shad. The absence of age class III and only 2 age class II shad indicate that conditions were not as favorable during those years. This is confirmed by examining the BVPS Unit No. 1, 1980 and 1981 annual reports which indicate that weather and subsequent river conditions were not as conducive to shad propagation.

Conclusions

1. The fish die-off which occurred on February 12, 1983 affected gizzard shad primarily in age class I, but ranging from age class I through VI. The die-off was not limited to a particular sex.

2. Based on analysis of the fish scales, excellent growth occurred in gizzard shad during 1982. It is probable that the population of this species was not substantially affected by the die-off and that overall, the shad population in the New Cumberland Pool (the reach of the Ohio River on which BVPS is located) should not be significantly affected.

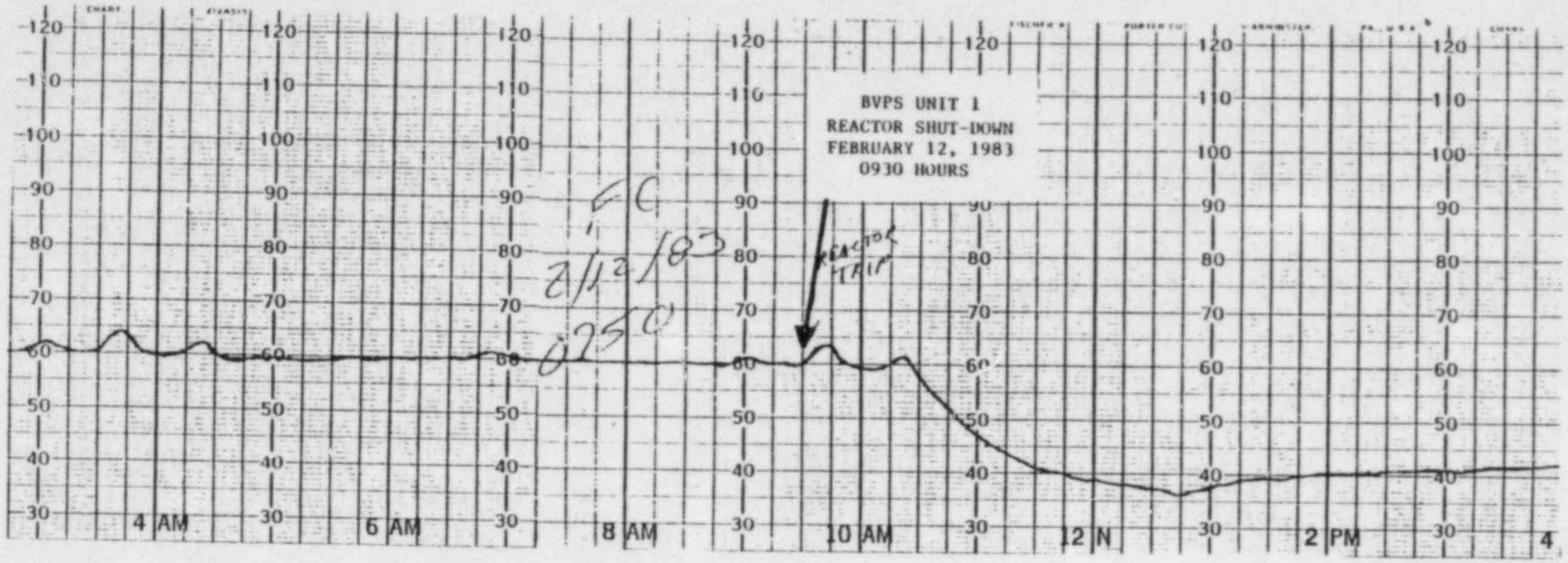
3. Because of the cessation of operation of the Shippingport Power Station and subsequent reduction of heated water input to only the discharge from BVPS Unit No. 1, events such as those occurring during the time period when the die-off took place could lead to additional shad mortality. It is expected that these events would only occur until Unit No. 2 becomes operational, at which time there would again be two warm water sources and the effects of a shut-down in either plant would be compensated for by the other.

References

Penelec, 1977. Field and Laboratory Assessment of Factors Affecting the Occurrence and Distribution of Gizzard Shad. Section 2, pages 1 through 79.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada. Bulletin 1984. Ottawa. 966 p.

