1993 ANNUAL ENVIRONMENTAL REPORT
NON-RADIOLOGICAL
DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION
UNITS NO. 1 & 2

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

BVPS
AQUATIC MONITORING PROGRAM
MONTHLY STATUS REPORT

DECEMBER 1993

(EXAMPLE OF A MONTHLY STATUS REPORT)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES
(Continued)

I. INTRODUCTION

This report presents a summary of the Non-Radiological Environmental Program conducted by Duquesne Light Company (DLC) during calendar year 1993, for the Beaver Valley Power Station (BVPS) Units 1 & 2, Operating License Numbers DPR-66 and NPF-73. This is a voluntary program, since the Nuclear Regulatory Commission (NRC) on February 26, 1980, granted DLC's request to delete all of the Aquatic Monitoring Program, with the exception of the fish impingement (Amendment No. 25), from the Environmental Technical Specifications (ETS), and in 1983, dropped the fish impingement studies from the ETS program of required sampling along with non-radiological water quality requirements. However, in the interest of providing a non-disruptive database DLC is continuing the Aquatic Monitoring Program.

A. SCOPE AND OBJECTIVES OF THE PROGRAM

The objectives of the 1993 environmental program were:

(1) to assess the possible environmental impact of BVPS operation on the benthos and fish communities in the Ohio River,

(2) to provide a sampling program for continuing a non-disruptive database for the Ohio River near BVPS, preoperational to present,

(3) to protect BVPS from the biofouling organisms,
- to evaluate the presence, growth and reproduction of Corbicula at BVPS,
- monitor for the potential infestation of the zebra mussel at BVPS.

B. SITE DESCRIPTION

BVPS is located on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania, on a 501 acre tract of land. The Shippingport Atomic Power Station once shared the site with BVPS before being decommissioned. Figure I-1 shows an aerial view of BVPS. 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. The population within a 5 mile (8 km) radius of the plant is approximately 18,000. The Borough of Midland, Pennsylvania, has a population of approximately 3,300.

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 1993 is shown on Figure I-3 as well as Table I-1. The maximum flow occurred in March (158,000 cfs).

Ohio River water temperatures generally vary from 32° to 84°F (0° to 29°C). Minimum and maximum temperatures generally occur in January and July/August, respectively. During 1993, minimum temperatures

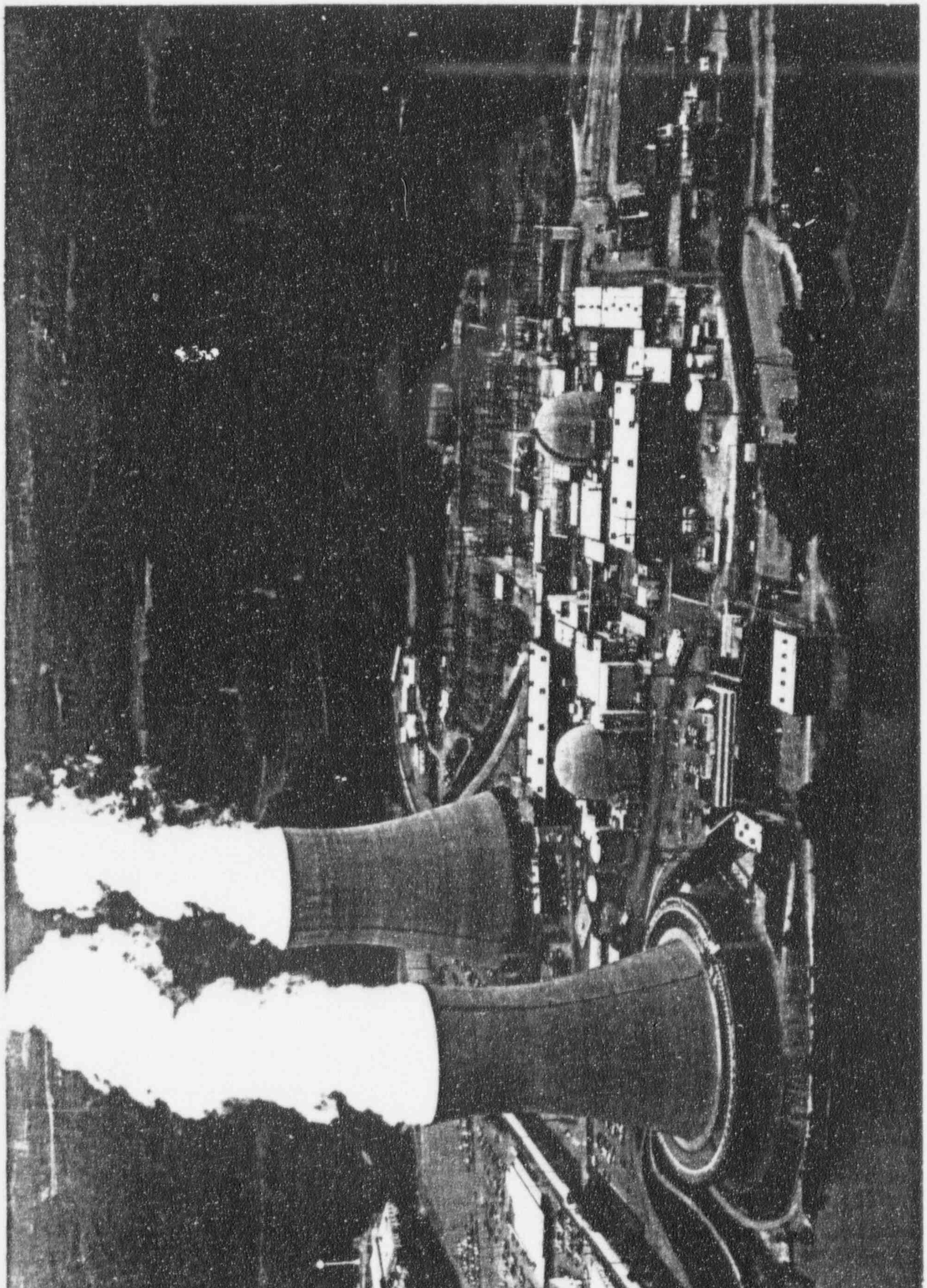


FIGURE I-1

VIEW OF THE BEAVER VALLEY POWER STATION
BVPS

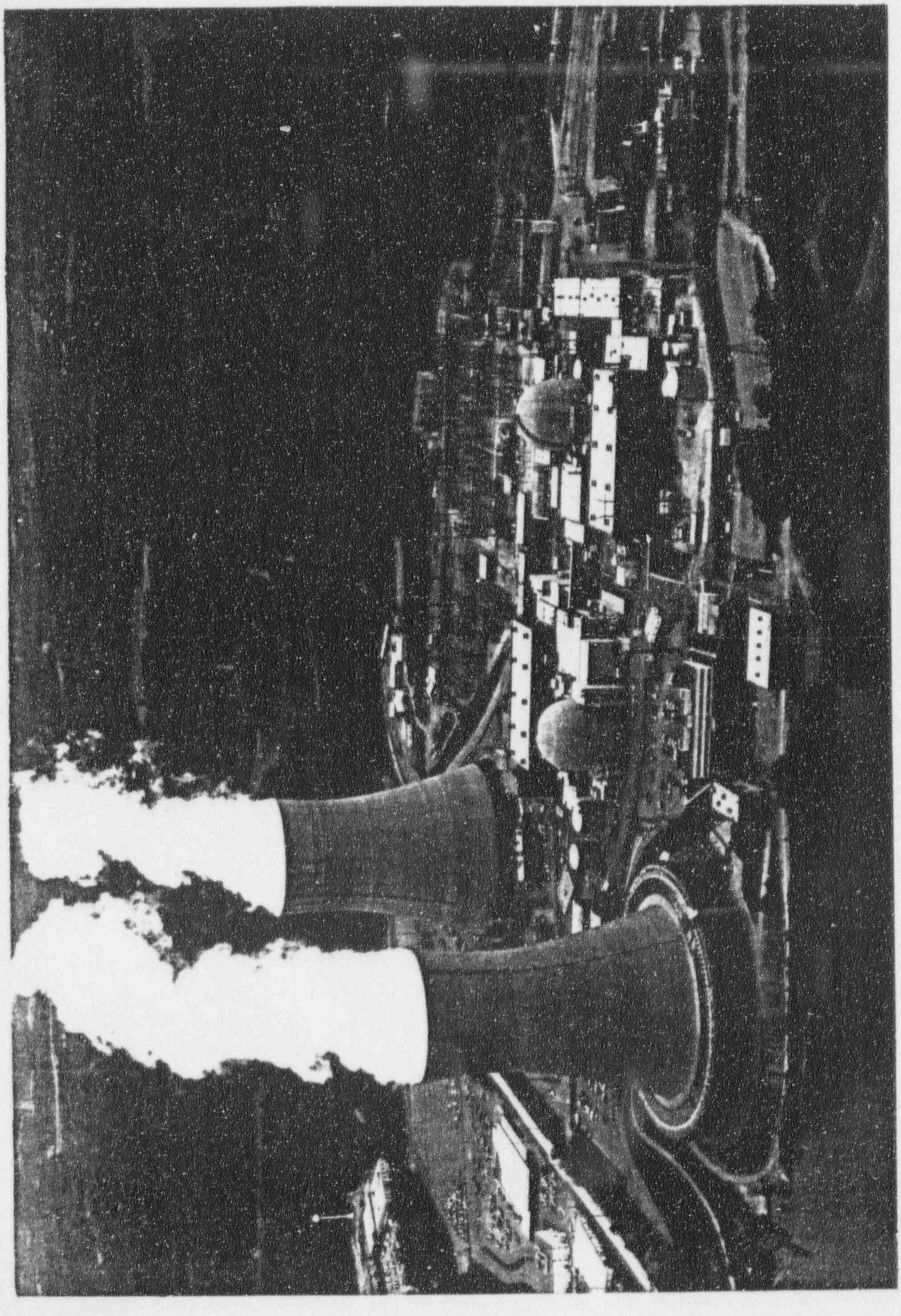


FIGURE I-1

VIEW OF THE BEAVER VALLEY POWER STATION
BVPS

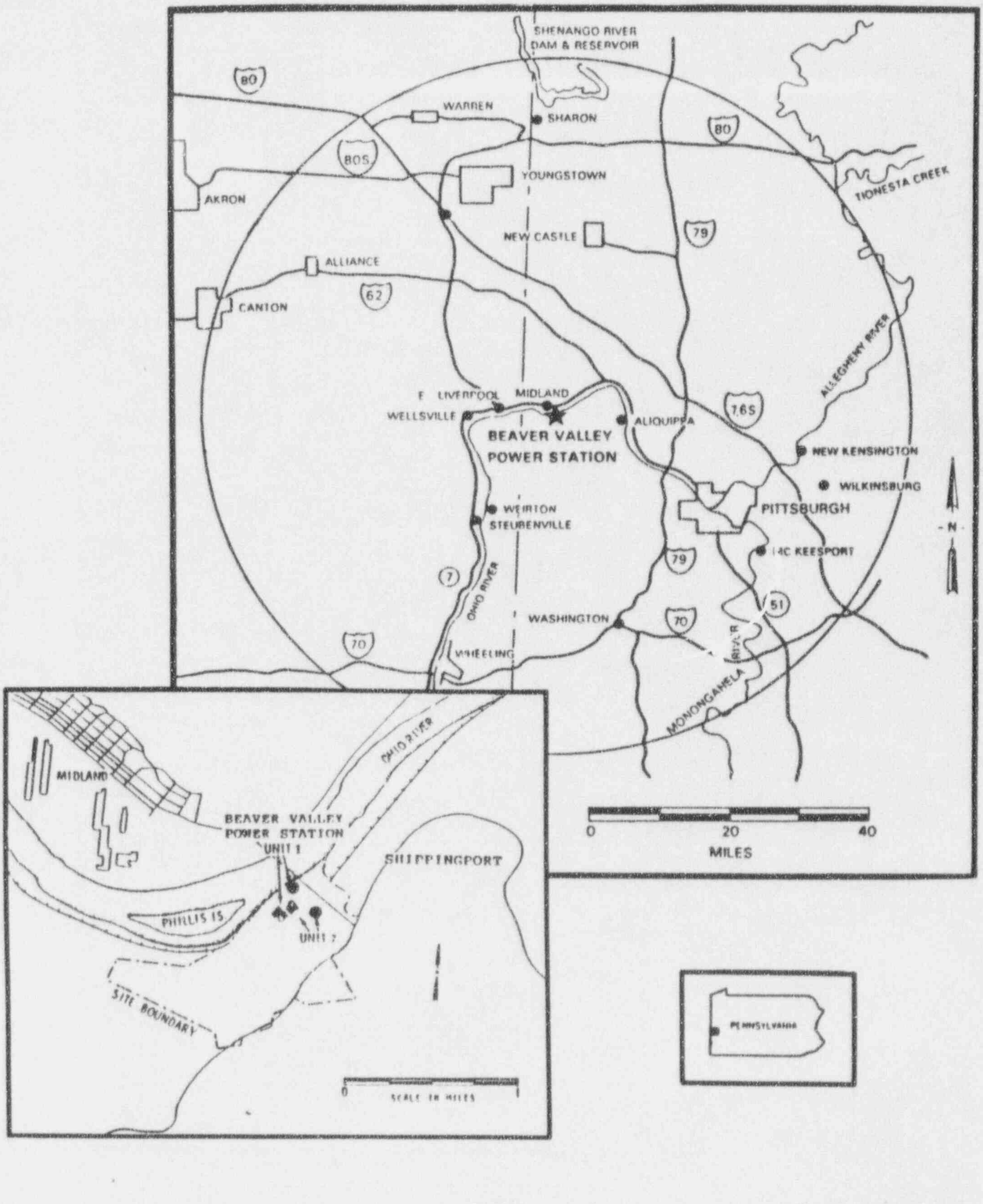


FIGURE I-2

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

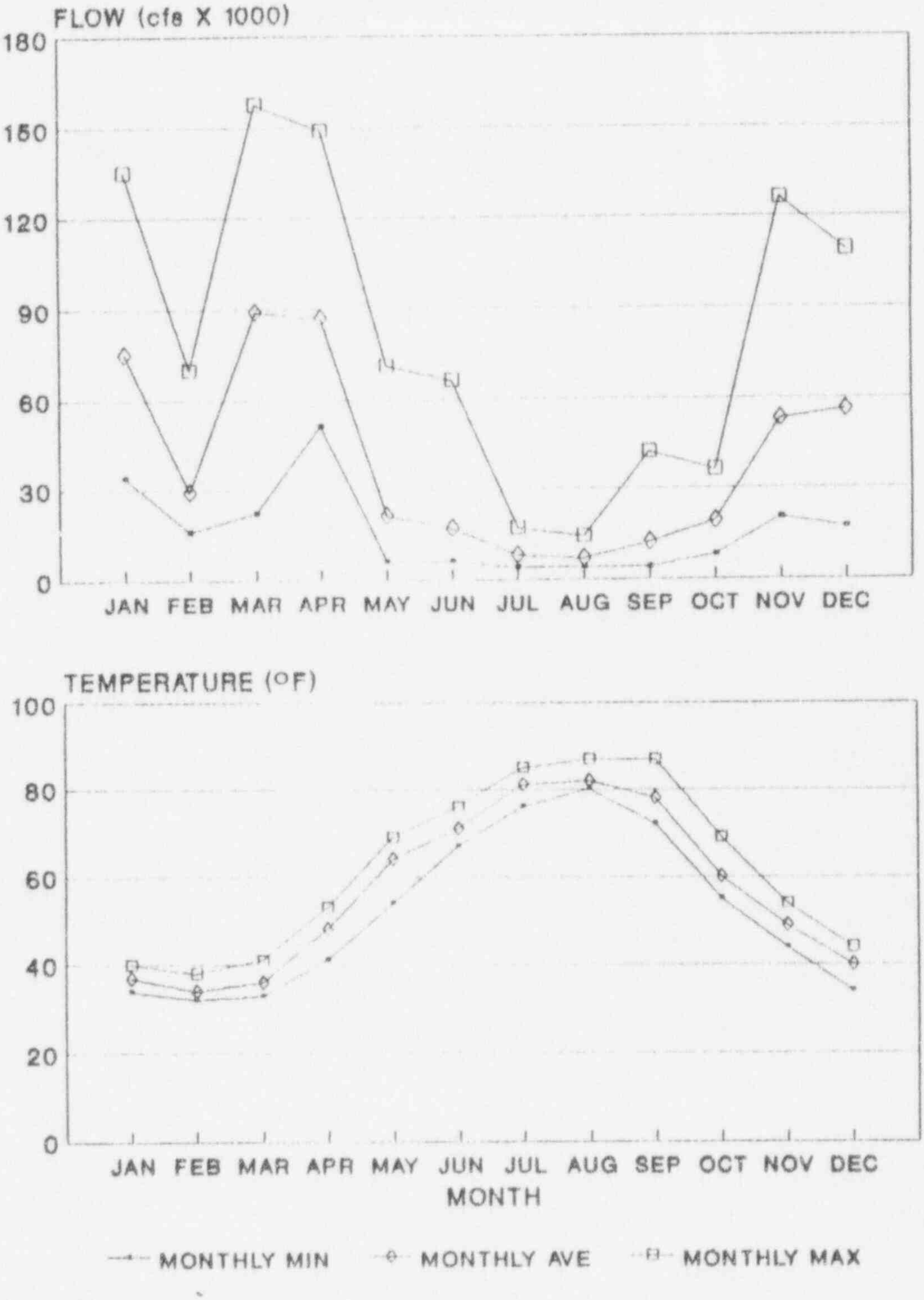


FIGURE I-3

OHIO RIVER FLOW (cfs) AND TEMPERATURE (°F)
RECORDED BY THE U.S. ARMY CORPS OF ENGINEERS
FOR THE NEW CUMBERLAND POOL, 1993
BVPS

TABLE I-1

OHIO RIVER FLOW (cfs) AND TEMPERATURE (°F) RECORDED BY THE
U.S. ARMY CORPS OF ENGINEERS FOR THE
NEW CUMBERLAND POOL, 1993
BVPS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow (cfs x 10^3)												
Monthly Maximum	135	70	158	149	71	66	17	14	42	36	126	109
Monthly Average	75	29	89	87	21	17	8	7	12	19	53	56
Monthly Minimum	34	16	22	51	6	6	4	4	4	8	20	17
Temperature (°F)												
Monthly Maximum	40	38	41	53	69	76	85	87	87	69	54	44
Monthly Average	37	34	36	48	64	71	81	82	78	60	49	40
Monthly Minimum	34	32	33	41	54	67	76	80	72	55	44	34

were observed in February and maximum temperatures in August/September (Figure I-3 and Table I-1).

BVPS Units 1 & 2 have a thermal rating of 2,660 megawatts (Mw). Units 1 & 2 have a design electrical rating of 835 Mw and 836 Mw, respectively. The circulating water systems are 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 and Unit 2 began operation in 1987.

II. SUMMARY AND CONCLUSIONS

The 1993 BVPS Units 1 and 2 Non-Radiological Environmental Monitoring Program included an Aquatic Program covering surveillance and field sampling of Ohio River aquatic life. The Aquatic Program is an annual program voluntarily conducted by Duquesne Light Company to assess the impact of the operating BVPS on the aquatic ecosystem in the Ohio River. This is the eighteenth year of operational environmental monitoring for Unit 1 and the sixth for Unit 2. As in the previous years, no evidence of adverse environmental impact to the aquatic life in the Ohio River was observed.

AQUATIC MONITORING PROGRAM

The Aquatic Environmental Monitoring Program was modified in 1993 to incorporate several improvements in sampling methodologies which reflect the latest developments in aquatic sampling and monitoring. These procedural changes were instituted after considerable planning and research. Each new element of the program was previously performed on a trial basis in 1992 and found to improve efficiency and were scientifically valid. These changes serve to make the BVPS Aquatic Program compatible with monitoring programs that are currently being conducted by various agencies and other scientific research projects conducted throughout the entire Ohio River drainage, making DLC's input a valuable component of the environmental monitoring and assessment of the entire Ohio River Watershed.

The 1993 Aquatic Program included surveys of the benthic macroinvertebrate community and the adult and juvenile (ichthyoplankton) fish communities of the Ohio River near BVPS. *Corbicula* monitoring, and monitoring for the potential invasion of the zebra mussel into the Ohio River near BVPS were also performed. The objectives for each portion of the program are presented in the following paragraphs and those methodologies that were modified in 1993 are identified.

The benthos sampling program was unaltered in 1993. Benthos sampling was conducted upstream and downstream of the BVPS to assess potential impacts of BVPS discharges. These data were compared to preoperational and other operational data to assess long term trends.

The fish sampling program was modified in 1993 to incorporate several changes in methodology. Night electrofishing was substituted for daytime electrofishing, which had been performed in prior BVPS operational and preoperational years. Night electrofishing has become the preferred method of various agencies and utilities which sample fish populations in the Ohio River drainage. This method generally produces better results in species composition and relative abundance than day electrofishing surveys. The period of time that gill nets were deployed in the river during each survey was also modified in 1993, from approximately 24 hours per set, to an overnight set (nets deployed before dusk, then removed the next morning). This change did not significantly affect total catch, but helped to increase percent survival of specimens caught. Shoreline seining was introduced on an experimental basis in 1993 to sample for juvenile fish and other species inhabiting shallow habitats near shore. Seining was performed in lieu of using minnow traps, a fish sampling device used during past BVPS surveys.

The ichthyoplankton sampling program was modified in 1993 to incorporate methodology changes which served to increase the efficiency of the program, while still providing scientifically sound data. The ichthyoplankton database compiled for BVPS during the seven year period (1986 through 1992) when both night and day surveys were performed shows that the night surveys have produced higher densities of ichthyoplankton than the day surveys. Additionally, other sampling programs in the Ohio River drainage have modified their ichthyoplankton sampling protocols such that all ichthyoplankton sampling is performed at night. For these reasons, the BVPS ichthyoplankton sampling program was revised in 1993 so that all surveys were performed at night. Another modification to the ichthyoplankton program was that the surveys were conducted twice a month (approximately every two weeks), rather than once a month as in previous years. This change permits better discernment of temporal fluctuations in the Ohio River ichthyoplankton population.

Additionally, ichthyoplankton sampling in the Ohio River main channel adjacent to the BVPS intake structure was modified such that sampling was performed only at Station 2 (Figure V-F-1, Section F), rather than at all five stations, as previously performed in 1976 through 1992. One surface tow and one bottom tow were performed simultaneously at Station 2 during each survey. Station 2 was selected as the sampling station for the modified program based on its proximity to the intake structure and that it is representative of the ichthyoplankton community present within the Ohio River water column in the vicinity of the BVPS. An added benefit of the ichthyoplankton sampling program is that this technique also provides valuable data on the densities of Corbicula juveniles that are in the water column. Since previous surveys demonstrated that night sampling provided a more accurate assessment of the numbers of clam juveniles entering BVPS, sampling efforts were redirected to concentrate on night sampling.

Corbicula studies were conducted to determine the presence of these clams in the Ohio River and their growth and reproduction inside the plant. There were a few modifications incorporated into the Corbicula monitoring program in 1993. The collection of petite ponar dredge samples at multiple transects on the Ohio River (R. M. 28.2 to 37.5) and in front of the BVPS intake structure to determine Corbicula densities, was discontinued in 1993. Corbicula densities for the Ohio River are determined for the ponar dredge samples collected in May and September for the regular benthos program at BVPS.

Corbicula monitoring within the BVPS was also modified in 1993. Corbicula larval cages, placed within both BVPS cooling towers from 1988 through 1992, to monitor monthly for Corbicula colonization and growth, were discontinued in 1993. A new method initiated in 1993 was the monthly collection of a sediment sample from the lower reservoir basin of each BVPS cooling tower by using a scraper. These samples were sorted for live and dead Corbicula to provide information on the density, size and mortality of Corbicula present in each of the BVPS cooling tower reservoirs. This reservoir scraper sampling program provides valuable up to date Corbicula density and growth data. This information is conveyed to BVPS chemistry and operations personnel verbally and via a Monthly Status Report.

