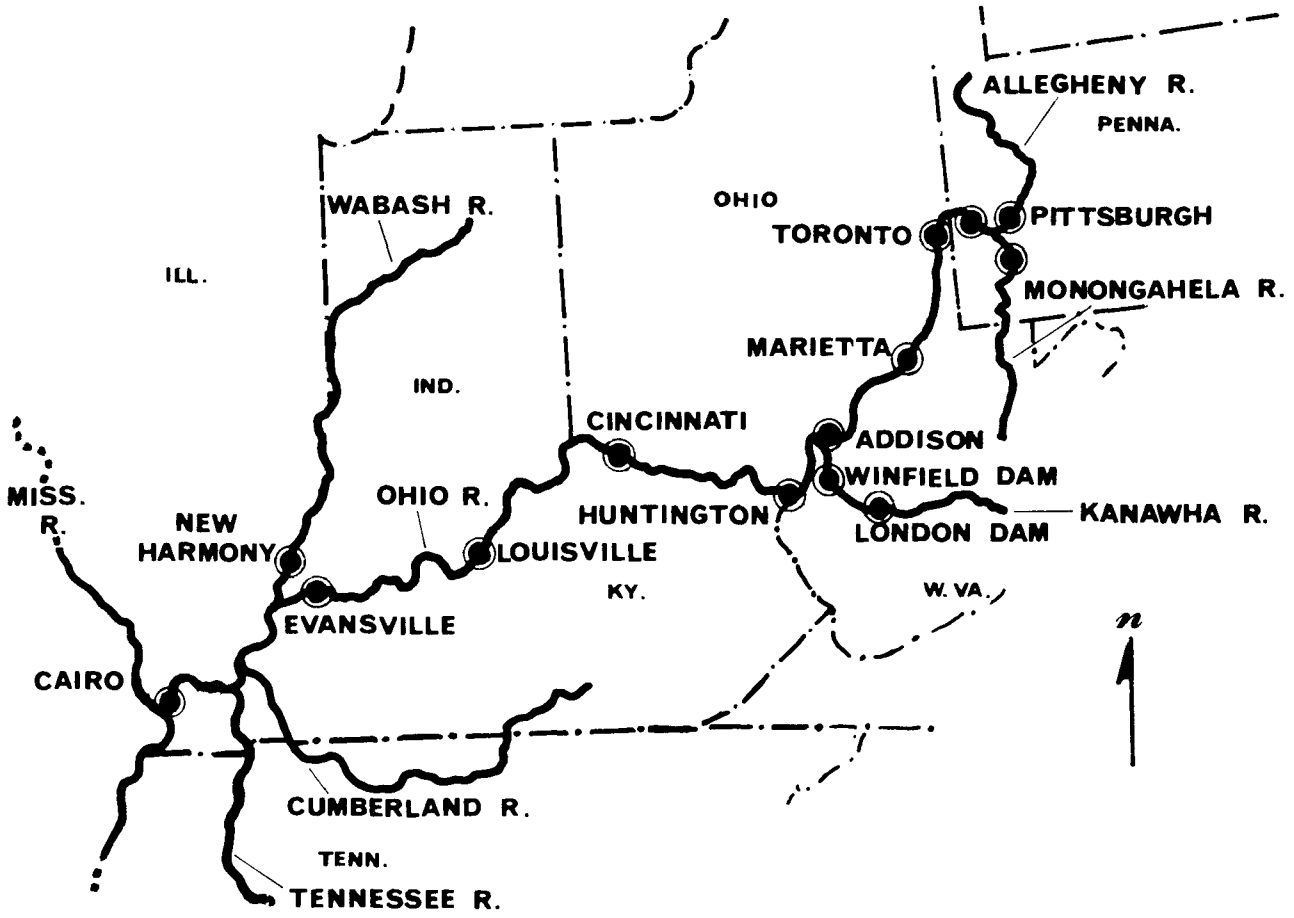
MACROINVERTEBRATE COLLECTIONS AND WATER QUALITY MONITORING IN THE OHIO RIVER BASIN 1963 - 1967



Prepared as a Cooperative Report By:
Office of Technical Programs, Ohio Basin Region &
Analytical Quality Control Laboratory
Water Quality Office
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MACROINVERTEBRATE COLLECTIONS AND WATER QUALITY MONITORING IN THE OHIO RIVER BASIN 1963 - 1967

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ABSTRACT

Macroinvertebrate populations were sampled at fourteen Ohio River and tributary stations over a five year period, 1963-1967. Selected physical and chemical surveillance data were related to biological quality. Ohio River stations included; Pittsburgh, Pennsylvania, Toronto, Marietta and Addison, Ohio, Huntington, West Virginia, Cincinnati, Ohio, Louisville, Kentucky, Evansville, Indiana and Cairo, Illinois. Tributary stations were located in the lower reaches of the Allegheny, Monongahela, Kanawha and Wabash Rivers. Distinct differences in the abundance and diversity of macroinvertebrates were observed. Pollution, primarily from industrial sources, greatly reduced the numbers and kinds of macroinvertebrates in the Allegheny, Monongahela, upper Ohio and lower Kanawha rivers. Larger and more diverse populations existed in the middle and lower reaches of the Ohio River. The faunal composition in the lower Ohio River and Wabash River indicated enriched waters. Population characteristics and trends in cyclic periods of abundance of certain species at the stations were found to be of utmost importance in evaluating effects of pollution on macroinvertebrates.

FOREWORD

A sampling program for macroinvertebrates was initiated in 1962 by the National Water Quality Network, Division of Water Supply and Pollution Control, Public Health Service as part of a national surveillance effort. This program was designed to supplement other information collected on water quality characteristics, such as physical, chemical, bacteriological, plankton, organics, trace elements and radioactivity. Unlike data gathered on these latter parameters, macroinvertebrate data were not placed in the Storage and Retrieval System (STORET), Washington, D.C.

This report summarizes macroinvertebrate data on the Ohio River and selected tributaries during the five year period, 1963-1967. Population characteristics and changes in the community composition are evaluated relative to general water quality.

Initially, several standard sampling methods were employed, including bottom dredges and trawls. Collections from these devices usually contained few organisms and little diversity and therefore, other means were sought which would provide a more varied fauna. A rock-filled artificial substrate sampler (basket sampler) was developed which proved to be effective for sampling macroinvertebrates in large rivers. Both dredges and baskets were utilized for monitoring macroinvertebrate communities.

Macroinvertebrate studies have continued as part of the water quality surveillance of the Ohio River Basin. Reports for succeeding years will be issued as data are evaluated.

ACKNOWLEDGEMENTS

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The authors also thank the U.S. Corps of Engineers, Pittsburgh, Huntington, and Louisville District Offices for giving permission to install artificial substrate samplers and we appreciate the kind assistance of the Ohio River lock and dam personnel during the study.

Lee B. Tebo, Jr., Chief Biologist, Southeast Region, Athens, Ga., H. Ronald Preston and Max A. Anderson, Aquatic Biologists, respectively, Upper Ohio Basin Office, Wheeling, W. Va., and Lower Ohio Basin Office, Evansville, Ind., Ohio Basin Region, WQO, EPA made significant contributions to the surveillance activity. Dr. C. I. Weber, Chief, Biological Methods, Analytical Quality Control Laboratory directed the biological surveillance activities the latter part of 1967 and has been involved in the development of methods used in the study. Other WQO, EPA biologists who either collected, sorted, or identified organisms included; Donald G. Stevens, George E. Morrison, Raymond H. Taylor, Richard Fullner, and Ronald Ulrich.

The physical and chemical data were compiled from several sources: the WQO, EPA data Storage and Retrieval System (STORET), Washington, D.C. and the National Water Quality Network, Annual Compilation of Data, Department of Health, Education, and Welfare; the U.S. Geologic Survey Water Resources Data for the various states; Reports from the Graduate School of Public Health, University of Pittsburgh, Neville Island Research Laboratory; and the Ohio River Valley Water Sanitation Commission (ORSANCO), Cincinnati. We thank these institutions and agencies for use of the data. Elmo C. Julian made the computer retrieval of data, and Robert C. Kroner, AQC Laboratory is thanked for his suggestions concerning presentation of the chemical data. We thank Fred G. Neumann and the Graphic Arts Section, OBR, WQO, EPA for preparation of the map and graphs.

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INTRODUCTION

Major contributions to our knowledge of aquatic life in large rivers of North America are few. A main reason for the lack of detailed studies is the difficulty encountered in obtaining meaningful information on the communities sampled. Large rivers are formidable due to variable current, substrates and a host of physical factors that complicate both the collection of representative organisms and the quantitative determination of their abundance and distribution.

Information obtained on the aquatic life resources of the main stem Ohio River includes plankton and fisheries data collected by the U. S. Public Health Service during a survey of the Ohio River (1942) and the Ohio River Valley Water Sanitation Commission (ORSANCO) (1962). The ORSANCO report consists mainly of a study of the Ohio River fisheries resources and includes a study of macroinvertebrates in the Louisville, Ky. vicinity. The Pymatuning Laboratory of Ecology, University of Pittsburgh publication, "Studies on the Aquatic Ecology of the Upper Ohio River System" (1965) presents detailed information on several aspects of limnology of the upper Ohio River including fish and algae, but macroinvertebrates are not considered.

The purpose of this study was to gather basic information on the existing bottom fauna and through continuing studies to observe changes from year to year due to the water quality. Stations were selected upstream from the major cities so that characteristics of the bottom fauna would reflect general environmental conditions rather than specific sources of municipal or industrial pollution. This also applied to the considerable amount of chemical and physical data obtained at these stations.

This report summarizes data on the macroinvertebrate communities obtained by dredge and artificial substrate samples collected at the following stations during a five year period, 1963-1967; Ohio River at Pittsburgh, Pa., Toronto and Addison, Ohio, Huntington, W. Va., Cincinnati, Ohio, Louisville, Ky., Evansville, Ind., and Cairo, Ill. A station was added at Marietta, Ohio (midway between Toronto and Addison) in 1966. Tributaries sampled include; Allegheny and Monongahela Rivers at Pittsburgh, the Kanawha River at London and Winfield Dams, W. Va., and the Wabash River at New Harmony, Ind. (Figure 1).

The macroinvertebrate communities sampled were exposed to basically four types of pollution; toxic, mild organic, moderate organic and heavy organic.

Toxic Pollution - Substances entering a water system which poisons aquatic life. Acute toxicity usually produces injury or death to organisms within a relatively short time (24-96 hrs.). Chronic toxicity acts over a longer period of time in limiting the fauna. A benthic fauna affected by toxicity usually exhibits little diversity and is unbalanced. Acid mine drainage is included in this category.

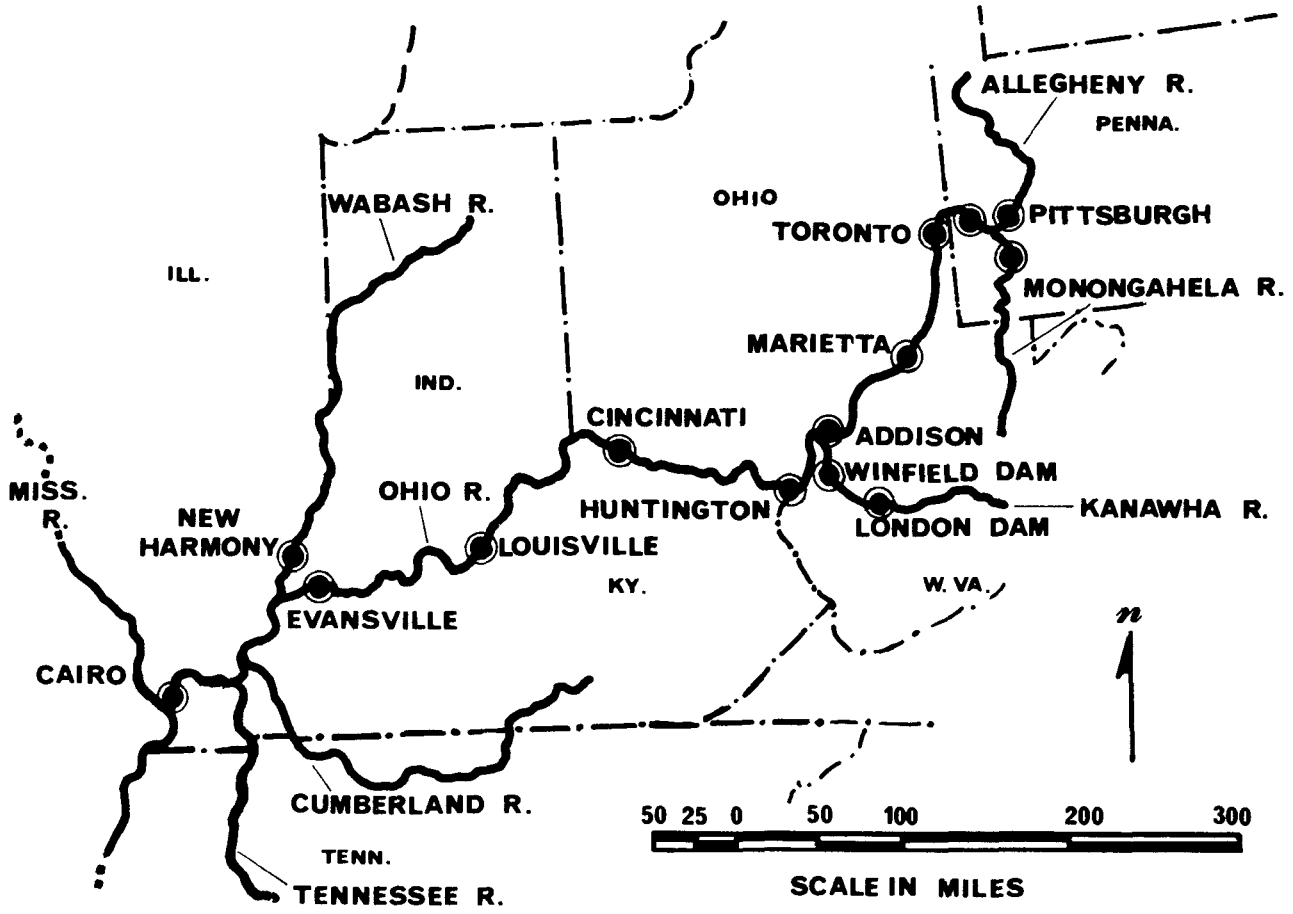

FIGURE 1. OHIO BASIN SHOWING MACROINVERTEBRATE SAMPLING STATIONS

Organic Pollution

Mild Organic Pollution - Organic substances which may have little or no toxic effect on the organisms but present in sufficient quantities to stimulate productivity. A benthic community stimulated by mild organic pollution may be composed predominatly of pollution-sensitive and facultative organisms. Some pollution-tolerant species may be present but not in large numbers.

Moderate Organic Pollution - Organic substances entering a water-system in sufficient quantities to greatly stimulate productivity of facultative organisms. Some pollution-sensitive kinds may be present and pollution-tolerant kinds are prevalent but not dominant.

Heavy (Gross) Organic Pollution - Organic substances entering a water system in great quantities sufficient to largely alter the aquatic environment. Pollution-tolerant organisms pervade the bottom sediments. Severe organic pollution may eliminate even the most tolerant of organisms.

Adverse effects of toxic, organic and other types of pollution on the bottom fauna were minimal at most stations since sampling was conducted immediately upstream from major cities and industrial sites.

Macroinvertebrates generally are assigned to three broad categories based on their sensitivity to pollution; pollution-sensitive, facultative and pollution-tolerant. The faunal list under the respective categories in the Appendix is an attempt to identify certain Ohio River Basin macroinvertebrates with the type of environment they most often frequent.

GENERAL TOPOGRAPHY & GEOLOGY OF THE OHIO RIVER BASIN

The Ohio River is formed by the confluence of the Allegheny and Monogahela Rivers at Pittsburgh, Pennsylvania, and flows southwesterly for 981 miles until it joins the Mississippi River at Cairo, Illinois. Three major physical divisions characterize the Ohio Basin. Rough hills and mountains of the Appalachian Highlands prevail in the east, as the river remains in the Appalachian Plateau for about one third of its length. The area west of the Appalachian Plateau and north of the Ohio River is composed mainly of the glaciated area of the Interior Plains (an area of gently sloping lowlands). Finally, to the south and west, the river basin is composed predominately of the low hills of the interior plateaus and is entirely unglaciated.

Most of the geological formations in the Ohio River Basin belong to the Paleozoic group, with limestone and shale being the common bedrocks. Formations in a small part of the area near the mouth of the Ohio River belong to the Cretaceous period of the Mesozoic era. The coal bearing formations of the Pennsylvania period occur in the eastern part of the basin and to a lesser extent in the western portion in Illinois, Indiana, and Kentucky.

The northern section of the watershed is overlain with glacial drift, resulting in the deep and fertile soils in the western portion of the basin. In the Appalachian highlands the soil is light and sandy, while in the south central region it is alluvial, consisting of a mixture of rich loam and clay.

The bottom substrate of the Ohio River is mainly sand and gravel or clay overlain with silt and/or organic detritus. Each section of the river has various combinations of these bottom types. In the upper Ohio River, many bottom deposits are covered by an oily muck with small coal particles interspersed with sand and gravel. The middle Ohio River bottom substrate is predominately a pasty clay overlain with sand, rubble, or fine leaf detritus. The bottom of the lower section of the river (below Louisville) is mud overlain with different grades of sand and leaf detritus.

METHODS

In 1963-64, the primary sampling devices used were 100 sq. in. Petersen and 36 sq. in. Ekman dredges. The samples provided valuable baseline data, a knowledge of bottom types, and some information on macroinvertebrate distribution. However, few aquatic insect larvae were collected in the dredgings, so, in 1964 a rock-filled artificial substrate was designed and constructed for the purpose of collecting a greater diversity of fauna. The primary advantage of the artificial substrate is the control of some physical factors which is necessary for collecting a variety of stream invertebrates.

The original construction of the rock-filled sampler was cubical in shape (Henson, 1965). The original hand-made, cubical frame type was replaced by a cylindrical barbecue basket[1] (Figures 2 & 3) measuring seven inches in diameter and 11 inches in length which was more corrosion resistant and could be purchased (Mason, *et al.* 1967, and Anderson and Mason, 1968). It was filled with approximately 30, two-inch minimum and three-inch maximum diameter limestone rocks weighing about 17 lbs. The sampler was suspended by 1/8 - inch steel wire cable for a six-weeks' sampling period at a depth of five feet from the water's surface. The cable was passed through the longitudinal axis of the sampler and secured with a Nicopress[2] sleeve.

In most cases the baskets were maintained at a constant depth of 5 feet from the water's surface by supporting them with polyurethane-filled five gallon can floats or by suspending them from floating boat docks. Baskets were also attached to the outer upstream guardwall of locks where the water level fluctuated only slightly.

At the time of collection the baskets were carefully brought to the surface to avoid dislodging organisms from the sampler. The rocks were emptied into a tub partially filled with water and each rock brushed to remove organisms. The organisms were separated from the water and sediment with a U.S. Standard No. 30 sieve (0.59 mm mesh openings), transferred to collecting jars, and preserved in a 70% ethanol with 200 mg/l rose bengal stain. During transportation to the laboratory the animal tissue stains red which facilitates sorting (Mason & Yevich, 1967). Macroinvertebrates collected from baskets were recorded as numbers/sampler. Tests were conducted at

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[1] RB 100 Tumble Basket manufactured by the Hewitt Home Products Company, National City, California, is no longer available but a substitute, Model 2911 Chicken Basket, can be obtained from Androck, Inc., 28 Union St., Worcester, Mass. 01608

[2] Nicopress Sleeve Tool, National Telephone Supply Co., Cleveland, Ohio.

Mention of commercial products or trade names does not constitute endorsement by the Environmental Protection Agency.

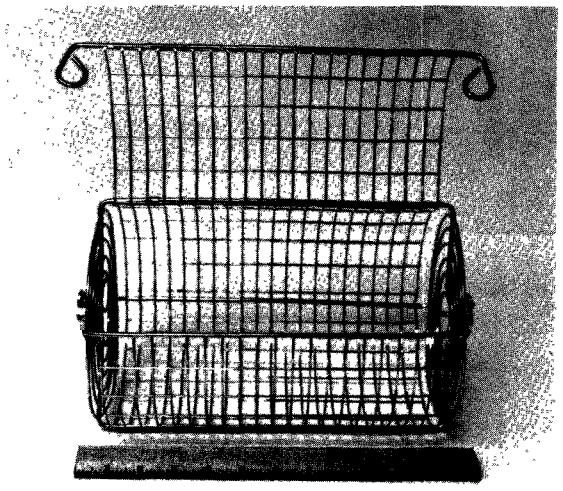

FIGURE 2. BASKET SAMPLER EMPTY

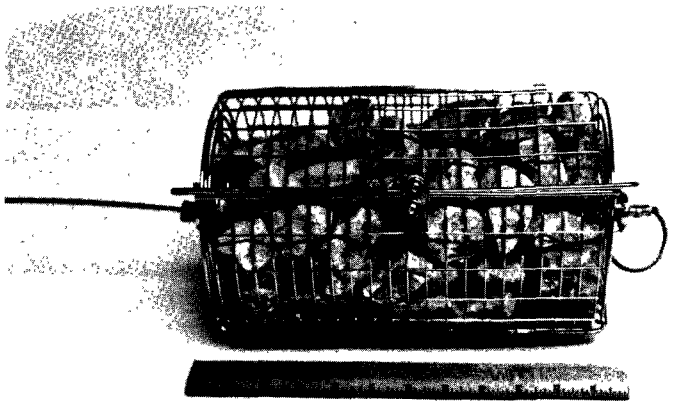

FIGURE 3. BASKET SAMPLER READY FOR INSTALLATION

Louisville in 1967 and Cincinnati in 1968 to determine if organisms were lost during retrieval. Nets and buckets with screened openings were held around the samplers, but no significant loss was noted.

All of the dredge samples were strained through a U.S. Standard No. 30 sieve and the separated organisms preserved in 70% ethanol and rose bengal stain. In the laboratory the organisms were rinsed in a U.S. Standard No. 40 sieve and sorted by hand under low magnification, identified, and counted. No less than three replicate dredgings were taken to calculate numbers/sq. ft.

The same level of identification for each major taxonomic category was uniform throughout the study. For example, most insect larvae were identified to genus and species, whereas worms were differentiated as oligochaetes, flatworms and nematodes. The relative proportion of pollution-sensitive, facultative and pollution-tolerant taxa to the total macroinvertebrate community, and physical and chemical data were considered in evaluating water quality at the respective stations.

The Ohio river mileage numbering system begins with zero at the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania. The river banks were designated right and left facing upstream.

Table I shows the intensity of sampling at 14 stations in the Ohio River Basin. During 1963, a total of 234 dredge samples were collected. In 1964 sampling was restricted to Cincinnati, Ohio, Louisville, Kentucky and Cairo, Illinois. However, from 1965 through 1967 a dredge series was collected at most stations. A total of 58 artificial substrate samples was collected in 1965, 45 in 1966, and 39 in 1967. Dredge sampling during the latter two years consisted of three replicates near both banks during one trip in August or September.

Unless otherwise stated the physical and chemical data in Tables III and IV were recorded as follows: Flow, daily readings in cubic feet per seconds (cfs); temperature, daily readings in degrees centigrade (°C) between 6:00 AM and 12:00 PM; dissolved oxygen (DO), total alkalinity (Alk.), total dissolved solids (TDS) expressed in mg/l, turbidity units and pH were recorded weekly. *Biochemical Oxygen Demand (BOD) values were recorded for some stations.*

The Appendix contains: glossary of terms; pollutional classification of Ohio River macroinvertebrates; summaries of macroinvertebrate data and physical and chemical data.

TABLE I. OHIO RIVER BASIN SURVEILLANCE STATIONS 1963-1967

Number of Dredge & Basket Samples

Station (River Mile)	1963 D	1963 B	1964 D	1964 B	1965 D	1965 B	1966 D	1966 B	1967 D	1967 B
OHIO RIVER										
Pittsburgh, Pa. (9)	2				3	2	6	3	6	3
Sand, Coal fines, oily sludge										
Toronto, Ohio (58)	8					2	6	3		2
Sand, rubble, gravel										
Marietta, Ohio (168)								3	6	3
Sand, gravel, localized silt										
Addison, Ohio (260)	24				3	3	12	2	6	2
Sand, loose gravel, silt										
Huntington, W. Va. (301)	22				6	3	12	3	6	3
Sand, silt, organic detritus										
Cincinnati, Ohio (463)	24		18	6	8	15	4	6	9	3
Sand, gravel, localized clay										
Louisville, Ky. (600)	54		18		6	10	6	3	6	3
Sand, gravel, silt										
Evansville, Ind. (787)	21				4	3	6	3	6	3
Predominately sand										
Cairo, Illinois (980)	12		6		3	5	6	3	6	2
Sand, rubble, mud, silt										
ALLEGHENY RIVER										
Pittsburgh, Pa. (8)	21				2	2	6	2	6	3
Sand, gravel, rubble										
MONONGAHELA RIVER										
Pittsburgh, Pa. (5)	3				3	2	6	4	6	3
Sludge, oil residues, etc.										
KANAWHA RIVER										
Winfield Dam, W. Va. (31)	23				1	3	6	3	6	3
Organic detritus, coal fines										
London, W. Va. (83)								3	6	3
Sand, gravel, rubble, silt										
WABASH RIVER										
New Harmony, Ind. (52)	20				2	8	6	4	6	3
Sand, silt, organic detritus										
TOTALS	234	0	42	6	41	58	82	45	81	39

D = Petersen or Ekman Dredges
B = Basket Sampler

DISCUSSION

ALLEGHENY RIVER - PITTSBURGH, PENNSYLVANIA (MILE 8.0)

Sampling at the Pittsburgh, Pennsylvania Allegheny River station was initiated in the spring of 1963 with a series of Ekman dredge samples taken just upriver from the Aspenwall water intake tower. Another series of six dredgings was collected from the same location in August and again in November. No bottom samples were obtained in 1964. In 1965 both basket and dredge samples were collected. Due to vandalism and the problem of maintaining the sampler at the water intake structure, the sampling location was moved to Lock and Dam #2 in 1966. Basket samples were collected in June and August and a dredge series in August. Basket samples were collected during three different sampling periods in 1967 (Figure 4).

The bottom near the left (north) bank was mostly sand and gravel, gravel and cobble at midstream, and muck on the right (south) bank. Bits of leaves and coal fines were present in most samples.