ATTACHMENT NO. 1

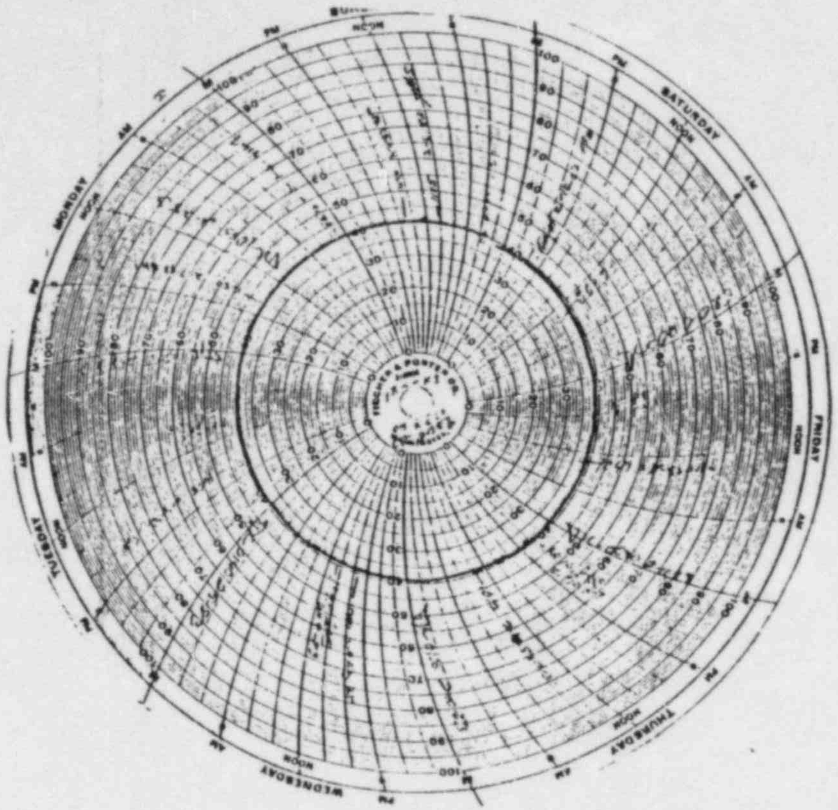


ATTACHMENT 1

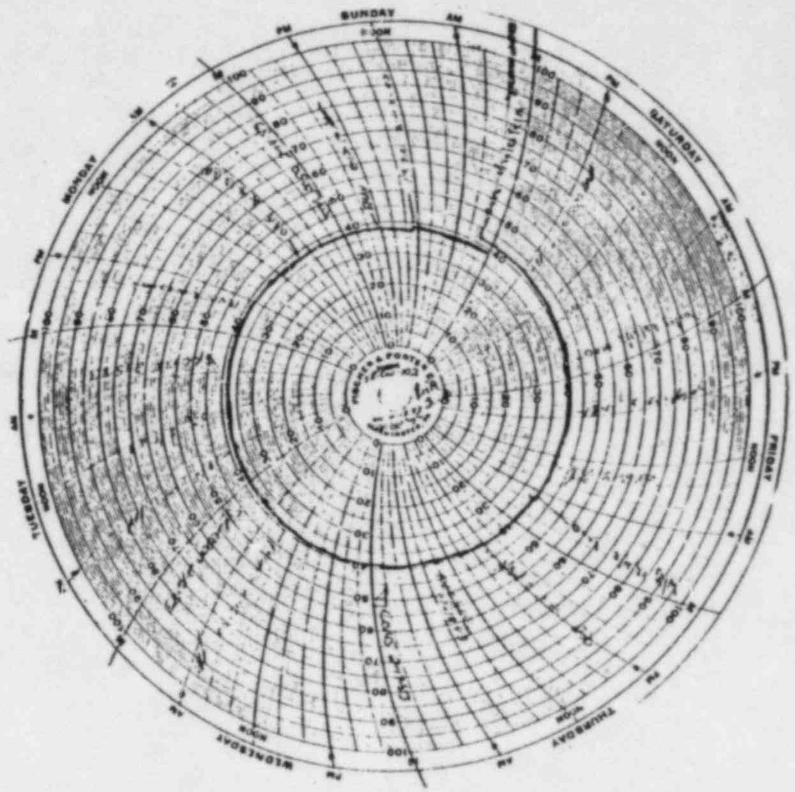
REPRODUCTION OF CONTINUOUS DISCHARGE
TEMPERATURE (°F) CHART
February 12, 1983
0300 to 1600 Hours
BVPS