The Monthly Status Report consists of written text and graphs which provide results for the Aquatic Monitoring Program surveys performed within the current month. This report has proven to be an effective and efficient way of informing BVPS personnel of the densities and growth of Corbicula in and around BVPS. This information is vital for BVPS operations and chemistry personnel in determining the dosing schedule for biofouling control. An example of a Monthly Status Report is presented as an Appendix.

The zebra mussel monitoring program consisted of plant and river sampling to monitor for the potential invasion of the zebra mussel into the Ohio River near BVPS. There were no modifications to the program in 1993.

The following paragraphs summarize the findings for each section of the BVPS Aquatic Program:

Benthos

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 76% of the macrobenthos collected, whereas Chironomidae and Mollusca accounted for about 21% and 4%, respectively.

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

Phytoplankton/Zooplankton

The plankton communities (phyto- and zooplankton) have been sampled and analyzed at BVPS on a monthly basis from 1973 through 1992. The results of this twenty year study showed that the long term trends for the plankton communities were consistent from year to year. Annual variations were attributable to either extremes in precipitation and/or temperature. Overall, the plankton communities, both phytoplankton and zooplankton were considered typical of those in temperate climates (Hutchinson 1967).

Therefore, having compiled an extensive plankton database for the Ohio River, BVPS modified the plankton program in 1993. Currently, samples are still collected from the same intake structure at monthly intervals and properly preserved as in previous years. However, these preserved samples have been archived pending a need for future laboratory analysis.

Fish

The fish community of the Ohio River in the vicinity of BVPS was sampled in 1993 by night electrof'shing, gill netting and seining. The results of the 1993 fish surveys show normal community structure based on species composition and relative abundance. Forage species were collected in the highest numbers, particularly gizzard shad. This indicates a normal fish community, since game species (predators) rely on this forage base for their survival. Variations in total annual catch are a natural occurrence and are attributable primarily to fluctuations in the population size of the forage species. Forage species, such as gizzard shad with high reproductive potentials frequently respond to changes in natural environmental factors (competition, food availability, cover, and water quality) with large fluctuations in population size.

Although variations in total catch occurred from station to station in 1993, species composition remained fairly stable. Common species collected in the surveys by all methods included gizzard shad, channel catfish, white bass, striped bass hybrid, common carp, smallmouth bass, spotted bass, walleye, and sauger. Differences observed in catch between the Control (1) and Non-Control Stations (2A, 2B and 3) were probably caused by habitat preferences of individual species in combination with the highly fluctuating and prolific gizzard shad population observed during the July and September surveys. Habitat preference is probably the most influential factor that affects where the different species of fish are collected and in what relative abundance.

Ichthyoplankton

All ichthyoplankton surveys were conducted at night in 1993. Gizzard shad dominated the 1993 ichthyoplankton catch from the back channel of Phillis Island. Freshwater drum and common carp ranked next in terms of abundance. Ichthyoplankton densities first began to increase in mid-May, peaked in late May and June, then decreased in early July. The months of April and August showed little to no spawning activity. This represents normal spawning cycles for the fish species inhabiting the Ohio River in the vicinity of the BVPS.

Fish Impingement

The results of the 1993 impingement surveys indicate that during the months of August and September large numbers of Corbicula were collected off of the traveling screens. Although this trend has occurred in previous years, the August and September 1993 totals were the second highest in the period since 1981. No zebra mussels were collected from the 1993 impingement surveys. The number of fish collected from the 1993 impingement surveys at BVPS was within the range observed for previous operational years and indicates that withdrawal of river water at BVPS intake for cooling purposes has very little effect on the fish populations.

Plankton Entrainment

1. Ichthyoplankton

Gizzard shad dominated the 1993 ichthyoplankton catch from the main channel of the Ohio River in front of the BVPS. Other fish collected were common carp and freshwater drum. Ichthyoplankton densities began to increase in early May, peaked in June and started to decrease in early July. The months of April and August showed little to no spawning activity. This represents normal spawning cycles for the fish species inhabiting the Ohio River in the vicinity of the BVPS.

2./3. Phytoplankton / Zooplankton

Currently, samples are still collected from the same intake structure at monthly intervals and properly preserved as in previous years. However, these preserved samples have been archived pending a need for future laboratory analysis.

Corbicula Monitoring

The weekly impingement data for 1993 show that juveniles and adult Corbicula float into BVPS. The highest collections of Corbicula off the traveling screens occurred in August and September, then decreased through December. The Corbicula impingement total for 1993 was the second highest since 1981, with the highest total occurring in 1989.

The monthly reservoir scraper samples collected in Units 1 and 2 cooling towers during 1993 indicated when Corbicula were entering and colonizing the reservoirs. During the months of August and September, Corbicula were entering the Units 1 and 2 cooling towers through the circulating water systems. The effects of the CT-1 dosings in 1993 were observed in the reservoir scraper samples collected from both Units 1 and 2 cooling towers. The scraper samples collected after dosing showed 100% mortality of smaller younger clams, with the larger older clams surviving.

Sediment samples were collected in the Unit 1 cooling tower (April 18, 1993) and Unit 2 cooling tower (September 21, 1993) lower reservoirs during the scheduled outages in order to estimate the Corbicula populations within those structures. The estimated number of Corbicula inhabiting the Units 1 and 2 cooling towers at the time of the surveys were 24 million and 8 million clams, respectively. Population surveys of both BVPS cooling tower reservoirs conducted during scheduled outages (1986 through 1993) have resulted in lower densities of Corbicula in the Unit 2 tower compared to the Unit 1 cooling tower. This can be attributed to differences in cooling tower design and the faster water currents in the Unit 2 cooling tower reservoir, which decrease sediment deposition.

Corbicula collected during the ichthyoplankton surveys conducted in 1993 demonstrate that Corbicula are migrating down the Ohio River and entering BVPS through the intake structure. The highest sample collection of Corbicula occurred in July.

Juvenile Corbicula from the 1993 summer spawn were first detected in the larval cages removed from the BVPS intake structure in July. This early summer spawning period typically occurs in the Ohio River near BVPS each year. These clams exhibited rapid growth during August and September, and during the size analysis were found to be predominantly of the 6.3 and 9.5 mm sieve size categories. As river temperatures dropped below 50 °F in early November, the growth rate of Corbicula present in the intake structure larval cages also decreased.

Corbicula larvae which colonized the intake structure larval cages during the summer and early fall have shown rapid growth. This was due to the higher river temperatures in the summer, when more food sources were also available to these filter feeders. The largest Corbicula removed from an intake structure larval cage in 1993 measured 23.92 mm in length.

Zebra Mussel Monitoring

The zebra mussel (Dreissena polymorpha) is an exotic freshwater mollusk that is believed to have been introduced into Lake St. Clair in 1987 via ballast water of ocean-going cargo vessels. Since then, they have spread rapidly to the other Great Lakes and are infesting riverine systems in the United States.

Due to the proximity of the Ohio River to Lake Erie, BVPS initiated a Zebra Mussel Monitoring Program in January 1990. The Zebra Mussel Monitoring Program in 1992 and 1993 utilized a new artificial substrate sampler developed by the Pennsylvania Department of Environmental Resources which provides a large surface area for the mussel larvae to attach. In 1993, no zebra mussels have been detected at BVPS, however, a confirmed sighting was reported by the U.S. Army Corps of Engineers at the Pike Island Locks and Dam. This facility is located on the Ohio River at M. P. 84.2, just 50 river miles downstream from the BVPS.

III. ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE

The BVPS Unit 1 ETS, Appendix B to Operating License No. DPR-66, initially required that significant environmental change analyses be performed on benthos, phytoplankton, and zooplankton data. However, on February 26, 1980, the NRC granted DLC a request to delete all of the Aquatic Monitoring Program, with the exception of the fish impingement, from the ETS (Amendment No. 25, License No. DPR-66). Consequently, the requirements for Analysis of Significant Environmental Change was deleted by the NRC, and is not applicable to the present Aquatic Monitoring Program. In 1983, the NRC also deleted the requirement for fish impingement studies. However, in the interest of providing a non-disruptive database, DLC is continuing the Aquatic Monitoring Program.

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 BVPS, 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, License No. DPR-66) 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, Office of Nuclear Reactor Regulation.

B. HERBICIDES

Monitoring and reporting of herbicides used for weed control during 1993, is no longer required as stated in Amendment No. 64; thus, this information is not included in this report.

V. AQUATIC MONITORING PROGRAM

A. INTRODUCTION

The environmental study area, established to assess potential impacts, consisted of four sampling stations each having a north and south shore (Figure V-A-1). Station 1 is located at river mile (RM) 34.5, approximately 0.3 mi (0.5 km) upstream of BVPS and is the Control Station. Station 2A is located approximately 0.5 mi (0.8 km) downstream of the BVPS discharge structure in the main channel. Station 2B is located in the back channel of Phillis Island, also 0.5 mi downstream of the BVPS discharge structure. Station 2B is the principal Non-Control Station because the majority of aqueous discharges from BVPS Units 1 and 2 are released to the back channel. Station 3 is located approximately 2 mi (3.2 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.

B. BENTHOS

Objectives

The objectives of the benthic surveys were to characterize the benthos of the Ohio River near BVPS and to determine the impacts, if any, of BVPS operations.

Methods

Benthic surveys were performed in May and September, 1993. Benthos samples were collected at Stations 1, 2A, 2B, and 3 (Figure V-B-1), using a Ponar grab sampler. Duplicate samples were taken off the

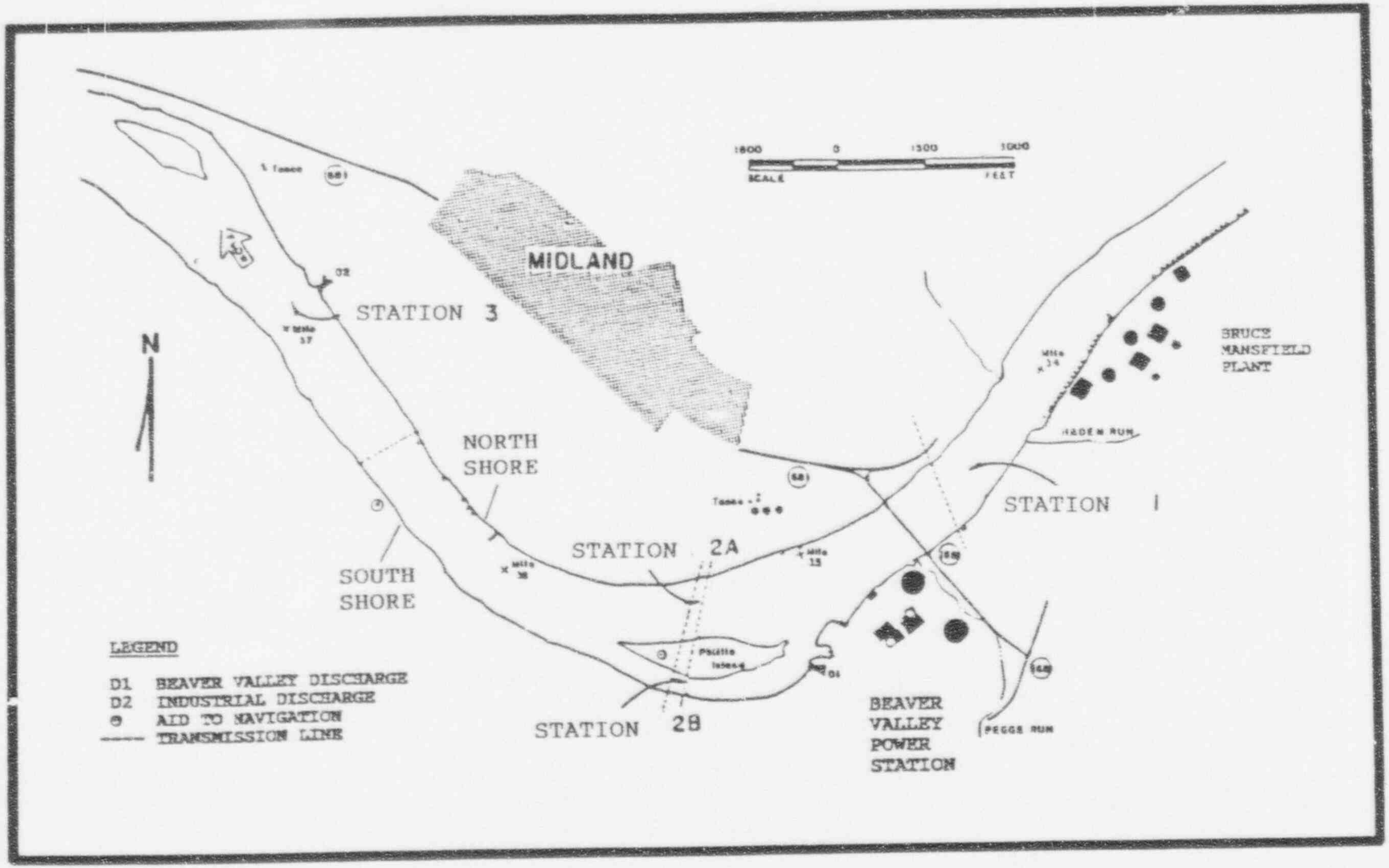


FIGURE V-A-1

SAMPLING STATIONS IN THE VICINITY OF THE BEAVER VALLEY POWER STATION BVPS

TABLE V-A-1

AQUATIC MONITORING PROGRAM SAMPLING DATES
1993 BVPS

Month	Benthos	Zebra Mussel and *Corbicula* Monitoring[a]	Fish	Impingement	Ichthyoplankton Night	Phyto- and Zooplankton
January		22		22, 29		15
February		19		26		19
March		26		12, 19		12
April		16, 30		9, 16, 23	14, 29	9
May	13	14, 28	13, 14	28	13, 27	7
June		11, 25		4, 11, 18, 25	10, 23	11
July		16, 30	21, 22	9, 16, 30	7, 21	16
August		20		6, 13, 20, 27	4, 18	20
September	16	3, 17	16, 17	3, 10, 17, 24		10
October		8, 22		1, 8, 15, 22, 29		8
November		19	11, 12	5, 12, 19, 26		12
December		17		3, 10, 17, 24, 31		10

[a] Zebra Mussel and *Corbicula* Monitoring also includes all Impingement dates.

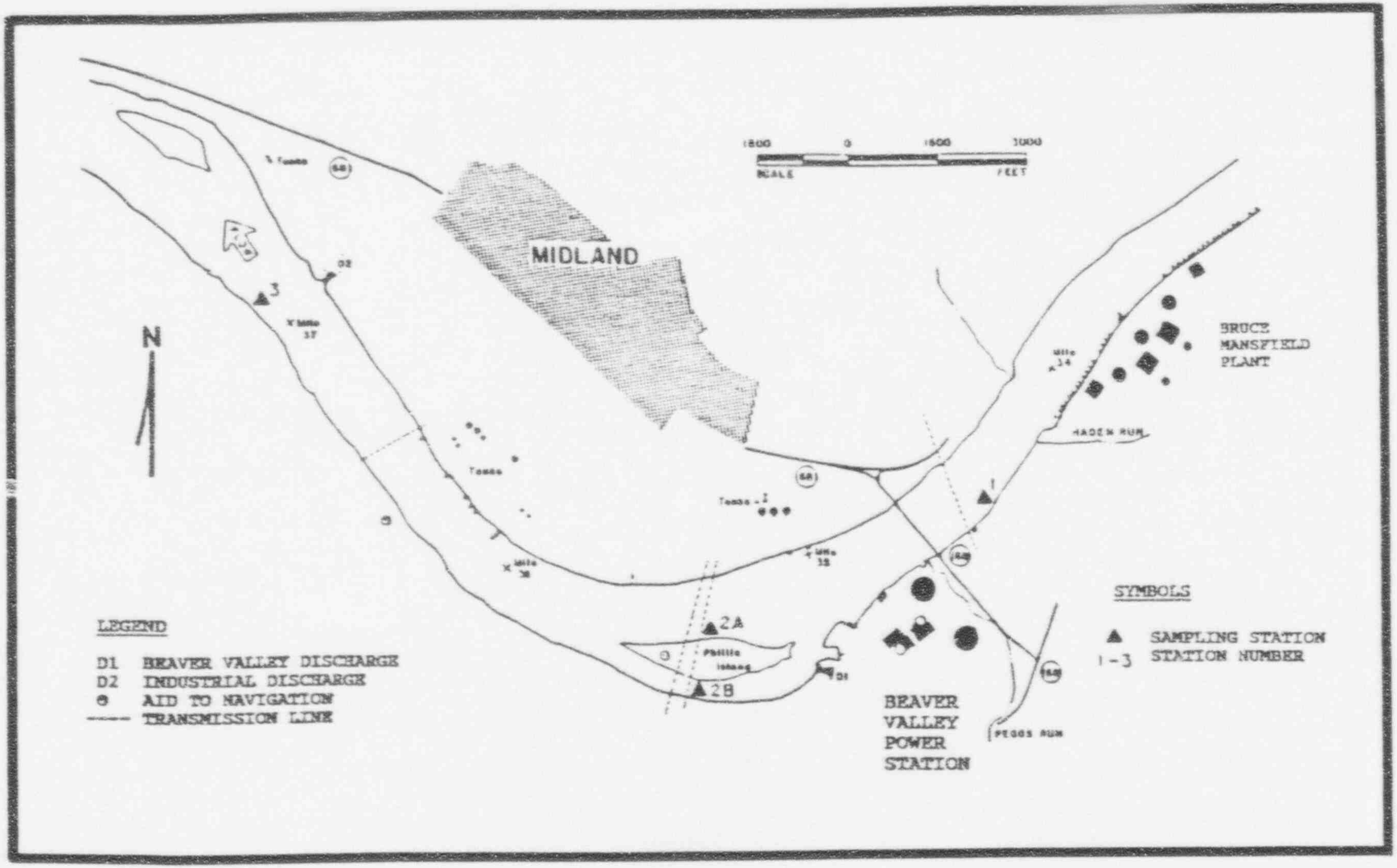


FIGURE V-B-1

BENTHOS SAMPLING STATIONS
BVPS

south shore at Stations 1, 2A, and 3. Sampling at Station 2B, in the back channel of Phillis Island, consisted of individual Ponar grabs 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. 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 the two replicates and three back channel samples. Three species diversity indices were calculated: Shannon-Weiner, 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 are the result of damming, channelization, and river traffic. Shoreline habitats were generally soft muck substrates composed of sand, silt, and detritus. An exception occurs along the north shoreline of Phillis Island at Station 2A where clay and sand predominate. The other distinct habitat, hard substrate, is located at midriver. The hard substrate is probably the result of channelization and scouring by river currents and turbulence from commercial boat traffic.

Results

Forty-four macroinvertebrate taxa were identified during the 1993 monitoring program (Table V-B-1). Species composition during 1993 was similar to that observed during previous preoperational (1973 through 1975) and operational (1976 through 1992) years. The macroinvertebrate assemblage during 1993 was composed primarily of burrowing organisms typical of soft unconsolidated substrates. Oligochaetes (worms) and chironomid (midge) larvae were abundant

TABLE V-B-1

SYSTEMATIC LIST OF MACROINVERTEBRATES COLLECTED FROM 1973 THROUGH 1993 IN THE OHIO RIVER NEAR BVPS

Taxa	Collected in Previous Years	Collected in 1993
Porifera		
Spongilla fragilis	X	
Cnidaria		
Hydrozoa		
Clavidae		
Cordylophora lacustris	X	
Hydridae		
Craspedacusta sowerbii	X	
Hydra sp.	X	X
Platyhelminthes		
Tricladida	X	
Rhabdocoela	X	
Nemertea	X	
Nematoda	X	X
Entoprocta		
Urnatella gracilis	X	X
Ectoprocta		
Fredericella sp.	X	X
Paludicella articulata	X	
Pectinatella sp.	X	
Plumatella sp.	X	
Annelida		
Oligochaeta		
Aeolosomatidae	X	
Enchytraeidae	X	X
Naididae		
Allonais pectinata	X	
Amphichaeta leydigi	X	
Amphichaeta sp.	X	
Arcteonais lomondi	X	
Aulophorus sp.	X	
Chaetogaster diaphanus	X	
C. diastrophus	X	
Dero digitata	X	
D. nivea	X	
Dero sp.	X	X
Nais barbata	X	
N. behningi	X	
N. bretscheri	X	
N. communis	X	
N. elinguis	X	X
N. pardalis	X	
N. simplex	X	
N. variabilis	X	
Nais sp.	X	
Ophidonais serpentina	X	
Paranais frici	X	X
Paranais sp.	X	
Piguetiella michiganensis	X	X
Pristina idrensis	X	X
Pristina longiseta	X	
P. osborni	X	
P. sima	X	X
Pristina sp.	X	
Ripistes parasita	X	
Slavina appendiculata	X	
Stephensoniana trivandrana	X	
Stylaria fossularis	X	X
S. lacustris	X	
Uncinais uncinata	X	
Vejdovskyella intermedia	X	
Vejdovskyella sp.	X	

TABLE V-B-1
(Continued)

Taxa	Collected in Previous Years	Collected in 1993
Tubificidae		
Aulodrilus limnobius	X	X
A. pigueti	X	X
A. pluriseta	X	X
Bothrioneurum vejdovskyanum	X	
Branchiura sowerbyi	X	X
Ilyodrilus templetoni	X	
Limnodrilus cervix	X	X
L. cervix (variant)	X	
L. claparedianus	X	
L. hoffmeisteri	X	X
L. spiralis	X	
L. udekemianus	X	X
Limnodrilus sp.	X	
Peloscolex multisetosus longidentus	X	
P. m. multisetosus	X	
Potamothrix moldaviensis	X	
P. vejdovskyi	X	
Psammoryctides curvisetosus	X	
Tubifex tubifex	X	
Unidentified immature forms:		
with hair chaetae	X	X
without hair chaetae	X	X
Lumbriculidae	X	
Hirudinea		
Glossiphoniidae	X	
Helobdella elongata	X	
H. stagnalis	X	
Helobdella sp.	X	
Erpobdellidae		
Erpobdella sp.	X	
Mooreobdella microstoma	X	
Arthropoda		
Acarina	X	X
Ostracoda	X	
Isopoda		
Asellus sp.	X	
Amphipoda		
Talitridae		
Hyalella azteca	X	
Gammaridae		
Crangonyx pseudogracilis	X	
Crangonyx sp.	X	
Gammarus fasciatus	X	
Gammarus sp.	X	X
Decapoda	X	
Collembola	X	
Ephemeroptera		
Heptageniidae	X	
Stenacron sp.	X	
Stenonema sp.	X	
Ephemeridae		
Ephemera sp.	X	
Hexagenia sp.	X	X
Baetidae	X	
Caenidae		
Caenis sp.	X	X
Tricorythidae		
Tricorythodes sp.	X	
Megaloptera		
Sialis sp.	X	
Odonata		
Gomphidae		
Dromogomphus spoliatus	X	
Dromogomphus sp.	X	X
Gomphus sp.	X	
Libellulidae		
Libellula sp.	X	

TABLE V-B-1
(Continued)

Taxa	Collected in Previous Years	Collected in 1993
Trichoptera		
Hydropsychidae	X	
Cheumatopsyche sp.	X	
Hydropsyche sp.	X	
Hydroptilidae		
Hydroptila sp.	X	
Oxyethira sp.	X	
Leptoceridae		
Ceraclea sp.	X	
Oecetis sp.	X	X
Polycentropodidae		
Polycentropus sp.	X	X
Coleoptera	X	
Hydrophilidae	X	
Elmidae		
Ancyronyx variegatus	X	
Dubiraphia sp.	X	
Helichus sp.	X	
Stenelmis sp.	X	
Psephenidae	X	
Diptera		
Unidentified Diptera	X	X
Psychodidae	X	
Pericoma sp.	X	
Psychoda sp.	X	
Telmatoscopus sp.	X	
Unidentified Psychodidae pupae	X	
Chaoboridae		
Chaoborus sp.	X	
Simuliidae		
Similium sp.	X	
Chironomidae		
Chironominae	X	
Tanytarsini pupa	X	
Chironominae pupa	X	X
Axarus sp.		X
Chironomus sp.	X	X
Cladopelma sp.	X	
Cryptochironomus sp.	X	X
Dicrotendipes nervosus	X	
Dicrotendipes sp.	X	X
Glyptotendipes sp.	X	
Harnischia sp.	X	X
Microchironomus sp.	X	
Micropsectra sp.	X	
Microtendipes sp.	X	
Parachironomus sp.	X	
Phaenopsectra sp.	X	
Polypedilum (s.s.) convictum type	X	
P. (s.s.) simulans type	X	
Polypedilum sp.	X	X
Rheotanytarsus sp.	X	
Stenochironomus sp.	X	
Stictochironomus sp.	X	
Tanytarsus sp.	X	
Xenochironomus sp.	X	
Tanypodinae		
Tanypodinae pupae	X	
Ablabesmyia sp.	X	X
Coelotanypus scapularis	X	X
Djalmabatista pulcher	X	
Djalmabatista sp.	X	
Procladius (Procladius)	X	
Procladius sp.	X	X
Tanypus sp.	X	
Thienemannimyia group	X	
Zavrelimyia sp.	X	

TABLE V-B-1
(Continued)

Taxa	Collected in Previous Years	Collected in 1993
Orthocladiinae	X	
Orthocladiinae pupae	X	
Cricotopus bicinctus	X	
C. (s.s.) trifascia	X	
Cricotopus (Isocladius)- -sylvestris Group	X	
C. (Isocladius) sp.	X	
Cricotopus (s.s.) sp.	X	X
Eukiefferiella sp.	X	
Hydrobaenus sp.	X	
Limnophyes sp.	X	
Nanocladius (s.s.) distinctus	X	
Nanocladius sp.	X	
Orthocladius sp.	X	
Parametriocnemus sp.	X	
Paraphaenocladius sp.	X	
Psectrocladius sp.	X	
Pseudorthocladius sp.	X	
Pseudosmittia sp.	X	
Smittia sp.	X	
Diamesinae		
Diamesa sp.	X	
Potthastia sp.	X	
Ceratopogonidae	X	X
Dolichopodidae	X	
Empididae	X	
Wiedemannia sp.	X	
Ephydridae	X	X
Muscidae	X	
Rhagionidae	X	
Tipulidae	X	
Stratiomyidae	X	
Syrphidae	X	
Lepidoptera	X	
Mollusca		
Gastropoda		
Ancylidae		
Ferrissia sp.	X	
Planorbidae	X	
Valvatidae		
Valvata perdepressa	X	
Pelecypoda	X	
Corbiculidae		
Corbicula fluminea	X	X
Sphaeriidae	X	
Pisidium sp.	X	X
Sphaerium sp.	X	
Unidentified immature Sphaeriidae	X	
Unionidae		
Anodonta grandis	X	
Anodonta immature	X	
Elliptio sp.	X	
Unidentified immature Unionidae	X	

(Tables V-B-2, V-B-3, and V-B-4). Common genera of oligochaetes were Limnodrilus, Aulodrilus, and Paranais. Common genera of chironomids were Polypedilum, Chironomus, and Coelotanypus. The Asiatic clam (Corbicula), which was collected from 1974 through 1978, has been collected in the 1981 through 1993 surveys. None were collected during 1979 or 1980 surveys.