Table III (Appendix A-51) shows that during the summer months the minimum DO value recorded was 6.6 mg/l in 1966 and the mean monthly value (3 months) was 7.3 mg/l. A pH of 5.0 was recorded in August, 1966 and the mean pH over the five year period during summer was 6.8. The maximum temperature in July, 1966 was 31°C and the mean temperature declined approximately 5°C from July to September (weekly readings).

Over the five years, the yearly mean DO values usually were above 10 mg/l, the maximum 14.9 mg/l, and the minimum value of 6.6 mg/l in 1966 (Table IV, Appendix A-55)). The pH averaged 6.8, but a low of 3.7 was reported in 1962. The water temperature ranged between a minimum of 0°C and a maximum of 31.7°C. The mean 5-day BOD was 1.4 mg/l and the maximum BOD recorded was 2.4 mg/l in March, 1963 (Sources of data: STORET and USPHS-WPSS Annual Compilation of Data).

The benthic fauna collected by dredge consisted mostly of pollution-tolerant bloodworms, *Chironomus riparius*, *Procladius* sp., and tubificid worms. A few facultative caddisfly larvae *Cyrnellus fraternus* and mayflies *Stenonema* occurred in the baskets. Of the seven species of midges collected from the baskets, *Psectrocladius* and *Parachironomus abortivus?* accounted for over half of the individuals.

The majority of species collected from the Allegheny River at Pittsburgh are tolerant to a wide range of environmental factors. The physical and chemical measurements suggest that the water should support a larger benthic fauna than was present. The meager number of individuals and almost complete absence of mayflies and certain midges suggest that the benthic fauna in the lower reach of the Allegheny River was subjected to toxicity.

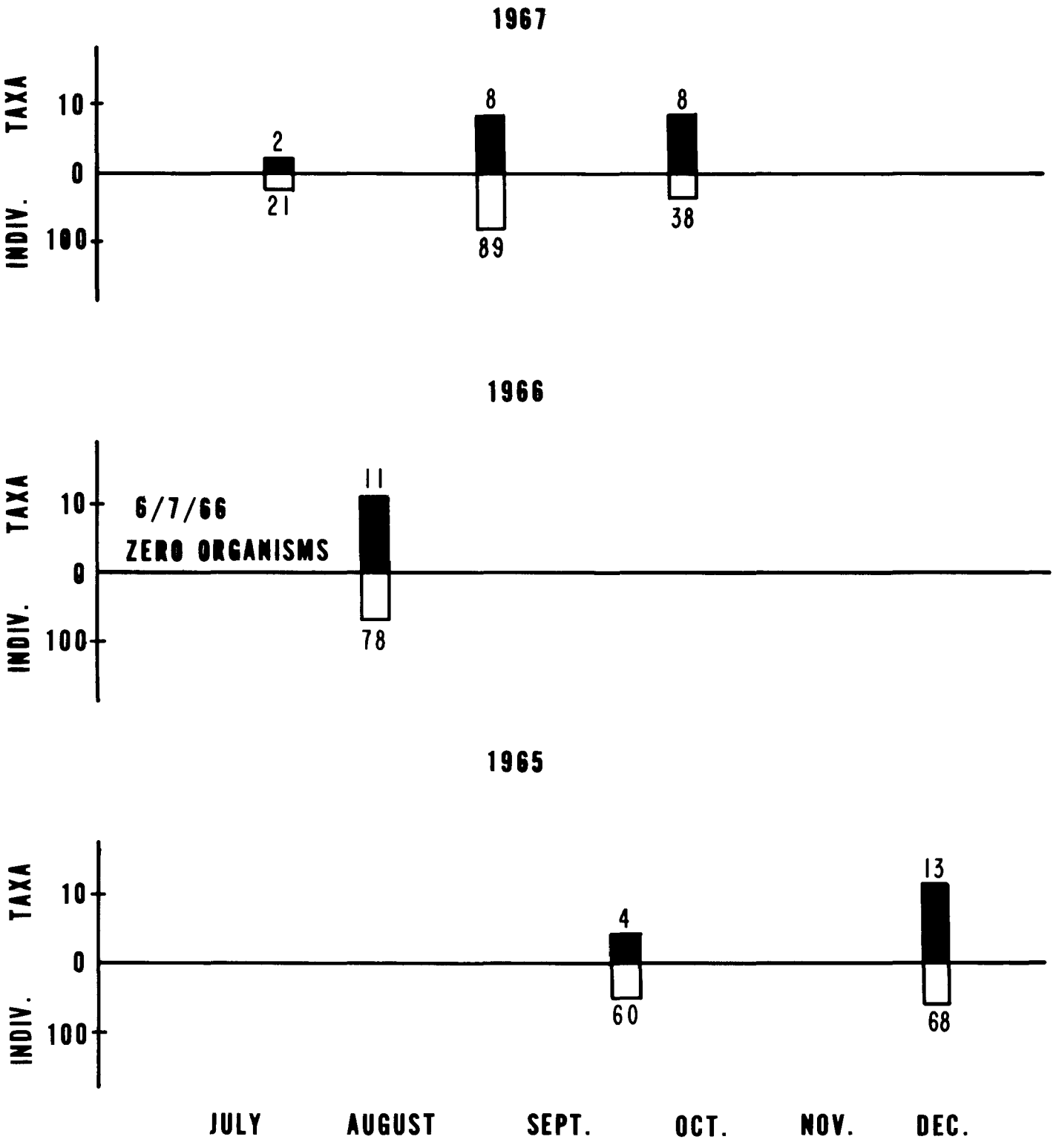

FIGURE 4. ALLEGHENY RIVER, PITTSBURGH, PA.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

MONONGAHELA RIVER - PITTSBURGH, PENNSYLVANIA (MILE 4.5-11.5)

The upper reach and tributaries of the Monongahela River received acid mine drainage and the lower reach transported industrial wastes. Oil and tar-like deposits covered the bottom in the lower reach. As many as six industrial outfalls were observed in 300 yds of river. The water was so corrosive that chromium-plated baskets deteriorated in six weeks, whereas baskets in the middle reach of the Ohio River lasted for nine months.

Chemical data for the Monongahela River is very limited. One DO value recorded in September, 1963 was 0.0 mg/l (Table III, Appendix A-45). Maximum temperatures of 32°C were recorded in July, 1963, 1965, and September, 1964, and 32.8°C in August, 1966. Many macroinvertebrates are adversly affected by sustained temperatures over 30°C and most insect larvae will not undergo moulting to pupal and adult stages at higher temperatures. Low pH also severely limits macroinvertebrate life. Values under 5.0 frequently were recorded.

Benthic sampling in 1963 consisted of two series of Petersen dredge samples collected in May and November near Beck's Run. Only one sample in the series contained organisms (a few worms). The 1965 and 1966 dredge samples also were void of organisms except for worms. Two artificial substrate basket samples were obtained in 1965 at Beck's Run, South Pittsburgh water intake (Figure 5). The combined fauna included one midge, one caddisfly and thousands of worms. In 1966, four samples were collected from basket samplers at Lock and Dam #2 (river mile 11.5, Braddock, Pennsylvania). Most of the organisms were coated with iron deposits. All of the 1966 collections from basket samplers at the Lock and Dam contained damselflies, either *Enallagma* or *Ischnura*. Five species of midges were also collected, the most common; *Cricotopus bicinctus* gr., *C. exilis* gr., *C. trifasciatus* gr., and *Polypedilum ophioides?* These midges generally are tolerant of polluted waters and low pH (Paine and Gaufin, 1956; and Curry, 1965). The 1967 dredge samples contained not more than four taxa including the bloodworm *Chironomus riparius*, the sewage fly *Psychoda*, the dragonfly nymph *Plathemia* and worms. Industrial and acid mine drainage pollution eliminated most benthic organisms from the lower reach of the Monongahela River.

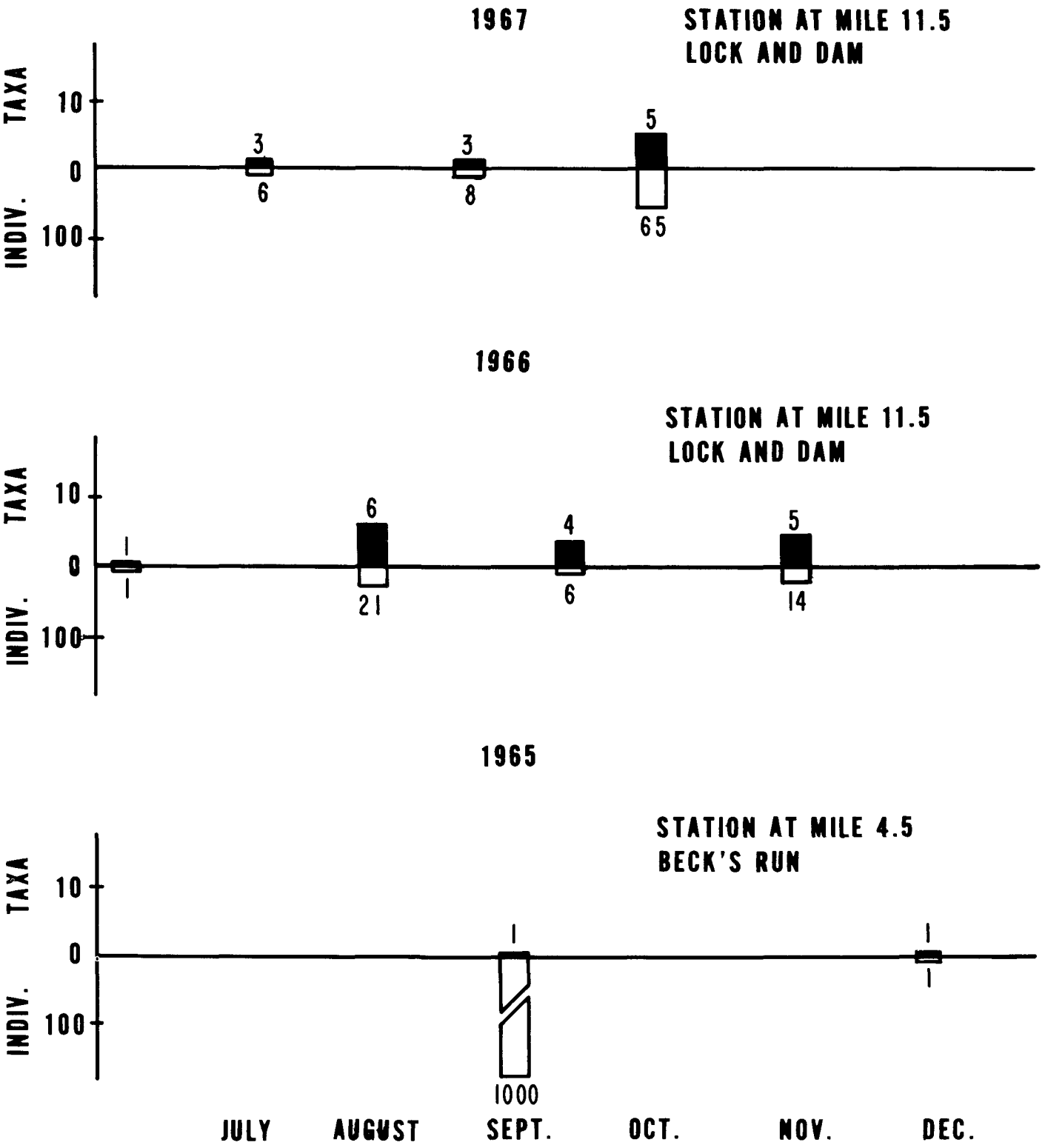

FIGURE 5. MONONGAHELA RIVER, PITTSBURGH, PA.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

OHIO RIVER - PITTSBURGH (MILE 6.2-9.2)

Bottom sampling in the Ohio River near Pittsburgh was initiated in November, 1963 with two Petersen dredge samples collected at the upstream end of Davis Island, 4.5 miles downstream from the confluence of the Allegheny and Monongahela Rivers.

In 1963 Petersen dredge samples were collected in late September at mile 9.2 at Lock and Dam #2 near the bank. The artificial substrate samplers were located at mile 9.2 near the University of Pittsburgh Public Health Research Laboratory on Neville Island. In 1966 the basket sampler was moved upstream to the Emsworth Lock and Dam (mile 6.2). Three samples were collected from the sampler during the summer at six-week intervals (Figure 6). A series of six Petersen dredge samples was taken at the downstream end of Neville Island.

During an ORSANCO (1962) survey July 25, 1959 a DO of 1.7 mg/l was recorded at Neville Island. There are no records of chemical and physical data for this station for 1963. In 1965, the minimum DO recorded at Neville Island was 5.2 mg/l, in September (Table III) the minimum pH was 4.0 in 1965 and 5.5 in 1966 (Table IV).

The bottom muck and water were oily. Tubificid worms comprised about 90% of the macroinvertebrate fauna in the dredge samples (Figure 7). Also occurring regularly was the phantom midge, *Chaoborus* sp.

Pollution-tolerant worms and Turbellaria comprised over 75% of the artificial substrate fauna in 1965 (Figure 8). As was the case in the Allegheny River, the dredge and basket samples were composed predominately of worms and midges. The most abundant midges were; *Parachironomus abortivus*, and *Cricotopus* spp. Leeches and the amphipod *Crangonyx pseudogracilis* were present in the 1967 artificial substrate samples and oligochaetes averaged 6,000/basket. Figure 9 shows that the number of taxa collected in 1967 was greater than in 1965 or 1966. The increase was due mainly to greater diversity of midges (See Appendix A-12).

There were more taxa collected at Neville Island than at the Monongahela River station but fewer than were collected at the Allegheny River station. The scarce benthic population at mile 9.2 and 6.2 indicates that the pollution originating in and upstream from Pittsburgh on the Allegheny and Monongahela Rivers prevented the growth of a diverse benthic fauna.

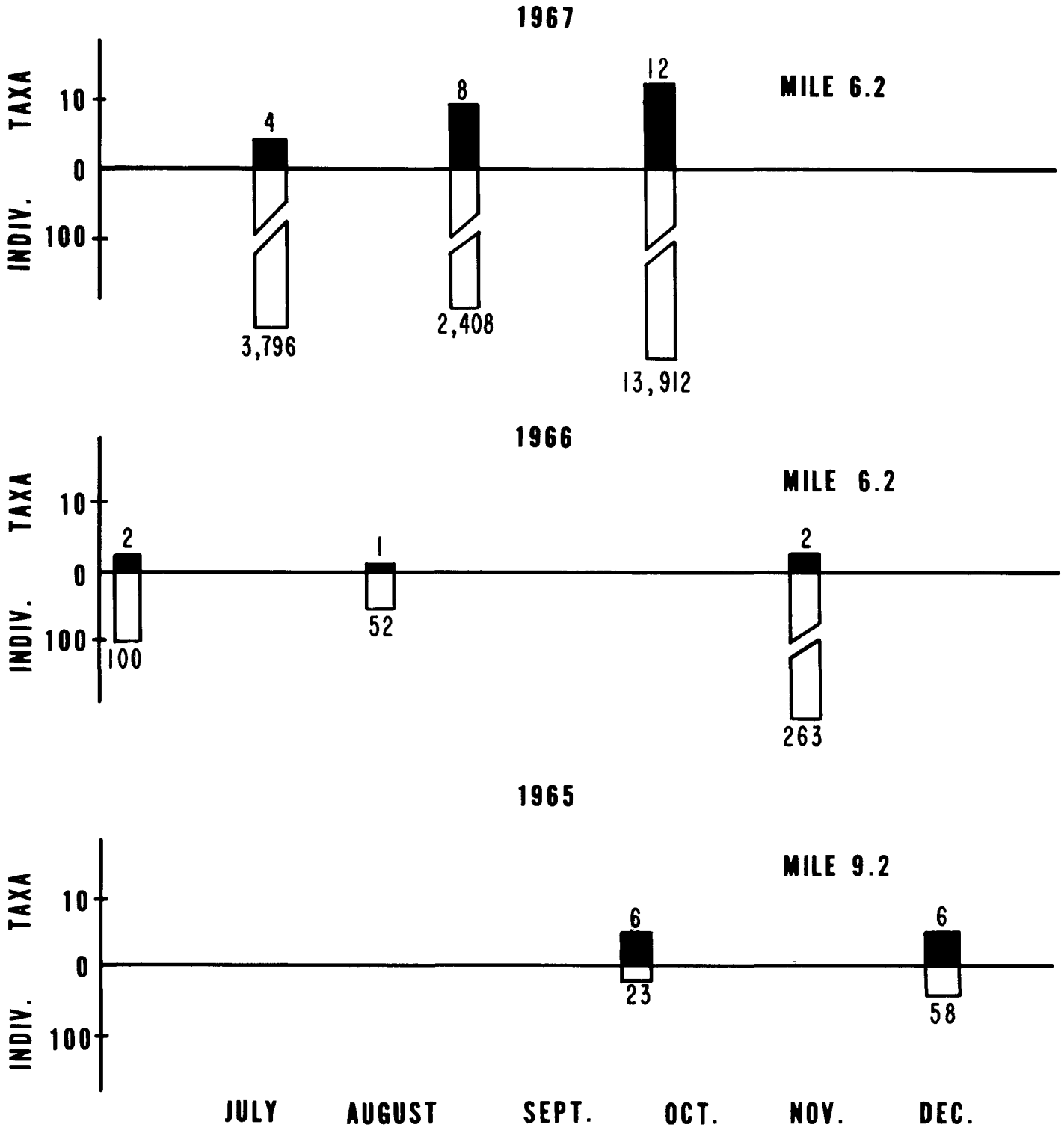

FIGURE 6. OHIO RIVER NEAR PITTSBURGH, PA.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

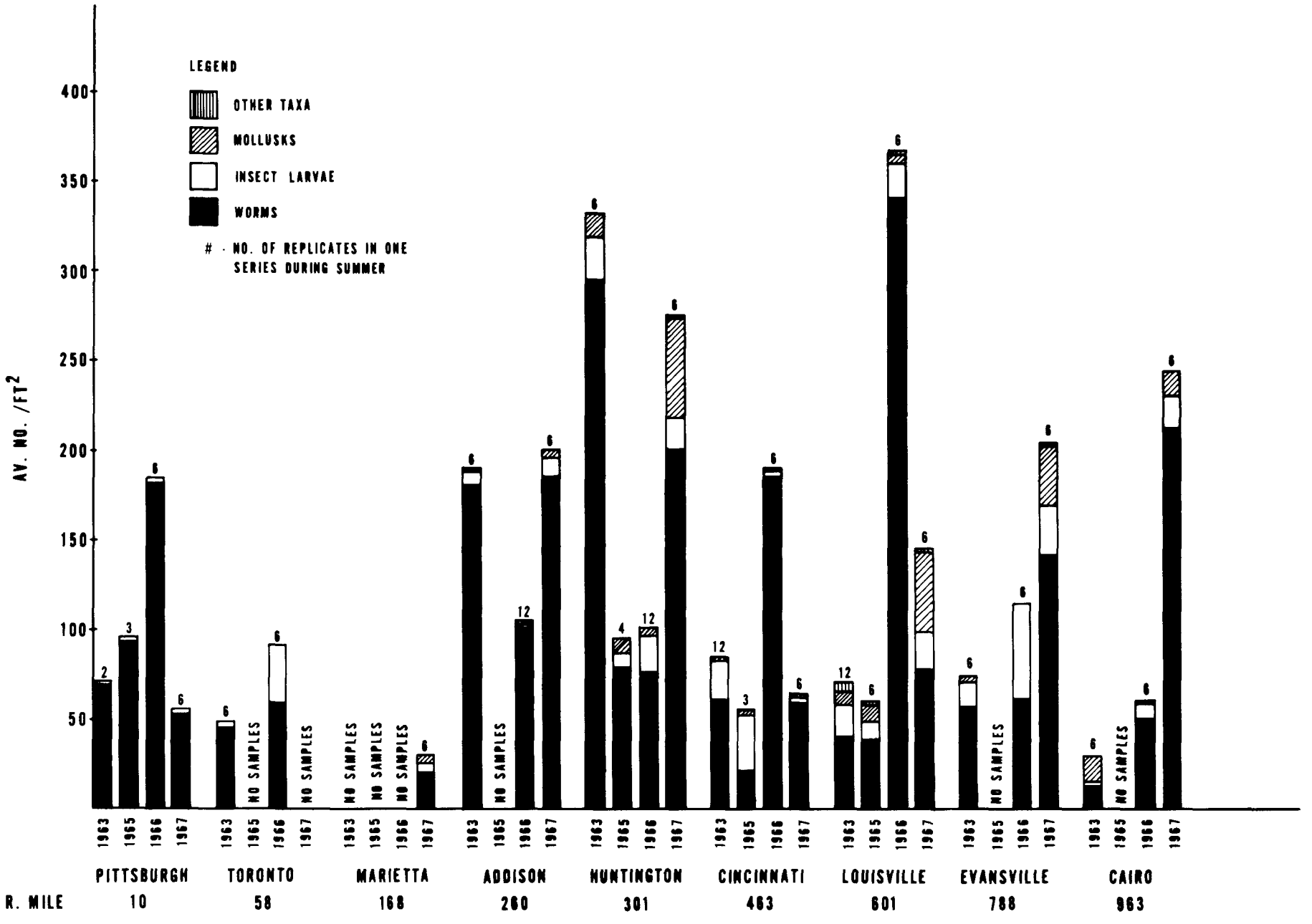

FIGURE 7. NUMBER OF MACROINVERTEBRATES/ft^2 COLLECTED AT OHIO RIVER STATIONS BY DREDGE 1963-67

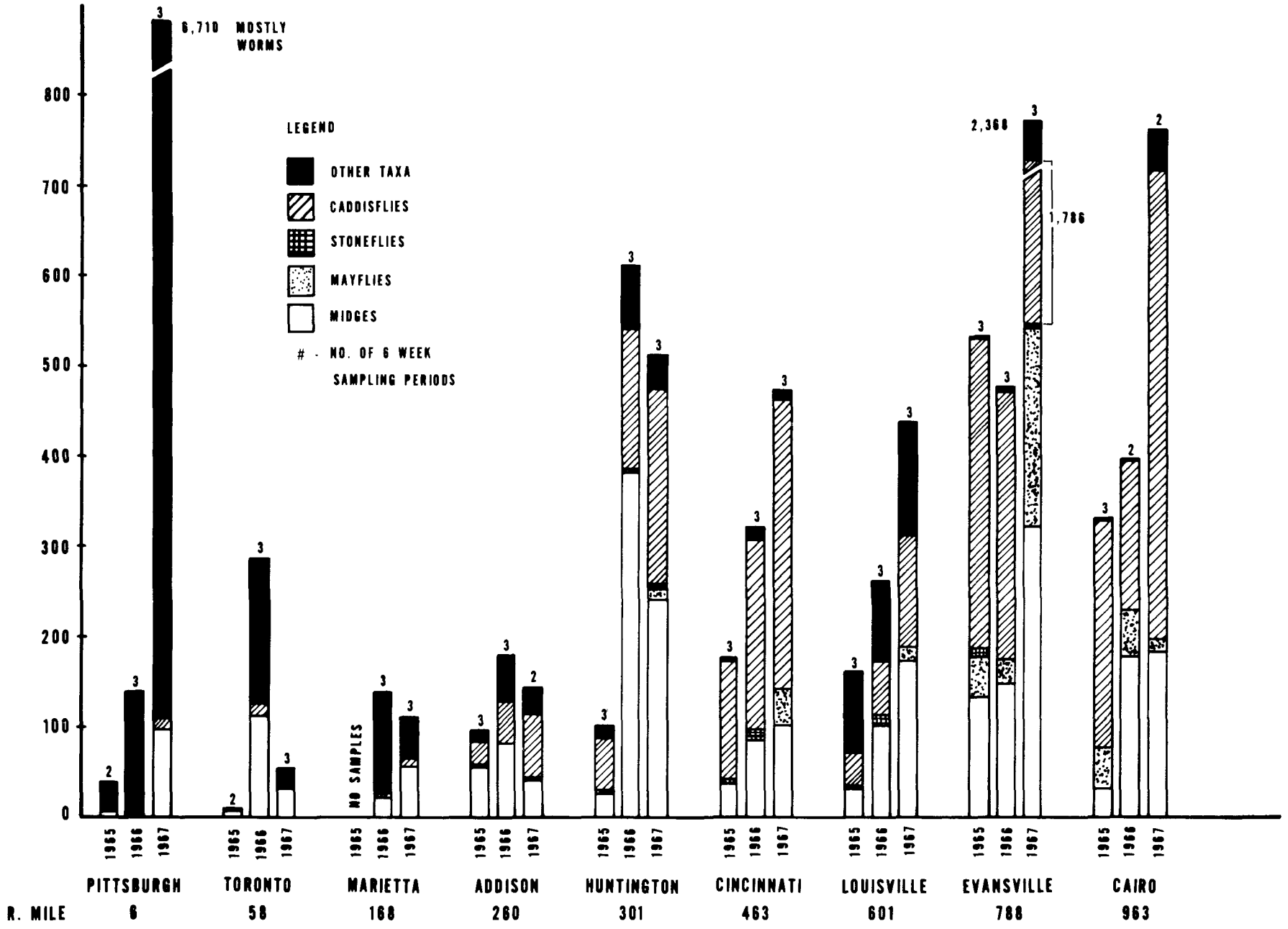

FIGURE 8. AVERAGE NUMBER OF MACROINVERTEBRATES/BASKET SAMPLER AT OHIO RIVER STATIONS 1965-67

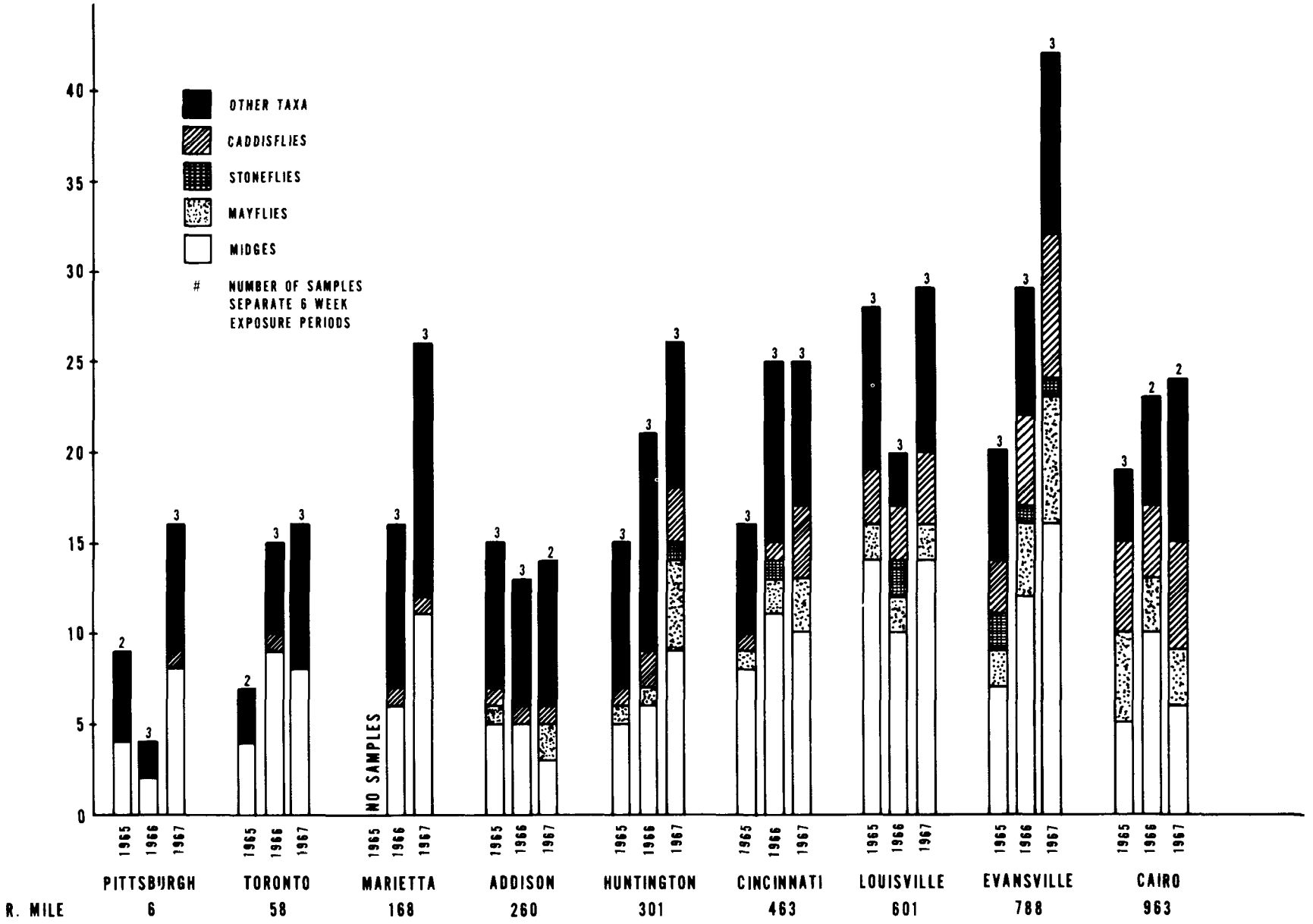

FIGURE 9. TOTAL MACROINVERTEBRATE TAXA COLLECTED AT OHIO RIVER STATIONS BY BASKET SAMPLER (ARTIFICIAL SUBSTRATE) 1965-67

OHIO RIVER - TORONTO, OHIO (MILE 57.5)

Petersen dredge samples were collected both during the summer and winter of 1963. Two baskets were collected in 1965 and three each in 1966 and 1967 at the Edison power plant (Figure 10). In August, 1966 a series of six dredge samples was taken just downstream from the power plant (left bank). The bottom on both sides of the river consists of coarse sand and leaf detritus, and clay and sand at midstream.