ATTACHMENT NO. 2

February 6 to 12, 1983



February 13 to 19, 1983

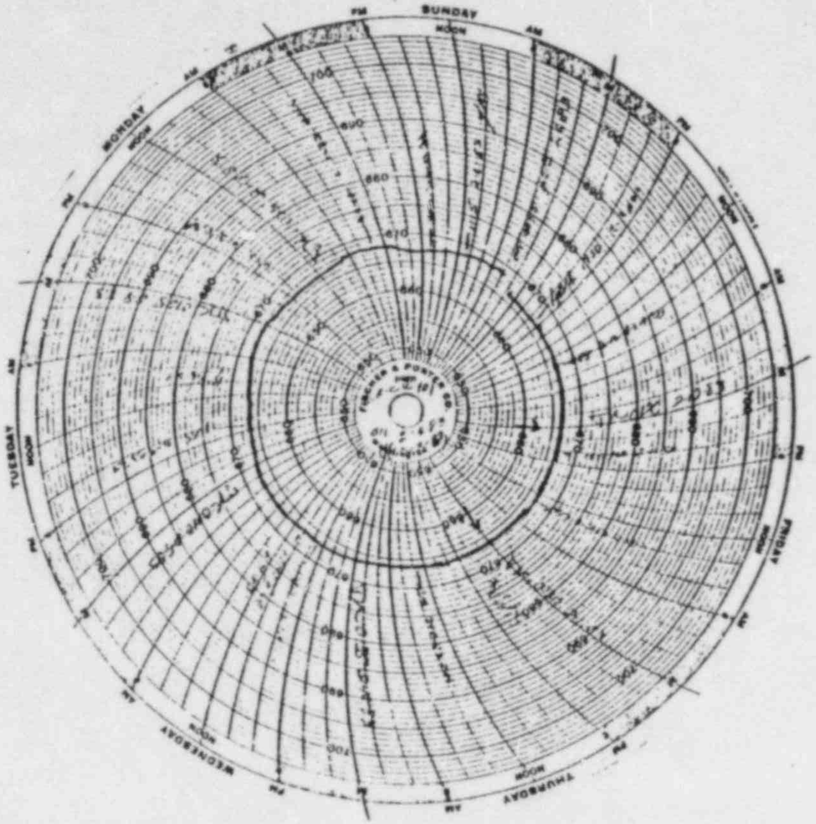


ATTACHMENT 2

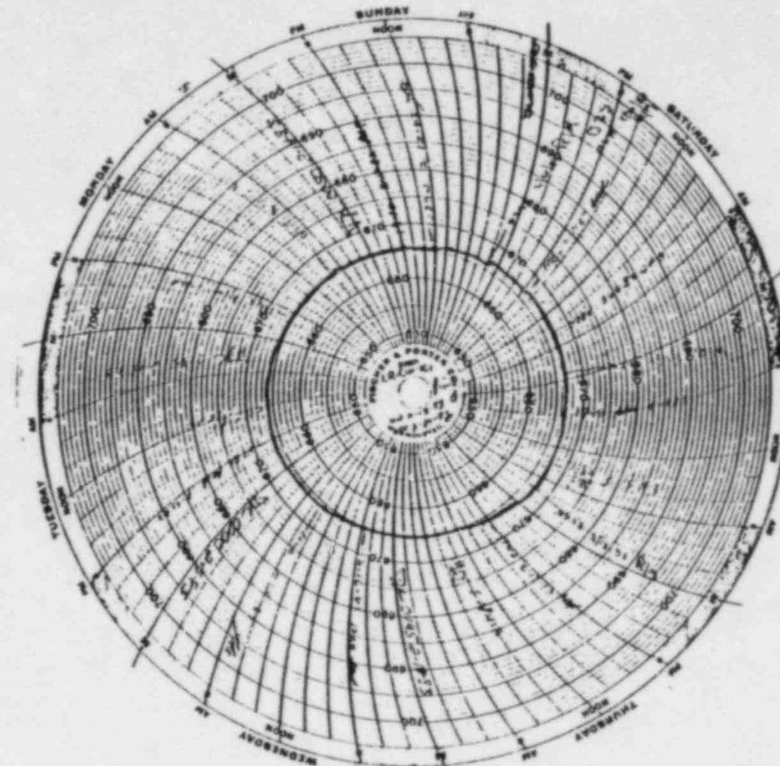
REPRODUCTION OF CONTINUOUS
RIVER INTAKE TEMPERATURES (°F)
February 6 through 19, 1983
BVPS

ATTACHMENT NO. 3

February 6 to 12, 1983



February 12 to 19, 1983



ATTACHMENT 3

REPRODUCTION OF CONTINUOUS
RIVER ELEVATION (MSL)
February 6 through 19, 1983
BVPS

Duquesne Light
Nuclear Division
P.O. Box 4
Shippingport, PA 15077-0004

Telephone (412) 393-6000

March 30, 1984
ND1MSL:3157

1983 Annual Environmental Report
Non-radiological - Volume 1

U.S. Nuclear Regulatory Commission
Mr. Peter Tam, Project Manager
Operating Reactors Branch No. 1
Division of Licensing
c/o Document Control Desk
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334

Dear Mr. Tam:

Enclosed are eighteen (18) copies of the 1983 Annual Environmental Report Non-radiological - Volume 1, for the Beaver Valley Power Station. The number of copies provided your office is in accordance with the distribution noted in Regulatory Guide 10.1.

Very truly yours,

J. D. Sieber

J. D. Sieber, Manager
Nuclear Safety and Licensing

JWM:lmd

Enclosure

IE25
1/18