Several individuals of the chironomid genus Axarus were collected at Station 2A in September 1993. This genus was a new addition to the taxa list of macroinvertebrates reported near BVPS (Table V-B-1). No threatened or endangered species were collected during 1993.

Community Structure and Spatial Distribution

Oligochaetes accounted for the highest mean percentage of the macroinvertebrates at all stations in May and September (Figure V-B-2). Among the individual stations, oligochaetes were always the dominant organism except in May at Station 2B where chironomid larvae were most abundant (Table V-B-2).

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 mean density of macroinvertebrates during 1993 was lowest at Station 2A in May and September. Highest mean densities occurred at Station 1 in May and September. Higher mean densities usually occur at Stations 1, 2B, and 3 where substrates near the shore were composed of soft mud or various combinations of sand and silt. The lower abundances at Station 2A were probably related to substrate conditions (clay and sand) along the north shoreline of Phillis Island.

TABLE V-B-2

MEAN NUMBER OF MACROINVERTEBRATES (Number/m²) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA AND OTHER ORGANISMS, 1993
BVPS

	STATION							
	1		2A		2B		3	
	#/m²	%	#/m²	%	#/m²	%	#/m²	%
May 13								
Oligochaeta	7035	83	40	44	928	43	3648	92
Chironomidae	1360	16	20	22	1144	53	168	4
Mollusca	0	0	0	0	0	0	60	2
Others	40	<1	30	33	80	4	109	3
Total	8435	99	90	99	2152	100	3985	101
September 16								
Oligochaeta	3155	67	257	37	1399	65	3114	87
Chironomidae	1420	30	247	35	552	26	375	10
Mollusca	118	3	89	13	79	4	99	3
Others	0	0	109	16	113	5	0	0
Total	4693	100	702	101	2143	100	3588	100

TABLE V-B-3

BENTHIC MACROINVERTEBRATE DENSITIES (Number/m²), MEAN OF TRIPLICATE FOR BACK CHANNEL AND DUPLICATE SAMPLES COLLECTED IN THE MAIN CHANNEL OHIO RIVER, MAY 13, 1993
BVPS

Taxa	STATION			
	1	2A	2B	3
Nematoda	10		13	20
Entoprocta				
Urnatella gracilis				+
Ectoprocta				
Fredericella sp.			+	
Annelida				
Enchytraeidae	10			10
Oligochaeta eggs	+		+	+
Dero sp.	10			
Nais elinguis			7	
Paranais frici	1025		20	926
Piguetiella michiganensis				1261
Pristina sima				10
Stylaria flossularis			7	59
Aulodrilus limnobius	177		13	30
Aulodrilus pigueti	158		7	10
Aulodrilus pluriseta	266		13	40
Branchiura sowerbyi			72	40
Limnodrilus cervix	30		7	20
Limnodrilus hoffmeisteri	522		164	148
Limnodrilus udekemianus	138		33	69
Immature w/o capilliform chaeta	3911	40	565	1015
Immature w/ capilliform chaeta	788		20	10
Amphipoda				
Gammarus sp.		20	40	79
Ephemeroptera				
Caenis sp.				10
Odonata				
Dromogomphus sp.			7	
Diptera				
Chironominae pupae			66	
Chironomus sp.			171	
Cryptochironomus sp.			20	30
Polypedilum sp.	1350	20	854	138
Coelotanypus scapularis	10			
Procladius sp.			26	
Cricotopus sp.			7	
Ceratopogonidae	20	10	20	
Ephydridae	10			
Mollusca				
Corbicula fluminea				60
Total	8435	90	2152	3985

+ Indicates organisms present.

TABLE V-B-4

BENTHIC MACROINVERTEBRATE DENSITIES (Number/m²), MEAN OF TRIPLICATE FOR BACK CHANNEL AND DUPLICATE SAMPLES COLLECTED IN THE MAIN CHANNEL
OHIO RIVER, SEPTEMBER 16, 1993
BVPS

Taxa	STATION			
	1	2A	2B	3
Cnidaria				
Hydra sp.		10	20	
Entoprocta				
Urnatella gracilis	+			
Annelida				
Oligochaeta eggs			+	+
Dero sp.	79		26	40
Piguetiella michiganensis		10		
Pristina idrensis		50		
Pristina sima	40			
Branchiura sowerbyi	40		164	158
Limnodrilus cervix			13	
Limnodrilus hoffmeisteri	552	79	79	316
Limnodrilus udekemianus	119		7	59
Immature w/o capilliform chaeta	2285	118	1090	2423
Immature w/ capilliform chaeta	40		20	118
Arthropoda				
Acarina			26	
Amphipoda				
Gammarus sp.		10	53	
Ephemeroptera				
Hexagenia sp.			7	
Trichoptera				
Oecetis sp.		89		
Polycentropus sp.			7	
Diptera				
Unidentified Diptera				20
Axarus sp.		187		
Cryptochironomus sp.	40	30		59
Dicrotendipes sp.			40	
Harnischia sp.				20
Polypedilum sp.	1300		236	59
Ablabesmyia sp.		30		
Coelotanypus scapularis	40		230	158
Procladius sp.	40		46	59
Mollusca				
Corbicula fluminea	118	89	79	59
Pisidium sp.				40
Total	4693	702	2143	3588

+ Indicates organisms present.

Comparison of Control and Non-Control Station

No adverse impact to the benthic community was observed during 1993. This conclusion is based on a comparison of data collected at Station 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), (Tables V-B-3 and V-B-4). In May, common taxa at both stations were the oligochaetes Limnodrilus spp., Aulodrilus, and Paranais, and the midge Polypedilum. In September, the oligochaetes Limnodrilus spp., Branchiura, and Dero, and the midge Polypedilum, were the common organisms collected at both stations.

In May and September 1993, a similar mean number of taxa were collected at Non-Control station 2B and at Control station 1 (Table V-B-5). This has occurred several times during the past surveys. The mean number of taxa and Shannon-Weiner indices for the back channel were within the range of or exceeded the values observed for other stations in the study area. Differences observed between Station 1 (Control) and 2B (Non-Control) and between other stations could be related to the differences in habitat. None of the differences were 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 76% of the individuals collected in 1993 (Figure V-B-2). A similar oligochaete assemblage has been reported each year. Chironomids and mollusks have composed most of the remaining fractions of the community each year. The Asiatic clam, Corbicula, had increased in abundance from 1974 through 1976, but

TABLE V-B-5

MEAN DIVERSITY VALUES FOR BENTHIC MACROINVERTEBRATES
COLLECTED IN THE OHIO RIVER, 1993
BVPS

	STATION			
	1	2A	2B	3
DATE: May 13				
No. of Taxa	13	2	11	16
Shannon-Weiner Index	2.37	1.11	1.98	2.61
Evenness	0.66	0.83	0.75	0.65
DATE: September 16				
No. of Taxa	8	7	8	11
Shannon-Weiner Index	1.97	2.29	1.97	1.89
Evenness	0.69	0.85	0.74	0.56

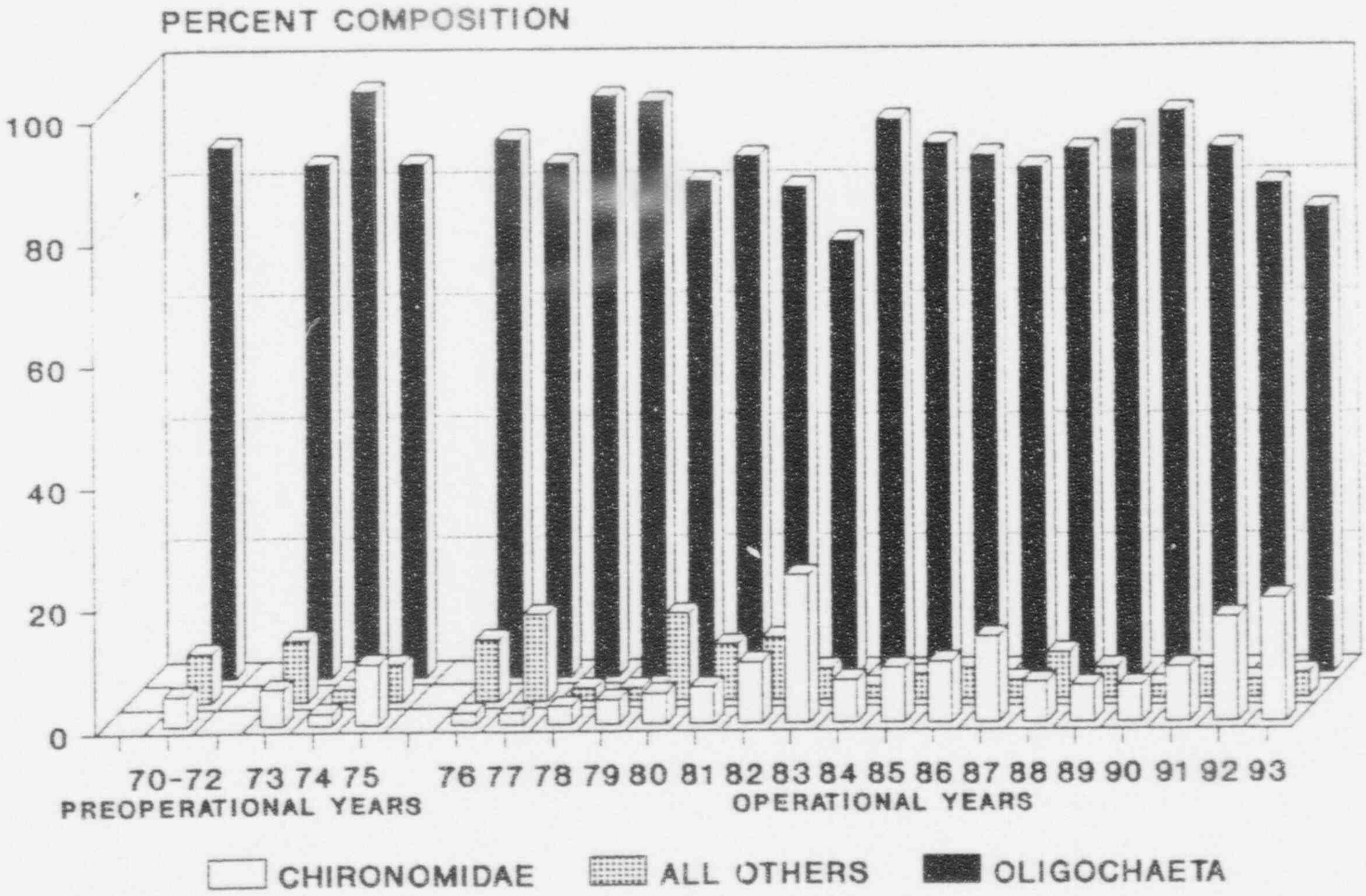


FIGURE V-B-2

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

declined in number during 1977. Since 1981, Corbicula have been collected in all benthic surveys, including 1993 when their densities were greater in September than in May.

Total macroinvertebrate densities for Station 1 (Control) and 2B (Non-Control) for each year since 1973 are presented in Table V-B-6. Mean densities of macroinvertebrates gradually increased from 1973 through 1976 (BVPS Unit 1 start-up) to 1983. In 1993, densities were greater at Station 1 than those at Station 2B. These higher densities at Station 1 in 1993 were well within the range of previous data from preoperational and operational years. There does not appear to be a consistent trend of higher or lower mean densities between the back channel of Phillis Island (Non-Control 2B) when compared to densities at Station 1 (Control). In years such as 1993, 1991, 1990, 1985, 1984, 1983, and 1979, mean densities were lower at Station 2B than at Station 1 whereas in other years mean densities were slightly higher at Station 2B. These differences could be related to substrate variability and randomness of sample grabs.

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 76% of the macrobenthos collected, whereas Chironomidae and Mollusca each accounted for about 21% and 4%, respectively.

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

TABLE V-B-6

BENTHIC MACROINVERTEBRATE DENSITIES (Number/m²) FOR STATION 1 (CONTROL) AND STATION 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS BVPS

	Preoperational Years						Operational Years									
	1973		1974		1975		1976		1977		1978		1979		1980	
Month	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
January																
February	205	0	703	311			358	200	312	1,100	1,499	2,545			1,029	1,296
March													425	457		
April																
May	248	508	1,116	2,197			927	3,660	674	848	351	126	1,004	840	1,041	747
June	5	40	507	686												
July	653	119	421	410												
August	99	244	143	541	1,017	1,124	851	785	591	3,474	601	1,896	1,185	588		
September			175	92											1,523	448
October	256	239														
November	149	292	318	263	75	617	388	1,295	108	931	386	1,543	812	806		
December																
Mean	231	206	483	643	546	871	631	1,485	421	1,588	709	1,528	857	673	1,198	830

TABLE V-B-6
(Continued)

	Operational Years													
	1981		1982		1983		1984		1985		1986		1987	
Month	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	209	456	3,490	3,026	3,590	1,314	2,741	621	2,256	867	601	969	1,971	2,649
September	2,185	912	2,956	3,364	4,172	4,213	1,341	828	1,024	913	849	943	2,910	2,780
Mean	1,197	684	3,223	3,195	3,881	2,764	2,041	725	1,640	890	725	956	2,440	2,714

	Operational Years											
	1988		1989		1990		1991		1992		1993	
Month	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	1,804	1,775	3,459	2,335	15,135	5,796	7,760	6,355	7,314	10,560	8,435	2,152
September	1,420	1,514	1,560	4,212	5,550	1,118	3,855	2,605	2,723	4,707	4,693	2,143
Mean	1,612	1,645	2,510	3,274	10,343	3,457	5,808	4,480	5,019	7,634	6,564	2,148

C./D. PHYTOPLANKTON / ZOOPLANKTON

The plankton communities (phyto- and zooplankton) have been sampled and analyzed at the BVPS on a monthly basis from 1973 through 1992. The results of this twenty year study showed that the long term trends for the plankton communities were consistent from year to year. Annual variations were attributable to either extremes in precipitation and/or temperature. Overall, the plankton communities, both phytoplankton and zooplankton were considered typical of those in temperate climates (Hutchinson 1967).

Therefore, having compiled an extensive plankton database for the Ohio River, BVPS modified the plankton program in 1993. Currently, samples are still collected from the same intake structure at monthly intervals and properly preserved as in previous years. However, these preserved samples have been archived pending a need for future laboratory analysis.

E. FISH

Objective

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

Methods

The Pennsylvania Fish and Boat Commission (PAF&BC), Ohio River Valley Water Sanitation Commission (ORSANCO), and utilities sampling in the Ohio River drainage have modified their fish sampling programs in recent years to incorporate the latest techniques in fish sampling. One modification has been that electrofishing surveys are now being conducted at night, rather than during daylight. Data compiled from numerous sources has shown that night electrofishing has generally produced better results in terms of species composition and relative abundance than day electrofishing.

Night electrofishing was performed at selected BVPS fish sampling stations on an experimental basis in September 1992, in preparation for incorporating this methodology into the 1993 BVPS Aquatic Ecology Procedures. This supplemental sampling was performed to test the effectiveness of night electrofishing, in relation to daytime surveys. This night sampling resulted in the collection of a few fish species that were not typically collected during day electrofishing surveys conducted at BVPS. The results from this trial survey supported the procedural change instituted in 1993 which incorporated night electrofishing into the BVPS fish sampling program. Juvenile fish seining was performed on an experimental basis at Station 1 (control) and Station 2B (non-control) during each 1993 BVPS fishery survey (Figure V-E-1). This method substituted for the minnow traps which had been set at BVPS fish sampling stations in previous years' surveys. A twenty foot long seine (1/4" nylon mesh) was used to collect fish located close to shore in a water depth of one to four feet. Three seine hauls were performed at both Station 1 (north shore) and Station 2B (south shore) during each survey.

Adult fish surveys were performed in May, July, September, and November 1993. During each survey fish were sampled at four stations (Figure V-E-1) utilizing gill nets and electrofishing. Seining was performed at Station 1 (north shore) and Station 2B (south shore)

The 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 at each station, one angled along each shoreline, with the small mesh positioned inshore. The Ohio River is divided by Phillis Island into two separate channels, the main channel (2A) and the back channel (2B). Two gill nets were set in each of these channels, resulting in a total of eight gill nets set per sampling date.

The amount of time that gill nets were present in the water column during each survey was also modified in 1993. In past BVPS surveys

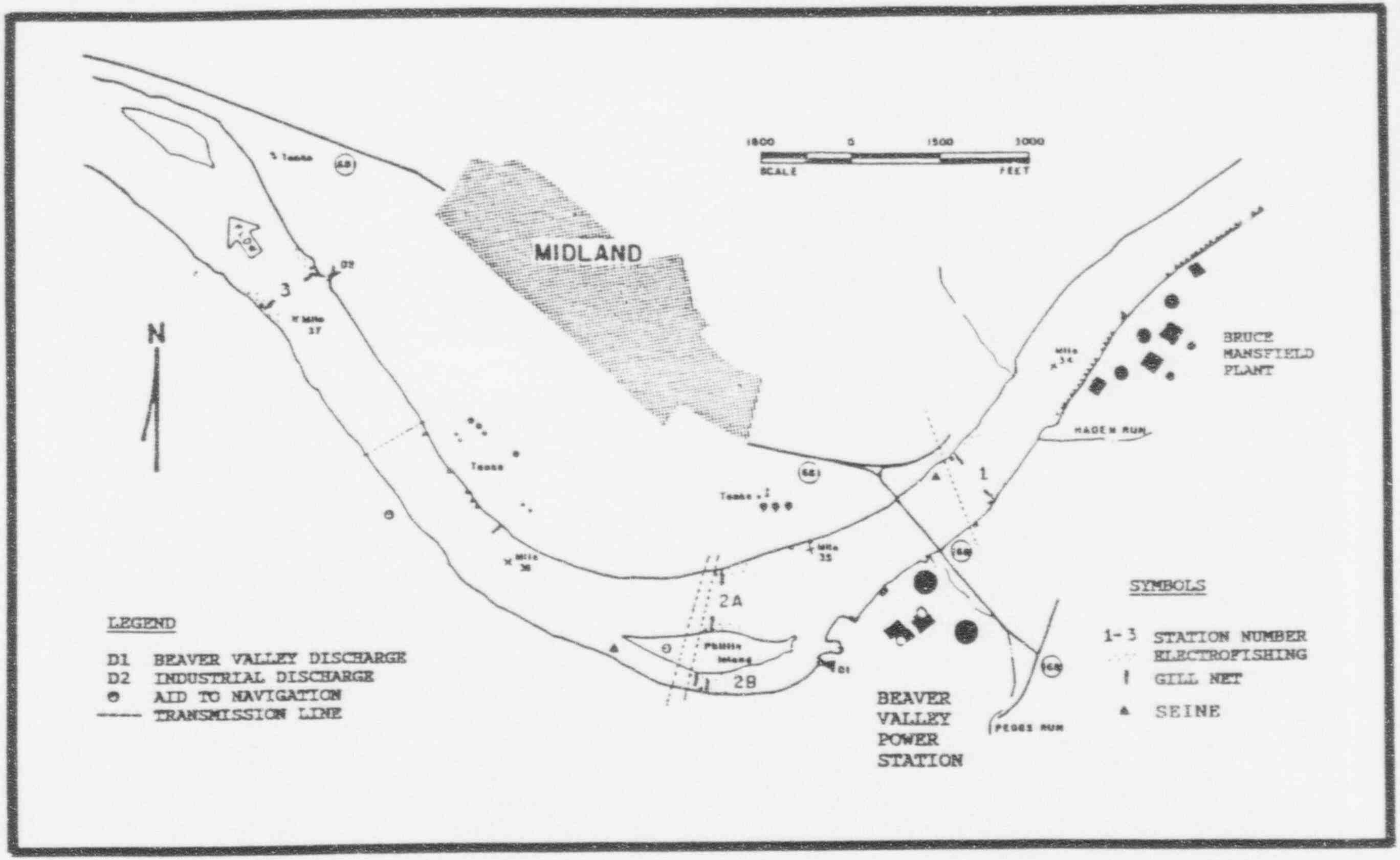


FIGURE V-E-1

FISH SAMPLING STATIONS
BVPS

(1974 to 1992), gill nets were set for approximately 24 hours. Starting in 1993, gill nets were set toward evening (preferred sampling period), left in place overnight, then pulled the following morning. This change did not decrease efficiency, however, it helped increase percent survival of specimens caught.

Night electrofishing was conducted using a boat-mounted boom electroshocker and underwater lights mounted to the bow of the boat. Direct current of 220 volts at one to two amperes was generally used. The north and south shoreline areas at each station were shocked for ten minutes (five minutes each shore) during each survey.

Fishes collected using gill nets, electrofishing equipment and the seine were processed according to the following procedures: All game fishes were identified, counted, measured for total length (mm), and weighed (g) individually. Non-game fishes were counted and lengths estimated and recorded as <6 inches, 6-12 inches, >12-18 inches, >18-24 inches, >24 inches. Live fish were returned to the river immediately after processing was completed. All fishes which were unidentifiable or of questionable identification were placed in plastic sample bottles, preserved, labeled and returned to the laboratory. Any fish which has not previously been collected at BVPS was retained for the voucher collection, unless it was a threatened or endangered species, in which case it would be photo-documented and released.