The mean summer temperature at Toronto was approximately 26°C during 1963 and 1964 (Table III). However, a maximum of 29.0°C was recorded during the summer of 1966 (Table IV). A maximum pH of 7.6 occurred in 1967 and the minimum value recorded was 4.0 in 1964 and 1967. The mean turbidity was approximately 30 turbidity units. No DO data were available for Toronto. The mean flow was approximately 6,000 cfs during the summers of 1963-64, but was only 4,400 cfs in 1966.

Organic detritus in the Toronto dredge samples was coated with a black tar-like substance and coal fines. Rocks in the basket samplers also were covered with these deposits.

The most abundant organisms in the dredge samples were pollution-tolerant oligochaetes and midges. Representative midges were; *Chironomus riparius* gr., *Dicrotendipes incurvus* gr., and *Procladius* sp., the latter being most abundant.

The artificial substrates yielded only a few *Cyrnellus fraternus* caddisflies in 1966; oligochaetes (*Nais communis* and *Dero* sp.); and the midges *Psectrocladius* sp., *Cricotopus* spp., and *Dicrotendipes* sp. were common. A few crayfish *Orconectes propinquus* and amphipod *Crangonyx* were collected. No pollution-sensitive stoneflies or mayflies were recorded in any sample.

The number of oligochaetes were fewer by 30% as compared to the Pittsburgh station 50 miles upstream (Figure 11). However, oligochaetes still comprised 63% of the macroinvertebrates collected at the station. The average number of individuals/basket sampler increased from nine in 1965 to approximately 280 in 1966 (mostly worms and midges). The total taxa increased from 7 in 1965 to 19 in 1966 and 15 in 1967. Inspection of the data (Appendix A-14) reveals that the 1965 collections were taken late in the year after peak insect emergences which undoubtedly accounted for the sparse collections.

The greater diversity at Toronto as compared with samples from the Pittsburgh vicinity indicated general improvement of water quality as related to the benthic fauna. However, over a period of years wastes accumulated on the bottom substrate permitted only the more tolerant organisms to survive.

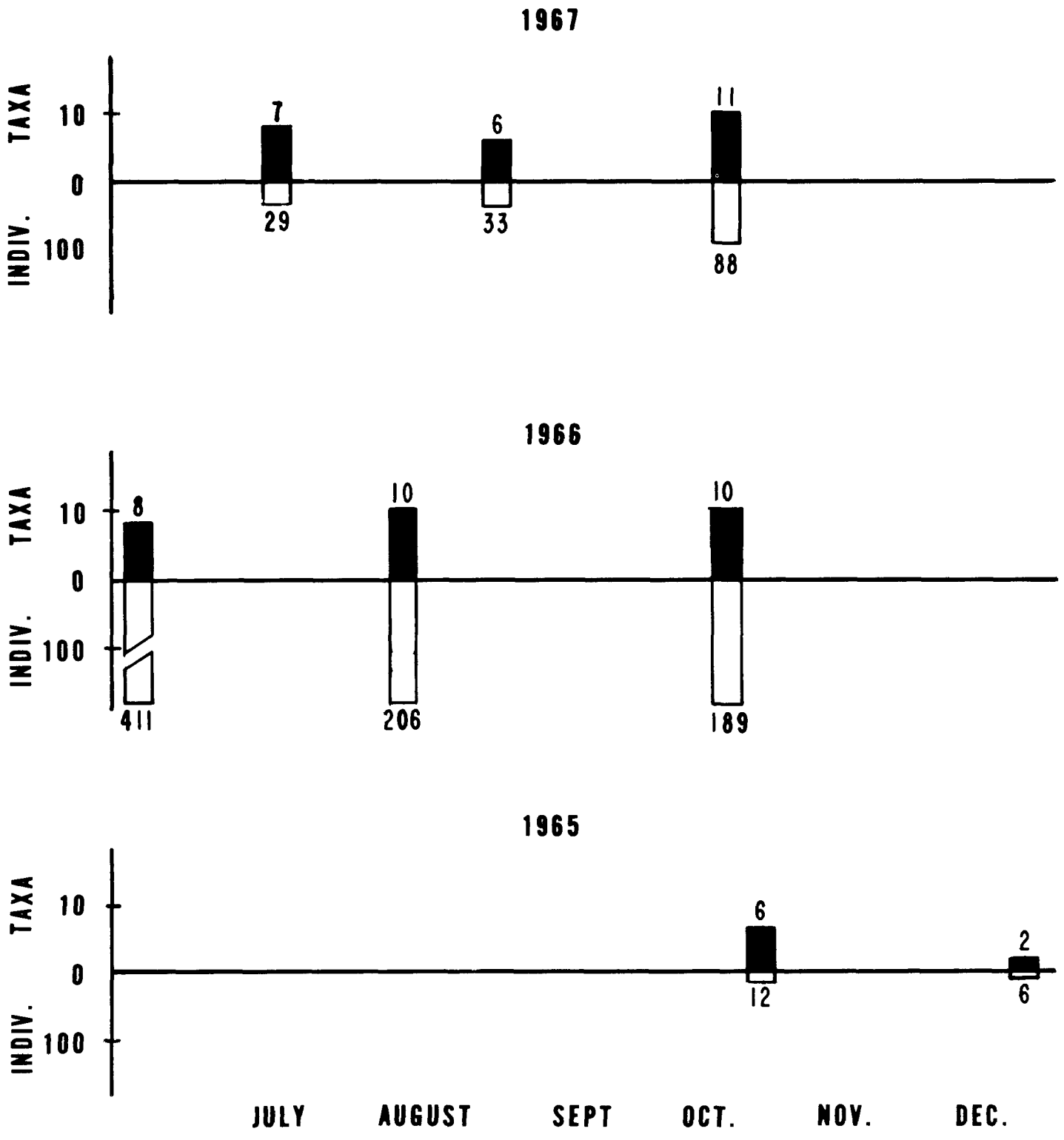

FIGURE 10. OHIO RIVER, TORONTO, OHIO-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

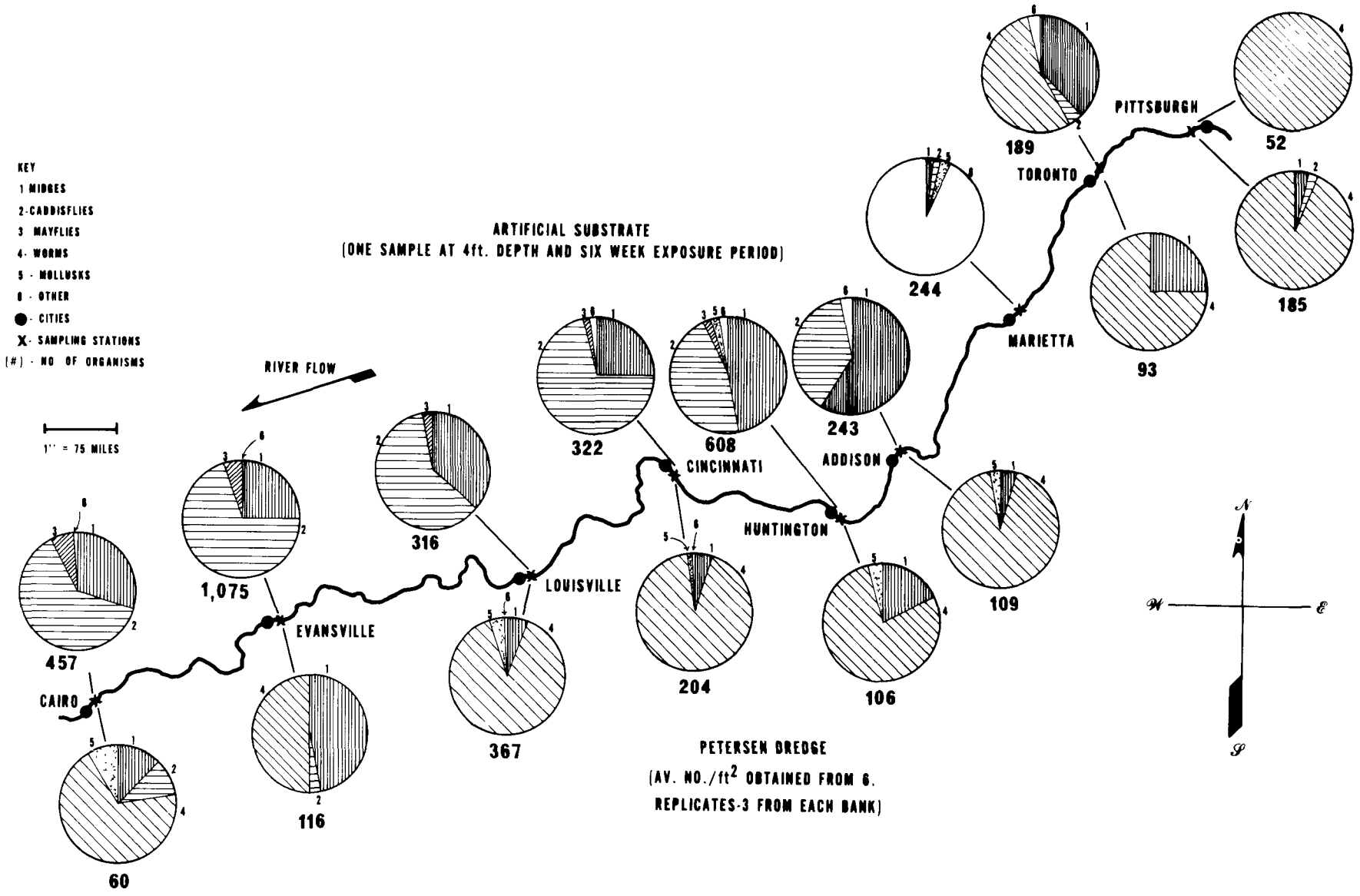

FIGURE 11. PERCENT COMPOSITION OF MACROINVERTEBRATE TAXA IN BASKET SAMPLES (TOP CIRCLES) AND DREDGE (BOTTOM CIRCLES) AT OHIO RIVER STATIONS, SEPTEMBER, 1966

OHIO RIVER - MARIETTA, OHIO (MILE 167.5)

Basket samplers were installed in late April of 1966 on the outer guard wall of Lock and Dam #17, left bank. This location is about four miles upstream from the city of Marietta, Ohio. The general topography is flat, although there are a few low, rolling hills present on the Ohio side. Both banks are very sandy and heavily wooded. The region is unglaciated and is underlain by limestone and shale.

Chemical and physical data were not available for this reach of the river.

Three 1966 basket collections at this station were rather unusual in that 75% of the fauna collected were Turbellaria (Figure 11). The flatworms, as a group, are tolerant of organic pollution but it cannot be assumed that their presence necessarily indicates man-made pollution and may reflect the occurrence of allochthonous organic matter such as decaying leaves. The most numerous macroinvertebrates; caddisfly larva *Cyrnellus fraternus*, the midges *Ablabesmyia rhamphe*, *Psectrocladius* sp., *Dicrotendipes nervosus* occurring at Marietta are facultative and can be found living in a wide range of environmental conditions. However, some taxa present *Chironomus riparius* gr., *Glyptotendipes amplus?* and the snail *Physa* are pollution-tolerant and are favored by organic enrichment. Pollution-tolerant organisms, however, were not abundant.

Mayflies were not present in any samples from the Pittsburgh vicinity of the Ohio River and Marietta, Ohio during the course of the study.

Bottom organisms in August, 1967 consisted of nematodes, caddisflies, oligochaetes, midges and asiatic clams. This was the farthest upstream collection of the asiatic clam *Corbicula*. The neuropteran *Sialis*, dragonfly *Gomphus vastus*, and *Cyrnellus fraternus* caddisfly averaged less than one/sq. ft.

Figure 12 shows that a more diverse fauna was present in the October, 1967 basket than in previous collections. In 1967 chironomid larvae accounted for nearly one-half of the total variety (26 taxa) and well over half of the total individuals. The predominant species were *Psectrocladius* sp., *Ablabesmyia mallochi*, *A. rhamphe* and *Glyptotendipes amplus?* Otherwise the species composition was similar to that of the 1966 baskets.

The total number of taxa at Marietta in 1966 was slightly greater than the number found at the upstream location at Toronto, Ohio although there were fewer individuals per sample. Improvement in water quality, if any, was slight between the Toronto and Marietta stations and the presence of many facultative and pollution-tolerant taxa is indicative of moderate organic enrichment.

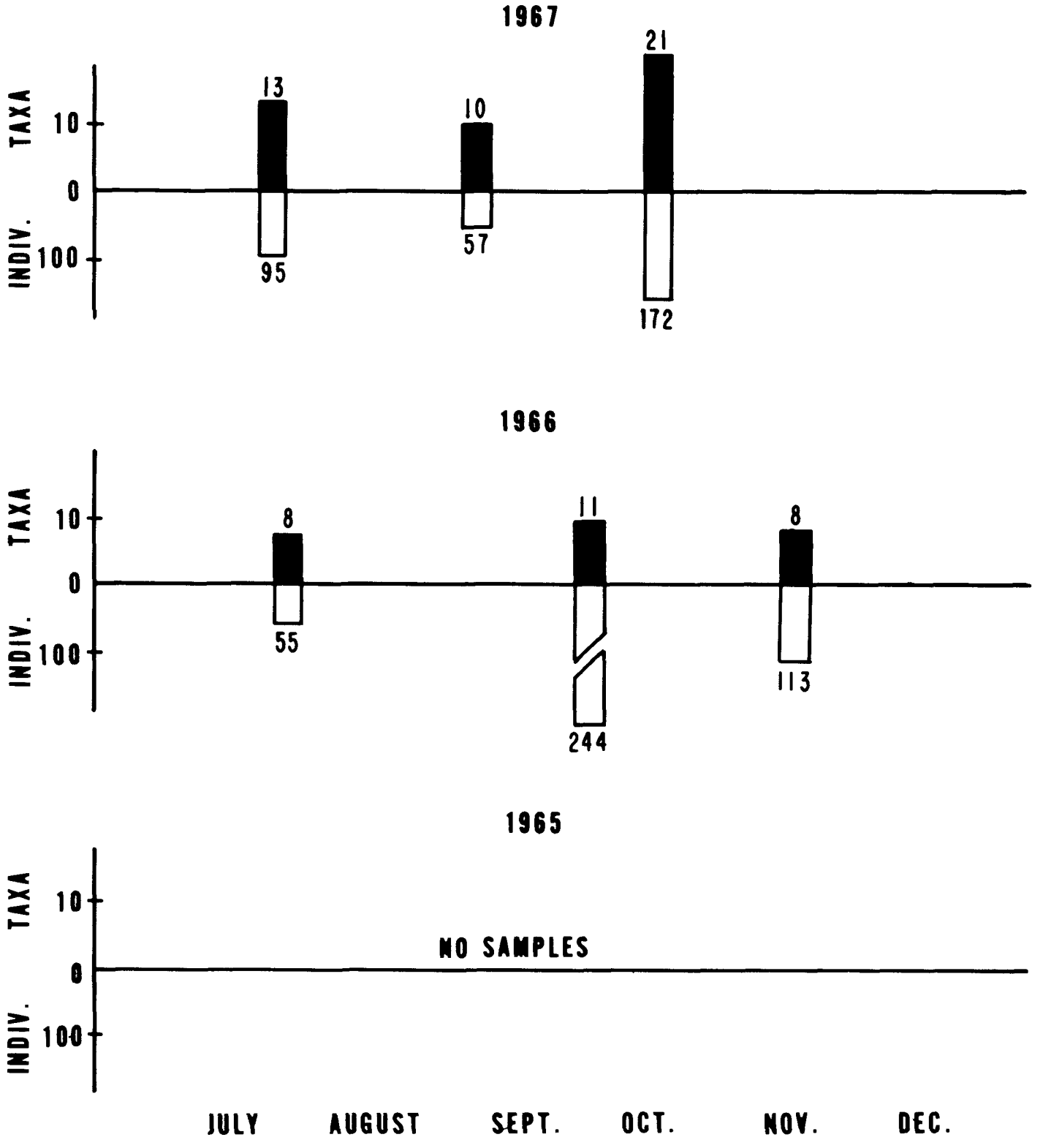

FIGURE 12. OHIO RIVER, MARIETTA,OHIO-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

OHIO RIVER - ADDISON, OHIO (MILE 260.0)

Dredge samples were collected near the Kyger Creek power plant in May, July, and November, 1963, July, 1965 and 1966 and August, 1967. Basket samplers were serviced in September and November, 1965, 1966, and August and October, 1967 (Figure 13). Basket-float units were used at the station because of water level fluctuations and were attached to wooden pilings directly across from the hydroelectric plant on the right bank.

Physical data (Tables III and IV) show the mean temperature was 26°C in July and August but dropped to 23°C by September. The mean DO during the summer was approximately 6.0 mg/l and the minimum value recorded was 4.8 mg/l in September, 1964. The mean pH was 7.2. The maximum TDS value each year was consistently higher than for the other stations.

Chaoborus punctipennis, a facultative dipterous species, was collected at Addison. Oligochaetes, mainly Tubificidae, were the most abundant organisms in the 1963, 1966, and 1967 dredge samples averaging 100/sq. ft. Larval midges consistently collected in the dredge samples were carnivorous; *Procladius* sp., *Coelotanypus* sp., and *Cryptochironomus digitatus* gr. Many individuals had partially consumed worms in their mouths.

The most abundant macroinvertebrates collected by artificial substrate were facultative Chironomidae; *Ablabesmyia rhamphe*, *Psectrocladius* sp., and *Dicrotendipes nervosus*. *Stenonema* mayfly nymphs were collected in the September, 1965 and October, 1967 baskets, the farthest upstream record for mayflies during the study. Also occurring were; the damselfly *Argia*, caddisfly *Cynellus fraternus* and coelenterate *Cordylophora lacustris*. Except for the presence of mayflies, the faunal composition at Addison was similar to that at Marietta. The limited sampling at Marietta only during 1966-67 does not allow detailed comparisons between the two stations.

The size and diversity of the Addison fauna appears to be restricted compared to communities downstream. The scarcity of pollution-sensitive mayflies, caddisflies, and complete absence of stoneflies even during winter suggest that upstream sources of toxic substances exerted a subtle limiting effect on the populations. The abundance of facultative taxa, like the fauna at Marietta, suggests the presence of organic matter.

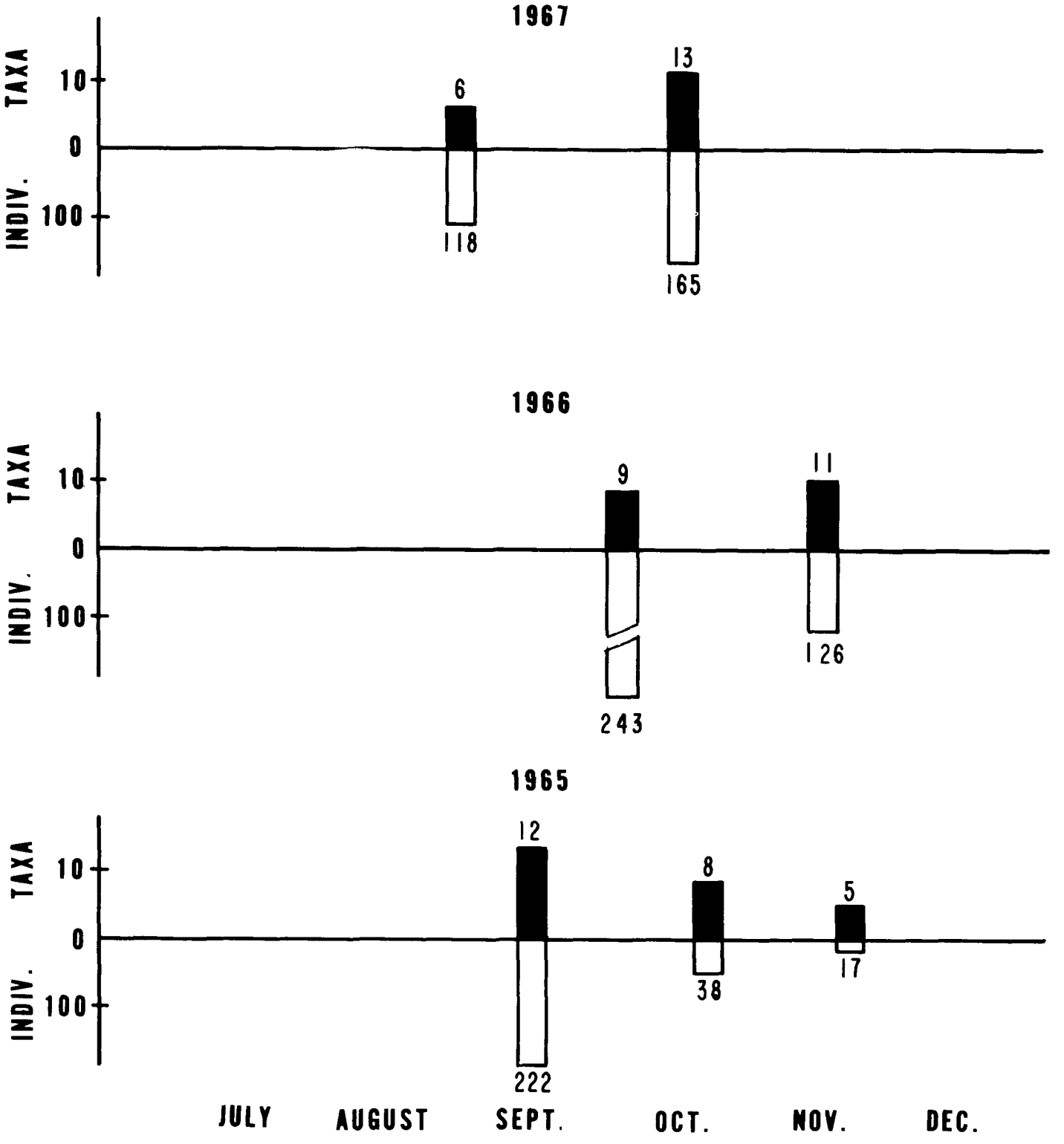

FIGURE 13. OHIO RIVER, ADDISON, OHIO - NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

OHIO RIVER - HUNTINGTON, WEST VIRGINIA (MILE 301.4)

In 1963, twenty-two dredge samples were taken in the vicinity of the Huntington municipal water intake near both banks and at mid-river. No sampling was conducted in 1964, but a series was collected in 1966 and 1967. Basket samplers were installed on a concrete pier of old Lock #27 and three, six-week collections were taken in 1965. In 1966 and 1967 the artificial substrates were collected at the Glenbrier Yacht Club floating dock one-half mile upstream from old Lock #27, right bank. The exposure periods and dates of installation were dissimilar during the three years (Figure 14).

The yearly mean DO values for 1963-65 and August, 1963 and 1965 values were lower than at the other main stem Ohio River stations (Figures 15 and 16).

The Kanawha River (discussed in detail later) transports municipal, industrial and other wastes and enters the Ohio River approximately 35 miles upstream from Huntington.

The most abundant benthic organisms collected by dredge were pollution-tolerant and facultative oligochaetes and midge larvae as was the case at most of the stations upriver. However, in contrast to the populations upstream, the numbers were more equally distributed within the taxa represented. Insect larvae of facultative and pollution-sensitive mayflies, caddisflies, and certain midges were present in some dredge samples (Figure 7). The dominant midges in the dredgings were; Tanypodinae (*Coelotanypus*, *Procladius*, and *Ablabesmyia*), *Cryptochironomus digitatus* gr., and *Polypedilum halterale*. A diverse molluscan fauna included the snails *Gyraulus*, *Somatogyrus*, and *Campeloma*, and the clams *Corbicula*, *Anadonta*, and *Leptodea*.

The basket samples contained a more diverse fauna than at the stations upstream (Figure 9) and a considerably greater number of individuals (Figure 8). Oligochaetes were almost entirely lacking in the samples. The most abundant organisms were caddisflies (mostly *Cyrnellus fraternus*) and midge larvae (*Dicrotendipes nervosus* and *Ablabesmyia rhamphe*). In addition, the mayfly *Stenonema* (3 spp.), the damselfly *Argia*, mollusks, and the coelenterate *Cordylophora* were commonly found in the baskets. Fifteen taxa were recorded in the 1965 basket collections, 21 in 1966, and 25 in 1967. The stonefly *Acroneuria arida*, and several mayflies including *Caenis*, *Tricorythodes* and *Stenonema* spp. were present in the July, 1967 sample. Stoneflies and mayflies, as groups, generally are considered pollution-sensitive. However, the taxa mentioned above are tolerant to a wide range of environmental conditions and inhabit water with organic enrichment if sufficient dissolved oxygen is available.

The macroinvertebrate fauna at Huntington appeared to be stimulated by moderate organic pollution from upstream, presumably from the Kanawha River, and the overall effect was to increase the abundance and diversity of bentnic fauna compared with upstream stations.

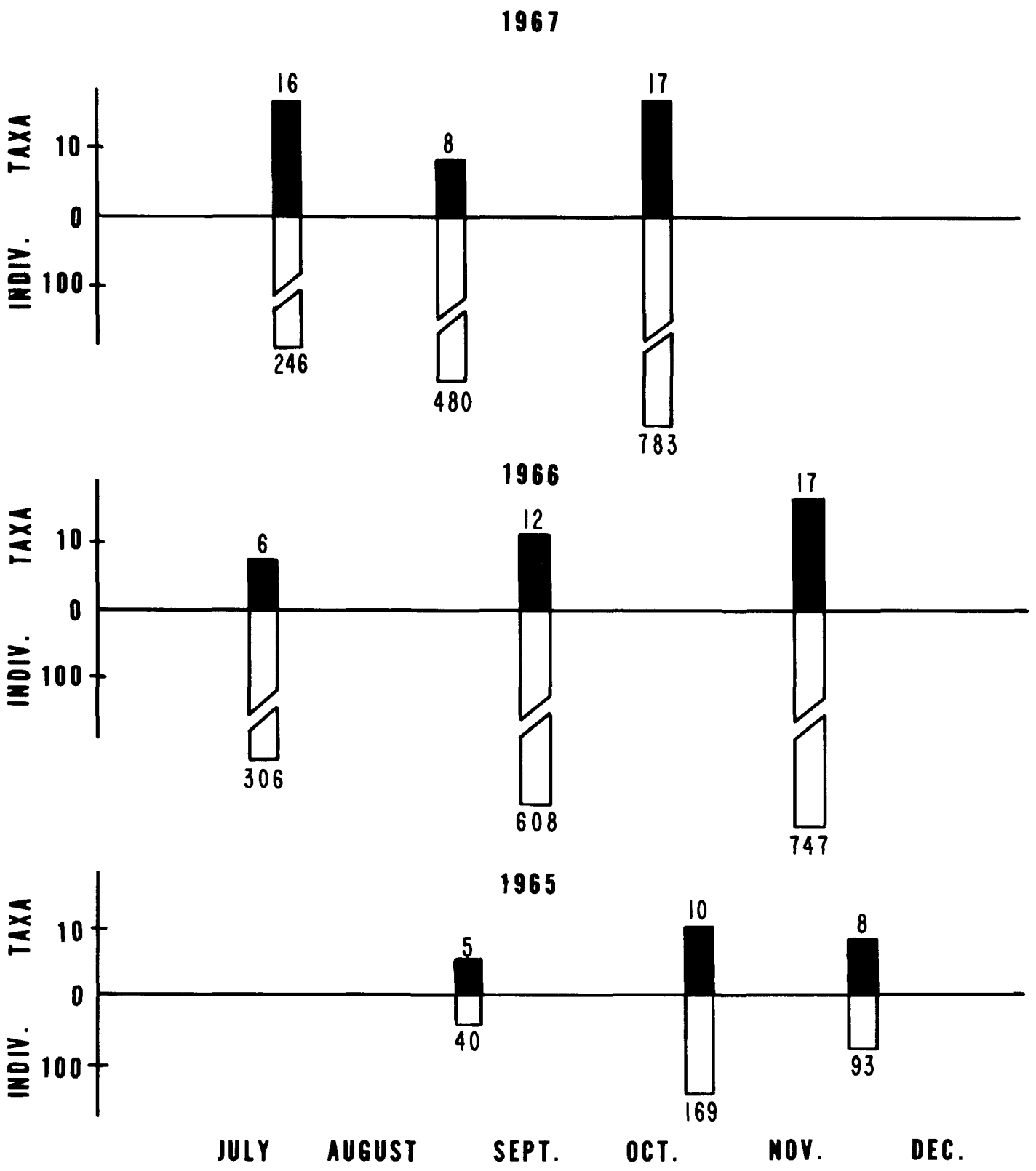

FIGURE 14. OHIO RIVER, HUNTINGTON, W.VA.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

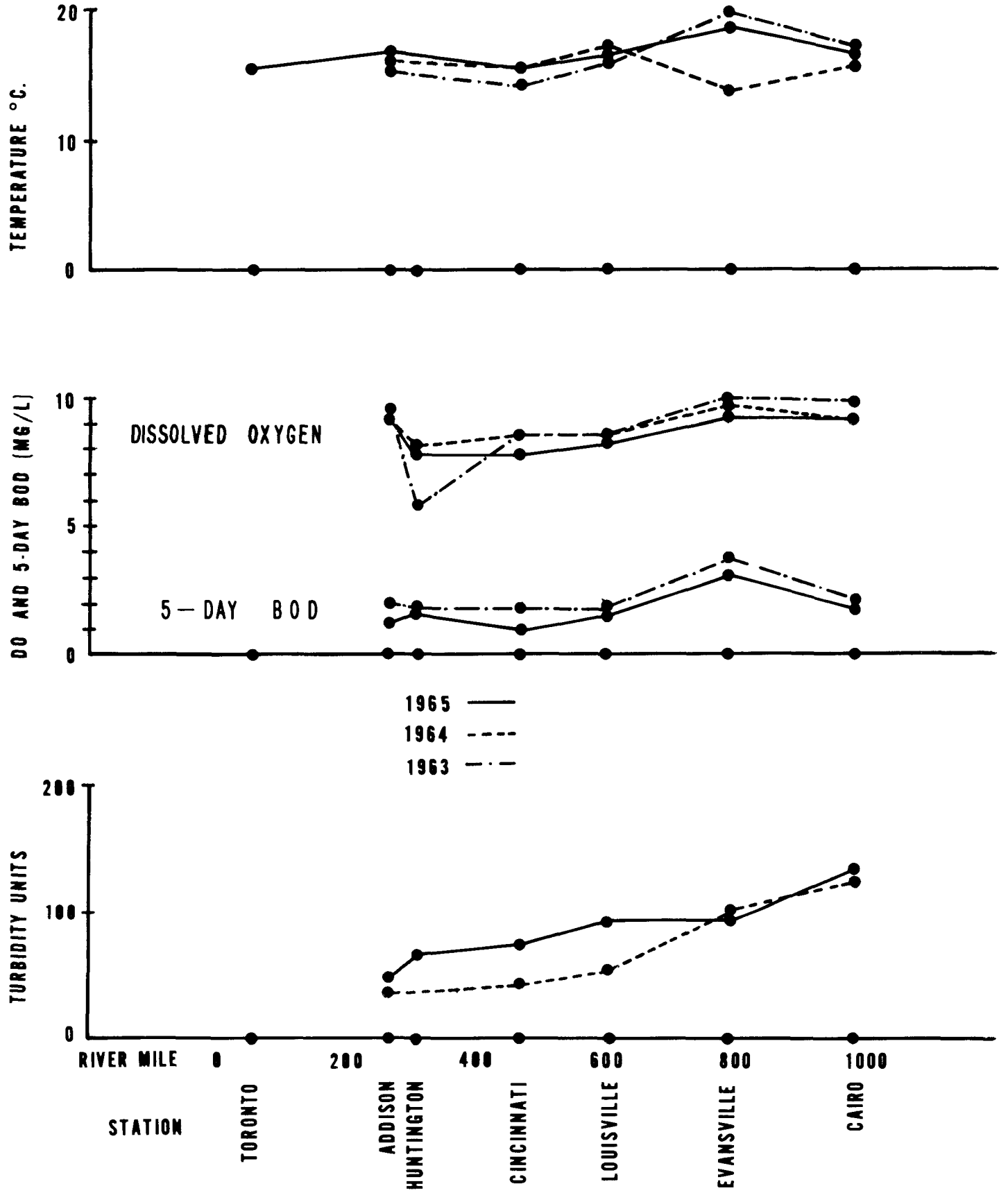

FIGURE 15. YEARLY MEAN TEMPERATURE, DO, BOD, AND TURBIDITY DURING 1963, 1964, AND 1965 OHIO RIVER STATIONS

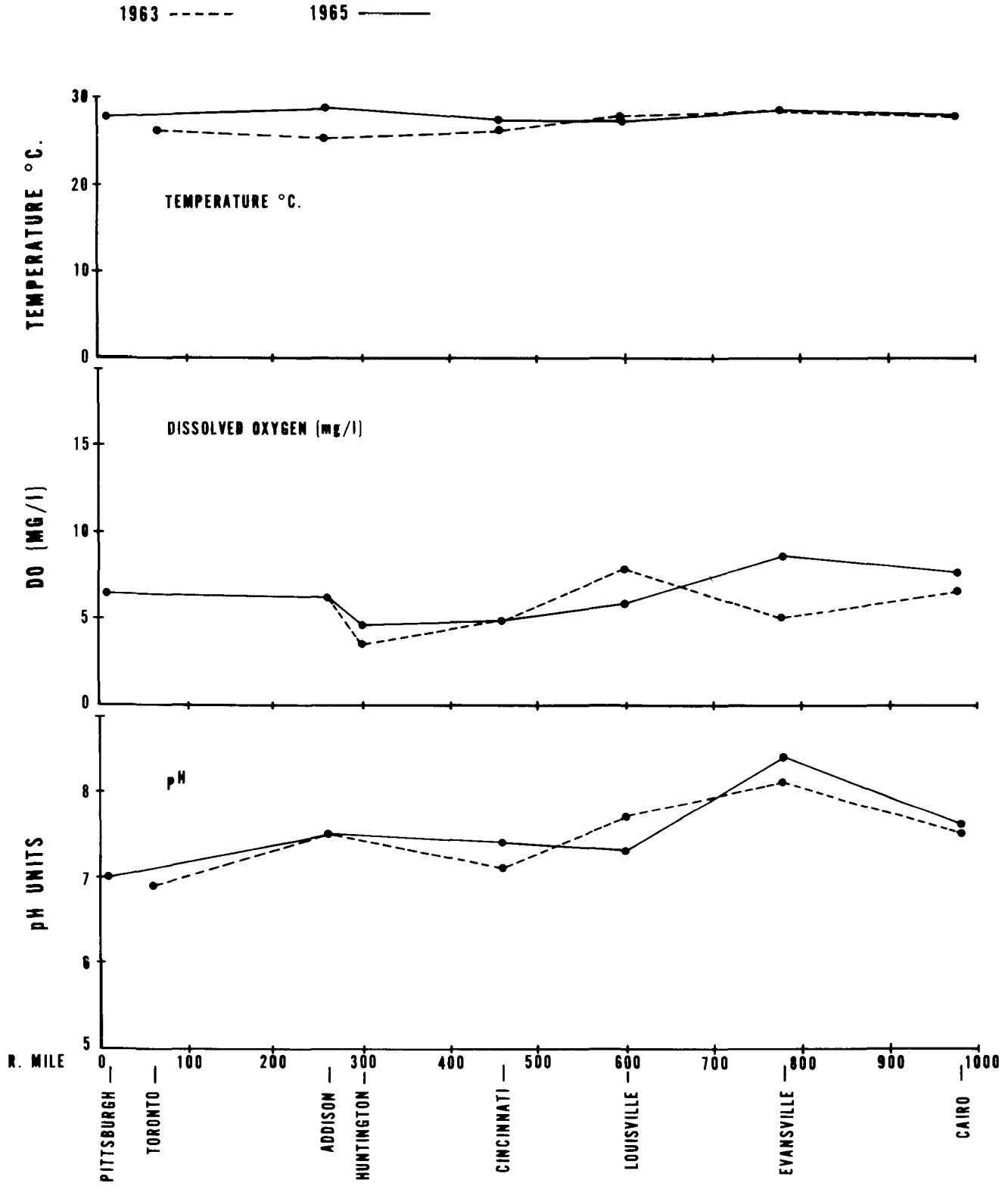

FIGURE 16. MEAN TEMPERATURE, DO, AND pH FOR OHIO RIVER STATIONS, AUGUST, 1963 AND 1965

OHIO RIVER - CINCINNATI, OHIO (MILE 462.8)

In May, 1963 two series of six Petersen dredge samples were collected at midstream and near the right bank at the Cincinnati Water Works intake. In August, 1963 and 1964 other series were collected near the right shore and at midstream. Dredge sampling in 1965, 1966 and 1967 consisted of series taken one-half mile upstream from the water intake.

In 1965, five basket samples were collected in June, July, August, October and November. These samples provided extremely valuable information on periods of abundance of various species occurring at Cincinnati. In 1966, five samples were collected in four months; July, September, October and November and in 1967 three samples were collected in July, September and October.

The monthly mean summer water temperature at Cincinnati during 1963-67 was approximately 26°C and the maximum temperature recorded was 29.4°C in August, 1964. The mean pH was 7.3, and DO values ranged from a low of 2.6 mg/l in August, 1963 to a high of 8.4 mg/l in August, 1966. However, the mean monthly DO averaged 6.5 mg/l during the summer months (Table III).

Dredge samples collected during the five-year period from the sand and gravel bottom contained mostly midge larvae numbering 5 to 22/sq. ft. *Procladius*, *Coelotanypus*, *Cryptochironomus*, and *Polypedilum* spp. were the most numerous. The bloodworm *Chironomus attenuatus* occurred sparingly in the 1963, 1964, and 1966 dredgings. Oligochaetes, mostly Naididae, numbered 16 to 196/sq. ft.

The distribution of clams in the Cincinnati reach of the river was most interesting. In 1962 exploratory dredge series in mid-channel contained 56 *Corbicula*/sq. ft. Sampling the same bottom in 1963 revealed mostly broken shells; few of the clams of the 1962 population were alive. Dredge samples near the right bank from 1964 to 1967 also contained few *Corbicula*. Reasons for the demise of the population probably relate to the extremely cold winter of 1962-63 and change in river habitat due to operation of the newly constructed Markland Lock and Dam at Warsaw, Kentucky.

On May 16, 1967, a barge broke loose and lodged in the gate at Markland Dam, requiring lowering of the river stage in the Cincinnati pool. Prior to this date the river level had not stabilized due to spring rains. The left bank (north) at each of two locations upstream and three downstream from Cincinnati was walked for one-quarter mile. The exposed 10 ft. of bank upstream from Cincinnati revealed 10 species of live clams and shells of 4 other species. (Table II). Two species of live clams were present six miles below Mill Creek, which transports a heavy organic and industrial load from the City of Cincinnati. Clams were not found 10 miles below Mill Creek. Three species of live clams were found 1.5 miles further downstream. Very few of the species visually observed were collected by the use of dredges during the study.

TABLE II. Ohio River Mollusk Collection - May 30, 1967

River Mile	459.0	459.5	↓ 478.5	482.3	483.8
PELECYPODA	11 species	9 species	7 species	0 species	6 species
	3.5 mi. above Cinn.	3 mi. above Cinn.	6 mi. below Mill Creek	10 mi. below Mill Creek	11.5 mi. below Mill Creek
Pelecypoda (17 species)					
Amblema plicata	X	*			
Anodonta grandis			*		*
Corbicula manilensis	X		*		*
Elliptio crassidens	X				
Elliptio dilatatus	X		*		
Fusconaia falva		*			
Lampsilis anodontoides			X		*
Leptodea fragilis	X		*		
Obliquaria reflexa	*	*			
Plagiola lineolata		X			
Pleurobema cordatum	*	*			
Proptera alata	X	*	X		X
Proptera capax (?)	X				
Proptera laevissima			*		X
Quadrula pustulosa	*	*			
Quadrula quadrula	X	*			X
Tritogonia verrucosa		X			
Gastropoda (6 species)					
Aquatic					
Campeloma ponderosum	X	X	X		X
Pleurocera canaliculata	X		*		X
Terrestrial					
Triodopsis notata		*	*		
Anguispira alternata			*		
Mesodon pennsylvanicus			*		
Triodopsic tridentata			*		

* = Shells only
X = Live
↓ = Mill Creek enters at River Mile 472.4

The basket collections were characterized by a large number of facultative midges; *Dicrotendipes nervosus*, *Psectrocladius*, and *Ablabesmyia rhamphe*. The caddisflies *Cyrnellus fraternus*, *Hydroptila*, *Leptocella*, and *Cheumatopsyche* also were recorded. Common mayflies were; *Stenonema interpunctatum*, *S. integrum Caenis*, and *Tricorythodes*. The stonefly *Taeniopteryx nivalis* was found only in November samples. This is the normal period of growth and activity for *Taeniopteryx* as indicated by Frison (1935). Other stoneflies were recorded mostly in late fall and early winter at several other Ohio River basin stations.

The damselfly *Argia apicalis* occurred regularly in the baskets. However, odonates are quite mobile and their occurrence in relation to pollutional effects is difficult to evaluate.

Cyrnellus fraternus was one of the most abundant caddisflies in Ohio River Basin basket samplers. The peak abundance of this caddisfly during the summer of 1965 was progressively later from northeast to southwest (Figure 17). At Cincinnati and Louisville the peak occurred in late July and early August whereas at Evansville and the Wabash River at New Harmony, 250 miles west, the peak occurred in late September. Information on peak abundances of predominant species over a period of years is invaluable for evaluating abnormal responses of populations caused by pollution.

The greatest diversity in any one artificial substrate was 19 taxa in the September, 1967 basket (Figure 18). The total taxa from all baskets was 15 in 1964, 19 in 1965, 23 in 1966 and 24 in 1967. The majority of the fauna was composed of facultative representatives in few numbers suggesting slight organic enrichment. The fauna steadily gained in diversity and number of individuals over the five year period indicating general improvement in water quality just upstream from Cincinnati.

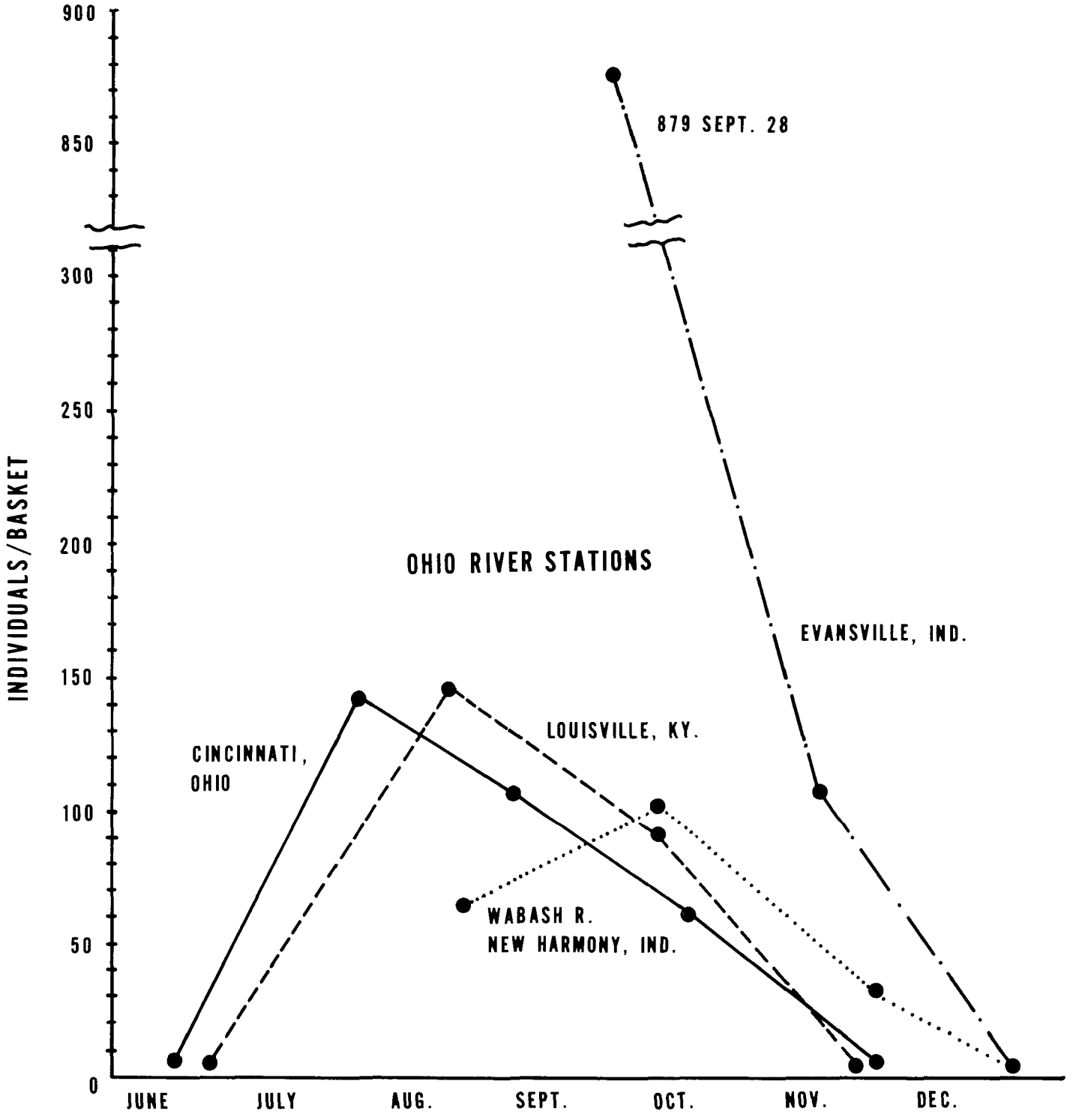

FIGURE 17. NUMBERS OF CADDISFLY LARVAE, Cyrnellus fraternus, IN BASKET SAMPLERS AT OHIO RIVER BASIN STATIONS DURING 1965

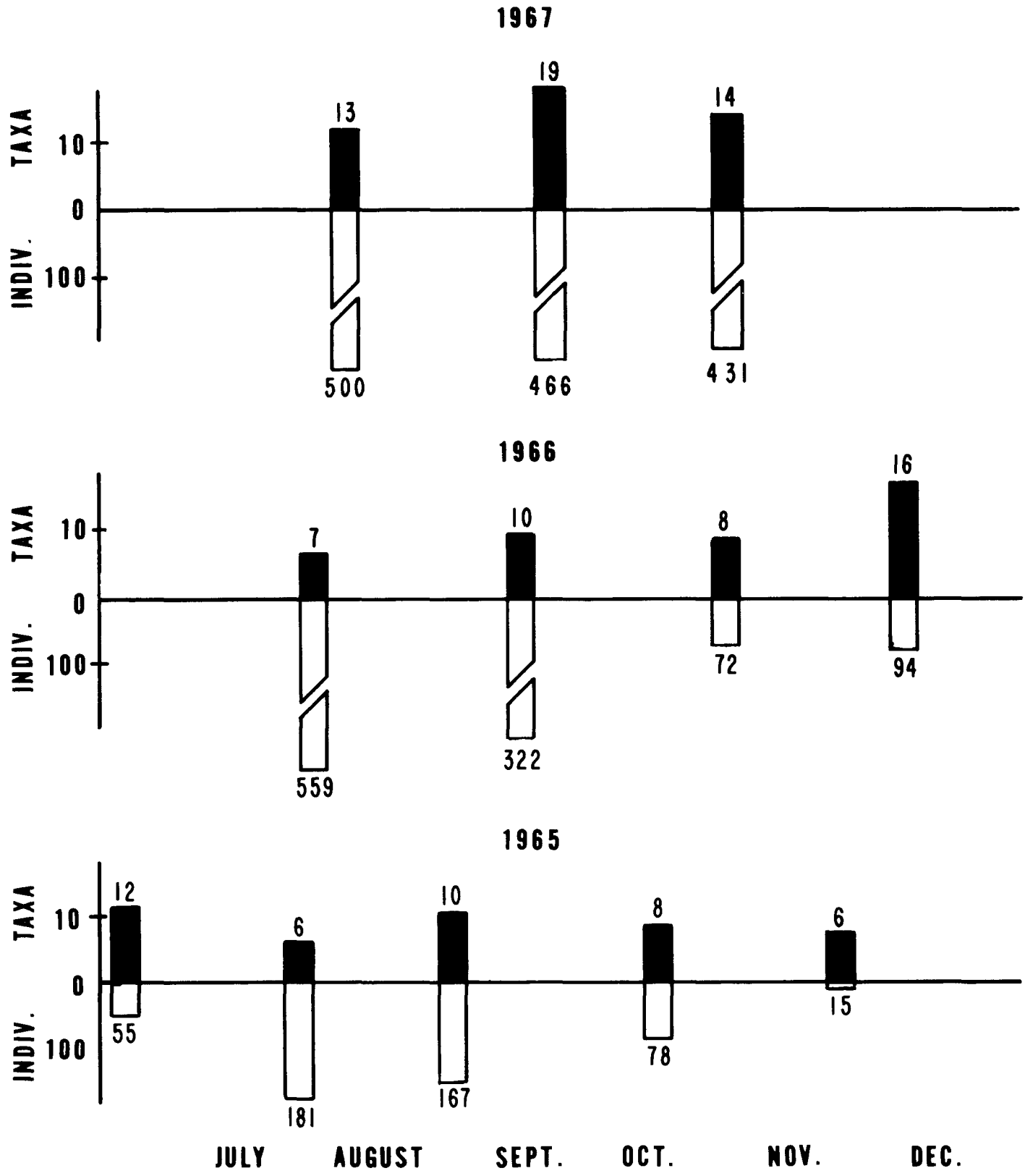

FIGURE 18. OHIO RIVER, CINCINNATI, OHIO-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

OHIO RIVER - LOUISVILLE, KENTUCKY (MILE 600.5)

The Louisville station was located upstream from industrial and municipal sources of pollution although several small creeks upstream from the station contributed allochthonous organic matter.