Results

Fish population surveys have been conducted in the Ohio River near BVPS from 1970 through 1993. These surveys have collected 68 fish species and four hybrids (Table V-E-1). Various agencies (PAF&BC, ORSANCO) have conducted fishery surveys in the New Cumberland Pool in recent years resulting in the identification of species not collected in previous BVPS surveys. These additional fish species (goldeye, redear sunfish, pumpkinseed-redear sunfish hybrid, and

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 THROUGH 1993
BVPS

Family and Scientific Name	Common Name
Lepisosteidae (gars)	
Lepisosteus osseus	Longnose gar
Hiodontidae (mooneyes)	
Hiodon alosoides	Goldeye
H. tergisus	Mooneye
Clupeidae (herrings)	
Alosa chrysochloris	Skipjack herring
A. pseudoharengus	Alewife
Dorosoma cepedianum	Gizzard shad
Cyprinidae (carps and minnows)	
Campostoma anomalum	Central stoneroller
Carassius auratus	Goldfish
Ctenopharyngodon idella	Grass carp
Cyprinella spiloptera	Spotfin shiner
Cyprinus carpio	Common carp
C. carpio x *C. auratus*	Carp-goldfish hybrid
Luxilus chrysocephalus	Striped Shiner
Macrhybopsis storeriana	Silver chub
Nocomis micropogon	River chub
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner
N. buccatus	Silverjaw minnow
N. hudsonius	Spottail shiner
N. rubellus	Rosyface shiner
N. stramineus	Sand shiner
N. volucellus	Mimic shiner
Pimephales notatus	Bluntnose minnow
P. promelas	Fathead minnow
Rhinichthys atratulus	Blacknose dace
Semotilus atromaculatus	Creek chub
Catostomidae (suckers)	
Carpiodes carpio	River carpsucker
C. cyprinus	Quillback
C. velifer	Highfin carpsucker
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hog sucker
Ictiobus bubalus	Smallmouth buffalo
I. niger	Black buffalo
Minytrema melanops	Spotted sucker

TABLE V-E-1
(Continued)

Family and Scientific Name	Common Name
Moxostoma anisurum	Silver redhorse
M. carinatum	River redhorse
M. duquesnei	Black redhorse
M. erythrurum	Golden redhorse
M. macrolepidotum	Shorthead redhorse
Ictaluridae (bullhead catfishes)	
Ameiurus catus	White catfish
A. melas	Black bullhead
A. natalis	Yellow bullhead
A. nebulosus	Brown bullhead
Ictalurus punctatus	Channel catfish
Noturus flavus	Stonecat
Pylodictis olivaris	Flathead catfish
Esocidae (pikes)	
Esox lucius	Northern pike
E. masquinongy	Muskellunge
E. lucius x *E. masquinongy*	Tiger muskellunge
Salmonidae (trouts)	
Oncorhynchus mykiss	Rainbow trout
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
M. chrysops x *M. saxatilis*	Striped bass hybrid
Centrarchidae (sunfishes)	
Ambloplites rupestris	Rock bass
Lepomis cyanellus	Green sunfish
L. gibbosus	Pumpkinseed
L. macrochirus	Bluegill
L. microlophus	Redear sunfish
L. gibbosus x *L. microlophus*	Pumpkinseed-redear sunfish hybrid
Micropterus dolomieu	Smallmouth bass
M. punctulatus	Spotted bass
M. salmoides	Largemouth bass
Pomoxis annularis	White crappie
P. nigromaculatus	Black crappie

TABLE V-E-1
(Continued)

Family and Scientific Name	Common Name
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	Walleye
S. canadense x *S. vitreum*	Saugeye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum

[1]Nomenclature follows Robins, *et al*. (1991)

alewife) are included on Table V-E-1, bringing the total number of fish taxa to 76 for the New Cumberland Pool of the Ohio River.

In 1993, 7787 fishes representing 38 species were collected during BVPS surveys by gill netting, electrofishing, and seining. The brook silverside, which was previously collected only in survey year 1983, was collected again in the 1993 survey during night electrofishing.

A total of 7350 fishes, representing 33 species were collected during 1993 BVPS surveys by electrofishing (Table V-E-2). Gizzard shad accounted for the largest percentage (93%) of the electrofishing catch in 1993. Gizzard shad were most numerous at Stations 2A and 2B around Phillis Island during the months of July and September (Tables V-E-2 and V-E-3). The fewest fish were collected by electrofishing in May (104), with redhorse species comprising 70% of the total catch (Table V-E-3).

It should be noted that "observed" fishes are typically included in the electrofishing total catch. This is sometimes necessary because of the turbidity and swiftness of the water, although these conditions were minimal in 1993. When these conditions do exist, it is often not physically possible for the collectors to net these stunned fishes. Therefore, they are identified to genus level (if possible), and lengths are estimated and recorded. Additionally, during summer months, gizzard shad are often encountered in very high densities during electrofishing, at which time the numbers and size ranges for these "observed" fish are estimated and recorded.

A total of 215 fishes, representing 24 species were collected by gill nets in 1993 (Table V-E-2). The gill net results varied by month with the highest catch in July (79 fishes). The most common fish species collected by gill nets in 1993 were channel catfish (35%), common carp (14%), gizzard shad (6%) and striped bass hybrid (5%). All other species accounted for 4% or less of the 1993 gill net catch.

TABLE V-E-2

NUMBER OF FISH COLLECTED AT VARIOUS STATIONS BY GILL NET (G), ELECTROFISHING (E), AND SEINING (S) IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1993
BVPS

Taxa	1			2A		2B			3		Grand Total			Annual Total	Percent Annual Total
	G	E	S	G	E	G	E	S	G	E	G	E	S		
Longnose gar,	2				1	3	2		3		8	3		11	0.1
Mooneye	3	6			1		2		1	10	4	19		23	0.3
Gizzard shad	3	580	57	2	2818	3	2257	2	5	1159	13	6814	59	6886	88.4
Spotfin shiner			9		2							2	9	11	0.1
Common carp	4	10		5	11	14	2		7	5	30	28		58	0.7
Striped shiner		2	7									2	7	9	0.1
Silver chub		3										3		3	<0.1
River chub		2			1							3		3	<0.1
Emerald shiner			68		3		9	45				12	113	125	1.6
Spottail shiner		1	14				1					2	14	16	0.2
Mimic shiner			13				1					1	13	14	0.2
Shiner spp.							130			40		170		170	2.2
Bluntnose minnow			4										4	4	0.1
River carpsucker				1		1			3		5			5	0.1
Quillback	1	3		1				1	4	2	6	5	1	12	0.2
Highfin carpsucker		1			1	2			1	1	3	3		6	0.1
Smallmouth buffalo		1		1			2		2	3	3	6		9	0.1
Silver redhorse		2				2	2		3	1	5	5		10	0.1
River redhorse					2							2		2	<0.1
Golden redhorse	6	19		1	41		8		1	18	8	86		94	1.2
Shorthead redhorse		11		1	12	3	3		1	9	5	35		40	0.5
Redhorse spp.		8			18		11			22		59		59	0.8
Brown bullhead							1					1		1	<0.1
Channel catfish	5	1		11	3	36	1		23	2	75	7		82	1.1
Flathead catfish		1		1					6		7	1		8	0.1
Tiger muskellunge									1		1			1	<0.1
Brook silverside		1										1		1	<0.1
White bass	2	1			1		4		4	3	6	9		15	0.2
Striped bass hybrid	3	1			1	4	2		4	1	11	5		16	0.2
Bluegill							2			1		3		3	<0.1
Smallmouth bass					1		5		1	1	1	7		8	0.1
Spotted bass	2					1	2		1		4	2		6	0.1
Largemouth bass		1				1					1	1		2	<0.1
Black crappie									4		4			4	0.1
Logperch			1							1		1	1	2	<0.1
Sauger		5			2				3		3	7		10	0.1
Walleye	1			1	3				1		3	3		6	0.1
Saugeye		2					1		3		3	3		6	0.1
Freshwater drum	2	4		3	8	1		1		7	6	19	1	26	0.3
Unidentified		19								1		20		20	0.3
Total	34	685	173	28	2930	71	2448	49	82	1287	215	7350	222	7787	

TABLE V-E-3

NUMBER OF FISH COLLECTED BY MONTH BY GILL NET (G), ELECTROFISHING (E), AND SEINING (S) IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1993
BVPS

Taxa	May G	May E	May S	Jul G	Jul E	Jul S	Sep G	Sep E	Sep S	Nov G	Nov E	Nov S	Grand Total G	Grand Total E	Grand Total S	Annual Total	Percent Annual Total
Longnose gar	2	2		2	1		4						8	3		11	0.1
Mooneye		1		3			1	2			16		4	19		23	0.3
Gizzard shad	6	9		5	4655	56	2	2083	3		67		13	6814	59	6886	88.4
Spotfin shiner									7		2	2		2	9	11	0.1
Common carp	19	4		7	1		2	5		2	18		30	28		58	0.7
Striped shiner								2	7					2	7	9	0.1
Silver chub											3			3		3	<0.1
River chub								2			1			3		3	<0.1
Emerald shiner			1		1	32		2	79		9	1		12	113	125	1.6
Spottail shiner						10		1	3		1	1		2	14	16	0.2
Mimic shiner											1	13		1	13	14	0.2
Shiner spp.								80			90			170		170	2.2
Bluntnose minnow									3			1			4	4	0.1
River carpsucker	2			3									5			5	0.1
Quillback		5		3		1	1			2			6	5	1	12	0.2
Highfin carpsucker		1		3				1			1		3	3		6	0.1
Smallmouth buffalo				3							6		3	6		9	0.1
Silver redhorse	2	3		3				1			1		5	5		10	0.1
River redhorse		1						1						2		2	<0.1
Golden redhorse	2	26		1	23		3	18		2	19		8	86		94	1.2
Shorthead redhorse	1	16		2	6		1	2		1	11		5	35		40	0.5
Redhorse spp.		27			10			13			9			59		59	0.8
Brown bullhead					1									1		1	<0.1
Channel catfish	27	3		33	2		15	2					75	7		82	1.1
Flathead catfish				4	1		3						7	1		8	0.1
Tiger muskellunge										1			1			1	<0.1
Brook silverside											1			1		1	<0.1
White bass					1		4	4		2	4		6	9		15	0.2
Striped bass hybrid					2		8	3		3			11	5		16	0.2
Bluegill					1			1			1			3		3	<0.1
Smallmouth bass		2		1	1			2			2		1	7		8	0.1
Spotted bass	2	2		[illegible]			1						4	2		6	0.1
Largemouth bass		1					1						1	1		2	<0.1
Black crappie							4						4			4	0.1
Logperch					1	1								1	1	2	<0.1
Sauger	1				2			2		2	3		3	7		10	0.1
Walleye	2			1	2			1					3	3		6	0.1
Saugeye								1		3	2		3	3		6	0.1
Freshwater drum	1	1		4	1	1		17		1			6	19	1	26	0.3
Unidentified					19						1			20		20	0.3
Total	67	104	1	79	4731	101	50	2246	102	19	269	18	215	7350	222	7787	

A total of 222 fishes representing ten species were collected by seining in 1993. Fish species collected included emerald shiner (51%), gizzard shad (27%), spottail shiner (6%) and mimic shiner (6%). Most of the fishes were collected in July and September (total number 203). Fewer fish were collected in May and November with totals of 1 and 18 fish, respectively (Table V-E-3). Bluntnose minnow was the only species collected exclusively by seining.

The most common species collected in 1993 BVPS surveys through the use of gill nets, electrofishing and seining included gizzard shad (88%), shiner species (4%), redhorse species (3%), channel catfish (1%) and common carp (1%). The remaining species each accounted for less than 1% of the total catch. Game fishes collected during the 1993 fish surveys included: tiger muskellunge, white bass, smallmouth bass, spotted bass, largemouth bass, black crappie, sauger, walleye and saugeye.

Comparison of Control and Non-Control Stations

The electrofishing data (Table V-E-2) reflects relatively minor differences in species composition between the Control Station (1) and Non-Control Stations 2A, 2B, and 3. However, total electrofishing catch varied widely among the stations due to the highly fluctuating gizzard shad populations during the July and September surveys (Table V-E-3). Electrofishing collects mostly small forage species (minnows and gizzard shad). Gizzard shad was the most abundant fish species collected by electrofishing at all four stations, however, the highest numbers were collected at Stations 2A and 2B.

Gill nets catch mostly game species and are more indicative of changes in fish abundance. The gill net results for 1993 indicate that all four stations had similarities in fish species caught. The number of fish taxa collected at Stations 1, 2A, 2B and 3 by gill netting were 12, 11, 12 and 22, respectively. Channel catfish (35%) and common carp (14%) were the fishes most frequently collected by gill nets. Game fishes such as striped bass hybrid, white bass, spotted bass and walleye were collected less frequently at the four stations. The most fishes were collected from gill nets located at Stations 2B and 3, with 71 and 82 fishes caught, respectively (Table V-E-2). Ohio River conditions were favorable (low flow and limited debris) in 1993 during all of the gill net surveys which contributed to the moderately high catches observed.

Summary and Conclusions

The fish community of the Ohio River in the vicinity of BVPS was sampled in 1993 by night electrofishing, gill netting and seining. The results of the 1993 fish surveys show normal community structure based on species composition and relative abundance. Forage species were collected in the highest numbers, particularly gizzard shad. This indicates a normal fish community, since game species (predators) rely on this forage base for their survival. Variations in total annual catch are a natural occurrence and are attributable primarily to fluctuations in the population size of the forage species. Forage species, such as gizzard shad with high reproductive potentials frequently respond to changes in natural environmental factors (competition, food availability, cover, and water quality) with large fluctuations in population size.

Although variations in total catch occurred from station to station in 1993, species composition remained fairly stable. Common species collected in the surveys by all methods included gizzard shad, channel catfish, white bass, striped bass hybrid, common carp, smallmouth bass, spotted bass, walleye, and sauger. Differences observed in catch between the Control (1) and Non-Control Stations (2A, 2B and 3) were probably caused by habitat preferences of individual species in combination with the highly fluctuating and prolific gizzard shad population observed during the July and September surveys. Habitat preference is probably the most influential factor that affects where the different species of fish are collected and in what relative abundance.

F. ICHTHYOPLANKTON

Objective

Ichthyoplankton sampling was performed in order to monitor the extent to which fishes utilize the back channel of Phillis Island as spawning and nursery grounds.

Methods

The BVPS Ichthyoplankton sampling program was modified in 1993 to incorporate methodology changes which served to increase the efficiency of the program, while still providing scientifically sound data. The ichthyoplankton database compiled for BVPS during the seven year period (1986 through 1992) when both night and day surveys were performed shows that the night surveys have produced higher densities of ichthyoplankton than the day surveys. Additionally, other sampling programs in the Ohio River drainage have modified their ichthyoplankton sampling protocols such that all ichthyoplankton sampling is performed at night. For these reasons, the BVPS ichthyoplankton sampling program was revised in 1993 so that all surveys were performed at night. Each night survey was started two hours after dusk.

Another modification to the ichthyoplankton program was that the surveys were conducted twice a month (approximately every two weeks), rather than once a month as in previous years. This change permits better discernment of temporal fluctuations in the Ohio River ichthyoplankton population.

The 1993 ichthyoplankton program night surveys were conducted twice a month from April through August, which is the primary spawning season for most resident fish species. One surface tow and one bottom tow were performed simultaneously at Station 2B (back channel of Phillis Island) during each survey (Figure V-F-1). The bottom sample was collected with a conical 505 micron mesh plankton net with a 0.5 m diameter mouth, mounted on a bottom sled. The surface sample was collected with an identical size net which was connected to a 0.5 m metal ring with an attached buoy.

A General Oceanics Model 2030 digital flowmeter was mounted centrically in mouth of each net to determine the volume of water filtered in each sample. A preservative containing rose bengal dye was added to the sample while in the field.

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

Combined densities for fish eggs, larvae, juveniles and adults collected in the 1993 ichthyoplankton samples from the back channel of Phillis Island are presented in Table V-F-1. No ichthyoplankton were collected in the first (April 14) survey samples, and only one ichthyoplankton specimen was collected in the April 29 surface sample. Ichthyoplankton densities were much higher in the May 13 samples, and peak densities were observed in the samples collected on May 27 and June 10. Ichthyoplankton densities decreased dramatically by the July 7 survey and remained low through July and August, with the exception of the July 21 bottom sample which had a density of 56 ichthyoplankton/100 m^3. The highest ichthyoplankton density in back channel samples occurred in the May 27 bottom sample (537/100 m^3).

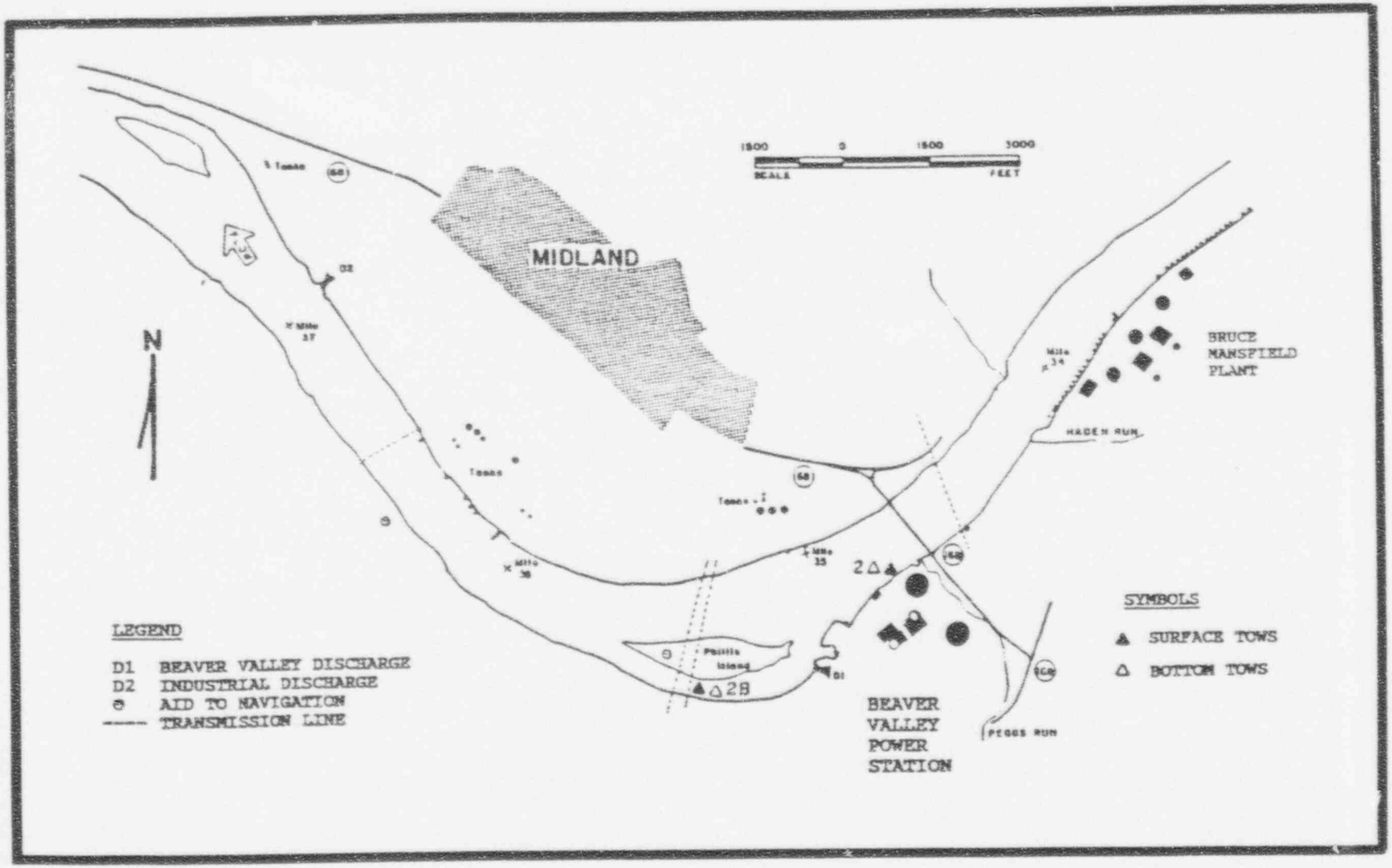


FIGURE V-F-1

ICHTHYOPLANKTON SAMPLING STATIONS
BVPS

TABLE V-F-1

COMBINED DENSITIES FOR FISH EGGS, LARVAE, JUVENILES, AND ADULTS (Number/100 m^3) COLLECTED WITH A 0.5m PLANKTON NET IN THE OHIO RIVER MAIN CHANNEL (STATION 2) AND BACK CHANNEL OF PHILLIS ISLAND (STATION 2B) DURING NIGHT SURVEYS, 1993
BVPS

Date	Location and Depth of Collection				Mean Density
	Main Channel		Back Channel		
	Surface	Bottom	Surface	Bottom	
April 14	0	0	0	0	0
April 29	0	1	1	0	1
May 13	82	88	69	56	74
May 27	227	274	339	537	344
June 10	1,106	245	521	176	512
June 23	263	327	411	380	345
July 7	20	56	4	12	23
July 21	15	22	2	56	24
August 4	1	4	0	3	2
August 18	0	1	0	0	<1

Species composition and yearly total densities for ichthyoplankton samples collected in the back channel of Phillis Island are presented in Table V-F-2. Ten taxa representing six families were identified from the back channel samples. Gizzard shad larvae dominated the ichthyoplankton catch (86%), with freshwater drum larvae and common carp larvae accounting for 5% and 2%, respectively. Gizzard shad, bluntnose minnow and freshwater drum were the only juvenile fish collected in ichthyoplankton samples from the back channel.

Summary and Conclusions

Gizzard shad dominated the 1993 ichthyoplankton catch from the back channel of Phillis Island. Freshwater drum and common carp ranked next in terms of abundance. Ichthyoplankton densities first began to increase in mid-May, peaked in late May and June, then decreased in early July. The months of April and August showed little to no spawning activity. This represents normal spawning cycles for the fish species inhabiting the Ohio River in the vicinity of the BVPS.

G. IMPINGEMENT

Objective

Impingement surveys were conducted to monitor the quantity of fish and *Corbicula* impinged on the traveling screens. These surveys were also conducted to monitor for the potential infestation of the zebra mussel.

Methods

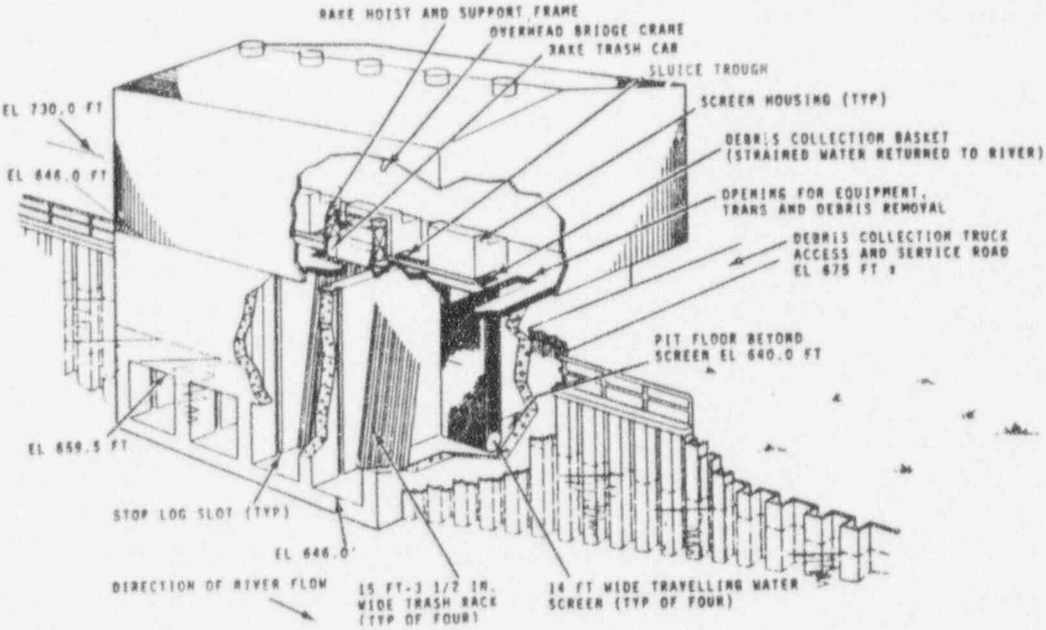
The surveys were conducted weekly throughout 1993 for a total of 38 weeks (Table V-A-1). Weekly impingement sampling was conducted on Friday mornings. A collection basket of 0.25 inch mesh netting was placed at the end of the screen washwater sluiceway (Figure V-G-1). One screen was washed for 15 minutes (one complete revolution of

TABLE V-F-2

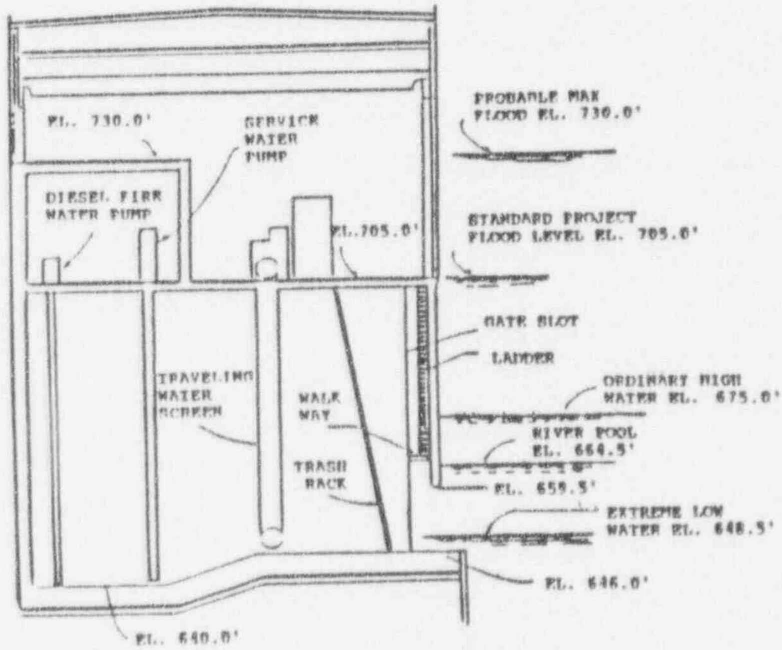
SPECIES OF FISH AND YEARLY TOTAL DENSITIES FOR FISH EGGS, LARVAE, JUVENILES, AND ADULTS (Number/100 m^3) COLLECTED DURING THE NIGHT ICHTHYOPLANKTON SURVEYS, 1993
BVPS

Taxa	Location and Depth of Collection				Mean Density
	Main Channel		Back Channel		
	Surface	Bottom	Surface	Bottom	
Eggs					
Minnows and Carps	<1	1	<1	<1	<1
Freshwater drum	16	17	4	5	11
Unidentified	1	<1	0	<1	<1
Larvae					
Gizzard shad (YL)	2	7	10	4	6
Gizzard shad (EL)	153	68	121	87	107
Gizzard shad (LL)	0	<1	<1	1	<1
Minnows and Carps (YL)	<1	<1	<1	0	<1
Minnows and Carps (EL)	<1	0	<1	<1	<1
Common carp (YL)	<1	<1	1	1	1
Common carp (EL)	5	2	3	<1	3
Shiner sp. (EL)	1	<1	<1	<1	<1
Minnow spp. (EL)	0	0	<1	<1	<1
Suckers (LL)	0	<1	0	0	<1
White bass (YL)	<1	0	0	<1	<1
Crappie sp. (EL)	<1	0	<1	<1	<1
Darter spp. (YL)	0	<1	<1	0	<1
Darter spp. (EL)	<1	<1	1	<1	<1
Sauger/Walleye spp. (YL)	0	<1	<1	<1	<1
Freshwater drum (YL)	1	1	2	2	2
Freshwater drum (EL)	1	3	5	5	4
Juveniles					
Gizzard shad (JJ)	0	1	<1	6	2
Emerald shiner (JJ)	0	<1	0	0	<1
Bluntnose minnow (JJ)	0	<1	0	<1	<1
Channel catfish (JJ)	0	<1	0	0	<1
Crappie sp. (JJ)	0	<1	0	0	<1
Johnny darter (JJ)	0	<1	0	0	<1
Freshwater drum (JJ)	0	<1	0	<1	<1
Adults					
Johnny darter	0	<1	0	0	<1
Total Density	180	100	147	111	

Developmental Stages
YL - Hatched specimens with yolk and /or oil gobules present.
EL - Specimens with no yolk and/or oil gobules and with no development of fin rays and/or spiny elements.
LL - Specimens with developed fin rays and/or spiny elements and evidence of a fin fold.
... fin and pigment development, i.e., immature adult.



(Three dimensional: Cutaway View)



(Two dimensional: Side View)

FIGURE V-G-1

INTAKE STRUCTURE
BVPS

the screen) and the aquatic organisms and associated debris were collected. All other screens were then washed as a pre-wash for the following week's impingement. Each week's screen wash collection represents, under normal operations, one week (7 days) of impinged sample. The impingement sample was sorted for Corbicula and fish, and examined for zebra mussels which could potentially be present.

Results

A total of 1,995 Corbicula (75% alive) were collected in 1993 from the 38 weekly impingement surveys, when one screen per week was washed. If all four screens had been washed each week during the year (as in 1981 through 1992), approximately 8,000 clams would have been collected in 1993, as illustrated in Figure V-I-4. The lengths for the largest and smallest Corbicula collected during impingement surveys in 1993 were 23.63 mm and 1.41 mm, respectively. The greatest number of Corbicula were collected during the weekly impingement surveys conducted in August and September (Figure V-I-4), when Corbicula densities exceeded 2,000 clams in each month. No zebra mussels were collected in the 1993 impingement surveys.

A total of 116 fishes were collected in 1993 from the 38 weekly impingement surveys (one screen washed each week). Fish species collected included gizzard shad, channel catfish, rock bass, spotted bass, bluegill and freshwater drum. The largest fish collected was a freshwater drum (181 mm total length) and the smallest fish was a bluegill (30 mm total length). No endangered or threatened species were collected (Commonwealth of Pennsylvania, 1990). Total weight of fish collected from impingement surveys in 1993 was 1.1 pounds (489 grams).

Summary and Conclusions

The results of the 1993 impingement surveys indicate that during the months of August and September large numbers of *Corbicula* were collected off of the traveling screens. Although this trend has occurred in previous years, the August and September 1993 totals were the second highest in the period since 1981. No zebra mussels were collected from the 1993 impingement surveys. The number of fish collected from the 1993 impingement surveys at BVPS was within the range observed for previous operational years and indicates that withdrawal of river water at BVPS intake for cooling purposes has very little effect on the fish populations.

H. PLANKTON ENTRAINMENT

1. Ichthyoplankton

Objectives

The ichthyoplankton entrainment studies conducted in the Ohio River main channel are designed to determine the species composition, relative abundance, and distribution of ichthyoplankton near 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 (DLC 1976, 1977, 1978, and 1979). Based on these results, a modified sampling program was utilized from 1980 through 1992 which sampled the Ohio River at five stations located across a transect adjacent to the BVPS intake structure. Surface tows were made at Stations 1 (right shore adjacent to BVPS intake structure), 3 (mid-channel), and 5 (left shore) and bottoms tows were taken at Station 2 and 4 (each halfway between mid-channel and right and left shores, respectively). Each tow was conducted for nine minutes, proceeding in an upstream direction. Samples were collected monthly, from April through August, during daylight hours at the five stations. Night collections were made in May and July.

The BVPS ichthyoplankton sampling program was modified in 1993 to incorporate several changes in methodology which served to increase the efficiency of the program, while still providing scientific sound data. These changes (all ichthyoplankton performed at night, surveys twice a month, rather than once a month) and the rationale for implementing them are discussed in Section F - Ichthyoplankton. Additionally, ichthyoplankton sampling in the main channel adjacent to the BVPS intake structure was modified such that sampling was performed only at Station 2 (Figure V-F-1, Section F), rather than at all five stations, as previously done in 1980 through 1992. One surface tow and one bottom tow were performed simultaneously at Station 2 during each survey for nine minutes proceeding in an upstream direction. Station 2 was selected for the sampling station for the modified program because of its proximity to the intake structure and it is representative of the ichthyoplankton community present within the Ohio River water column in the vicinity of the BVPS.

Sampling at Station 2 in the main channel was performed immediately after the ichthyoplankton sampling in the back channel of Phillis Island was completed for each survey. Sampling methodologies used for ichthyoplankton collection in the main channel were identical to the methodologies outlined in the Methods section of Section F Ichthyoplankton.

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/100 m^3) were calculated using appropriate flowmeter data.

Results

Combined densities for fish eggs, larvae, juveniles and adults collected in the 1993 ichthyoplankton samples from the main channel (Station 2) of the Ohio River are presented in Table V-F-1 (Section F, Ichthyoplankton). No ichthyoplankton were collected in the samples collected on April 14, 1993 and only one ichthyoplankton specimen was collected in the April 29 (bottom) sample. The increase in ichthyoplankton in the May 13 samples (average 85/100 m^3) indicated that the spawning season had started in the Ohio River. Ichthyoplankton densities were higher in the samples collected on May 27 (average 250/100 m^3) and remained elevated in both of June's collections. The peak ichthyoplankton density (1,106/100 m^3) occurred in the June 10 surface sample. Ichthyoplankton densities decreased dramatically by the July 7 survey and remained low through the remainder of July and August.

The number of fish eggs, larvae, juveniles and adults collected from the 1993 ichthyoplankton samples from the main channel (Station 2) are identified according to taxa in Table V-F-2 (Section F). These taxa represented eight fish families. Gizzard shad larvae accounted for 82% of the total catch. Freshwater drum eggs accounted for the majority of the eggs collected. Juvenile specimens, collected only in the bottom tows in the main channel, accounted for seven species. The only adult fish collected in the main channel during ichthyoplankton tows was a johnny darter (bottom tow).

Summary and Conclusions

Gizzard shad dominated the 1993 ichthyoplankton catch from the main channel of the Ohio River in front of the BVPS. Other fish collected were common carp and freshwater drum. Ichthyoplankton densities began to increase in early May, peaked in June and started to decrease in early July. The months of April and August showed little to no spawning activity. This represents normal spawning cycles for the fish species inhabiting the Ohio River in the vicinity of the BVPS.

2./3. Phytoplankton / Zooplankton

The plankton communities (phyto- and zooplankton) have been sampled and analyzed at the BVPS on a monthly basis from 1973 through 1992. The results of this twenty year study showed that the long term trends for the plankton communities were consistent from year to year. Annual variations were attributable to either extremes in precipitation and/or temperature. Overall, the plankton communities, both phytoplankton and zooplankton were considered typical of those in temperate climates (Hutchinson 1967).

Therefore, having compiled an extensive plankton database for the Ohio River, BVPS modified the plankton program in 1993. Currently, samples are still collected from the same intake structure at monthly intervals and properly preserved as in previous years. However, these preserved samples have been archived pending a need for future laboratory analysis.

I. CORBICULA MONITORING PROGRAM

Introduction

The introduced Asiatic clam, Corbicula fluminea (Figure V-I-1), was first detected in the United States in 1938 in the Columbia River near Knappton, Washington (Burch 1944). It has since spread throughout the country, inhabiting any suitable freshwater habitat. Information from prior aquatic surveys has demonstrated the presence of Corbicula in the Ohio River in the vicinity of the BVPS, and the plant is listed in NUREG/CR-4233 (Counts 1985).

One adult clam is capable of producing many thousands of larvae called veligers. These veligers are very small (approximately 0.2

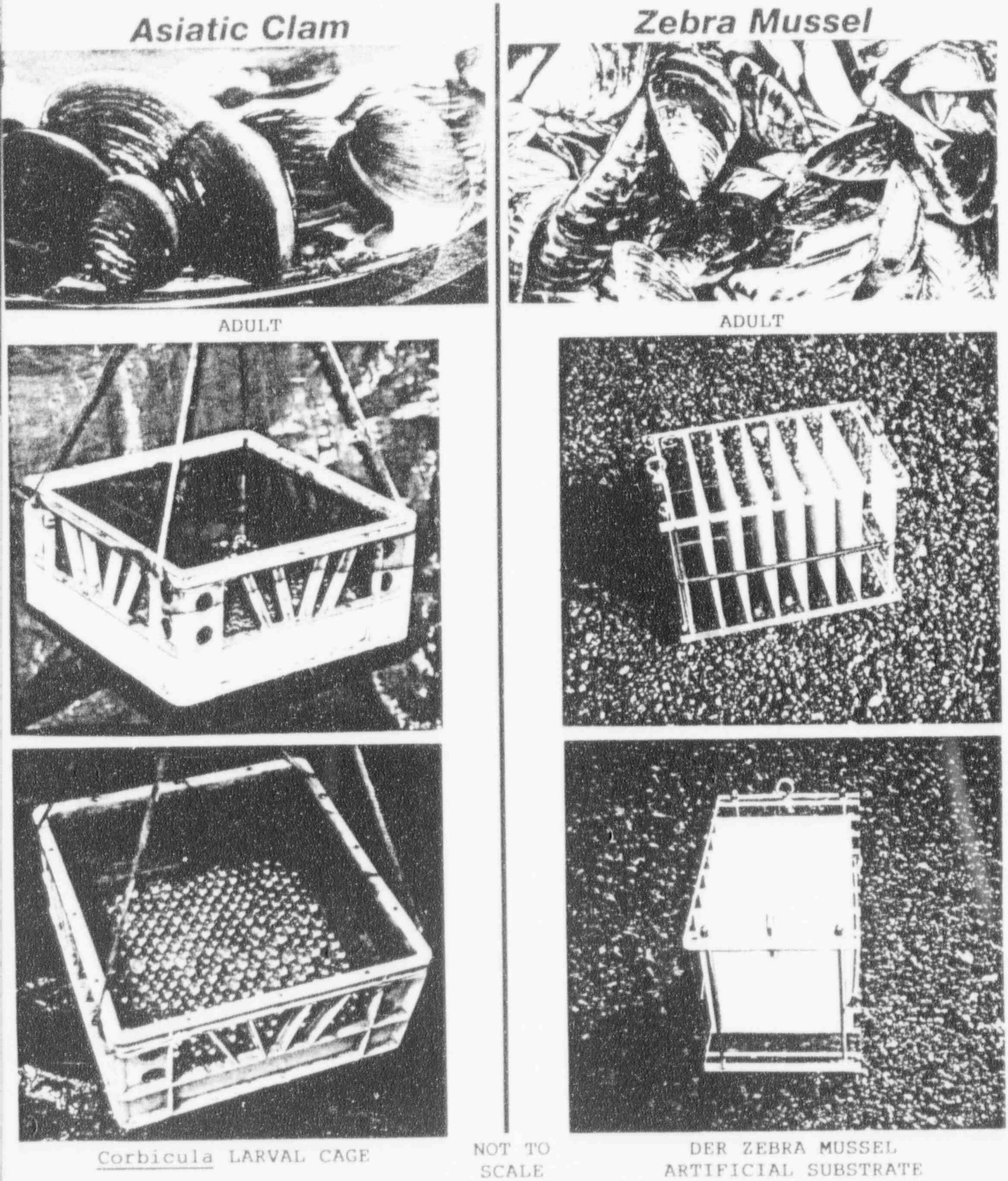


FIGURE V-1-1

PHOTOGRAPHS OF <u>Corbicula</u> WITH LARVAL CAGE
AND ZEBRA MUSSEL WITH ARTIFICIAL SUBSTRATE
BVPS

mm) and will pass easily through the water passages of a power plant. Once the veliger settles to the substrate, growth of the clam occurs rapidly. If clams develop within a power plant's water passages, they impair the flow of water through the plant. Reduction of flow may be so severe that a plant shutdown is necessary. The clams are of particular concern when they develop undetected in emergency systems where the flow of water is not constant (NRC, IE Bulletin 81-03).

The Corbicula Monitoring Program includes the Ohio River and the circulating river water system of the BVPS (intake structure and cooling towers). This report describes this Monitoring Program and the results obtained during field and plant surveys conducted through 1993.

1. Monitoring

Objectives

The objective of the Monitoring Program was to evaluate the presence of Corbicula at BVPS and the Ohio River in the vicinity of the intake structure, in order to evaluate the potential for infestation of the BVPS.

Methods

(Intake Structure - Screen Washing)

The weekly impingement surveys at the intake structure monitored the number of Corbicula which could potentially enter the BVPS from the Ohio River. Corbicula obtained during the washing of the traveling screen (see Section G, Impingement Methods), were returned to the laboratory for size analysis. These clams were rinsed through a series of stacked U.S. Standard sieves ranging in mesh size from 16.0 mm to 0.6 mm. The number of live and dead clams retained on each sieve was recorded.

(Cooling Towers - Reservoir Scraper Sampling)

Corbicula enter the BVPS from the Ohio River by passing through the water intakes, and they eventually settle out in the lower reservoirs of Units 1 and 2 cooling towers. The density and growth development of these Corbicula, are monitored by taking monthly samples from the lower reservoir sediments by using a scraper sampler. The sampler consists of a D-frame net attached behind a foot long metal scraping edge. This device is connected to a pole long enough to allow the sampler to extend down into the reservoir sediment area from the outside wall of the cooling tower.

During each monthly sampling event, five scraper pulls (each 4 ft. length) were taken along the bottom of the reservoir, scraping up sediment covering approximately 20 square feet of area for each cooling tower. The sample collected from each tower was returned to the laboratory and processed. Samples were individually washed and Corbicula removed and rinsed through a series of stacked U.S. Standard sieves ranging in mesh size from 16.0 mm to 0.6 mm. Live clams on each sieve were counted and the numbers were recorded. It should be noted that the size distribution data obtained using the sieves reflects the width of the clams, rather than length.

(Cooling Towers - Corbicula Density Determination)

Population surveys of both BVPS cooling tower reservoirs have been conducted during scheduled outages (1986 through 1993) in order to estimate the number of Corbicula present in these structures. In 1993, both BVPS cooling towers were sampled during their respective scheduled outages to estimate the Corbicula population.

(Unit 1 Cooling Tower)

The Corbicula population in the lower reservoir of the Unit 1 cooling tower was estimated based on sampling performed during a scheduled outage. Seventeen samples were collected on April 18, 1993 at designated sampling locations using a (6" x 6") petite ponar dredge (Figure V-I-2).

The substrate of each sample was characterized at the time of collection. The samples were returned to the laboratory and sorted for Corbicula within 72 hours of collection. This procedure increased overall sorting efficiency because formalin, normally used to preserve the samples for long periods of time, was not needed and live Corbicula could be seen moving in the sorting trays. Counts were made of live and dead Corbicula in each dredge sample. These sample counts were converted to densities (clams/m^2) based on the surface area sampled by the dredge. An average density was then calculated for each cooling tower sample. An estimate of the area of the cooling tower basin covered by sediment was calculated, since the Corbicula were concentrated almost entirely in the sediment. The estimated population was calculated by multiplying the average density times the area of sediment coverage.

(Unit 2 Cooling Tower)

The Corbicula population in the lower reservoir of the Unit 2 cooling tower was estimated based on sampling performed during a scheduled outage. Ten samples were collected on September 21, 1993 at designated sampling locations using a petite ponar dredge (Figure V-I-3). The methods used for sample processing and the calculation of the estimated Corbicula population are identical to those described in the Unit 1 cooling tower population survey section.

(Ohio River - Ichthyoplankton Surveys)

The ichthyoplankton surveys (April through August) performed in front of the intake structure also served to monitor for the number

(TWO DIMENSIONAL: CROSS SECTIONAL HORIZONTAL VIEW)