Dredge sampling at Louisville in 1963 consisted of two series collected in May and August. Six samples each were taken from the left (north) bank, midstream, and the right (south) bank near the Louisville Water intake structure. Dredge sampling in August, 1964 consisted of a series taken near both banks and mid-channel. In 1965, 1966 and 1967, the dredge series consisted of three samples each near the left and right banks. Four basket collections were taken during June, August, September and November, 1965 and three during each of the years, 1966 and 1967 (Figure 19).

The DO monthly means during the summer ranged from 7.2-8.4 mg/l in 1963, 6.2-7.3 in 1964, 4.4-6.2 in 1965, 3.8-4.9 in 1966, and 3.8-4.4 in 1967 (Table III). The maximum temperature was 30.0°C in August, 1964. The minimum pH was 7.1 in September, 1964.

The series of dredge samples collected near both banks (soft mud and sand) and mid-channel (sand) in May and August, 1963 and August, 1964 were almost identical in composition and contained the midge larvae; *Coelotanypus* and *Procladius;* the clams *Corbicula, Lampsilis* and *Sphaerium;* and oligochaetes (mostly Tubificidae). Samples from the left bank generally contained a greater number of individuals and diversity (worms, midges and mollusks) than those from the sandy right bank. Facultative *Cryptochironomus digitatus* gr. and pollution-tolerant *Chironomus attenuatus* (midges) were collected only from the left bank. The phantom midge *Chaoborus punctipennis* was prevalent in the 1964 samples. Dredge samples from the right bank in 1964 contained midge larvae *Procladius* and *Cryptochironomus* averaging 28/sq. ft. Several mollusks were also collected, including the pelecypods *Corbicula, Pisidium* and *Sphaerium* and the gastropods *Campeloma* sp., *Pleurocera* sp., *Physa* sp., and *Gyraulus* sp.. Oligochaetes averaged less than 100/sq. ft. The 1965 and 1966 dredge samples showed little deviation from those in 1963 and 1964 except that oligochaetes increased to approximately 300/sq. ft.

A dramatic increase in the number of pollution-tolerant oligochaetes occurred in the July, 1966 dredge series (Figure 7). The combined taxa in 1967 was 24, the largest diversity taken by dredge series at any Ohio River station during the five-year study. Of the total, nine taxa were midges, two were caddisflies, three were damselflies, and four were mollusks. (Appendix A-25).

Thirty different taxa appeared in four artificial substrate collections at Louisville in 1965. Fourteen species of midge larvae and pollution-sensitive caddisflies *Athripsodes* and *Agraylea* were present. Facultative organisms; caddisfly, *Cyrnellus fraternus* and mayflies *Stenonema* spp. also were very abundant. *Corbicula* and Turbellaria were present in nearly every sample. In 1966, 20 taxa were collected including two stoneflies, *Taeniopteryx nivalis* and *Acroneuria* sp. and three samples in 1967 contained a total of 28 taxa (Appendix A-27). Changes in the bottom fauna during the five year period reflect increasing enrichment.

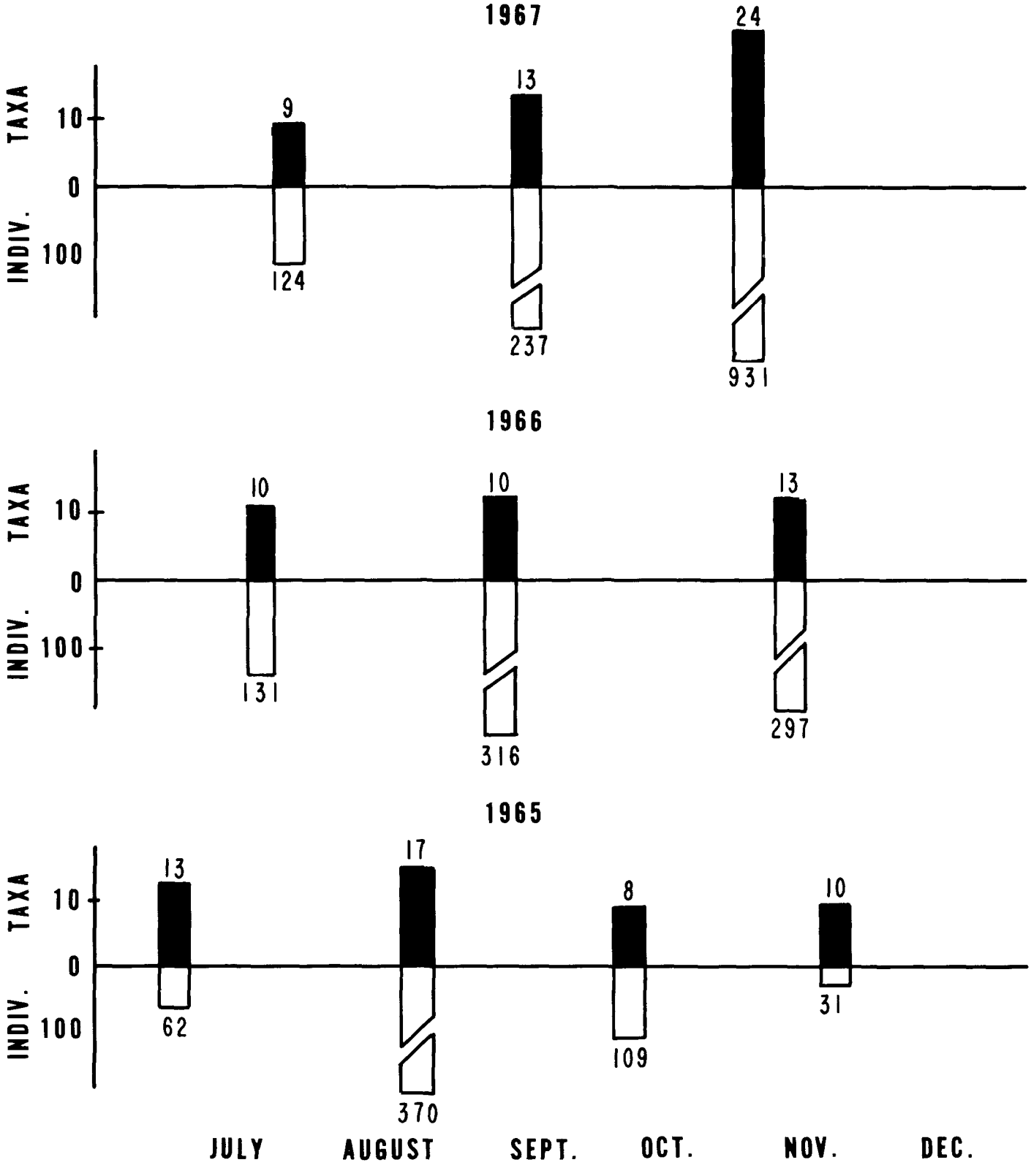

FIGURE 19. OHIO RIVER, LOUISVILLE, KY.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

OHIO RIVER - EVANSVILLE, INDIANA (MILE 787.5)

The city of Evansville is located on the outer side of a large horseshoe bend in the river. In May and August, 1963, a series of six Petersen dredge samples was collected at Highway 41 bridge (mile 787.5) five miles upstream from Evansville. There were no samples in 1964. Two samples were collected under the bridge near the left bank in June, 1965. In August, 1966 and September, 1967, samples were collected near the left bank four miles downstream from the bridge. Few dredgings were taken near the right bank because of an extensive and shallow sand bar.

Artificial substrate sampling at the Evansville station was initiated in August of 1965 with samples collected in September, November and December. The basket sampler was attached to the downstream end of the Evansville Boat Club dock located on the left bank next to Highway 41 bridge. Basket samples were collected in July, August and November of 1966, and June, September and October of 1967 at the same location. High water in this reach of the Ohio River usually prevented the installation of basket samplers until late July.

Chemical and Physical data for 1963-1965 (Table IV, Figure 15) show that the mean temperature, DO, BOD, pH and turbidity values increased at Evansville as compared to the upstream stations. Table III presents the data in greater detail for the summer months. The mean summer temperatures were approximately 28°C for July and August, and 24°C in September. The monthly mean DO, 1963-67, was 8.0 mg/l, and the measurements ranged from a low of 3.7 in September, 1965 to a high of 10.2 in September, 1964 and July, 1966. The pH ranged from 7.5 to 8.8. The turbidity units ranged from 25 to 440 during the five years.

Midge larvae and oligochaetes were the most abundant macroinvertebrates collected in the dredge samples. Many of the taxa were the same as collected at Louisville, including *Coelotanypus* and *Procladius*. Organisms from the sandy bottom included a number of clams, including *Leptodea* sp. and *Corbicula*. Many Ephemeroptera (*Stenonema* spp.) were found on rocks along the right Kentucky bank in June, 1965. The percent composition of macroinvertebrates in the 1966 dredgings was approximately 50% midge larvae and 50% oligochaetes. A total of 116 organisms/sq. ft. was collected at Evansville in the August, 1966 dredge samples as compared to 367/sq. ft. for the July samples at Louisville (Figure 7). The difference was largely due to oligochaetes.

In 1965, a total of 23 taxa was collected from three baskets and the most abundant organism was the caddisfly *Cyrnellus fraternus*. Pollution-sensitive stoneflies, *Isoperla bilineata* and *Taeinopteryx*, were collected only in the December sample. The dragonfly naiad *Neurocordulia* occurred in the September sample. In 1966, the total taxa increased to 29, and in 1967 (Figure 9) a greater variety of midges, caddisflies and mayflies occurred in the baskets.

The composition of the midge fauna at Evansville changed from predominately facultative *Psectrocladius* and *Dicrotendipes nervosus* in 1965 to pollution-tolerant *Glyptotendipes* spp., which arefavored by organic enrichment and slower stream flow (Appendix A-31).In 1967, the fauna again was different than the preceding year. In addition to the change in the midge population, the caddisflies *Neureclipsis crepuscularis*, *Hydrophyche orris* and *Potamyia flava* were

abundant only during 1967. *Stenonema* were very numerous but other mayflies, *Tricorythodes* and *Baetis* were few in number. The stonefly *Isoperla* was collected in the November sample. Figure 20 shows that the diversity as well as abundance or organisms increased dramatically in the September, 1967 sample. A total of 40 taxa was collected from baskets in 1967, the largest variety at any one station on the Ohio River.

There was an increasing trend in the abundance and diversity of macroinvertebrates at Evansville during the years studied (Figures 8 and 9). The large, diverse populations of midges, caddisflies and mayflies reflect stimulation by moderate organic enrichment.

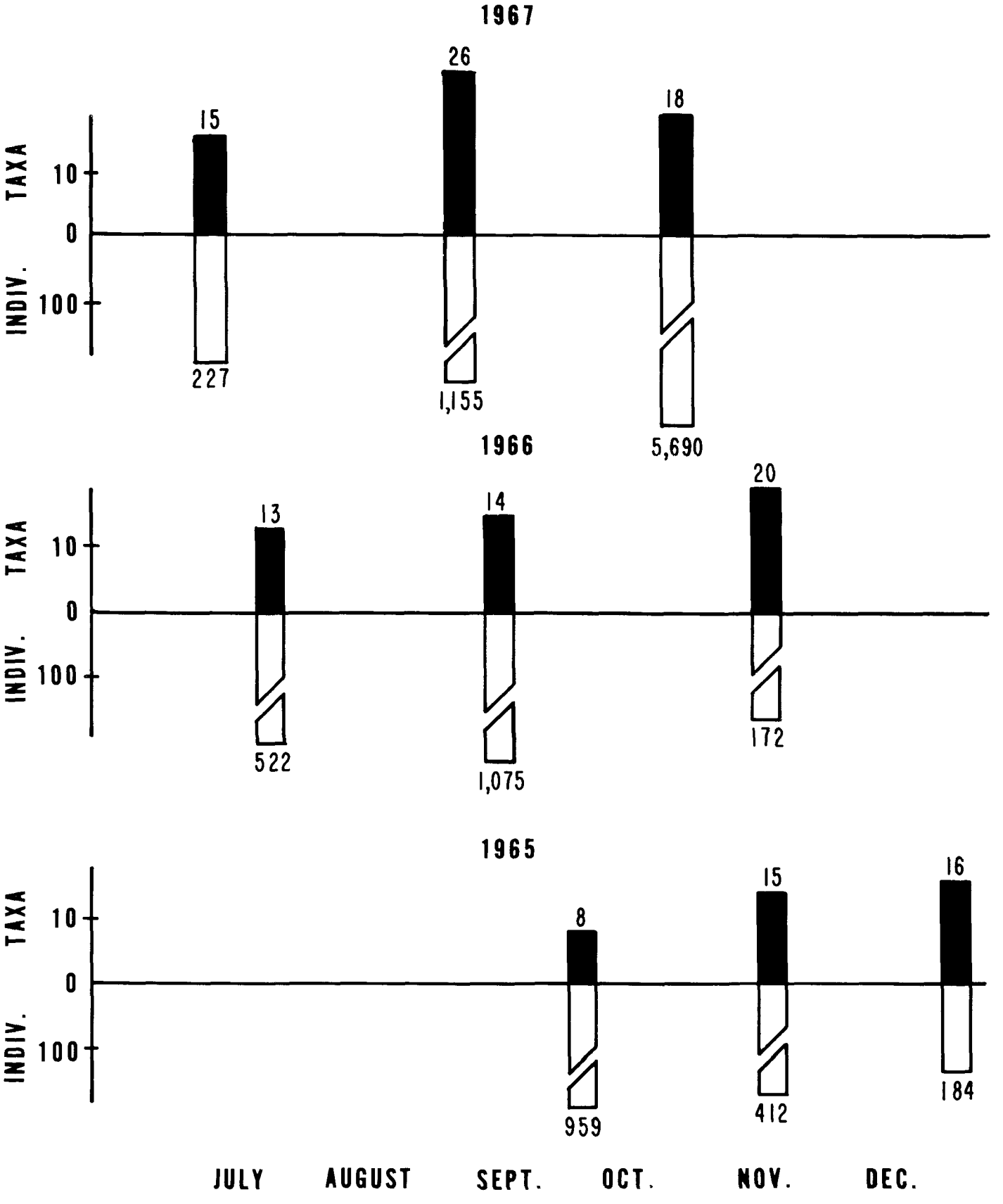

FIGURE 20. OHIO RIVER, EVANSVILLE, IND.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

OHIO RIVER - CAIRO, ILLINOIS (MILE 980.4)

The Cairo, Illinois station was at Highway 60 bridge (River Mile 980.4) during 1963-65. This station was one-half mile upstream from the confluence of the Ohio and Mississippi Rivers, a wide expanse of river. Dredge sampling in 1963 at Cairo, Illinois consisted of a dredge series in May and August near the right bank. Also a dredge series from mud and sand bottom at the bridge was collected July, 1964. No dredge samples were obtained in 1965.

In 1966 the sampling location was moved from the bridge, to Lock and Dam #53, Grand Chain, Illinois, 18 miles upstream from Cairo. The move was made to avoid vandalism to the basket samplers and to facilitate retrieval. The water at Cairo was more corrosive to the baskets and steel cable than at Grand Chain, but less corrosive than the Monongahela River at Pittsburgh. The water level fluctuates greatly at Grand Chain even during the summer and therefore the baskets were suspended on polyurethane-filled, five-gallon cans to maintain a constant depth. Floating debris and high water continually caused difficulty in maintaining the samplers at the lock and dam.

The DO values were not sufficiently low to be limiting on the majority of macroinvertebrates. A low of 4.5 mg/l was recorded in July, 1965, but the mean value was 5.6 mg/l. The mean pH was 7.5 The year 1966 was a period of low flow, with an average of 176,000 cfs while the average for the other years was 237,000 cfs.

August dredge samples from the series at Highway 60 Bridge in 1963 contained few midges (*Coelotanypus* and *Stenochironomus)* and oligochaetes; 3/sq. ft. and 12/sq. ft., respectively. *Corbicula* numbered 13/sq. ft. in the August sample. The late July, 1964 series at the same location contained, in addition to a few midges and oligochaetes, burrowing mayflies *Hexagenia limbata?* and 17 *Corbicula*/sq. ft.

Usually few macroinvertebrates were collected in the dredge series (Appendix A-33). The majority were oligochaetes. In 1967, 13 taxa were found in 6 samples, five of which were midges, *Coelotanypus, Procladius, Polypedilum scalaenum, P. halterale,* and *Cyptochironomus digitatus* gr.

Basket samplers, during three sampling periods in 1965 (Figure 21), contained 13, 10 and 15 taxa, respectively. Facultative caddisflies; *Hydropsyche orris* and *Potamyia flava;* mayflies; *Stenonema, Tricorythodes,* and *Baetis* were predominant. The dragonfly *Neurocordulia* occurred in the August and November samples. In 1966, 16 taxa were obtained at Grand Chain, two thirds of which were midge and caddisflies. The predominant midge throughout the years sampled was *Polypedilum illinoense* which prefers sluggish enriched streams. A total of 23 taxa was collected in the late September and late October, 1967 samples. Most of the species were similar to those listed for 1965-66 (Appendix A-34).

Hydropsychid caddisflies dominated the late September, 1966 basket collections (Figure 11) and numbered over half of the total individuals. In 1966 only 59 were collected in the October sample. In 1965, 458 larvae were

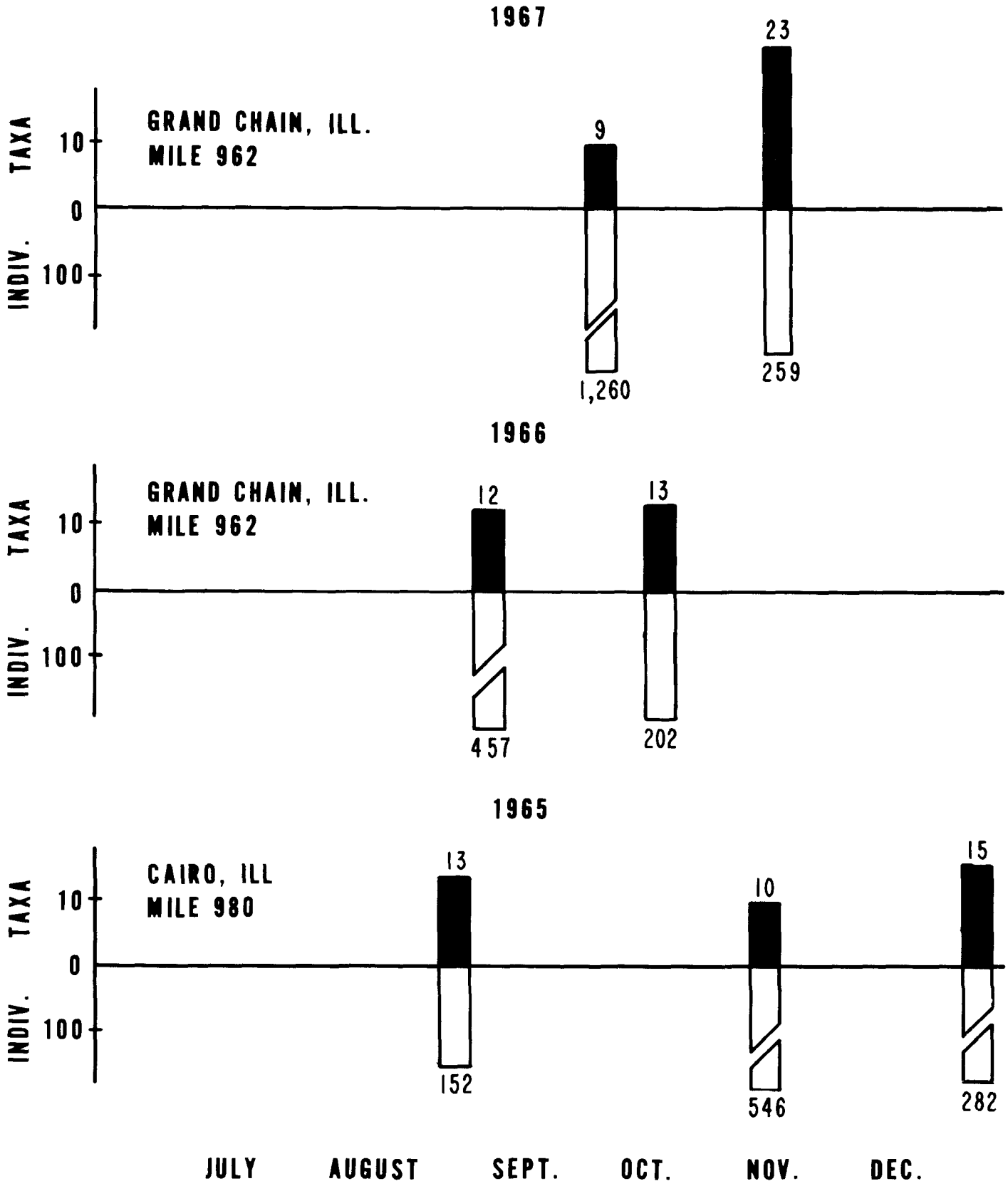

FIGURE 21. OHIO RIVER, CAIRO, ILL.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

collected as late as November and 202 in December. During the period of low flow in 1966, Hydropsychidae were most abundant in July and August. General periods of abundance for stream insects may vary considerably from year to year depending on environmental factors.

Figures 7, 8, 9 and 11 show that generally the numbers and diversity of macroinvertebrates were less than those at the Evansville station. Fewer pollution-sensitive organisms were present. However, in certain respects elements of the fauna resembled collections at Cincinnati, Louisville and Evansville.

OHIO RIVER TRIBUTARIES

KANAWHA RIVER - LONDON, WEST VIRGINIA (MILE 82.6)

The London, West Virginia station, 13 miles above the Charleston industrial complex, was established in 1966 as a control. The basket sampler float-unit was attached to the London Lock and Dam upstream outer guard wall. Samplers were collected in July, September and November. In 1967, Petersen dredge series, three near the left bank and three near the right, were collected at Glasgow three miles downstream from the dam. Also, in 1967 three baskets were collected in July, August, and October (Figure 22).

Temperature and flow data are available for 1963, 1966 and 1967. A limited number of chemical values exists for June through August at mile 74 in 1964 and 1965. These data show the minimum DO was 6.3 mg/1, and the average monthly value approximately 7 mg/1. The temperature did not exceed 31°C and the minimum pH was 7.1 (Table IV).

The 1967 bottom dredgings contained a mixture of sand and silt. Midge larvae; *Cricotopus*, *Chironomus* s.s., *Procladius*, *Coelotanypus*, *Cryptochironomus*, *Paracladopelma*, *Polypedilum*, *Xenochironomus*, *Ablabesmyia*, and *Dicrotendipes* sp. accounted for 10 of the 16 taxa collected in the six samples. The presence of the pollution-associated bloodworm *Chironomus attenuatus* gr. is indicative of organic enrichment. The Asiatic clam *Corbicula* was the most abundant organism in the dredgings, averaging 95/sq. ft.

The baskets in 1966 contained a total of 33 taxa, half of which were midge larvae. The fauna contained representatives of the caddisfly *Cyrnellus fraternus*, mayflies *Tricorythodes* and *Stenonema*, odonates *Argia*, *Enallagma* spp. (damselflies) and *Macromia* and *Neurocordulia* (dragonflies), neuropteran *Climacia*, flatworms, crustaceans, molluscans, bryozoans *Plumatella* and *Urnatella gracilis* and coelenterates *Cordylophora* and *Hydra*. The composition of the fauna in terms of numbers was quite heavily inclined toward facultative midges (*Dicrotendipes*), amphipods, Turbellaria and gastropods (*Gyraulus*). Twenty-three taxa were collected in the July sample, 14 in September, and 9 in November (Appendix A-38).

The 1967 baskets contained 37 different kinds of macroinvertebrates with uniform distribution in number of individuals in each taxonomic category. None of the taxa were outstandingly abundant except for amphipods and *Stenonema* mayflies.

The presence of pollution-tolerant bloodworms, *Chironomus attenuatus* and *Procladius*, flatworms, pulmonate snails and leeches, in limited numbers, indicates mild to moderate organic enrichment at London, W. Va.