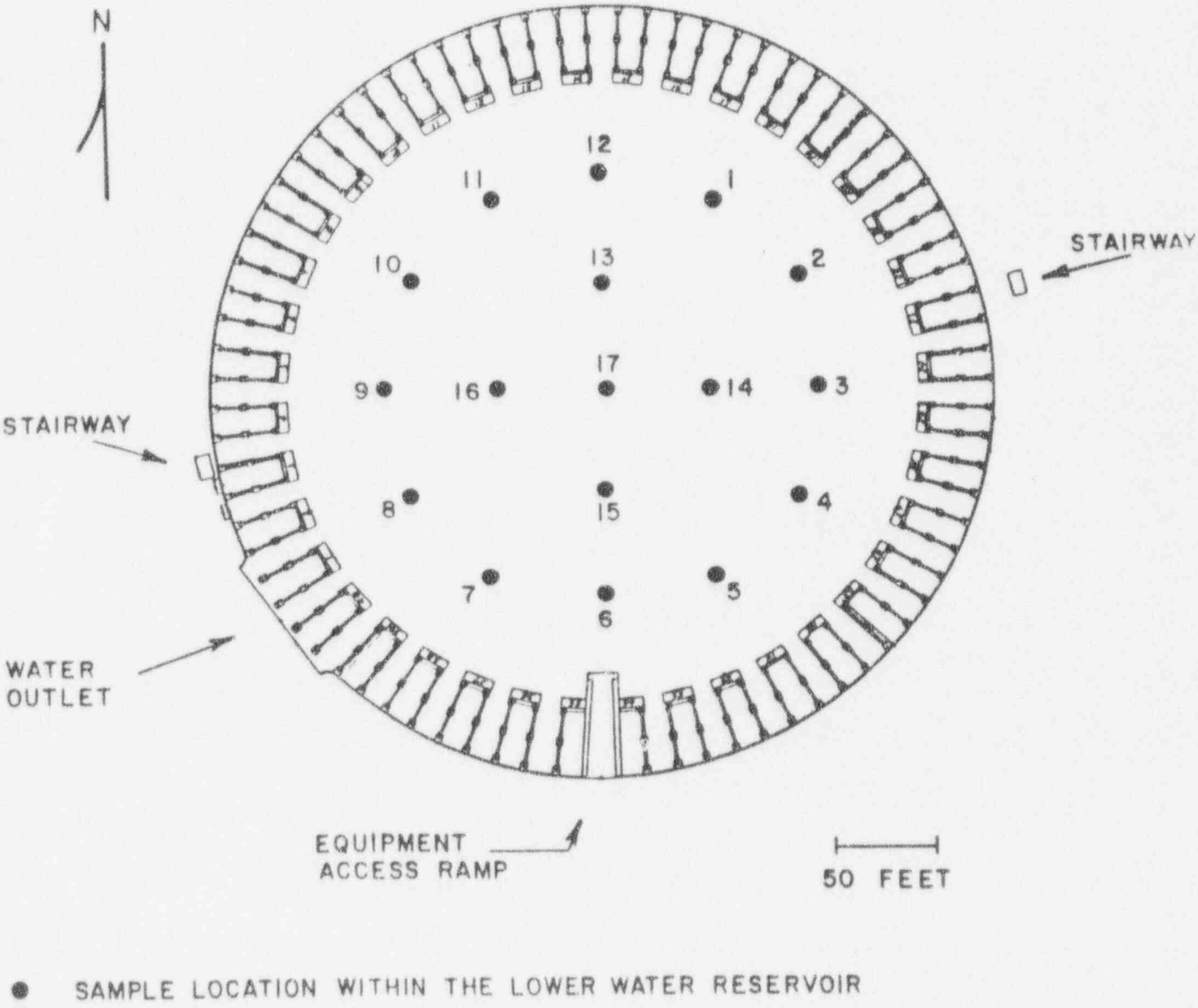


FIGURE V-I-2

Corbicula MONITORING PROGRAM SAMPLING STATIONS OF THE LOWER RESERVOIR OF UNIT 1 COOLING TOWER BVPS

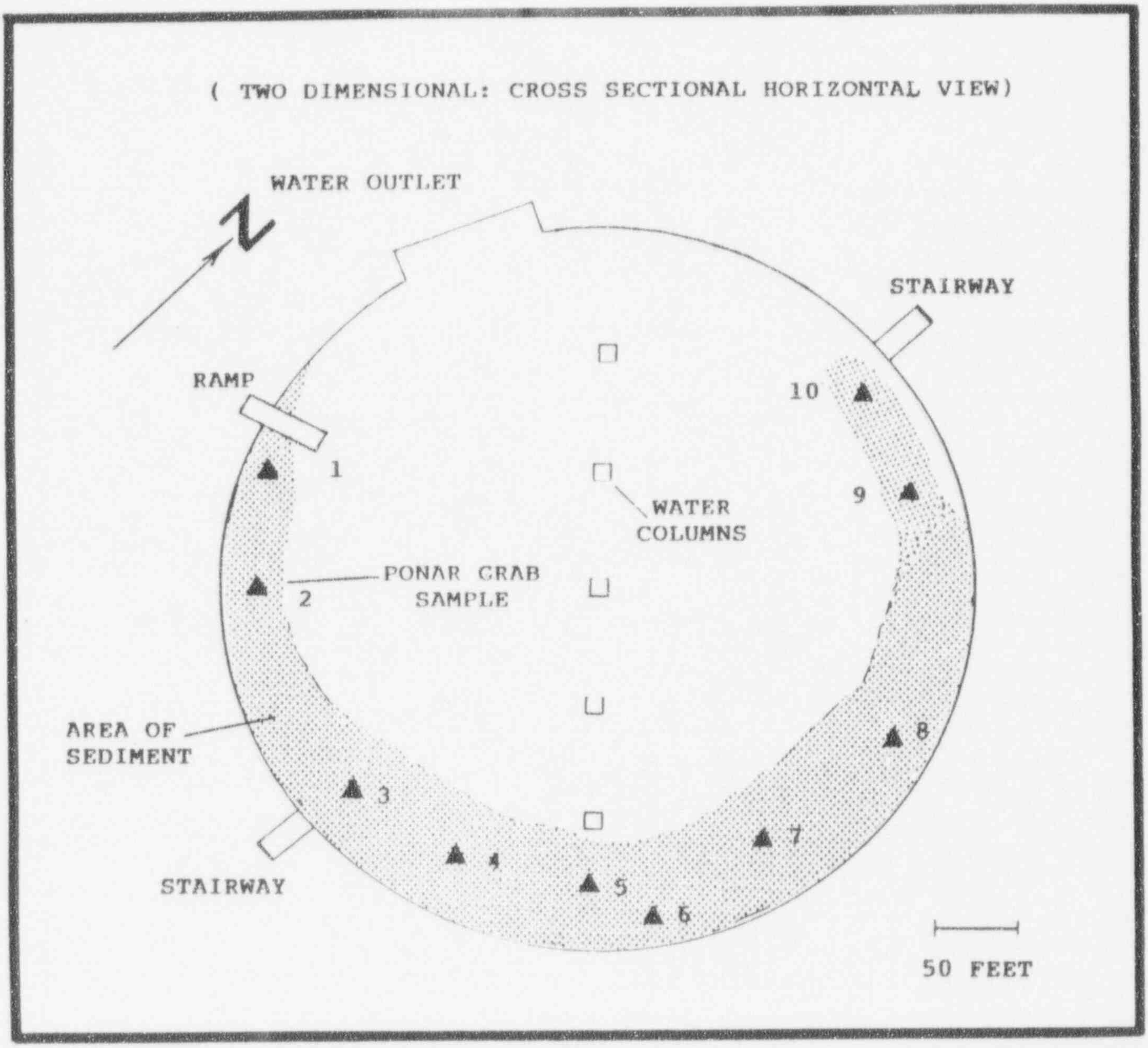


FIGURE V-I-3

Corbicula MONITORING PROGRAM SAMPLING STATIONS
OF THE RESERVOIR OF UNIT 2 COOLING TOWER
BVPS

of Corbicula which could potentially enter BVPS from the Ohio River. Corbicula can become suspended in the water column and are carried by river currents to new habitats. While performing the ichthyoplankton surveys, these clams are often collected in the samples along with the ichthyoplankton. The 1993 ichthyoplankton samples were sorted at the laboratory for Corbicula and numbers recorded. Corbicula densities (clams/100 m^3 water filtered) were calculated based on the volume of water filtered.

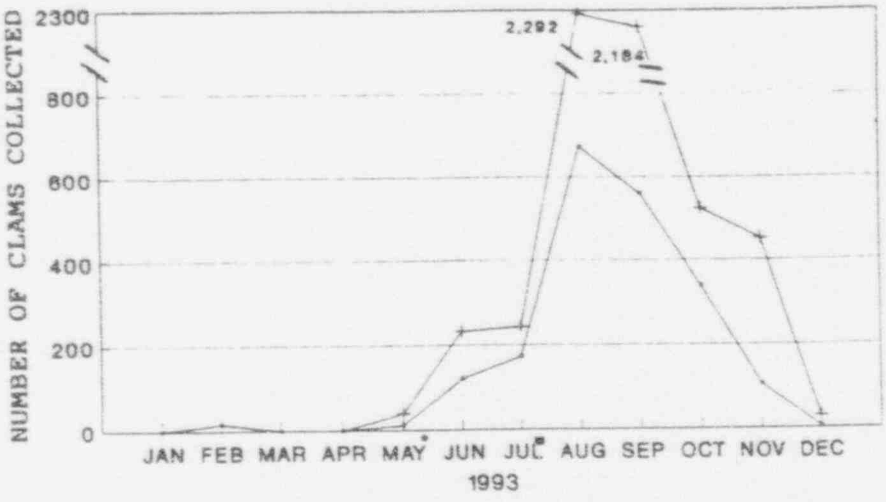
Results

(Intake Structure - Screen Washing)

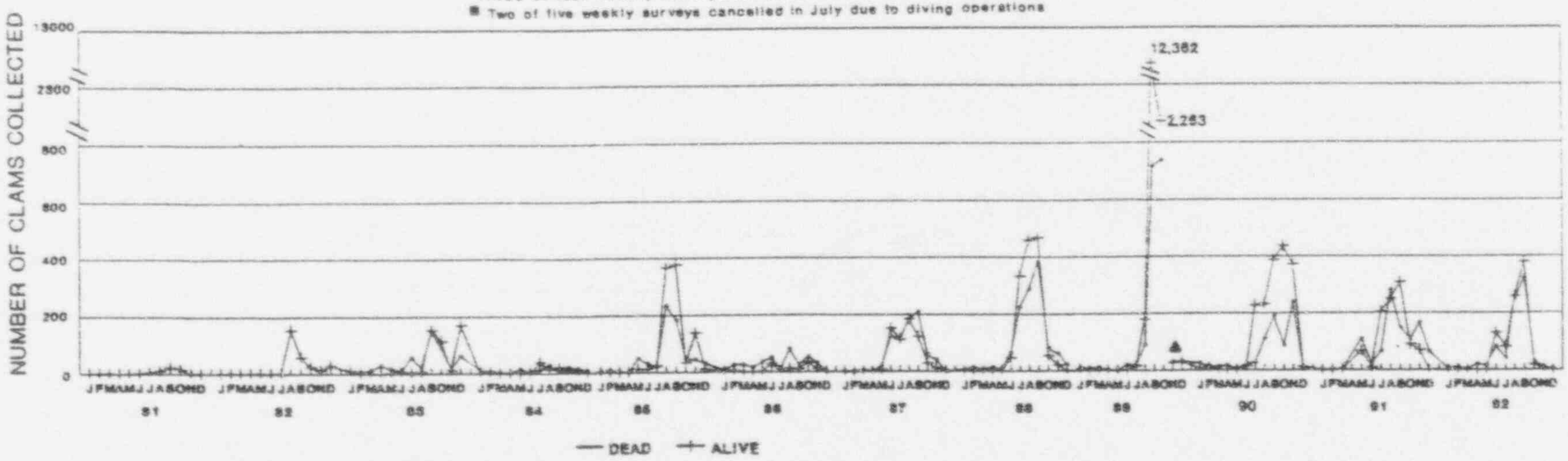
A total of 1,995 Corbicula were collected during the 1993 impingement surveys, when one traveling screen was washed each week. Monthly totals for Corbicula collected during impingement surveys for the years 1981 through 1993 are presented in Figure V-I-4. The monthly totals for 1993 have been multiplied by four to account for the fact that in 1993 only one screen was washed during each weekly survey, in contrast to previous years' surveys when all four screens were typically washed. The majority of Corbicula were collected in the impingement surveys conducted in August and September with numbers exceeding 2,000 for each month's collection. The 1993 results represent the second highest collection of Corbicula off of the traveling screens since 1981, with the highest number occurring in 1989 (Figure V-I-4). Seventy-five percent of the Corbicula collected from the screens in 1993, were alive. The largest and smallest Corbicula collected during 1993 impingement surveys were 23.63 mm (length) and 1.41 mm (length), respectively.

(Cooling Towers - Reservoir Scraper Sampling)

In 1993, a total of 4,633 Corbicula (91% alive) were collected from the Unit 1 cooling tower using the scraper sampler. The largest Corbicula collected measured 19.23 mm in length.



* Three of four weekly surveys cancelled in May due to maintenance
■ Two of five weekly surveys cancelled in July due to diving operations



▲ DATA FOR NOVEMBER AND DECEMBER 1989 REPRESENTS ONLY ONE SAMPLING PERIOD FOR EACH MONTH DUE TO EITHER DIVING OR MAINTENANCE.

FIGURE V-I-4

SUMMARY OF Corbicula COLLECTED FROM THE INTAKE STRUCTURE TRAVELING SCREENS DURING IMPINGEMENT SURVEYS, 1981 THROUGH 1993
BVPS

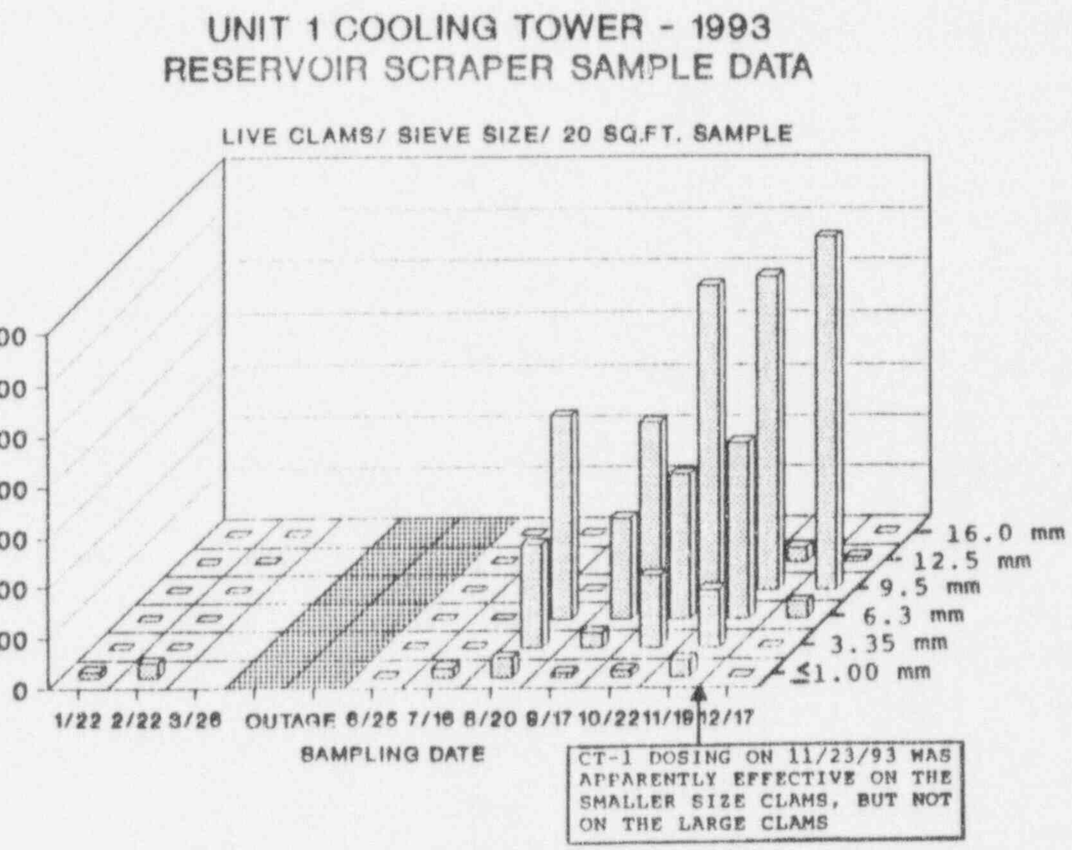
In 1993, DLC continued its Corbicula Control Program (fourth year) which included the use of a molluscicide (CT-1) to help prevent the proliferation of Corbicula within the BVPS plant and cooling towers. BVPS was granted permission by the Pennsylvania Department of Environmental Resources to use CT-1 in the BVPS Units 1 and 2 river water systems. The Unit 1 river water system was treated with CT-1 on October 6, 1992. Reservoir scraper samples collected in January and February 1993 contained very small, live Corbicula which entered the Unit 1 cooling tower after CT-1 dosing in October 1992 (Figure V-I-5 - top graph).

During the scheduled Unit 1 outage in April 1993, the cooling tower reservoir water was drained and the sediment and Corbicula in the basin were removed. The July scraper sample contained very small Corbicula (≤ 1.00 mm) which began to recolonize the Unit 1 cooling tower. A marked increase in the number of Corbicula entering the Unit 1 cooling tower was observed in August through October. These clams also increased in size during this period. Unit 1 was dosed with CT-1 on November 23, 1993. The December scraper sample data shows that the smaller clams were killed (<6.3 mm width size), however, the larger clams apparently survived (Figure V-I-5 - top graph).

(Unit 2 Cooling Tower)

In 1993, a total of 4,360 Corbicula (17% alive) were collected from the Unit 2 cooling tower using the scraper sampler. The largest Corbicula collected measured 21.44 mm in length.

On October 28, 1992, the Unit 2 river water system was treated with CT-1. The January and February 1993 scraper samples contained small, live Corbicula which had entered the Unit 2 cooling tower after the October 1992 dosing. In March through May, these Corbicula grew in size however, density remained relatively constant (Figure V-I-5 - bottom graph).



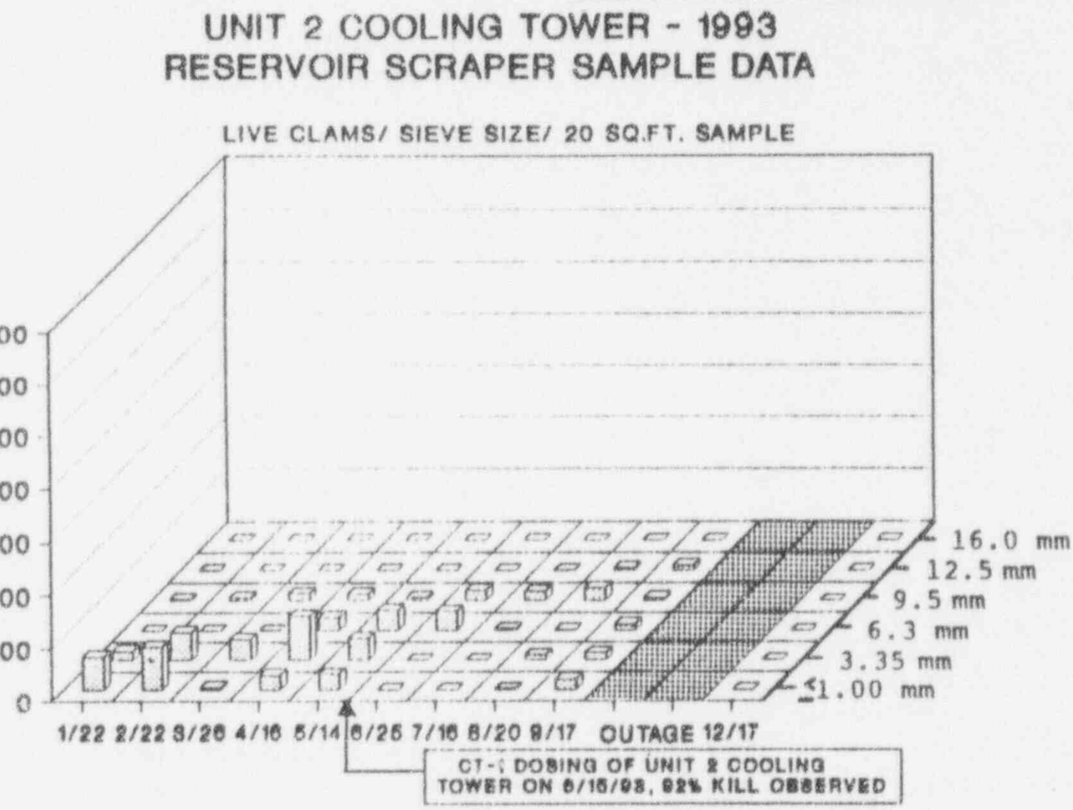


FIGURE V-I-5

Corbicula DENSITIES AND SIZE DISTRIBUTION IN SCRAPER SAMPLES COLLECTED FROM UNITS 1 AND 2 COOLING TOWERS, 1993
BVPS

The Unit 2 river water system was treated with CT-1 on June 15, 1993. The June scraper sample data showed that all small clams were dead (< 6.3 mm sieve sizes) however, the larger clams apparently survived (Figure V-I-5 - bottom graph). Samples collected in August and September indicated a recolonization of the Unit 2 cooling tower reservoir, just prior to the Unit 2 scheduled outage. No Corbicula were collected in the December scraper sample.

(Cooling Towers - Corbicula Density Determinations)

(Unit 1 Cooling Tower)

The results of the March 29, 1993 (upper reservoir) and April 18, 1993 (lower reservoir) Corbicula density determinations in the Unit 1 cooling tower are presented in Table V-I-1. The number of live and dead Corbicula in each sample, as well as, the size ranges for the largest and smallest live clams from all samples is presented. Based on the 17 ponar dredge samples collected from the lower reservoir, the estimated number of Corbicula inhabiting this area was 24 million clams, of which 81.8% were dead (Figure V-I-6). The largest Corbicula collected measured 28.74 mm in length. Figure V-I-6 presents the results of Corbicula population surveys conducted in both BVPS cooling towers since 1986. There were three CT-1 dosings of the Unit 1 cooling tower (December 1991, June and October 1992) in the two year period between outages (April 1991 to April 1993). Collectively, these three dosings have prevented multiple generations of Corbicula from developing in the lower reservoir of the Unit 1 cooling tower. Each CT-1 dosing eliminates the vast majority of Corbicula in the tower, including both adult clams (capable of spawning) and small clams which represent future spawning populations.

TABLE V-I-1

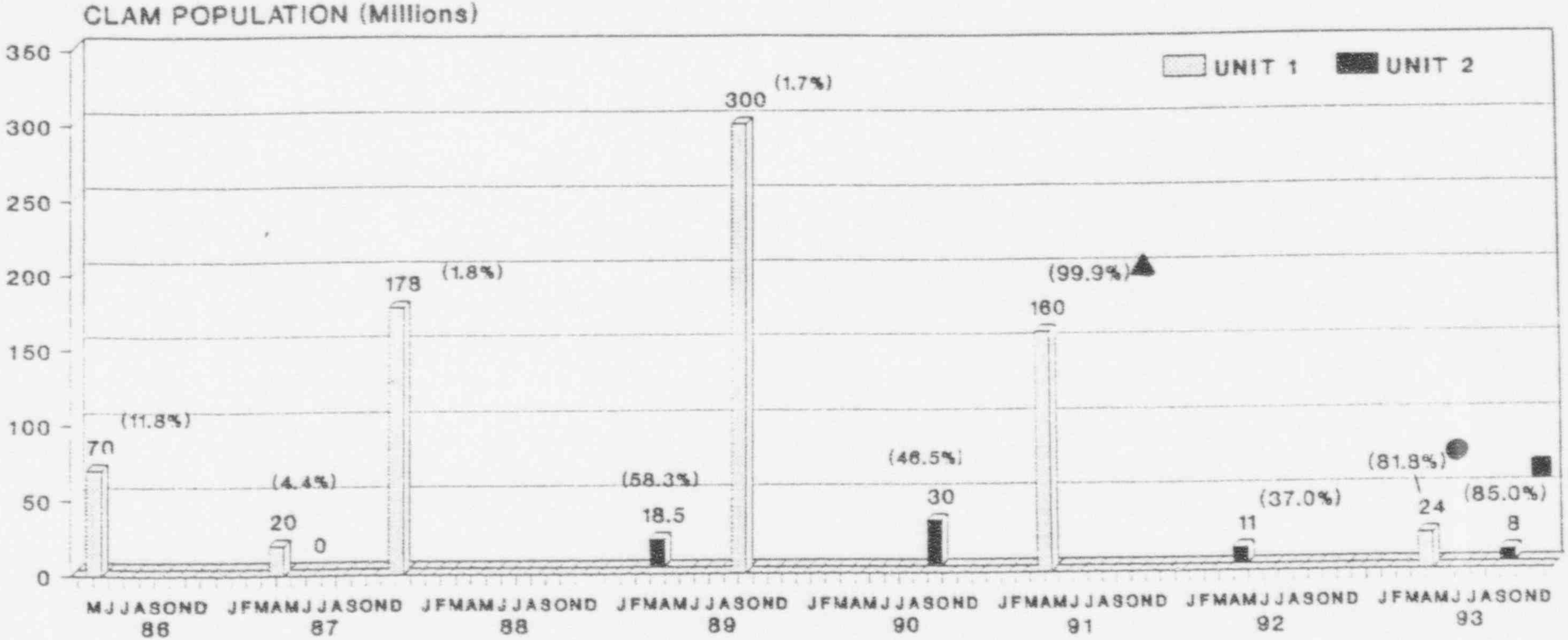
Corbicula COLLECTED IN UNIT 1 COOLING TOWER
MARCH 29, 1993 (UPPER RESERVOIR) AND APRIL 18, 1993
(LOWER RESERVOIR)
BVPS

Station	Substrate	Clams Collected Alive	Clams Collected Dead	Station Density Live Clams/m^2
Upper Reservoir Qualitative Sample (East)	silt	10	6	431
Lower Reservoir				
1	silt	4	26	172
2	silt	2	99	86
3	silt	6	58	259
4	silt	11	76	474
5	silt	13	97	560
6	silt	1	3	43
7	silt	2	1	86
8	silt	0	0	0
9	silt	1	1	43
10	silt	7	43	302
11	silt	12	48	517
12	silt	14	46	603
13	silt	4	26	172
14	silt	24	7	1034
15	silt	0	10	0
16	silt	14	25	603
17	silt	14	15	603

Estimated number of *Corbicula* present in the lower reservoir of the Unit 1 cooling tower at the time of sampling was 24 million clams, of which 18.2% were alive and 81.8% were dead.

Size range (Length)

Sampling Location	Small	Large
Upper Reservoir	≤1.00 mm	---
Lower Reservoir	1.93 mm	28.74 mm



▲ Survey performed after 1990 Corbicula Control Program, June and November 1990 CT-1 dosings of Unit 1 river water system.

● Unit 1 river water system dosed with CT-1 on October 6, 1992.

■ Unit 2 river water system dosed with CT-1 on June 15, 1993.

( ) Indicates percentage of dead Corbicula in estimated total.

FIGURE V-I-6

APPROXIMATE POPULATIONS OF Corbicula LOCATED IN UNITS 1 AND 2 COOLING TOWERS
DERIVED FROM SURVEYS CONDUCTED IN 1986 THROUGH 1993
BVPS

(Unit 2 Cooling Tower)

The results of the September 21, 1993 Corbicula density determination of the Unit 2 cooling tower are presented in Table V-I-2. Based on the ten ponar dredge samples collected from the reservoir, the estimated number of Corbicula inhabiting this area was 8 million clams, of which 85% were dead (Figure V-I-6). This high mortality is a result of the Unit 2 river water system being treated with CT-1 earlier in the summer (June 15, 1993).