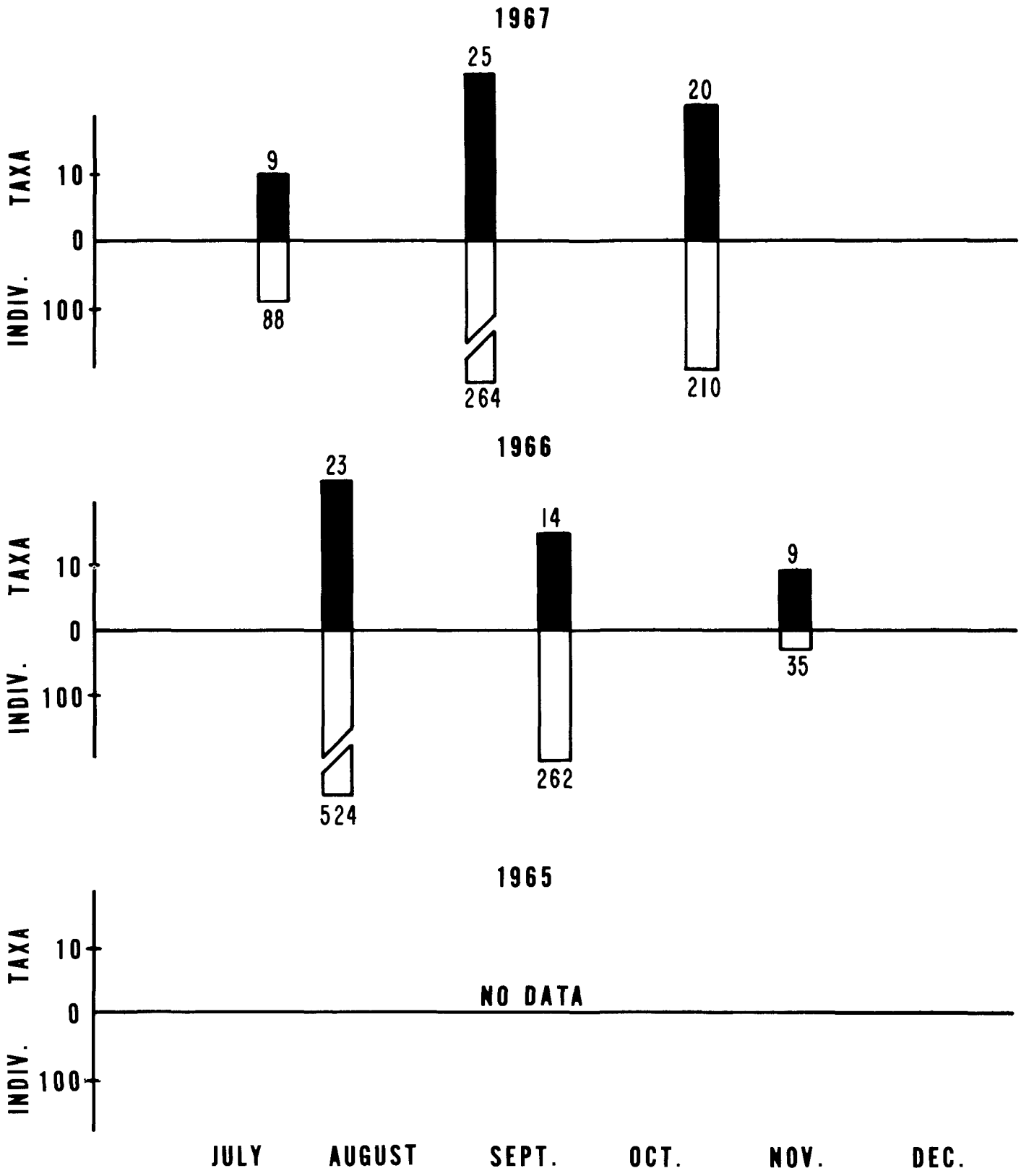

FIGURE 22. KANAWHA RIVER, LONDON DAM, W. VA.-NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

KANAWHA RIVER-WINFIELD DAM, WEST VIRGINIA (MILE 31.1)

Winfield Dam is located 30 miles below the Charleston, West Virginia industrial complex. The stream at this station is approximately 200 yards wide and 20 ft deep. The water is dark brown in appearance. During May, 1963 a series of dredge samples was taken 0.5 mile upstream and downstream from the lock and dam, and in July and November at the downstream location. No dredgings were taken in 1964 or 1965. In July, 1966 and August, 1967 dredge samples were collected above the lock and dam near the Winfield Toll Bridge (Mile 32.2). Three separate basket collections were taken each year during 1965-67.

The water temperature averaged approximately the same as the nearest main stem Ohio River station at Addison, Ohio. The maximum values were usually one to two degrees higher and in 1964 the maximum value was 32.5°C. The mean monthly DO values were usually below 1 mg/l during the summer, and minimum values of 0.0 mg/l were recorded during most summer months (Table III). The pH seldom dropped below 6.5 during the summer.

Odors of hydrogen sulfide and other chemicals were noticeable in the area of the locks. Undecomposed leaves, coal fines, and tar-like deposits covered the bottom. Quite often the surface water at the dam was black with coal dust.

Dredge samples upstream and downstream from the lock and dam in May, 1963, contained less than 100 worms/sq. ft., less than one midge larva/sq. ft. *(Coelotanypus)*; and two elmid beetles/sq. ft. The July series contained less than one midge larva/sq. ft. *(Procladius)* and 860 worms/sq. ft. The November series contained only worms, 364/sq. ft. The dredge series in July, 1966 one mile above the dam contained 17 worms/sq. ft., one *Chaoborus* (phantom midge larva), and a partially decomposed *Stenonema* mayfly nymph. The 1967 dredge series contained 7 taxa, mostly represented by a few midges; *Procladius*, *Chironomus attenuatus* and *Psectrocladius*.

The baskets in three 1965 collections (Figure 23) contained a total of three taxa or less. Other than worms, one midge and one caddisfly were present. During 1966, 8 taxa were recorded in the three baskets, and the greatest numbers were nematodes and worms (totaling 9,700 individuals in the November 3 sample). The unbalanced population at Winfield Dam contrasted to the 33 taxa uniformly distributed in composition at London, West Virginia is dramatic evidence of the pollutional effects from the Charleston complex on the aquatic life in the river. The nearly complete elimination of all macroinvertebrates, except for one or two select groups, is a typical response of macroinvertebrates to gross toxic pollution.

The 1967 basket collections contained a greater total diversity in that 18 taxa were recorded, but most were pollution-tolerant bloodworms *(Procladius*, *Dicrotendipes incurvus* gr. and *Chironomus attenuatus)*. During the summer of 1967 some of the major chemical plants at Charleston were on strike. The nature and amount of toxic substances entering the river during this period were

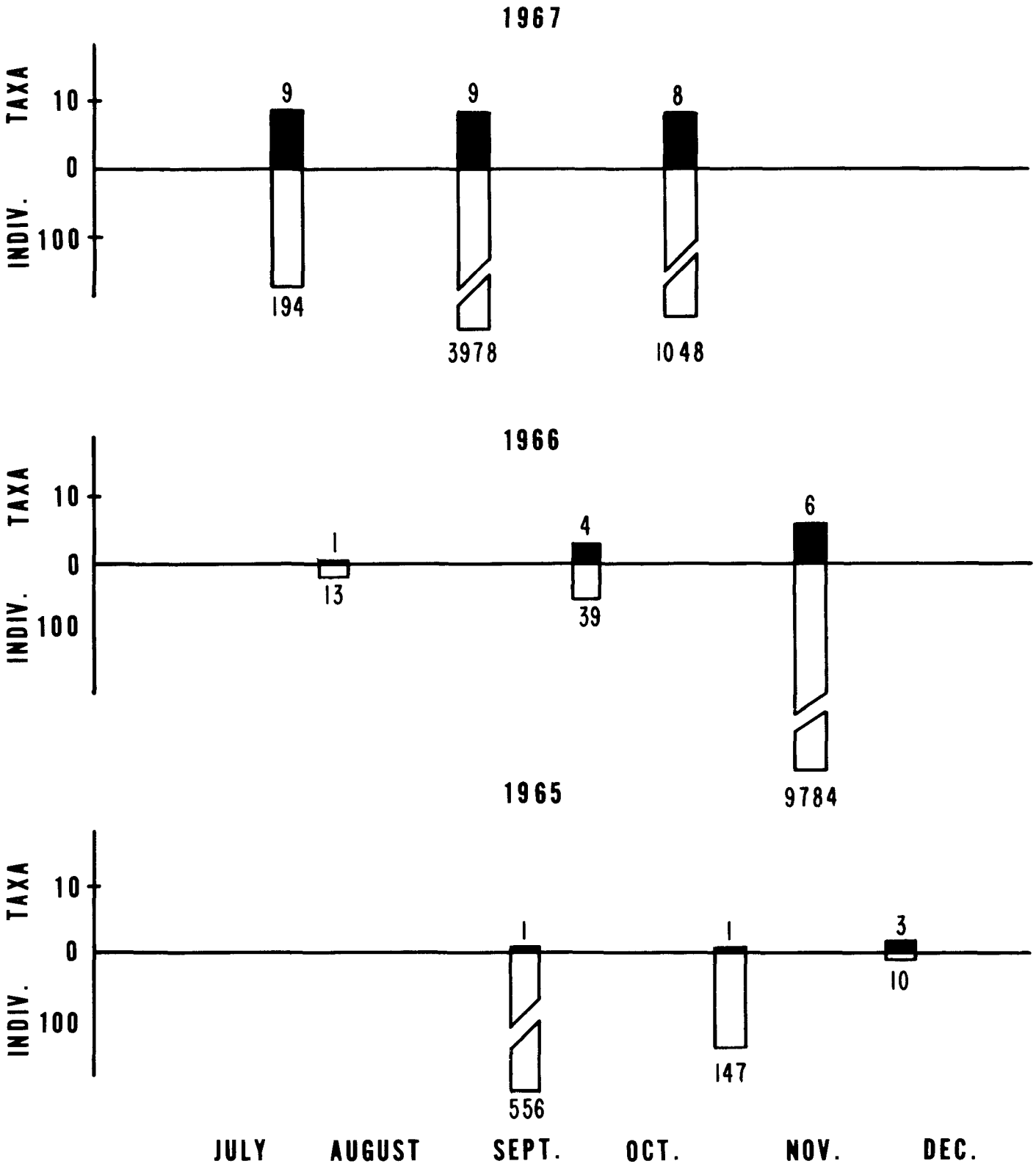

FIGURE 23. KANAWHA RIVER, WINFIELD DAM, W. VA.–NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

not known, but the greater diversity of macroinvertebrates in the basket samplers suggested a lessened effect of pollution on the macrofauna during this period.

The bottom fauna at Pt. Pleasant, West Virginia (mile 1.5) was predominatly bloodworms, (*C. attenuatus* and *Glyptotendipes)* and sludgeworms.

The effects of industrial pollution diminished sufficiently at Pt. Pleasant, West Virginia permitting organisms tolerant to organic pollution to inhabit the stream.

WABASH RIVER - NEW HARMONY, INDIANA (MILE 51.5)

During the summer, the Wabash River at New Harmony, Indiana is shallow (6-12 ft) with numerous sand bars as it winds southward toward the Ohio River 50 miles away. The river often overflows its bank onto a mile-wide flood plain during spring floods. The current is variable and localized deposits of debris are common, forming a multi-substrate bottom.

Petersen dredge samples in series of three were collected near each bank 100 yds below Highway 460 bridge in 1963, 1965, and 1967. No sampling was conducted in the Wabash River during 1964. In 1966, samples were collected 50 yds above the bridge. The fauna collected in the dredgings showed little similarity within a series due to the various microhabitats encountered.

Basket samples were collected in August, September, November and December, 1965, July, August, October and November, 1966 and July, September and October, 1967 (Figure 24).

The mean water temperature was 5°C higher in July than September. The mean TDS was consistently greater (364 mg/l) than at any of the other OBR stations sampled and reached its highest mean value in 1966, a year of low flow. The mean pH ranged between 7.5-8.0 during the summers of 1963-66. The mean alkalinity was 179 mg/l, much higher than at other stations and maximum values of 250 mg/l were not uncommon. The yearly mean DO ranged between 9.1 and 11.5 mg/l (Table IV) for the five years with a minimum record of 4.9 mg/l in July, 1963.

Moderate worm populations and midge larvae (49 and 14/sq. ft., respectively) were dredged from the muddy bottom in 1963. Midges included *Stenochironomus*, *Cryptochironomus* spp. and Tanypodinae. The mayfly *Caenis* and burrowing mayfly *Hexagenia*, the snails *Physa* and *Amnicola* were present in the 1965 dredgings. In 1966, one *Hexagenia*/sq. ft. was collected. The pollution-tolerant bloodworms *Procladius* and *Coelotanypus* were the most abundant bottom organisms of the 21 taxa collected (Appendix A-41). Bottom samples in 1967 contained a greater variety of macroinvertebrates than was collected by dredge at any other Ohio River Basin station. The 38 taxa, in well-balanced proportions, included 5 mayfly species: *(Hexagenia, Pentagenia, Stenonema, Caenis* and *Baetis)*; 18 midge species, 3 caddisflies species *(Potamyia, Leptocella* and *Oecetis)* and clams *(Quadrula, Corbicula, Lampsilis* and *Sphaerium)*. Worms, bryozoans, leeches, flatworms and nematodes also were present.

The four basket samples in 1965 contained an abundant and diverse community totaling 47 taxa (Appendix A-43) with an average of 666 individuals/basket. Stoneflies were present in the September and November collections. Both the August and October 1966 basket samples contained over 15,000 individuals, three-fourths of which were pollution-tolerant bloodworms, *Glyptotendipes* prob. *barbipes*. This midge inhabits streams with heavy organic pollution. The total taxa in four 1966 baskets were 25. Thirty nine taxa, many of which are pollution-tolerant, were collected in both basket and dredge in 1966 as compared to 61 taxa in 1965. The dramatic change in the faunal composition which took place from one year to the next is considered to be the result of low flow conditions

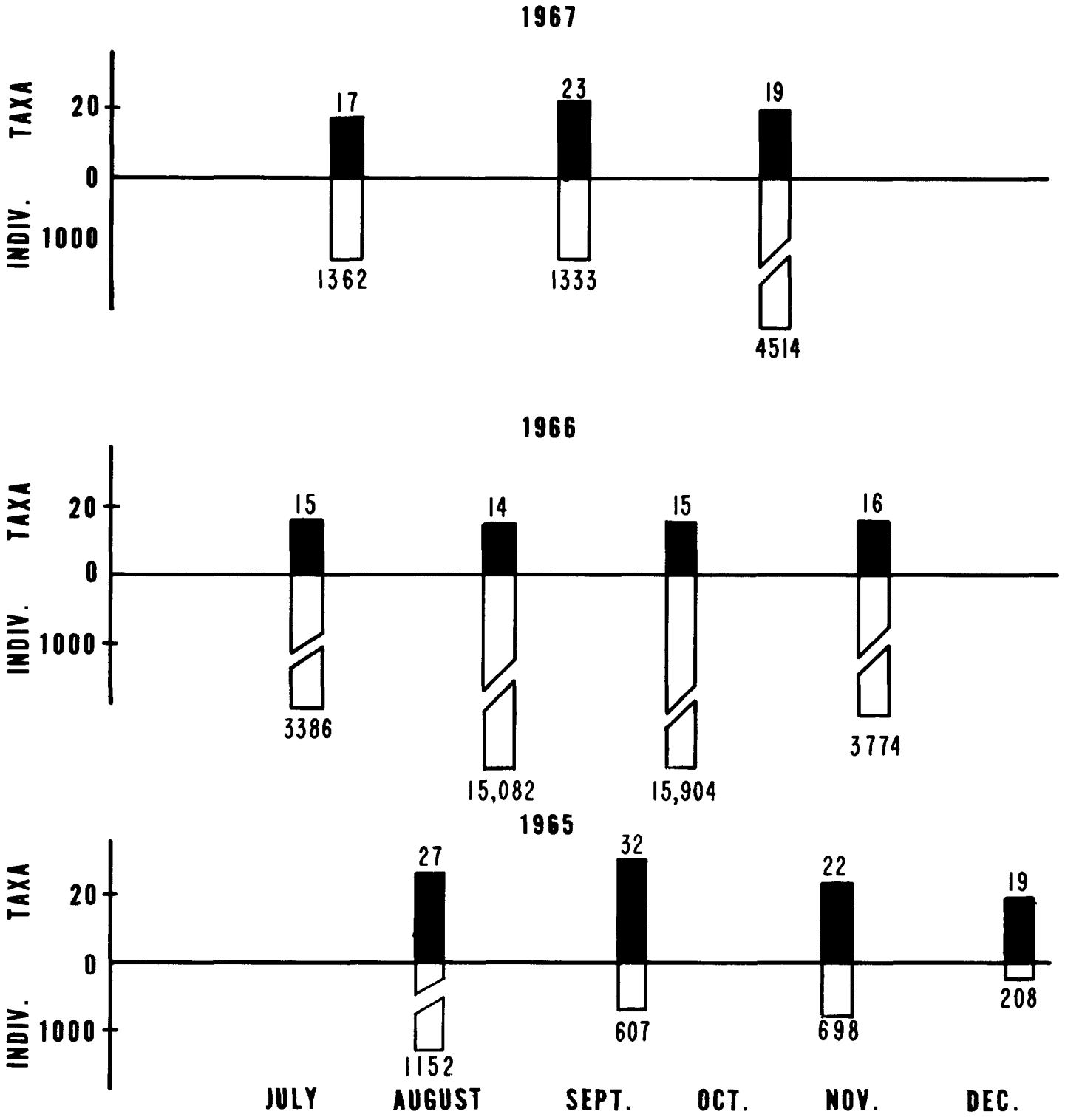

FIGURE 24. WABASH RIVER, NEW HARMONY, IND.—NUMBER OF TAXA AND INDIVIDUALS COLLECTED FROM BASKET SAMPLERS, 1965-1967

in 1966 and consequent greater concentration of nutrients. In 1967, the faunal diversity in the baskets increased to 33 taxa and the number of individuals (especially *G. barbipes?)* declined in numbers to nearly the same as in 1965. The largest sample in 1967 contained 4,500 individuals represented by 19 taxa. The return of the fauna to a more balanced state in 1967 indicated that 1966 was not a typical year in terms of water quality at New Harmony.

The abundance and diversity of organisms in the Wabash River at New Harmony indicate that the benthic fauna was stimulated by moderate organic pollution.

SUMMARY

The composition and distribution of macroinvertebrates at nine Ohio River and five tributary stations were studied during 1963-67. The long-term study revealed that macroinvertebrate populations in the industrialized upper Ohio River area were sparse throughout the years sampled. The fauna was characterized by pollution-tolerant and facultative organisms. There was a noticeable increase in the number and variety of benthic organisms in the middle and lower reaches of the Ohio River as compared to the upper reach. At some stations the faunal composition varied only slightly from year to year whereas at others changes were pronounced. During the five year period the abundance and diversity of macroinvertebrates increased at most of the stations in the middle and lower reaches. There was a general increase in the yearly mean temperature, dissolved oxygen, BOD, pH, and turbidity at Louisville, Kentucky and Evansville, Indiana compared with the other main stem stations.

Pollution from the lower Allegheny and Monongahela rivers limited the macroinvertebrate populations downstream from Pittsburgh, Pennsylvania to those organisms tolerant of low pH and toxic wastes, principally bloodworms and oligochaetes. Pollution-sensitive caddisflies, mayflies and stoneflies were not found at Pittsburgh. Caddisflies appeared at Toronto, Ohio; mayflies were present 260 miles downstream at Addison, Ohio, and stoneflies at Huntington, West Virginia. These taxa were present at other stations downstream from Huntington.

The most diverse fauna in basket samplers (artificial substrates) at any Ohio River station was collected at Evansville, Indiana, in 1967. Dominant forms at Evansville, Indiana and Cairo, Illinois were; hydropsychid caddisflies, *Hydropsyche simulans, H. orris, Potamyia flava,* and *Cheumatopsyche.* The snails *Pleurocera* and *Physa* were common.

There was no noticeable improvement in the abundance and kinds of bottom fauna in the Monongahela River at Pittsburgh during the five years. Dredge samples throughout 1963-67 contained only pollution-tolerant sludgeworms and a few bloodworms. Occasionally, damselflies and midges were collected from the artificial substrate samplers.

The Allegheny River at Pittsburgh was found to have a more diverse fauna than the Monongahela. However, the populations did not approximate either the number or diversity of organisms collected at the middle and lower Ohio River stations.

Dredge and basket samples from the Kanawha River at Winfield Dam, West Virginia (approximately 30 miles downstream from the Charleston Industrial Complex), contained mostly worms. Basket samples collected 18 miles above Charleston at London, West Virginia contained a balanced macroinvertebrate fauna. Low dissolved oxygen concentrations and toxic substances in the water below Charleston greatly reduced the variety of macroinvertebrates.

The macroinvertebrate fauna in the Wabash River at New Harmony, Indiana changed considerably from 1963 to 1967. In 1963 and 1965 a large and diverse fauna consisting of facultative midges, caddisflies, odonates and mollusks existed. In 1966, the number of taxa decreased by nearly one-half and thousands of pollution-tolerant bloodworms were present. Correspondingly, 1966 was a period of low flow during the summer, which limited the water for dilution of organic matter. In 1967 the fauna returned to its former composition.

The taxa found to be ubiquitous in the Ohio River Basin were; midges, *Dicrotendipes nervosus*, *Procladius* sp., *Coelotanypus*, *Cricotopus* spp., *Ablabesmyia* spp., *Crytochironomus* spp., and *Psectrocladius* spp. Also, present at most stations were the caddisfly *Cyrnellus fraternus*, the damselfly *Argia*, the mayfly *Stenonema* and the coelenterate *Cordylophora lacustris*. The midges *Glyptotendipes* spp., and *Chironomus attenuatus* were common inhabitants in water with organic enrichment. *Chironomus riparius* gr., *Cricotopus* spp. and *Procladius* were commonly found in water receiving toxic pollutants and low pH.

Taxa more limited in distribution included: the midge *Chironomus riparius* (upper Ohio River) *C. attenuatus* and *Xenochironomus xenolabis* (middle Ohio River) and *Tanypus* (lower Ohio River); the crayfish *Orconectes obscurus* (Allegheny River and upper Ohio), *O. rusticus* (Wabash River and middle Ohio); the caddisflies *Potamyia flava* and *Hydropsyche orris*, stoneflies *Isoperla bilineata* and *Acroneuria* spp., mayflies *Hexagenia* and Caenidae and the dragonfly *Neurocordulia* sp. (middle and lower Ohio River). The asiatic clam *Corbicula* was found from Marietta to Cairo. The stoneflies *Acroneuria* occurred in the spring and summer and *Taeniopteryx nivalis* was collected in the late fall. Peak periods of hydropsychid caddisflies were observed from mid-August to late September in the middle and lower Ohio River Basin.

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GLOSSARY

Allochthonous:

"Pertaining to those substances, materials or organisms in a waterway which originate outside and are brought into the waterway."[1]

Artificial Substrate:

"A device placed in the water (for a specified period of time) that provides living spaces for a multiplicity of organisms..."[1] The artificial substrate sampler used in this study is a rock-filled basket.

Balanced Benthic Community:

A community of bottom dwelling organisms characterized by a large variety with relatively even distribution of individuals within each taxonomic group. An *unbalanced community* is characterized by a few taxa represented by a large number of individuals.

Basket Sampler: (See "Artificial Substrate")

Benthos (Benthic Organisms):

"Bottom-dwelling organisms..."[1] Organisms, both plant and animal, associated with the bottom sediments. In this report the term denotes only macroinvertebrate organisms.

Bloodworms:

"Midge fly larvae. Many of the species have hemoglobin in the blood causing a red color and are often associated with rich organic deposits."[1]

Bottom Fauna: (See "Macroinvertebrate")

Community Diversity:

"Pertaining to the variety of species within a given association of organisms."[1] A diverse benthic fauna contains many different kinds or species, but the term is not related to abundance of organisms in this report.

Dredge Series:

Any number of replicate dredge samples taken in sequence at a sampling location. In this report, replicate samples of three or six were used to calculate average numbers per sq. ft.

Enrichment:

"An increase in the quantity of nutrients available to aquatic organisms for their growth."[1] Nutrients include both organic and inorganic materials.

Facultative Organisms:

Facultative organisms are tolerant to a wide range of environmental conditions.

Habitat:

"A specific type of place that is occupied by an organism, a population or a community."[1]

Intolerant Organisms: (See Pollution-Sensitive Organisms)

"Organisms that exhibit a rapid response to environmental changes and are killed, driven out of the area, or as a group are substantially reduced in numbers when their environment is fouled."[1]

Macroinvertebrates:

Aquatic invertebrates generally visible to the unaided eye. In this report macroinvertebrates are those invertebrates that are retained on a U. S. Standard No. 30 sieve (0.59 mm mesh openings).

Multisubstrate Bottom:

A stream bottom composed of a variety of different types of materials, e.g., sand, mud, gravel and organic detritus, all within the same general vicinity.

Organism:

"Any living individual."[1]

Pollution-Sensitive Organisms:

Pollution-sensitive organisms are those which through bioassay tests and experience are known to require environmental conditions associated with non-polluted habitats, e.g., high DO, pH near neutral, etc.

Pollution-Tolerant Organisms:

Pollution-tolerant organisms are known to tolerate environmental conditions associated with polluted water, e.g., low DO, pH, etc.

Species:

An evolved, or probably still evolving, genetically distinct, reproductively isolated, natural population. Species in this report refers to the most precise level of taxonomic identification.

Sludgeworms:

"Aquatic segmented worms (class Oligochaeta) that exhibit marked population increases in waters polluted with decomposable wastes."[1]

Taxon (Taxa, pl.):

"A kind of organism. Any taxonomic unit or category of organisms; e.g., species, genus, family, order, etc."[1]

Tolerant Organism: (See Pollution-Tolerant Organisms)

"... organisms capable of withstanding adverse conditions within the habitat."[1]

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[1]Taken from: Matthews, John E. 1969. "Glossary of Aquatic Ecological Terms". Special Publication. U. S. Dept. Interior, Federal Water Pollution Control Administration, Ada, Okla.

POLLUTIONAL CLASSIFICATION OF COMMON OHIO RIVER MACROINVERTEBRATES
(Provisional)

Pollution-sensitive	Facultative	Pollution-tolerant
Diptera	Diptera	Diptera
Chironomidae	Chironomidae	Chironomidae
Pentaneura	Ablabesmyia mallochi	Procladius denticulatus
Ablabesmyia	A. janta	Psilotanypus bellus
Labrundinia pilosella	A. rhamphe	Coelotanypus concinnus
Orthocladius	Guttipelopia	* Cricotopus bicinctus gr.
Nanocladius	Conchapelopia	Dicrotendipes incurvus
Corynoneura	Coelotanypus scapularis	Glyptotendipes lobiferus
Thienemanniella xena	Tanypus carinatus	G. barbipes?
Phaenopsectra	Psectrocladius nigrus	* Chironomus riparius gr.
Dicrotendipes neomodestus	* Cricotopus exilis gr.	* C. attenuatus gr.
Glyptotendipes senilis	C. trifasciatus gr.	* C. plumosus gr.
Stenochironomus macateei	Dicrotendipes nervosus	
Xenochironomus xenolabis	D. modestus	
Calopsectra	Glyptotendipes amplus?	
Paratanytarsus dissimilis	G. meridionalis	
Micropsectra deflecta	Polypedilum halterale	
Dicrotendipes fumidus	P. scalaenum	
Tribelos fuscicornis	P. illinoense	
	P. tritum	
	P. simulans	
	Endochironomus nigricans	
	Pseudochironomus julia	
	* Cryptochironomus fulvus gr.	
	C. blarina	
	* Parachironomus abortivus gr.	
	P. pectinatellae	
	Paracladopelma nais	
	Cryptotendipes emorsus	
	Harnischia collator	
	Xenochironomus rogersi?	
	Rheotanytarsus	
	Cladotanytarsus	
	Culicidae	Syrphidae
	Chaoborus punctipennis	Eristalis
	Simuliidae	Psychodidae
	Empididae	Psychoda
	Tipulidae	
	Ceratipogonidae	
	Anthomyiidae	
Trichoptera	Trichoptera	
Hydropsychidae	Hydropsychidae	
Hydropsyche simulans	Hydropsyche orris	
H. frisoni	* H. bifida gr.	
Macronemum	Potamyia flava	
	Cheumatopsyche	

* gr. = group: a species complex

Pollution-sensitive	Facultative	Pollution-tolerant
Trichoptera (cont.)	Trichoptera (cont.)	
Psychomyiidae	Psychomyiidae	
Neureclipsis crepuscularis	Cyrnellus fraternus	
Psychomyia	Polycentropus	
Hydroptilidae	Ephemeroptera	
Hydroptila waubesiana	Heptageniidae	
Ochrotrichia	Stenonema integrum	
Agraylea	S. scitulum	
Leptoceridae	S. femoratum	
Oecetis		
Leptocella		
Athripsodes		
	Caenidae	
Ephemeroptera	Caenis	
Heptageniidae	Tricorythidae	
Stenonema terminatum		
S. interpunctatum		
	Plecoptera	
Hexageniidae	Perlidae	
Hexagenia limbata	Acroneuria abnormis	
Pentagenia vittgera		
Baetidae	Odonata	
Baetis vagans		
Siphlonuridae	Zygoptera	
Isonychia	Argia apicalis	
	A. translata	
Plecoptera	Ischnura verticalis	
Perlidae	Enallagma antennatum	
Acroneuria arida	E. signatum	
Nemouridae	Anisoptera	
Taeniopteryx nivalis	Dromogomphus	
Perlodidae	Erpetogomphus	
Isoperla bilineata	Macromia	
	Gomphus spiniceps	
	G. vastus	
	Neurocordulia moesta	
	Plathemis	
	Hemiptera	
	Corixidae	
	Coleoptera	Coleoptera
	Elmidae	Hydrophilidae
	Stenelmis sexlineata	Berosus
	Dubiraphia	
	Helodidae	
	Dineutus	
Neuroptera	Megaloptera	
Sisyridae	Corydalidae	
Climacia areolaris	Corydalus cornutus	
	Sialidae	
	Sialis	
	Crustacea	
	Decapoda	
	Orconectes propinquus	
	O. rusticus	

Pollution-sensitive	Facultative	Pollution-tolerant
	Crustacea (cont.)	
	Amphipoda	
	Hyalella azteca	
	Crangonyx pseudogracilis	
	Gammarus	
	Isopoda	
	Asellidae	
	Asellus	
	Lirceus	
	Oligochaeta	Oligochaeta
	Naididae	Tubificidae
	Nais	Tubifex tubifex
	Stylaria	Limnodrilus hoffmeisteri
	Nematoda	Branchiura sowerbyi
	Turbellaria	
	Hirudinea	Hirudinea
	Dina	Helobdella stagnalis
	Placobdella	Mooreobdella microstoma
	Mollusca	Mollusca
	Gastropoda-Pulmonata	Gastropoda-Pulmonata
	Ancylidae	Physidae
	Ferrissia	Physa integra
	Lymnaeidae	
	Lymnaea	
	Planorbidae	
	Gyraulus	
	Gastropoda-Prosobranchia	
	Pleuroceridae	
	Pleurocera	
	Goniobasis	
Pelecypoda	Pelecypoda	
Unionidae	Corbiculidae	
Proptera alata	Corbicula maniliensis	
Leptodea fragilis	Unionidae	
	Lampsilis	
	Anadonta grandis	
	Quadrula pustulosa	
	Sphaeriidae	
	Sphaerium	
Bryozoa-Ectoprocta	Bryozoa-Ectoprocta	
Lophopodidae	Plumatellidae	
Lophopodella carteri	Plumatella repens	
Pectinatella magnifica	Cristatillidae	
	Cristatella mucedo	
	Bryozoa-Endoprocta	
	Urnatella gracilis	
Porifera	Coelenterata	
Spongillidae	Clavidae	
	Cordylophora lacustris	
	Hydridae	
	Hydra	

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Allegheny River-Pittsburgh, Pa.

Av.No./ft^2

ORGANISM: Date	1963 5/9	1963 8/1	1963 11/5	1965 9/30	1966 8/3	1967 8/15
Diptera						
Chironomidae						
Ablabesmyia janta?						<1
A. mallochi						<1
Guttipelopia sp.						<1
Procladius sp.	1	2	5	5	3	
Coelotanypus sp.			1			
Chironomus attenuatus				1		3
C. riparius			48			
Cryptochironomus digitatus gr.			1			1
Parachironomus abortivus						1
Dicrotendipes nervosus				1		
D. neomodestus						1
Stenochironomus						3
Glyptotendipes amplus?						<1
Culicidae						
Chaoborus sp.				6	<1	
Trichoptera						
Cyrnellus fraternus				1		8
Coleoptera	1					
Berosus sp.	<1					
Oligochaeta	5	48	5	9	15	29
Nematoda						<1
Mollusca						
Pelecypoda						
Pisidium sp.?			<1			
Bryozoa						
Plumatella sp.				S		
Lophopodella carteri		S		S		S
Paludicella articulata						X
Coelenterata						
Cordylophora lacustris		X	X			
Total Individuals	8	50	61	23	19	51
Total Taxa	4	3	7	6	3	13

X=present

S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Allegheny River-Pittsburgh, Pa.

Individuals/Sampler

	8/5 1965			4/26 1966			5/23 1967			
ORGANISM: Date	9/30	12/2		6/7	8/3		7/11	8/22	10/4	
Diptera										
Chironomidae										
Ablabesmyia rhamphe	1	7			16			10		
A. mallochi								5		
Conchapelopia sp.					4					
Procladius sp.		1								
Psectrocladius sp.		11			29				1	
Cricotopus sp.									1	
C. trifasciatus gr.					1				1	
C. slossonae?									2	
Dicrotendipes incurvus gr.								5		
D. neomodestus					2			2	1	
Polypedilum tritum?								2		
Parachironomus abortivus					20		1	30		
Culicidae										
Chaoborus sp.		1								
Trichoptera										
Cyrnellus fraternus	56	10			1		20	25	18	
Polycentropus sp.		1								
Ephemeroptera										
Stenonema sp.		2								
Odonata										
Zygoptera										
Argia sp.	1	1								
Ischnura sp.		2								
Crustacea										
Decapoda										
Orconectes obscurus	2	5			1					
O. propinquus		1								
Crangonyx sp.		3			1					
Oligochaeta		23			2			10	14	
Nematoda					1					
Bryozoa										
Plumatella sp.									X	
Total Individuals	60	68		0	78		21	89	38	
Total Taxa	4	13		0	11		2	8	8	

X=present

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Monongahela River-Pittsburgh, Pa.

Av.No./ft^2

ORGANISM: Date	1963 5/9	1963 11/5	1965 9/30	1966 8/3	1967* 8/22
Diptera					
Chironomidae					
Chironomus riparius gr.					2
Ephydridae?					1
Psychodidae					
Psychoda sp.					1
Hemiptera					
Corxidae					F
Odonata					
Anisoptera					
Plathemis lydia					<1
Nematoda					<1
Oligochaeta	3	2	3	8	58
Total Individuals	3	2	3	8	64
Total Taxa	1	1	1	1	6

* 1967 samples taken 9 miles upstream from those in 1963-66

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Monongahela River-Pittsburgh, Pa.

Individuals/Sampler

ORGANISM:	8/9 1965		4/26 1966				5/23 1967			
Date	9/30	12/2	6/7	8/3	9/26	11/9	7/11	8/22	10/5	
Diptera										
Chironomidae										
Conchapelopia sp.?	1									
Cricotopus bicinctus gr.				5	3			2		
C. sp. 2 Rob.									2	
C. exilis gr.				5						
C. trifasciatus gr.				6						
Psectrocladius sp.							1		2	
Dicrotendipes nervosus						2	1			
Polypedilum scalaenum						1			3	
P. ophioides?				4	1					
Glyptotendipes sp.					1	1				
Trichoptera										
Cyrnellus fraternus		1								
Odonata										
Zygoptera										
Ischnura verticalis			1		1	2		5	17	
Enallagma clausum?				1		8			41	
Coleoptera										
Phytobius sp.							4			
Oligochaeta	1000							1		
Coelenterata										
Hydra sp.				X						
Total Individuals	1001	1	1	21	6	14	6	8	65	
Total Taxa	2	1	1	6	4	5	3	3	5	

X=present

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Pittsburgh, Pa.

Av.No./ft^2

ORGANISM: Date	1963 11/5	1965 9/29	1966 8/3	1967 8/15
Diptera				
Chironomidae				
Procladius sp.			<1	<1
Cryptochironomus digitatus gr				<1
Parachironomus abortivus				<1
Culicidae				
Chaoborus sp.	1	1	<1	
Trichoptera				
Cyrnellus fraternus			2	
Coleoptera				F
Oligochaeta	67	94	181	53
Hirudinea				
Helobdella sp.				<1
Turbellaria		<1		
Bryozoa				
Plumatella sp.		X		
Pectinatella sp.		X		
Lophopodella sp.		X		
Porifera			X	
Total Individuals	68	96	185	57
Total Taxa	2	6	5	5

X=present

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Pittsburgh, Pa.

Individuals/Sampler

	8/7 1965			4/26 1966				5/31 1967		
ORGANISM: Date	9/29	12/2		6/7	8/3	11/9		7/10	8/21	10/4
Diptera										
Chironomidae										
Ablabesmyia rhamphe	2								20	
Psectrocladius sp.				2						
P. simulans?		3								
Cricotopus trifasciatus gr.		3				3				32
C. fugax										16
C. sp. 1										8
Dicrotendipes nervosus	1	2							20	24
Parachironomus abortivus								64	64	
P. pectinatellae									8	
Polypedilum sp.										8
Trichoptera										
Cyrnellus fraternus										16
Crustacea										
Amphipoda										
Crangonyx pseudogracilis								22	120	8
Decapoda										
Orconectes obscurus	1									
O. propinquus	1									
Oligochaeta	9	39		98	52	260		3710	2144	13,696
Turbellaria	9	10								16
Nematoda									32	88
Mollusca										
Gastropoda										
Planorbidae (1 sp.)		1								
Bryozoa										
Plumatella sp.								X	X	X
Pectinatella magnifica						S				S
Lophopodella carteri										S
Cristatella mucedo						S				
Coelenterata										
Hydra sp.										X
Total Individuals	23	58		100	52	263		3796	2408	13,912
Total Taxa	6	6		2	1	2		4	8	12

X=present

S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Toronto, Ohio

Av.No./ft^2

ORGANISM: Date	1963 11/4		1966 8/4								
Diptera											
Chironomidae											
Procladius sp.			15								
Psectrocladius sp.			4								
Cricotopus bicinctus gr.			1								
C. trifasciatus gr.			1								
C. sp. 1			<1								
Chironomus riparius gr.	1										
Cryptochironomus digitatus gr.	<1										
Parachironomus abortivus			1								
Chironomus attenuatus			<1								
Oligochaeta	57		69								
Hirudinea	<1										
Mollusca											
Pelecypoda	F										
Total Individuals	60		93								
Total Taxa	4		8								

F=fragment

SUMMARY OF MACROINVERTEBRATE DATA — ARTIFICIAL SUBSTRATE

STATION: Ohio River-Toronto, Ohio

Individuals/Sampler

ORGANISM: Date	9/8 1965			4/26 1966				5/31 1967		
	10/27	12/22		6/7	8/4	10/4		7/10	8/21	10/4
Diptera										
Chironomidae										
Ablabesmyia auriensis					130	15				
A. rhamphe	3								20	5
Psectrocladius sp.					22	20		23	2	6
P. sp. 3 Rob.	3			20						
P. elatus?				8						
Orthocladius sp.					2					
Cricotopus trifasciatus gr.				5	6					
C. bicinctus gr.				4	13					
C. fugax?										7
C. exilis gr.										2
Dicrotendipes nervosus	2					30		2	6	3
D. incurvus gr.					5					
Glyptotendipes amplus?								1		
Parachironomus abortivus				5						
Polypedilum tritum									3	
Calopsectra sp.		1								
Trichoptera										
Cyrnellus fraternus					6	34				
Odonata										
Zygoptera										
Enallagma sp.					1					
Argia sp.	2									
Crustacea										
Amphipoda										
Crangonyx pseudogracilis				1				1		4
Decapoda										
Orconectes propinquus	2			1	3	1			2	1
Oligochaeta		5		367	18	61		1		51
Turbellaria										9
Mollusca										
Gastropoda										
Physa sp.								1		
Ferrissia sp.						28				
Bryozoa										
Plumatella sp.						X			X	
Urnatella gracilis						X				
Coelenterata										
Hydra sp.						X				X
Cordylophora lacustris								X		X
Total Individuals	12	6		411	206	189		29	33	88
Total Taxa	5	2		8	10	10		7	6	11

X=present

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Marietta, Ohio

Av.No./ft^2

ORGANISM: Date	1967 8/17									
Diptera										
Chironomidae										
Procladius sp.	<1									
Ablabesmyia sp.	<1									
A. rhamphe	<1									
Chironomus riparius gr.	<1									
Tanytarsus Group A Rob.	<1									
Neuroptera										
Sialis sp.	<1									
Trichoptera										
Cyrnellus fraternus	<1									
Odonata										
Anisoptera										
Gomphus vastus	<1									
Oligochaeta	22									
Nematoda	<1									
Mollusca										
Pelecypoda										
Corbicula sp.	2									
Total Individuals	33									
Total Taxa	11									

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Marietta, Ohio

Individuals/Sampler

ORGANISM: Date	4/27 1966 7/15	9/22	11/2		5/25 1967 7/13	8/23	10/3			
Diptera										
Chironomidae										
Ablabesmyia sp.						29				
A. rhamphe	37				15		6			
A. mallochi					30		2			
Psectrocladius sp.	2	3					2			
P. simulans?					14		25			
Dicrotendipes sp.							1			
D. nervosus	5	1			12	4	2			
Glyptotendipes amplus?					10					
Parachironomus abortivus		1			10		4			
Polypedilum sp.	5									
Chironomus riparius gr.							1			
Tanytarsus Group A Rob.							1			
Trichoptera										
Cyrnellus fraternus	4	9	1			8	9			
Odonata										
Zygoptera										
Argia apicalis		1	2			7	13			
Anisoptera										
Neurocordulia moesta							1			
Crustacea										
Decapoda										
Orconectes propinquus	1				1	3				
Amphipoda										
Crangonyx sp.							1			
Oligochaeta					1	2	53			
Hirudinea										
Piscicolidae					1					
Turbellaria	1	217	94			4	44			
Nematoda		2	15							
Mollusca										
Gastropoda										
Physa sp.		10	1		1					
Ferrissia sp.							6			
Pelecypoda										
Corbicula sp.							1			
Bryozoa										
Plumatella sp.							X			
Fredericella sp.			X							
Urnatella gracilis		X	X		X	X	X			
Coelenterata										
Cordylophora lacustris		X	X		X	X	X			
Hydra sp.	X	X			X	X	X			
Total Individuals	55	244	113		95	57	172			
Total Taxa	8	11	8		13	10	21			

X=present

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Addison, Ohio

Av.No./ft^2

	1963			1965	1966		1967			
ORGANISM: Date	5/7	7/30	11/6	7/13	7/21		8/23			
Diptera										
Chironomidae				<1						
Procladius sp.	<1	6	1	2	2		6			
Coelotanypus sp.		<1	49				1			
Ablabesmyia rhamphe							<1			
Dicrotendipes sp.			1							
D. nervosus							<1			
Glyptotendipes sp.							<1			
Cryptochironomus digitatus gr.		1	3		<1		<1			
Parachironomus abortivus							<1			
Culicidae										
Chaoborus sp.		<1	<1	2						
Trichoptera										
Cyrnellus fraternus							<1			
Hydropsyche sp.					<1					
Odonata										
Anisoptera										
Dromogomphus sp.	<1									
Coleoptera	<1									
Crustacea										
Decapoda										
Orconectes propinquus							<1			
Oligochaeta	14	183	29	87	103		148			
Hirudinea										
Mooreobdella microstoma	<1				<1		<1			
Nematoda	<1									
Mollusca										
Gastropoda										
Helisoma sp.			<1							
Amnicola limosa	<1									
Pelecypoda										
Corbicula sp.					<1		2			
Leptodea fragilis							<1			
Bryozoa										
Plumatella repens		S	X							
Pectinatella magnifica			S							
Lophopodella carteri		S	X							
Hyalinella sp.							S			
Ephemeroptera				1						
Total Individuals	20	192	85	93	109		166			
Total Taxa	7	5	9	5	6		13			

X=present
S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA — ARTIFICIAL SUBSTRATE

STATION: Ohio River-Addison, Ohio

Individuals/Sampler

ORGANISM: Date	7/13 1965			7/21 1966		7/11 1967	
	9/1	10/19	11/16	9/21	11/2	8/23	10/3
Diptera							
Chironomidae							
Procladius sp.	9						
Ablabesmyia rhamphe	65		1	6		20	1
Psectrocladius nigrus?				100			
P. sp. 3 Rob.	77	1	1		2	4	10
Cricotopus sp.					2		
Dicrotendipes nervosus				36	1	13	30
D. modestus	6			6			
D. incurvus gr.		1					
Cryptochironomus digitatus gr.	1						
Trichoptera							
Cyrnellus fraternus	50	18	12	91	5	70	66
Ephemeroptera							
Stenonema integrum	1						2
S. interpunctatum							1
Odonata							
Zygoptera							
Argia apicalis	11	12	1	2	5	9	
Crustacea							
Decapoda							
Orconectes propinquus	1	1		1	2		
Cambarus bartoni						2	
Oligochaeta		1	2		92		51
Hirudinea							
Piscicolidae		2			11		
Turbellaria		2		1	2		
Nematoda					4		1
Mollusca							
Gastropoda							
Physa sp.	1						
Gyraulus sp.							1
Ferrissia sp.							2
Bryozoa							
Plumatella sp.					X		
Urnatella gracilis							X
Coelenterata							
Cordylophora lacustris	X			X	X		X
Hydra sp.	X						
Porifera							X
Total Individuals	222	38	17	243	126	118	165
Total Taxa	12	8	5	9	11	6	13

X=present

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Huntington, W. Va.

Av.No./ft^2

ORGANISM:	1963			1965		1966	1967
Date	5/6	7/29	11/12	7/12	8/31	7/21	8/22
Diptera							
Chironomidae		<1					
Procladius sp.		8	21	5	4	13	7
Ablabesmyia mallochi		<1			1		1
Coelotanypus sp.	<1	3	8			1	2
Dicrotendipes sp.						<1	
D. nervosus							<1
Harnischia sp.						<1	
Cryptochironomus digitatus gr.	2	9	10		4	4	5
Paracladopelma nais							1
Polypedilum halterale		1	3	<1			<1
P. scalaenum						1	
Xenochironomus festivus?						1	
X. rogersi						<1	
Cryptochironomus blarina	<1						
Culicidae							
Chaoborus sp.					1		
Trichoptera							
Cyrnellus fraternus					<1		<1
Oecetis sp.	<1						
Ephemeroptera							
Stenonema sp.						<1	
Neuroptera							
Saloidea				<1			
Oligochaeta	91	295	196	138	57	78	199
Turbellaria							<1
Nematoda	<1		1				
Mollusca							
Gastropoda							
Campeloma rufum				<1	<1	<1	
Amnicola sp.		<1	7				
Gyraulus sp.	F	F					
Pleurocera sp.	<1						
Pelecypoda							
Corbicula sp.	F	14	31	7	5	3	55
Leptodea sp.			2	<1			
Quadrula quadrula							<1
Proptera alata							1
Adonata sp.		1					
Bryozoa							
Pectinatella magnifica			S				
Lophopodella carteri		S		S			
Coelenterata							
Hydra sp.					X		
Total Individuals	98	334	279	154	74	106	276
Total Taxa	7	10	9	7	9	12	13

X=present
S=statoblast
F=fragment

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Huntington, W. Va.

Individuals/Sampler

ORGANISM:	7/12 1965			6/5 1966			6/1 1967			
Date	8/31	10/18	11/17	7/14	9/20	11/3	7/10	8/21	10/2	
Diptera										
Chironomidae										
Ablabesmyia rhamphe	1		2	58	30	50	27	125		
A. sp. 1		2								
Psectrocladius sp.							35		50	
P. sp. 3 Rob.		15			10	30				
Dicrotendipes sp.									5	
D. nervosus	4	11	31	85	200	400	50	75	150	
D. incurvus gr.							55			
Chironomus riparius gr.									10	
Polypedilum scalaenum				1			4		60	
Glyptotendipes sp.		3	1		45	60				
Parachironomus pectinatellae					6		2			
P. abortivus								25	20	
Trichoptera										
Cyrnellus fraternus	35	100	40	152	294	24	40	220	424	
Cheumatopsyche sp.						1			1	
Potamyia flava									1	
Ephemeroptera										
Stenonema integrum								2		
S. femoratum							2			
S. interpunctatum		3			1	2	1		3	
Caenis sp.							1	1		
Tricorythodes sp.							2			
Plecoptera										
Acroneuria arida							1			
Odonata										
Zygoptera										
Argia sp.			1		1	1				
Crustacea										
Amphipoda										
Crangonyx pseudogracilis		1								
Oligochaeta			3	2		141	18		20	
Turbellaria			3			1			3	
Nematoda						5				
Mollusca										
Gastropoda										
Physa sp.						1				
Ferrissia sp.					1	31	2		6	
Planorbidae sp. 1.		3								
Pelecypoda										
Corbicula sp.		31	12		20		6	32	29	
Sphaerium sp.				8						
CONTINUED										
Total Individuals										
Total Taxa										

SUMMARY OF MACROINVERTEBRATE DATA

ARTIFICIAL SUBSTRATE

STATION: Ohio River-Huntington, W. Va.

CONTINUATION

Individuals/Sampler

ORGANISM: Date	7/12 1965 8/31	10/18	11/17	6/5 1966 7/14	9/20	11/3	6/1 1967 7/10	8/21	10/2
Hydracarina									1
Bryozoa									
Pectinatella magnifica					X	X			
Hyalinella punctata						X			
Coelenterata									
Cordylophora lacustris	X	X				X			X
Hydra sp.	X				X	X	X	X	X
Total Individuals	40	169	93	306	608	747	246	480	783
Total Taxa	5	10	8	6	12	17	16	8	17

X=present

SUMMARY OF MACROINVERTEBRATE DATA

DREDGE

STATION: Ohio River-Cincinnati, Ohio

Av.No./ft^2

ORGANISM:	1963		1964	1965	1966	1967
Date	5/2	8/8	8/12	8/25	7/24	6/16
Diptera					<1	
Chironomidae						
Procladius sp.	<1	4	3	5	2	1
Coelotanypus sp.	1	5	7	3	1	
Ablabesmyia rhamphe		<1	<1			
Smittia sp.						<1
Dicrotendipes sp.			<1			
D. nervosus				1		
Polypedilum halterale	4			7		<1
P. ophioides?	1					<1
P. parascalaenum						
Chironomus attenuatus		<1	1		<1	
Stenochironomus sp.	<1					
Cryptochironomus digitatus gr.	1	<1	2	6	<1	<1
Trichoptera						
Cyrnellus fraternus			<1			
Ephemeroptera						
Stenonema sp.		<1				
Odonata						
Anisoptera						
Gomphus spiniceps		<1			<1	
Coleoptera				1		
Crustacea						
Amphipoda						
Crangonyx pseudogracilis		<1				
Oligochaeta	16	126	23	19	196	39
Nematoda	<1					
Mollusca						
Pelecypoda						
Corbicula sp.	F	2	1	2	<1	3
Proptera sp.		<1	<1			
Gastropoda						
Pleurocera sp.		<1		1		
Planorbula sp.				3		
Physa sp.				3		
Bryozoa						
Pectinatella magnifica	S			X		
Diptera						
Culicidae						
Chaoborus punctipennis			3			
Total Individuals	26	145	44	51	204	47
Total Taxa	8	14	11	12	8	7

X=present

S=statoblast

F=fragment

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Cincinnati, Ohio

	Individuals/Sampler								Years continued	
	7/8 1964			5/7 1965						
ORGANISM: Date	8/12	9/15		6/8	7/16	8/25	10/6	11/16		
Diptera										
Chironomidae										
Ablabesmyia rhamphe	19	2			19	4				
A. sp. 1	1			3						
Psectrocladius sp.	9			1	4	4	11	1		
Dicrotendipes nervosus	7			1	12	43	1	2		
Parachironomus abortivus	3									
P. pectinatellae						6				
Harnischia sp.				1						
Cryptochironomus digitatus gr.							1			
Polypedilum scalaenum				2						
Xenochironomus xenolabis						2				
Trichoptera										
Cyrnellus fraternus	92	61		6	144	107	62	7		
Ephemeroptera										
Stenonema sp.	1			37	2	1				
Caenis sp.	5			2						
Tricorythodes sp.							1			
Odonata										
Zygoptera										
Argia sp.	1	1		1			2	2		
Anisoptera										
Dromogomphus sp.	8	17								
Coleoptera										
Dubiraphia sp.				1						
Crustacea										
Decapoda										
Orconectes sp.	2									
Oligochaeta	2									
Turbellaria	1							3		
Bryozoa										
Pectinatella magnifica						X	X			
Coelenterata										
Cordylophora lacustris	X			X	X	X	X	X		
Hydra sp.	X			X						
Total Individuals	151	81		55	181	167	78	15		
Total Taxa	15	4		12	6	9	8	6		

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Cincinnati, Ohio

Individuals/Sampler

ORGANISM: Date	6/28 1966 7/29	9/12	10/25	11/21	6/13 1967 7/25	9/5	10/17
Diptera							
Chironomidae							
Ablabesmyia rhamphe	8	8	1	8	60	14	
Conchapelopia sp.							2
Psectrocladius sp.	107	16	10	32	20	46	18
Cricotopus trifasciatus gr.					10		
C. exilis gr.						2	
Dicrotendipes nervosus	56	15	5	8	30	16	25
D. neomodestus	13				15	8	
Polypedilum scalaenum		8			10	10	
Xenochironomus xenolabis		4				1	
Glyptotendipes senilis?				4			
Tanytarsus (Rheotanytarsus)						2	
Trichoptera							
Cyrnellus fraternus	347	267	50	6	336	333	275
Leptocella sp.						2	
Cheumatopsyche sp.							1
Hydroptila waubesiana						1	
Plecoptera							
Taeniopteryx nivalis				4			
Ephemeroptera							
Stenonema integrum		1		2	4	16	3
S. interpunctatum					11	5	82
Caenis sp.				2			
Tricorythodes sp.						1	
Odonata							
Zygoptera							
Argia apicalis		3	1		1		2
Crustacea							
Amphipoda							
Hyalella azteca	1						
Oligochaeta	27			22	3	7	9
Turbellaria			5	2			11
Nematoda				2			
Mollusca							
Gastropoda							
Physa sp.						1	
Pelecypoda							
Corbicula sp.				2		1	3
Bryozoa							
Pectinatella magnifica		X		S			
Plumatella repens			X	S			
Coelenterata							
Cordylophora lacustris		X	X	X	X	X	X
Hydra sp.				X	X	X	X
Craspedacusta sowerbii				X			
Porifera				X			
Total Individuals	559	322	72	94	500	466	431
Total Taxa	7	10	8	16	13	19	14

X=present

S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Louisville, Ky.