(River)

Table V-I-3 summarizes Corbicula densities (clams/100 m^3 volume water filtered) in ichthyoplankton samples collected at night once a month in May and July for 1988 through 1992, and twice each month for April through August 1993. Corbicula densities in 1993 peaked in the samples collected on July 21, 1993 (except for back channel surface sample, which peaked on May 13). The May 13, 1993 samples indicated Corbicula were present in the water column, with highest densities in the back channel samples. The April and June 1993 samples contained no Corbicula. (Table V-I-3). The Corbicula collected in the ichthyoplankton samples were typically 2-4 mm in length.

Summary

The weekly impingement data for 1993 show that juveniles and adult Corbicula float into BVPS. The highest collections of Corbicula off the traveling screens occurred in August and September, then decreased through December. The Corbicula impingement total for 1993 was the second highest since 1981, with the highest total occurring in 1989.

The monthly reservoir scraper samples collected in Units 1 and 2 cooling towers during 1993 indicated when Corbicula were entering and colonizing the reservoirs. During the months of August and

TABLE V-I-2

Corbicula COLLECTED IN UNIT 2 COOLING TOWER
SEPTEMBER 21, 1993
BVPS

Station	Substrate	Clams Collected Alive	Clams Collected Dead	Station Density Live Clams/m²
1	silt	28	31	1,207
2	silt	24	125	1,034
3	silt	9	128	388
4	silt	18	71	776
5	silt	17	37	733
6	silt	22	223	948
7	silt	14	99	603
8	silt	13	68	560
9	silt	7	129	302
10	silt	23	57	991

Estimated number of *Corbicula* present in the reservoir of the Unit 2 cooling tower at the time of sampling was 8 million clams, of which 15% were alive.

Size range (Length)

Sampling Location	Small	Large
Reservoir	2.52 mm	23.26 mm

TABLE V-I-3

Corbicula DENSITIES (Clams/100 m^3) PRESENT IN ICHTHYOPLANKTON SAMPLES COLLECTED AT NIGHT WITH A 0.5 m PLANKTON NET IN THE OHIO RIVER, 1988 THROUGH 1993
BVPS

	Sample Location			
	Main Channel		Back Channel	
Date	Surface	Bottom	Surface	Bottom
1988				
May 11	0	1	22	19
July 14	0	15	1	9
1989				
May 24	1	0	1	6
July 13	2	3	5	10
1990				
May 25	0	0	1	3
July 26	35	30	38	27
1991				
May 14	1	1	14	22
July 25	139	36	9	6
1992				
May 19	36	100	71	62
July 9	49	130	38	205
1993				
April 14	0	0	0	0
29	0	0	0	0
May 13	3	4	44	57
27	0	1	0	6
June 10	0	0	0	0
23	0	0	0	0
July 7	7	19	0	1
21	54	89	31	68
August 4	8	8	4	5
18	0	0	0	5

September, Corbicula were entering the Units 1 and 2 cooling towers through the circulating water systems. The effects of the CT-1 dosings in 1993 were observed in the reservoir scraper samples collected from both Units 1 and 2 cooling towers. The scraper samples collected after dosing showed 100% mortality of smaller younger clams, with the larger older clams surviving.

Sediment samples were collected in the Unit 1 cooling tower (April 18, 1993) and Unit 2 cooling tower (September 21, 1993) lower reservoirs during the scheduled outages in order to estimate the Corbicula populations within those structures. The estimated number of Corbicula inhabiting the Units 1 and 2 cooling towers at the time of the surveys were 24 million and 8 million clams, respectively. Population surveys of both BVPS cooling tower reservoirs conducted during scheduled outages (1986 through 1993) have resulted in lower densities of Corbicula in the Unit 2 tower compared to the Unit 1 cooling tower. This can be attributed to differences in cooling tower design and the faster water currents in the Unit 2 cooling tower reservoir, which decrease sediment deposition.

Corbicula collected during the ichthyoplankton surveys conducted in 1993 demonstrate that Corbicula are migrating down the Ohio River and entering BVPS through the intake structure. The highest sample collection of Corbicula occurred in July.

2. Corbicula Larvae Study

Objective

The Corbicula larvae study was designed to collect data on spawning activities in the Ohio River.

Methods

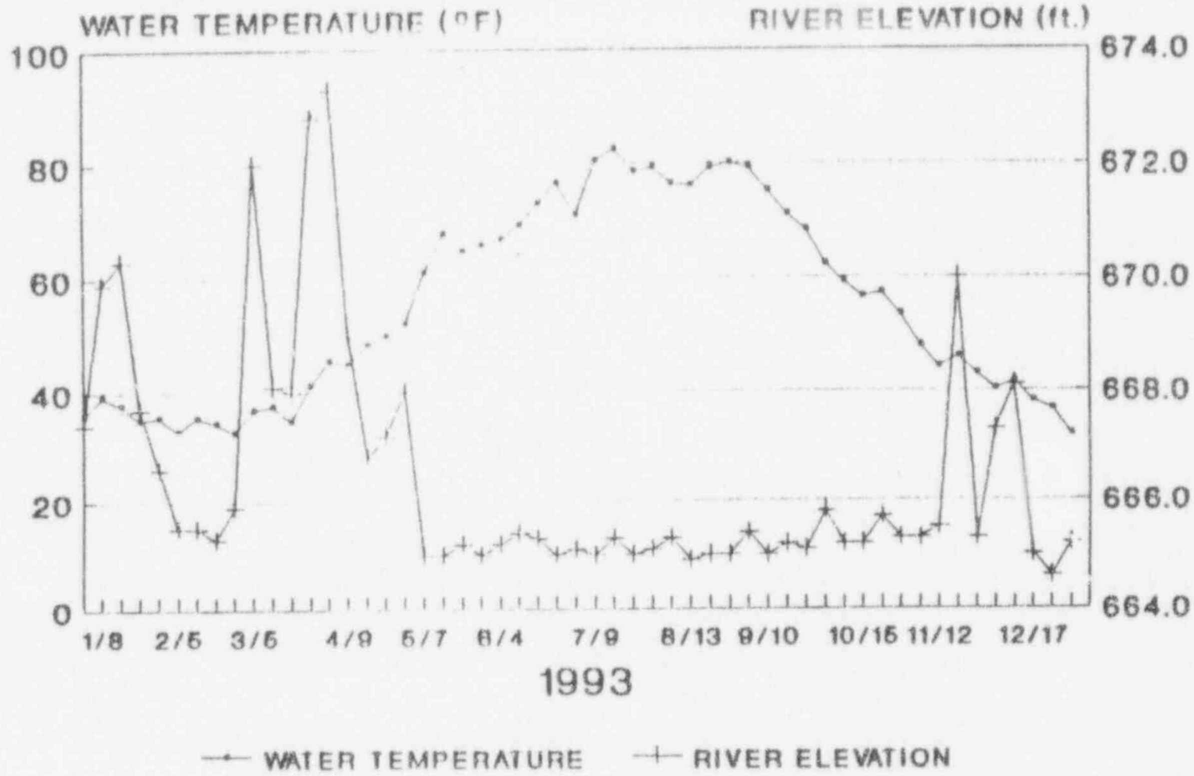
Specially constructed clam cages (Figure V-I-1) were utilized for this study. Each cage was constructed of 1 mm mesh fiberglass screening secured within a one square foot durable plastic frame, which contained approximately ten pounds of industrial glass beads (3/8" diameter) to provide ballast and a uniform substrate for the clams. The clam cage mesh size permits only very small clams or pediveliger larvae to enter and colonize the cage.

Larval cages were maintained in the intake structure according to the following procedure. Each month, two empty clam cages were placed in the intake structure bays. Each cage was left in place for five months, after which time it was removed and examined for clams. A maximum of ten cages were maintained in the intake structure. The Corbicula larval study was discontinued in the Units 1 and 2 cooling towers in 1993.

Each clam cage removed after the five-month colonization period was returned to the laboratory where it was washed to obtain the clams which had colonized inside the cage. Corbicula obtained from each cage were rinsed through a series of stacked U.S. Standard sieves ranging in mesh size from 16.0 mm to 0.6 mm. Live and dead clams on each sieve were counted and the numbers were recorded. The largest and smallest clams were measured using Vernier calipers to establish a length range for the sample. It should be noted that the size distribution data obtained using the sieves reflects clam width, rather than length.

Results

Figure V-I-7 illustrates size distribution data which represents the average for the two larval cages which were removed each month from the intake structure. The two intake structure larval cages removed in January 1993 contained some juvenile Corbicula (average live 63). These clams most likely entered the cages during the



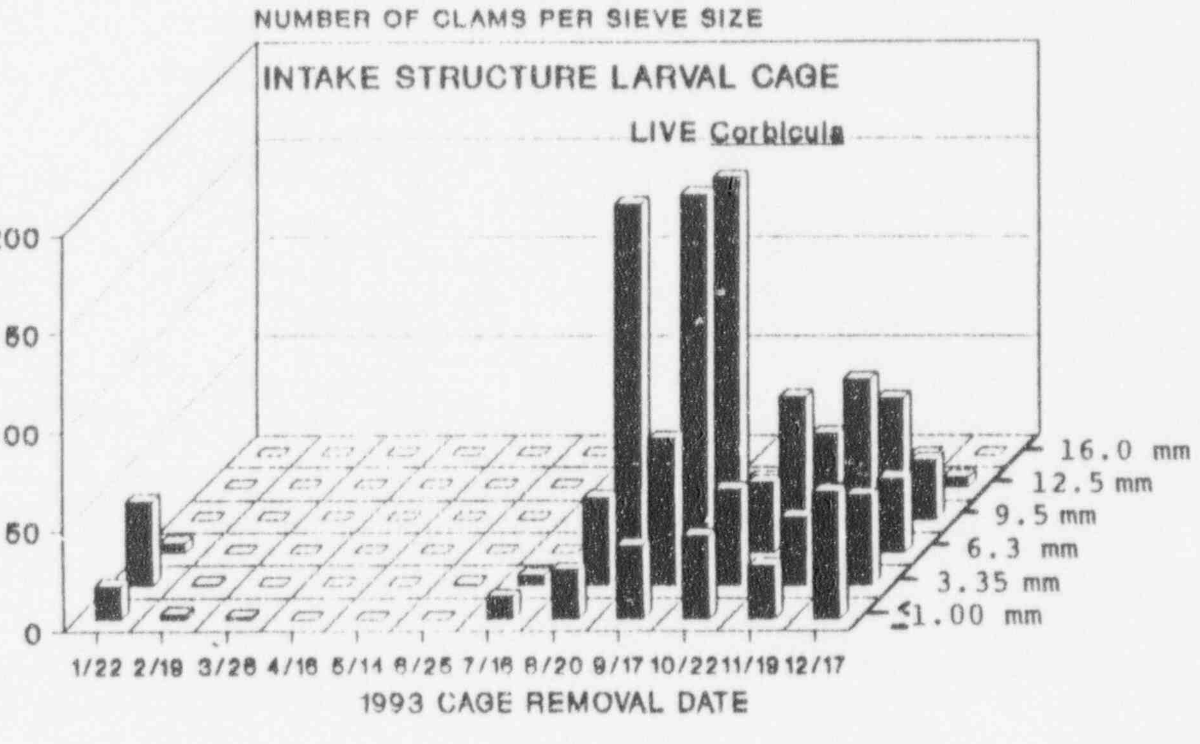


FIGURE V-I-7

RESULTS OF THE Corbicula LARVAE STUDY SIZE DISTRIBUTION
IN THE INTAKE STRUCTURE, 1993
BVPS

late summer spawning period of 1992 and experienced slight to moderate growth prior to the decrease in ambient river water temperatures.

Colonization of the intake structure larval cages by juvenile Corbicula from the 1993 Ohio River spawn was initially observed in cages removed on July 16 (Figure V-I-7) and continued through August and September. Corbicula densities remained high in cages removed during the remaining months of 1993. Corbicula removed from the intake structure larval cages in August through November were predominantly of the 6.3 and 9.5 mm sieve size categories (Figure V-I-7). The largest Corbicula measured 23.92 mm in length and was removed from one of the October larval cages.

From May through October 1993, the Ohio River was near the normal pool elevation and temperatures were above 80 °F in July (Figure V-I-7). As river temperatures dropped below 50 °F in early November, the growth rate of Corbicula present in the intake structure larval cages also decreased.

Summary

Juvenile Corbicula from the 1993 summer spawn were first detected in the larval cages removed from the BVPS intake structure in July. This early summer spawning period typically occurs in the Ohio River near BVPS each year. These clams exhibited rapid growth during August and September, and during the size analysis were found to be predominantly of the 6.3 and 9.5 mm sieve size categories. As river temperatures dropped below 50 °F in early November, the growth rate of Corbicula present in the intake structure larval cages also decreased.

3. *Corbicula* Growth Study

Objective

The growth study examines the maximum growth attained by *Corbicula* which colonize the larval cages placed in the BVPS intake structure.

Methods

Empty larval cages were placed in the intake structure each month to determine the maximum growth of invading larvae over a five-month period of colonization. The length and width of the largest *Corbicula* found in each larval cage removed after the five-month colonization period had been measured to the nearest 0.05 mm using manual Vernier calipers in 1988 through 1991. In 1992 and 1993 digital Vernier calipers were used to measure clams to the nearest 0.01 mm. The larvae study began in August 1988 (initial cage placement) and has continued through December 1993 (cage removal after July 1993 placement), resulting in a five-month colonization period per evaluation.

Results

Table V-I-4 lists length data for the largest *Corbicula* found in each larval cage removed from the BVPS intake structure over the past six years. The largest *Corbicula* collected in 1993 from an intake structure larval cage (sample period May to October) measured 23.92 mm in length (Table V-I-4). The larval cages exposed during the sampling periods of November to April and December to May collected no *Corbicula*. Elevated summer and fall river water temperatures and adequate food sources probably contributed to the moderately high growth of the largest clams removed from the cages in October, November and December (≤ 20.00 mm length).

TABLE V-I-4

MAXIMUM *Corbicula* GROWTH LENGTH ACHIEVED IN A FIVE-MONTH PERIOD
SUMMARIZED FROM THE LARVAE STUDY CAGE COLLECTIONS
1988 THROUGH 1993
BVPS

Date		Maximum Clam Growth Length (mm)					
		Intake Structure					
Cage Placement	Cage Removal	1988	1989	1990	1991	1992	1993
August	January	-	18.10	13.10	12.90	16.45	11.88
September	February	-	9.85	4.50	4.75	7.00	4.34
October	March	-	4.00	1.00	2.50	0	2.28
November	April	-	8.40	0	0	1.00	0
December	May	-	7.30	0	0	2.00	0
January	June	6.70	0	5.70	6.15	3.50	5.11
February	July	16.00	7.85	13.25	15.70	6.98	14.76
March	August	21.15	17.20	17.20	20.65	13.54	17.26
April	September	23.90	19.20	17.10	25.45	19.00	21.65
May	October	25.50	20.10	19.30	22.50	19.41	23.92
June	November	22.60	14.90	18.30	21.30	17.42	21.21
July	December	21.00	15.45	16.90	20.50	16.42	20.00

(-) No data was collected due to plant operations.

Summary

Corbicula larvae which colonized the intake structure larval cages during the summer and early fall have shown rapid growth. This was due to the higher river temperatures in the summer, when more food sources were also available to these filter feeders. The largest Corbicula removed from an intake structure larval cage in 1993 measured 23.92 mm in length.

J. ZEBRA MUSSEL MONITORING PROGRAM

Introduction

Zebra mussels (*Dreissena polymorpha*) are exotic freshwater mollusks that look similar to marine barnacles, and have brown shells marked with alternating zig-zag yellowish bands (Figure V-I-1). They are believed to have been introduced into North America through the ballast water of ocean-going cargo vessels probably from Eastern Europe. They first appeared in Lake St. Clair in 1987 and have spread rapidly to other Great Lakes and have begun to infestate the lower Ohio River in recent years. Zebra mussels were detected at Pike Island Locks and Dam at Mile Point 84.2 of the Ohio River in June 1993 by the U.S. Army Corps of Engineers. This is approximately 50 river miles downstream from BVPS.

Adult zebra mussels can live up to five years and grow to two inches in length. Recent research suggests that each female may be capable of producing one million microscopic (veliger larvae) offspring per year, that can easily pass through water intake screens. They use very adhesive hairlike (byssus) threads to attach themselves to any hard surfaces (e.g., boat hulls, intake pipes and other mussels). Transportation of these organisms between water bodies is accomplished in part by boats having adult mussels attach to their hulls or larvae in their live wells and/or bilges. BVPS, in anticipation of this possible infestation and responding to NRC Notice No. 89-76 (Biofouling Agent-Zebra Mussel, 21 November 1989), instituted a Zebra Mussel Monitoring Program in January 1990.

The Zebra Mussel Monitoring Program includes the Ohio River and the circulating river water system of the BVPS (intake structure and cooling towers). This section describes this Monitoring Program and the results obtained during field and plant surveys conducted through 1993.

1. Monitoring

Objectives

The objectives of the Monitoring Program were:

(1) to identify if zebra mussels are in the Ohio River adjacent to BVPS and provide early warning to operations personnel as to their possible infestation.

(2) to provide life history data as to when the larvae are mobile in the Ohio River and provide insights as to their vulnerability to potential treatments.

(3) to provide data as to their growth rates under different water temperatures and provide estimates as to the time it requires for these mussels to reach clogging size.

Methods

(Intake Structure)

The Pennsylvania Department of Environmental Resources (DER) developed a formal Zebra Mussel Monitoring Program in 1992. DER biological sampling protocols involve the deployment of artificial substrates in the water column to detect colonization by zebra mussel larvae.

The DER zebra mussel sampler measures 10" (L) x 6.5" (W) x 7" (D) and holds six PVC plates (each 6" x 6") (see Figure V-I-1). The samplers are deployed at a depth of 2 m or at mid-depth for waters less than 2 m deep. Two plates are pulled from each sampler usually every two weeks for microscopic examination. The plates that are pulled for examination must be the pair that have been in the sampler (water column) the longest.

BVPS began participating in the DER Zebra Mussel Monitoring Program in April 1992. Two DER zebra mussel samplers were deployed in separate bays of the BVPS intake structure at 2 m depths. Two plates from each sampler were pulled twice a month (once a month when water temperature was ≤ 8 °C) for examination using a dissecting microscope (50X magnification). The results of each examination were submitted to the DER on the standard data forms which they provided.

In addition to the DER artificial substrates specifically designated for zebra mussel surveillance, the Corbicula larval clam cages were also inspected for zebra mussel colonization (Figure V-I-1). Experience with collecting these mussels on the outside of identical cages used in Lake Erie during the summer of 1988 has demonstrated the suitability of these substrates as good monitoring devices.

Two other surveillance techniques used in the intake structure were:

(1) the weekly impingement monitoring program, and
(2) observations of the divers during regularly scheduled cleanout operations.

(Cooling Towers)

The cooling towers were monitored for zebra mussels using two techniques:

(1) checking the monthly reservoir scraper sample collected in each cooling tower.

(2) checking for zebra mussels as part of the Corbicula population survey conducted during regularly scheduled outages (Units 1 and 2 in 1993).

(Ohio River Shoreline)

Each week, in conjunction with the regular impingement survey, the BVPS discharge area was observed for fish, waterfowl and beaver activities. In 1993, the discharge area, along with the barge slip next to the Unit 1 cooling tower, were designated as observation zones for zebra mussels. The barge slip wall was sampled monthly using a scraper (with net attached). Approximately 12 square feet of the barge slip wall was scraped each month. The pilings and rocks were also checked for colonization since these organisms will attach to any hard surface.

(Communications Network)

The informal communication network established in 1992 for monitoring zebra mussel movements within the Ohio River was continued in 1993. This included an exchange of information between the U.S. Army Corps of Engineers, ORSANCO, universities, industrial water users, and other electric utilities. BVPS is dedicated to cooperation in this communications program and the formal program developed by the DER in 1992.

Results

The results of the 1993 Zebra Mussel Monitoring Program have revealed that no zebra mussels were collected in the plant or in the Ohio River adjacent to BVPS as part of any sampling activity. In the summer of 1993, there were confirmed reports of zebra mussel sightings in the upper Ohio River (Pike Island Locks and Dam M.P. 84.2). In view of the rapid expansion of these organisms within the Great Lakes and these most recent sightings, BVPS is vigilant to their potential arrival in the Ohio River in the vicinity of the BVPS.

Summary

The zebra mussel (Dreissena polymorpha) is an exotic freshwater mollusk that is believed to have been introduced into Lake St. Clair in 1987 via ballast water of ocean-going cargo vessels. Since then, they have spread rapidly to the other Great Lakes and are infesting riverine systems in the United States.

Due to the proximity of the Ohio River to Lake Erie, BVPS initiated a Zebra Mussel Monitoring Program in January 1990. The Zebra Mussel Monitoring Program in 1992 and 1993 utilized a new artificial substrate sampler developed by the Pennsylvania Department of Environmental Resources which provides a large surface area for the mussel larvae to attach. In 1993, no zebra mussels have been detected at BVPS, however, a confirmed sighting was reported by the U.S. Army Corps of Engineers at the Pike Island Locks and Dam. This facility is located on the Ohio River at M. P. 84.2, just 50 river miles downstream from the BVPS.

VI. REFERENCES

Burch, J. Q., 1944. Checklist of West American Mollusks. Minutes, Conchology Club of Southern California 38:18.

Commonwealth of Pennsylvania, 1990. Pennsylvania's Endangered Fishes, Reptiles and Amphibians. Published by the Pennsylvania Fish Commission.

Counts, C. C. III, 1985. Distribution of Corbicula fluminea at Nuclear Facilities. Division of Engineering, U.S. Nuclear Regulatory Commission. NUREGLCR. 4233. 79 pp.

Dahlberg, M. D. and E. P. Odum, 1970. Annual cycles of species occurrence, abundance and diversity in Georgia estuarine fish populations. Am. Midl. Nat. 83:382-392.

DLC, 1976. Annual Environmental Report, Non-radiological Volume #1. Duquesne Light Company, Beaver Valley Power Station. 132 pp.

DLC, 1977. Annual Environmental Report, Non-radiological Volume #1. Duquesne Light Company, Beaver Valley Power Station. 123 pp.

DLC, 1979. Annual Environmental Report, Non-radiological Volume #1. Duquesne Light Company, Beaver Valley Power Station. 149 pp.

DLC, 1980. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 160 pp.

DLC, 1981. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 105 pp. + Appendices.

DLC, 1982. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 126 pp.

DLC, 1983. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 124 pp. + Appendix.

DLC, 1984. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 139 pp.

DLC, 1985. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 106 pp.

DLC, 1986. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 152 pp.

DLC, 1987. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 145 pp.

DLC, 1988. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 161 pp.

DLC, 1989. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 145 pp.

DLC, 1990. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 181 pp.

DLC, 1991. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 165 pp.

DLC, 1992. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 164 pp.

Hutchinson, G. E., 1967. A treatise on limnology. Vol. 2, Introduction to lake biology and the limnoplankton. John Wiley and Sons, Inc., New York. 1115 pp.

Hynes, H. B. N., 1970. The ecology of running waters. Univ. Toronto Press, Toronto.

NRC, IE Bulletin 81-03: Flow Blockage of Cooling Tower to Safety System Components by Corbicula sp. (Asiatic Clam) and Mytilus sp. (Mussel).

Pielou, E. C., 1969. An introduction to mathematical ecology. Wiley Interscience, Wiley & Sons, New York, NY.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott, 1991. Common and Scientific Names of Fishes from the United States and Canada (fifth edition). American Fisheries Society Special Publication No. 20:1-183.

Shiffer, C., 1990. Identification Guide to Pennsylvania Fishes. Pennsylvania Fish Commission, Bureau of Education and Information. 51 pp.

Winner, J. M., 1975. Zooplankton. In: B. A. Whitton, ed. River ecology. Univ. Calif. Press, Berkely and Los Angeles. 155-169 pp.

APPENDIX

BVPS
AQUATIC MONITORING PROGRAM
MONTHLY STATUS REPORT

DECEMBER 1993

(EXAMPLE OF A MONTHLY STATUS REPORT)

BVPS
Aquatic Monitoring Program
Monthly Status Report
December 1993

I. Corbicula and Zebra Mussel Monitoring

A. Corbicula Monitoring

1. Larval Cages

a. Intake Structure:

- The average number of live Corbicula collected from the intake structure larval cages in December was 180 clams (Figure 1 - bottom graph). Thirty-five percent (63) of these clams were retained on the ≤1.00 mm sieve. These juvenile clams probably entered the cages in September, however, they experienced minimal growth in the fall and early winter due to declining river water temperatures.

2. **Units 1 and 2 Cooling Towers - Corbicula sampling of the reservoirs using a scraper - December 17, 1993**

a. Unit 1 Cooling Tower:

- The Unit 1 cooling tower was dosed with CT-1 on November 23, 1993. One mortality bag containing 40 live Corbicula was placed in the cooling tower reservoir and exposed to the CT-1 during the dosing operation. There was 100% mortality observed in this bag eight days after CT-1 dosing was completed.

  However, five pulls of the scraper along the Unit 1 cooling tower basin produced 731 live and 225 dead Corbicula. This data showed that 76% of 956 Corbicula retrieved were alive. The CT-1 dosing was apparently effective in killing the smaller clams (<6.3 mm width), but not the larger clams. The size distribution data indicates that 94% of the live clams were retained on the 9.5 mm mesh sieve (Figure 2 -top graph). The largest live clam measured 18.68 mm (L) x 16.48 mm (W).

b. Unit 2 Cooling Tower:

- No Corbicula were collected in the Unit 2 cooling tower reservoir scraper sample in December (Figure 2 - bottom graph).

3. Intake Structure Traveling Screens

- There were 7 live and 1 dead Corbicula collected in December from the weekly washing (5 surveys) of one traveling screen. This live clam total is lower than last month's total (113). The monthly totals have been multiplied by four (28 live and 4 dead - Figure 3) to account for the fact that in 1993 only one screen is being washed during each weekly survey, in contrast to previous years' surveys where all four screens were typically washed. This multiplication factor permits comparison of 1993 survey data with data compiled since 1981 (Figure 3 bottom graph).

- Figure 4 presents Ohio River water temperature and elevation data for 1993, up to the end of December. The river temperature readings ranged from the low 40's to mid 30's (°F) during the month. The river elevation readings for the month were near the normal pool elevation, except for the second week when pool elevation increased due to rain activity.

B. Zebra Mussel Monitoring

- No zebra mussels were found on the DER Zebra Mussel substrate plates removed from the BVPS intake structure bays A and D on December 17, 1993.

- The Unit 1 barge slip on the Ohio River was sampled (wall scraper) for zebra mussels on December 17, 1993. No zebra mussels were found in the sample.

II. Fish

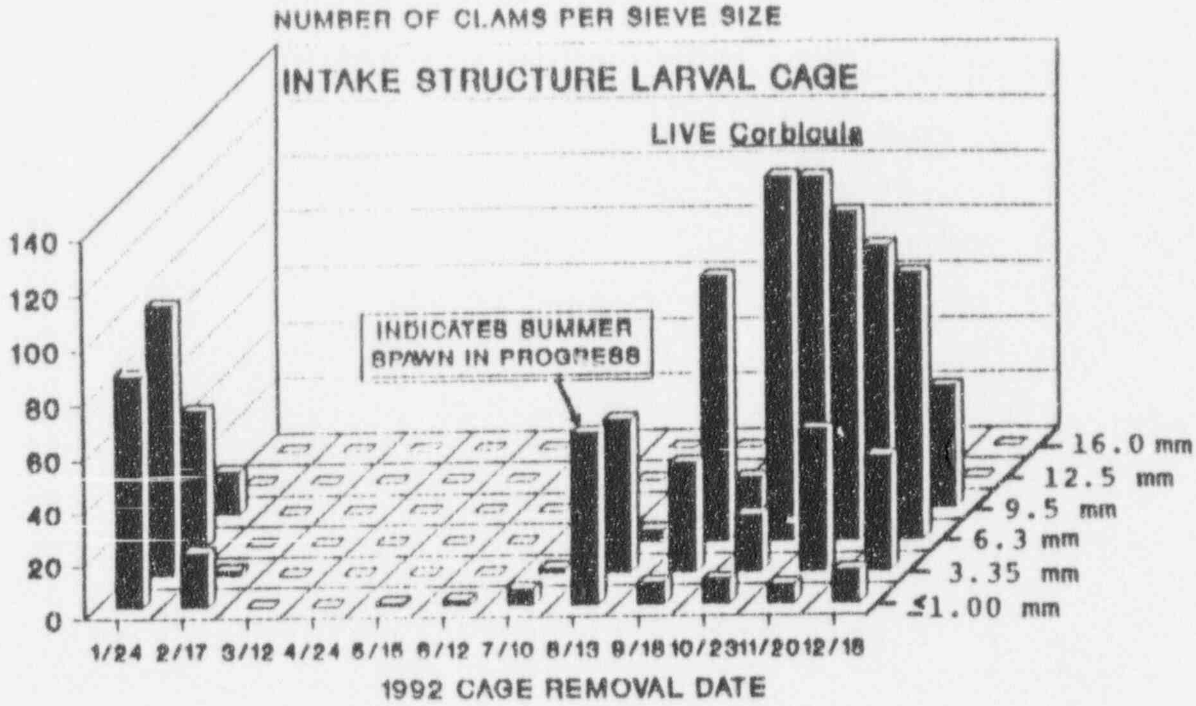
A. Fish Surveys

- The next fish survey will be conducted in May 1994.

B. BVPS Fish Tank

- A Creek chub was added to the educational fish tank in December.

- The educational fish tank also contained these species in December: Green sunfish, Black crappie, Yellow perch, Sauger, Smallmouth bass, Striped bass hybrid, Bluegill, Pumpkinseed, Bullhead, and Fathead minnow.



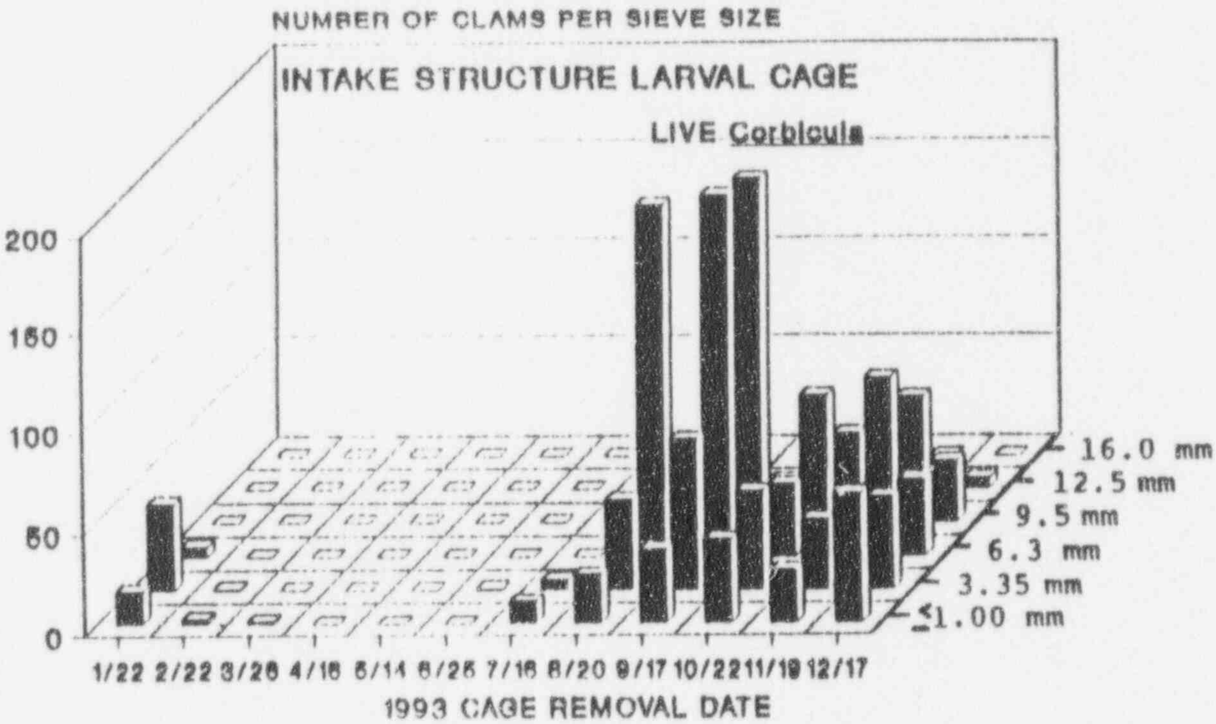
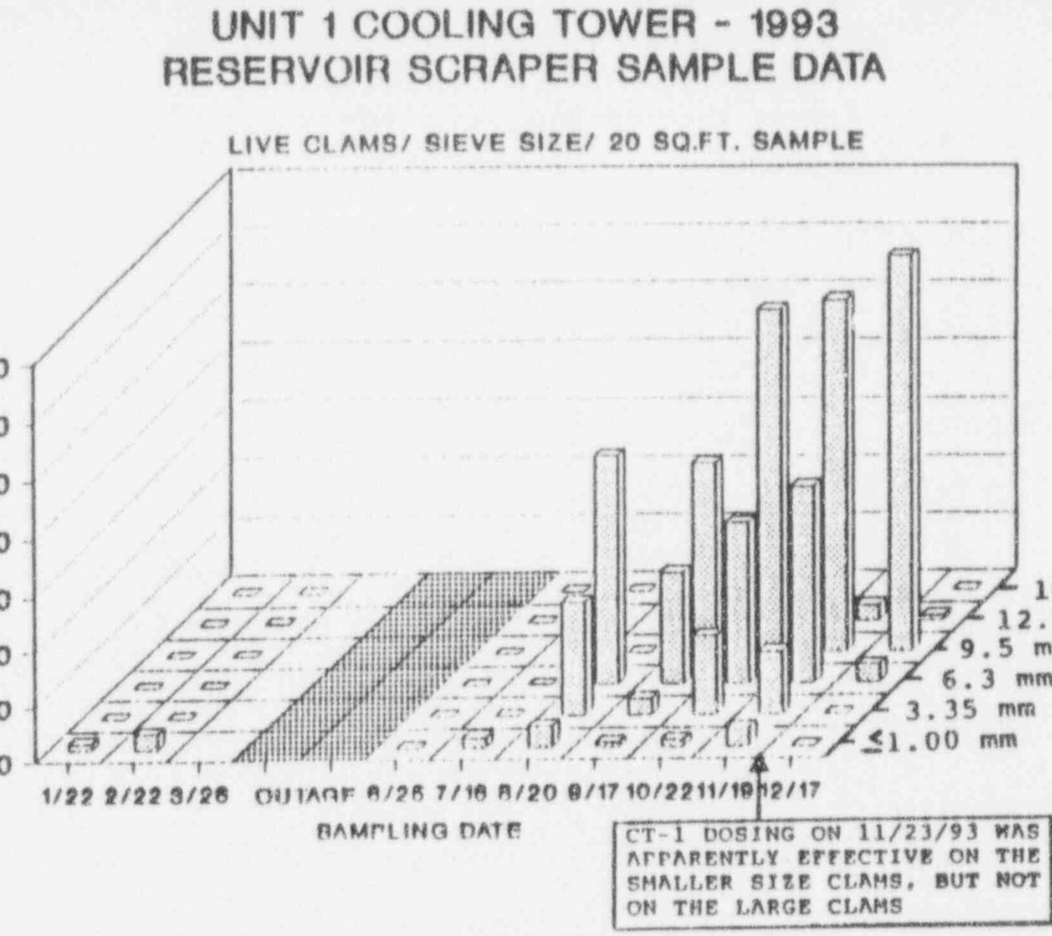


FIGURE 1

Corbicula LARVAL CAGE 1992 AND 1993 DATA
INTAKE STRUCTURE
BVPS



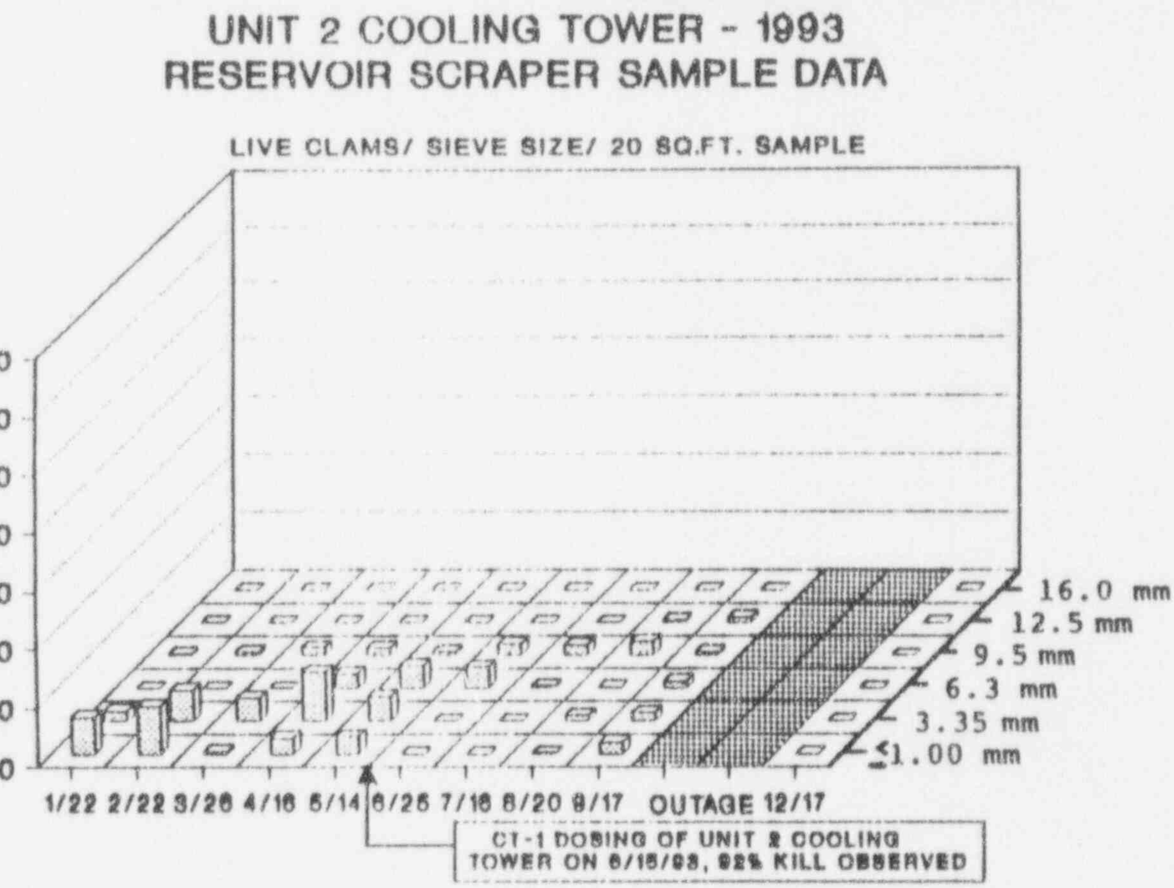
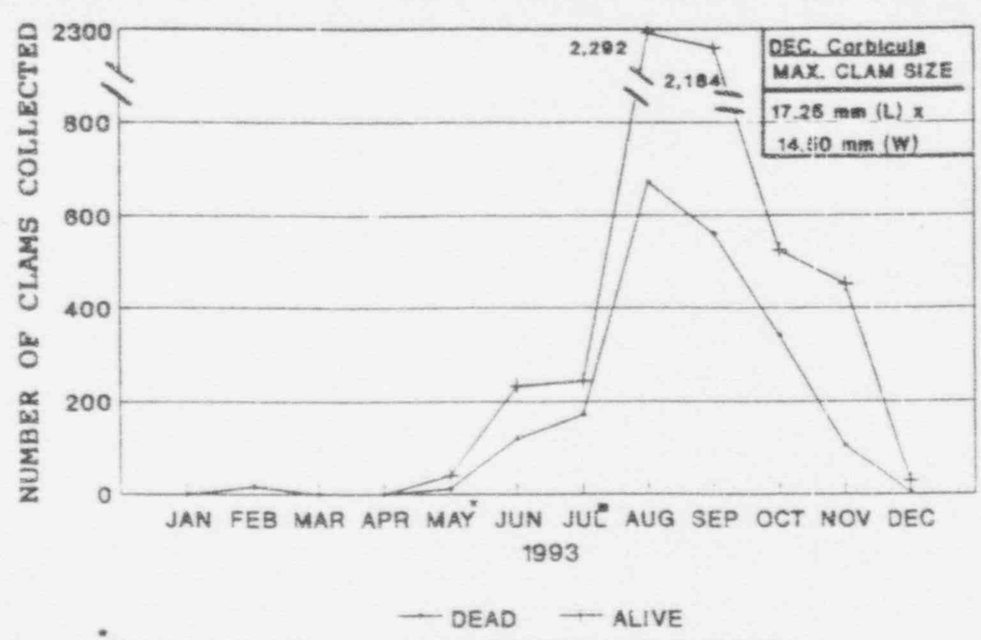


FIGURE 2

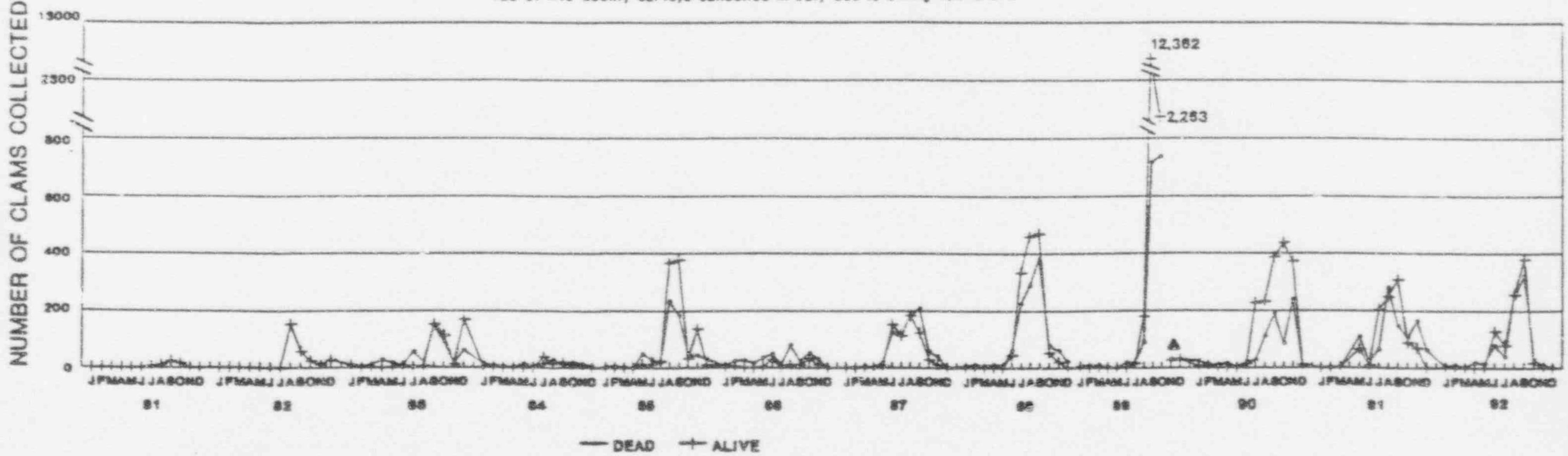
Corbicula DENSITIES AND SIZE DISTRIBUTION IN SCRAPER SAMPLES COLLECTED FROM BVPS COOLING TOWERS

BVPS



* Three of four weekly surveys cancelled in May due to maintenance

▣ Two of five weekly surveys cancelled in July due to diving operations



▲ DATA FOR NOVEMBER AND DECEMBER 1989 REPRESENTS ONLY ONE SAMPLING PERIOD FOR EACH MONTH DUE TO EITHER DIVING OR MAINTENANCE.

NUMBER OF Corbicula COLLECTED OFF TRAVELING SCREENS DURING THE IMPINGEMENT SURVEYS FOR 1981 THROUGH 1992 AND 1993 FOR MONTHS TO DATE

FIGURE 3

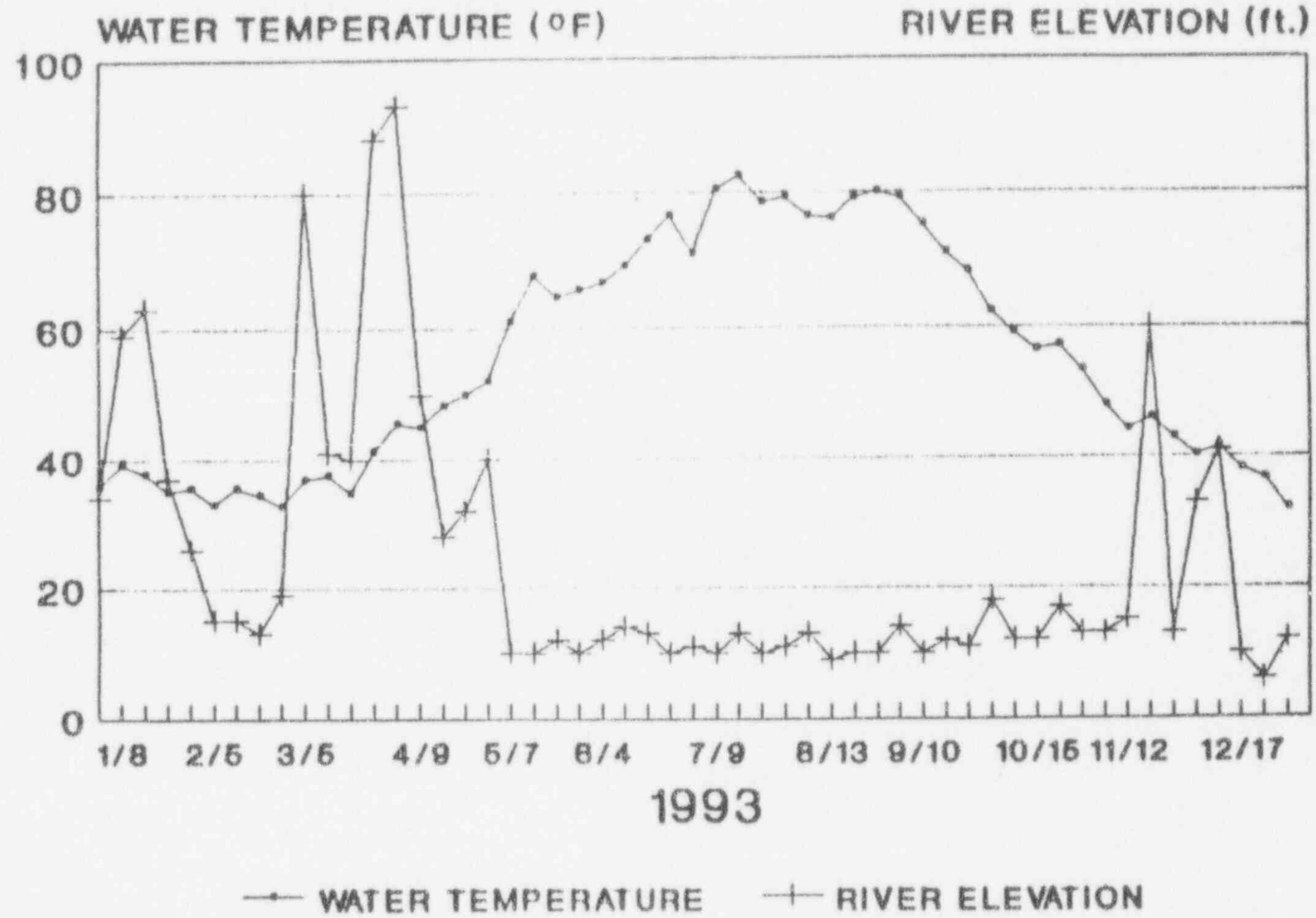


FIGURE 4

WEEKLY OHIO RIVER WATER TEMPERATURE AND RIVER ELEVATION DATA
FOR 1993 TO DATE - INTAKE STRUCTURE
BVPS