Av.No./ft^2

ORGANISM:	1963 Date 5/24	8/12	1964 8/13	1965 5/17	1966 7/6	1967 8/31
Diptera						
Chironomidae						
Procladius sp.	2	21	3		17	<1
Coelotanypus sp.	4	7	13	3	2	4
Ablabesmyia rhamphe		<1	<1			
A. mallochi						3
Conchapelopia sp.						<1
Cryptochironomus digitatus gr.		<1	<1		1	3
Chironomus attenuatus		1				
Glyptotendipes sp.			<1			
Polypedilum halterale	<1	<1				
P. scalaenum						2
Dicrotendipes nervosus						<1
D. modestus						2
Psectrocladius sp.						<1
Cricotopus sp.			<1			
Culicidae						
Chaoborus punctipennis		4	6			
Trichoptera						
Cyrnellus fraternus		<1				2
Oecetis sp.			<1			
Potamyia flava						<1
Hemiptera						
Corxidae	<1					
Odonata						
Anisoptera						
Dromogomphus sp.		E				
Zygoptera						
Enallagma sp.						<1
E. doubledayi						<1
E. signatum						<1
Crustacea						
Amphipoda						
Crangonyx pseudogracilis			<1			
Isopoda						
Asellus sp.				1		
Hirudinea						
Placobdella sp.		2	1		1	<1
Dina sp.						1
Oligochaeta	71	29	37	9	339	77
Turbellaria			1			
Nematoda						<1
CONTINUED						
Total Individuals						
Total Taxa						

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Louisville, Ky.
CONTINUATION

ORGANISM:	1963		1964	1965	1966	1967
Date	5/24	8/12	8/13	5/17	7/6	8/31
Mollusca						
Gastropoda						
Somatogyrus sp.	1	2	1	2		1
Ferrissia sp.			<1			
Pleurocera	<1	<1	<1	1		
Physa sp.		F				<1
Amnicola sp.		1	<1	<1		
Viviparous sp.		<1				
Pelecypoda						
Corbicula sp.	<1	2	7	4	6	44
Sphaerium sp.	<1	2	1			
Lampsilis sp.	1					
Proptera sp.		<1				
Anadonta grandis						<1
Quadrula sp.					<1	
Bryozoa						
Plumatella sp.		S				X
Pectinatella magnifica		S				
Lophopodella carteri	S	S				
Coelenterata						
Cordylophora lacustris			X			X
Total Individuals	84	78	79	21	367	151
Total Taxa	10	17	19	7	7	24

X=present
F=fragment
S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Louisville, Ky.

	Individuals/Sampler									
	5/17	1965			5/23	1966		6/8	1967	
ORGANISM: Date	6/15	8/10	9/28	11/12	7/6	8/24	11/7	7/20	8/31	10/12
Diptera										
Chironomidae		2								
Ablabesmyia rhamphe	17	39					2			
Procladius sp.						5				
Conchapelopia sp.									6	4
Coelotanypus sp.	1	2								
Orthocladius sp.		3								
Psectrocladius sp.	11	6		1	22	21	3	20	35	68
Cricotopus exilis gr.										4
C. trifasciatus gr.					81	6	2	6		14
C. bicinctus gr.					12	2	5	30	12	14
Cricotopus sp. 1	2									
Dicrotendipes sp.	2		1							
D. nervosus		48		6	3	68		6	24	108
D. modestus			6		5		8			14
D. neomodestus									6	14
Cryptochironomus digitatus gr.										27
Parachironomus abortivus	1	4						1		
P. pectinatellae		4								
Xenochironomus xenolabis		8				1			12	
Polypedilum sp.		2				12		6		27
P. scalaenum	1	1							24	6
Glyptotendipes sp.				2		2	14			
Trichoptera										
Cyrnellus fraternus	5	150	91	5	4	198	1	51	109	206
Hydropsyche orris					1				2	2
Potamyia flava										3
Hydroptila waubesiana				1			3			5
Arthripsodes sp.		1								
Ephemeroptera										
Stenonema integrum	8					1		3	2	4
S. interpunctatum	8				1		1	1		34
Caenis sp.	5				1					
Plecoptera										
Acroneuria sp.					1		1			
Taeniopteryx nivalis							9			
Odonata										
Zygoptera										
Argia sp.		1								
Crustacea										
Decapoda										
Orconectes rusticus	1									
Amphipoda										
Crangonyx sp.			1	6						
Oligochaeta							248			307
CONTINUED										
Total Individuals										
Total Taxa										

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Louisville, Ky.

CONTINUATION	5/17		1965		5/23	1966		6/8	1967	
ORGANISM: Date	6/15	8/10	9/28	11/12	7/6	8/24	11/7	7/20	8/31	10/12
Turbellaria		37	2	4						
Nematoda										1
Mollusca										
Gastropoda										
Physa sp.			2							
Somatogyrus sp.				2						2
Ferrissia sp.									5	
Pelecypoda										
Corbicula sp.		62	6	4						67
Bryozoa										
Plumatella sp.		X							X	
Pectinatella sp.		X								
Stolella sp.										X
Coelenterata										
Cordylophora lacustris	X		X	X						X
Hydra sp.							X		X	X
Total Individuals	62	370	109	31	131	316	297	124	237	931
Total Taxa	13	17	8	10	10	10	13	9	13	24

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Evansville, Ind.

Av.No./ft^2

ORGANISM: Date	1963 5/17	1963 8/15	1965 6/16	1966 8/24	1967 9/5
Diptera					
Chironomidae	<1				
Ablabesmyia rhamphe	<1	<1			
Procladius sp.	<1	1	1	<1	<1
Coelotanypus sp.	<1	6			4
Tanypus sp. B, Joh.					2
Cricotopus bicinctus gr.	<1				
Dicrotendipes sp.				<1	
Chironomus attenuatus				4	
Glyptotendipes sp.				1	2
Stenochironomus sp.			1		
Polypedilum illinoense	1	1	1		
P. halterale		1		44	2
P. scalaenum	<1				
Cryptochironomus digitatus gr	<1	4		1	6
C. blarina					4
Paracladopelma nais					<1
Anthomyiidae					
Limnophora aequifrons	<1			<1	
Culicidae					
Chaoborus punctipennis		1			
Ceratopogonidae					1
Empididae	<1				
Trichoptera					
Cyrnellus fraternus				<1	
Hydropsyche sp.					F
Leptoceridae	<1	<1			
Ephemeroptera					
Hexagenia sp.					<1
Traverella sp.					5
Coleoptera	F				
Crustacea					
Amphipoda					
Crangonyx pseudogracilis	<1				
Lepidoptera	1				
Oligochaeta	20	57	2	62	140
Hirudinea		<1			1
Mollusca					
Gastropoda					
Planorbidae		<1			
Somatogyrus sp.	<1		1		<1
Ferrissia sp.					<1
Pelecypoda					
Corbicula sp.	<1	1	1		36
Leptodea sp.		1			
Anadonta sp.					1
CONTINUED					
Total Individuals					
Total Taxa					

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Evansville, Ind.

CONTINUATION

Av.No./ft^2

ORGANISM: Date	1963 5/17	1963 8/15	1965 6/16	1966 8/24	1967 9/5
Bryozoa					
Plumatella sp.		S			
Pectinatella magnifica	S	S			S
Lophopodella sp.				S	
Coelenterata					
Cordylophora lacustris	X				
Total Individuals	35	77	7	116	209
Total Taxa	16	13	6	9	17

X=present
S=statoblast
F=fragment

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Evansville, Ind.

Individuals/Sampler

ORGANISM: Date	8/10 1965 9/28	11/3	12/21	5/24 1966 7/8	8/24	11/4	5/5 1967 6/19	7/17 9/5	10/20
Diptera									
Chironomidae									
Ablabesmyia rhamphe	36	2	1	17	17		13	50	
Conchapelopia sp.								29	140
Coelotanypus sp.	15	2							
Procladius sp.		4							
Psectrocladius sp.	2	116	7	26	55	30		116	9
Cricotopus bicinctus gr.			4				15		
C. trifasciatus gr.				10		5	15		
Dicrotendipes sp.						4			
D. modestus				1	1				
D. nervosus	15	92	39	6	14	15	1		
Glyptotendipes lobiferus			15	45	86	15		6	9
G. amplus?								6	
Stenochironomus gibbus								1	
Polypedilum illinoense						40	20	174	72
P. tritum?							3		
P. halterale	3			3	12				
Cryptochironomus digitatus gr.		2							
Parachironomus abortivus						5		12	
P. pectinatellae								6	
Tanytarsus(Rheotanytarsus) sp.						10	1	232	
Simuliidae						1	3		
Empididae									
Hemerodromia sp.								6	24
Anthomyiidae									
Limnophora sp.								1	
Trichoptera									
Cyrnellus fraternus	879	116	8	393	852	7		94	608
Neureclipsis crepuscularis					3			11	48
Hydropsyche orris				1	1	5		110	344
H. nr. frisoni								19	
H. simulans									8
Potamyia flava			12			4		145	3964
Hydroptila waubesiana						1			
Leptocella pavida									4
Athripsodes tarsi-punctatum								4	
Ochrotrichia tarsalis		4							
Plecoptera									
Isoperla bilineata			10			2			
Taeniopteryx nivalis			2						
Acroneuria arida?							1		
CONTINUED									
Total Individuals									
Total Taxa									

SUMMARY OF MACROINVERTEBRATE DATA — ARTIFICIAL SUBSTRATE

STATION: Ohio River-Evansville, Ind.

CONTINUATION — Individuals/Sampler

ORGANISM:	Date	8/10 1965 9/28	11/3	12/21	5/24 1966 7/8	8/24	11/4	5/5 1967 6/19	7/17	10/20
Ephemeroptera										
Stenonema integrum			40	40	15	12	8	75	112	8
S. interpunctatum			4	34	3	15	10	4	6	428
S. (Pulchellum) sp. 3										4
Caenis sp.								9		
Tricorythodes sp.			8				1		5	
Isonychia sp.									6	
Baetis vagans						1		1		
Odonata										
Zygoptera										
Argia apicalis		6	6	6					1	
Anisoptera										
Neurocordulia sp.		3								
Crustacea										
Amphipoda										
Crangonyx pseudogracilis					1					4
Hyalella azteca					1					
Oligochaeta				4			8	66		8
Turbellaria						4				
Nematoda							1			
Mollusca										
Gastropoda						2				
Pelecypoda										
Corbicula sp.									2	8
Sphaerium sp.			16	2						
Bryozoa										
Plumatella sp.									X	X
Pectinatella magnifica									S	
Coelenterata										
Cordylophora lacustris			X	X						
Hydra sp.			X	X			X	X		
Hydracarina									1	
Total Individuals		959	412	184	522	1075	172	227	1155	5690
Total Taxa		8	15	16	13	14	20	15	26	18

X=present
S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Ohio River-Cairo, Ill.

Av.No./ft^2

ORGANISM:	1963		1964	1966	1967
Date	5/16	8/13	7/26	8/25	8/29
Diptera					
Chironomidae					
Procladius sp.			<1		2
Coelotanypus sp.	1	3	3		2
Ablabesmyia rhamphe			1		
Polypedilum scalaenum					1
P. halterale					1
Cryptochironomus digitatus gr			<1	4	6
Stenochironomus sp.	<1				
Culicidae					
Chaoborus sp.		<1			
Ceratopogonidae			<1		1
Trichoptera					
Neureclipsis crepuscularis					<1
Hydropsyche sp.				3	
Ephemeroptera					
Hexagenia limbata?			5		
Traverella sp.					<1
Caenis sp.			<1		
Odonata					
Anisoptera					
Gomphus sp.		<1			<1
Coleoptera	F				
Crustacea					
Isopoda					
Asellus sp.	<1				
Oligochaeta		12	4	51	211
Nematoda					<1
Mollusca					
Pelecypoda					
Corbicula sp.	F	13	17	2	9
Hirudinea					
Placobdella sp.					<1
Bryozoa					
Pectinatella magnifica					S
Lophopodella sp.	S	S	S		S
Total Individuals	3	30	34	60	238
Total Taxa	3	5	9	4	13

F=fragment
S=statoblast

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Ohio River-Cairo, Ill.

Individuals/Sampler

ORGANISM: Date	6/17 1965				7/14 1966			8/8 1967		
	8/12	11/4	12/28		8/25	10/3		9/22	10/30	
Diptera										
Chironomidae										
Ablabesmyia rhamphe	3		1		1					
Conchapelopia sp.									6	
Psectrocladius sp.	2	16	10							
Cricotopus bicinctus gr.					20	41				
Dicrotendipes sp.			3		8	4			3	
D. modestus						7				
D. incurvus gr.									2	
D. nervosus		4	5							
Polypedilum illinoense	19	24	2		90	53		300	8	
P. scalaenum								32	4	
Tanytarsus (Rheotanytarsus) sp.									1	
Empididae										
Hemerodromia sp.									3	
Trichoptera										
Cyrnellus fraternus	11		6		3				9	
Neureclipsis crepuscularis	4		2					40	30	
Hydropsyche orris	15	110	102		129	56		472	10	
H. simulans		4								
H. nr frisoni					165	3		72	2	
Potamyia flava		344	97					312	93	
Cheumatopsyche sp.	40		3						1	
Hydroptila sp.						1				
Ephemeroptera										
Stenonema integrum	37	28	49		13	6		8	9	
Isonychia sp.	2									
Caenis sp.	7									
Tricorythodes sp.		4	1		5	23			2	
Baetis sp.	6				19	7			9	
Odonata										
Anisoptera										
Neurocordulia sp.	6	12								
Zygoptera										
Argia sp.									2	
Coleoptera										
Stenelmis sp.					1				F	
Crustacea										
Isopoda										
Asellus sp.						F			1	
Amphipoda										
Stygobromus sp.						1				
Oligochaeta								8	62	
Nematoda					3					
Turbellaria			1					16		
CONTINUED										
Total Individuals										
Total Taxa										

SUMMARY OF MACROINVERTEBRATE DATA — ARTIFICIAL SUBSTRATE

STATION: Ohio River-Cairo, Ill.

CONTINUATION

Individuals/Sampler

ORGANISM:	6/17 1965			7/14 1966		8/8 1967	
Date	8/12	11/4	12/28	8/25	10/3	9/22	10/30
Mollusca							
Pelecypoda							
Corbicula sp.							2
Bryozoa							
Plumatella sp.							X
Pectinatella magnifica							S
Lophopodella carteri						S	S
Coelenterata							
Cordylophora lacustris	X		X		X		X
Hydra sp.		X	X				X
Total Individuals	152	546	282	457	202	1260	259
Total Taxa	13	10	15	12	12	9	23

X=present
S=statoblast
F=fragment

SUMMARY OF MACROINVERTEBRATE DATA

DREDGE

STATION: Kanawha River-London, W. Va.

Av.No./ft^2

ORGANISM: Date	1967 8/22
Diptera	
Chironomidae	
Procladius sp.	3
Coelotanypus sp.	5
Ablabesmyia mallochi	<1
Cricotopus slossonae?	<1
Polypedilum halterale	1
Cryptochironomus digitatus gr.	2
Paracladopelma nais	2
Chironomus attenuatus	<1
Dicrotendipes sp.	1
Xenochironomus rogersi	1
Neuroptera	
Sialis sp.	<1
Coleoptera	
Dubiraphia sp.	<1
Crustacea	
Amphipoda	F
Hydracarina	<1
Oligochaeta	14
Mollusca	
Pelecypoda	
Corbicula sp.	95
Total Individuals	130
Total Taxa	15

F=fragment

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Kanawha River-London, W. Va.

Individuals/Sampler

ORGANISM: Date	5/10 1966 7/22	9/21	11/3	6/1 1967 7/11	8/22	10/3
Diptera						
Chironomidae						
Ablabesmyia sp.	2	14				
A. mallochi					7	
Orthocladius sp.	3					
Psectrocladius sp.	40	10	2	17	6	
Cricotopus bicinctus gr.						3
C. ceris ?					2	
C. slossonae					10	
Corynoneura sp.		1				
Dicrotendipes nervosus	22	1				
D. incurvus gr.	8					
D. neomodestus	4				20	
D. modestus		20				
Cryptochironomus digitatus gr.					3	
Parachironomus abortivus	5				7	
Polypedilum scalaenum	23	2	1		4	
Glyptotendipes senilis?		4				2
Xenochironomus sp.	1					
Phaenopsectra sp.	2					12
Micropsectra deflecta	5	8				
Ceratopogonidae						
Probezzia sp.	94			27		
Trichoptera						
Cyrnellus fraternus	1	17		6		20
Ephemeroptera						
Stenonema integrum				4	1	7
S. interpunctatum	2			15	4	68
Tricorythodes sp.	1					3
Odonata						
Zygoptera						
Argia translata		17				3
Enallagma sp.			1			
E. signatum					1	
E. antennatum						5
Ischnura verticalis					1	
Chromagrion sp.				1	1	
Anisoptera						
Macromia sp.	1					
Neurocordulia obsolita				1	1	
Neuroptera						
Climacia areolaris	9				1	4
Hemiptera						
Pentacora sp.					2	
CONTINUED						
Total Individuals						
Total Taxa						

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Kanawha River-London, W. Va.

CONTINUATION

Individuals/Sampler

ORGANISM: Date	5/10 1966 7/23	9/21	11/3	6/1 1967 7/11	8/22	10/3
Crustacea						
Decapoda						
Orconectes rusticus	1			1	1	
Amphipoda						
Hyalella azteca	244	4			88	5
Crangonyx pseudogracilis	19	1		16	89	
Oligochaeta			1		2	7
Hirudinea						
Illinobdella sp.						1
Piscicolidae					1	
Turbellaria	14	159	16		3	29
Mollusca						
Gastropoda						
Gyraulus sp.	23		13			
Ferrissia shimekii			1			
F. tarda					3	25
Physa sp.					6	15
Pelecypoda						
Corbicula sp.		4				1
Bryozoa						
Plumatella sp.	X					X
Urnatella gracilis			X			X
Coelenterata						
Cordylophora lacustris			X			
Hydra sp.					X	X
Total Individuals	524	262	35	88	264	210
Total Taxa	23	14	9	9	25	20

X=present

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Kanawha River-Winfield Dam, W. Va.

Av.No./ft^2

ORGANISM: Date	1963 5/7	1963 7/30	1963 11/6	1966 7/22	1967 8/23
Diptera					
Chironomidae					
Procladius sp.		<1			4
Coelotanypus sp.	<1				
Psectrocladius sp.					<1
Chironomus attenuatus					1
Culicidae					
Chaoborus sp.				<1	<1
Ephemeroptera					
Stenonema sp.				F	
Coleoptera					
Elmidae	2				
Berosus sp.	1				
Oligochaeta	162	860	364	17	1052
Hirudinea					
Mooreobdella microstoma					<1
Mollusca					
Gastropoda					
Physa sp.				F	
Bryozoa					
Lophopodella carteri					S
Pectinatella magnifica					S
Hyalinella sp.					S
Total Individuals	166	861	364	18	1060
Total Taxa	4	2	1	2	6

X=present
S=statoblast
F=fragment

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Kanawha River-Winfield Dam, W. Va.

Individuals/Sampler

ORGANISM: Date	7/13 1965 9/1	10/18	11/18	4/26 1966 7/21	9/21	11/3	6/1 1967 7/11	8/23	10/3
Diptera									
Chironomidae									
Ablabesmyia rhamphe						24		2	
Procladius sp.							1		
Psectrocladius sp.							4		
Dicrotendipes nervosus			1						
D. incurvus gr.						40		40	12
Parachironomus abortivus					2		1	12	4
Chironomus attenuatus								6	8
Tanytarsus Group A Rob.									4
Culicidae									
Chaoborus sp.							17		
Fungivoridae									4
Trichoptera									
Cyrnellus fraternus			1						
Odonata									
Anisoptera									
Perithemis tenera							1		
Oligochaeta	556	147	8	13	32	1672	147	3632	1004
Nematoda						8000		274	4
Turbellaria						8		8	8
Mollusca									
Gastropoda									
Physa sp.					3	40	10	2	
Gyraulus sp.							12		
Helisoma sp.					2		1		
Ferrissia sp.								2	
Total Individuals	556	147	10	13	39	9784	194	3978	1048
Total Taxa	1	1	3	1	4	6	9	9	8

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Wabash River-New Harmony, Ind.

Av.No./ft^2 *

ORGANISM: Date	1963 8/14	1965 6/16	1965 8/11	1966 8/25	1967 9/5
Diptera					
Chironomidae					
Procladius sp.	1		8	14	1
Coelotanypus sp.	5			14	5
Tanypus sp. B. Joh.	4		4		2
T. sp. 1.	1				
Pentaneurini gen. & sp. n.					1
Ablabesmyia sp. 1					2
A. sp. 2					1
Labrundinia pilosella					1
Dicrotendipes sp.			4		1
Polypedilum halterale			4	1	3
P. scalaenum				1	
P. illinoense			4		
P. convictum?					1
P. parascalaenum?				3	1
Cryptochironomus digitatus gr.			4	6	2
C. sp 4 Rob.	1				
Parachironomus abortivus	1				
P. pectinatellae			4		
P. sp. 2 Rob.					1
Xenochironomus rogersi?				1	2
X. scopula?				1	
Chironomus attenuatus					1
Glyptotendipes lobiferus				1	2
G. barbipes?				1	
Stenochironomus taeniapennis	1				
Tanytarsus (Rheotanytarsus)					1
T. Group A. Rob.					1
Ceratopogonidae				3	1
Empididae					
Hemerodromia sp.					1
Trichoptera					
Leptocella sp.					1
Potamyia flava				1	8
Oecetis sp.					1
Ephemeroptera					
Hexagenia limbata	1	6		1	1
H. rigida?					1
Pentagenia vittgera					1
Caenis sp.			24	4	7
Baetis sp.					9
Coleoptera					
Stenelmis sp.				1	1
CONTINUED					
Total Individuals					
Total Taxa					

* 1967 samples collected from different substrate type than those in 1963-66

SUMMARY OF MACROINVERTEBRATE DATA DREDGE

STATION: Wabash River-New Harmony, Ind.

CONTINUATION

Av.No./ft^2

ORGANISM: Date	1963	1965		1966	1967
	8/14	6/16	8/11	8/25	9/5
Nematoda				1	1
Oligochaeta	49	36	88	18	56
Hirudinea					
Placobdella sp.					1
Turbellaria					1
Mollusca					
Gastropoda					
Physa sp.			4		
Planorbidae			16		
Amnicola sp.			4		
Ferrissia sp.		2			
Pelecypoda					
Corbicula sp.				F	1
Sphaerium sp.		2	8	1	1
Quadrula sp.				1	1
Lampsilis sp.					1
Bryozoa					
Pectinatella magnifica	S		S	S	S
Lophopodella carteri	S		S	X	S
Urnatella gracilis				X	X
Total Individuals	65	46	176	74	124
Total Taxa	10	4	13	21	38

X=present

S=statoblast

F=fragment

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Wabash River-New Harmony, Ind.

Individuals/Sampler

	6/17		1965		6/8		1966		6/19	1967	
ORGANISM: Date	8/10	9/29	11/17	12/20	7/15	8/25	10/7	11/9	7/25	9/5	10/20
Diptera											
Chironomidae											
Ablabesmyia sp. 1	98	61	380	27	50	150	100	100		10	
A. mallochi									80	40	
Conchapelopia sp.									40	96	80
Labrundinia sp.									16	12	
Pentaneurini sp. 1.										4	
Coelotanypus sp.	10	23									
Procladius sp.		11									
Psectrocladius sp.		5									
Orthocladius sp.				1							
Corynoneura celeripes										12	
Dicrotendipes nervosus	7				50	300		25			
D. modestus	10		36								
Cryptochironomus digitatus	6		16	1				25			
Parachironomus pectinatellae										6	
P. abortivus	3	16									
Polypedilum illinoense	21	18	12	2							50
Chironomus riparius gr.									4		
Glyptotendipes barbipes?	4	48	24	18	2900	11000	13500	1000	350	600	3500
Tribelos sp.		1							80	50	
Tanytarsus(Rheotanytarsus)		1									
Calopsectra sp.			24	5							
Ceratopogonidae	1	1									
Trichoptera											
Cyrnellus fraternus	64	119	1		56	872	1008	60		82	576
Hydropsyche orris			1								4
Potamyia flava		180	60	74	4		16	8	32	25	92
Macronemum sp.		1									
Cheumatopsyche sp.	23										
Leptocella sp.			4	3						2	28
Athripsodes sp.										1	
Hydroptilidae											4
Plecoptera											
Acroneuria abnormis		2	4								
A. sp. 1.		2									
Isoperla bilineata				5							
Ephemeroptera											
Stenonema ares	138			4							
S. integrum		29	20	9	222		8	4	280	271	88
S. interpunctatum									8		4
Isonychia sp.	1				8				4		
Caenis sp.	667	13			40	8			316	56	4
Tricorythodes sp.	24	4			12					2	4
Baetis sp.	2									8	
Hexagenia sp.	11	2									
CONTINUED											
Total Individuals											
Total Taxa											

SUMMARY OF MACROINVERTEBRATE DATA ARTIFICIAL SUBSTRATE

STATION: Wabash River-New Harmony, Ind.

CONTINUATION

Individuals/Sampler

ORGANISM:	6/17	1965			6/8	1966			6/19	1967	
Date	8/10	9/29	11/17	12/20	7/15	8/25	10/7	11/9	7/25	9/5	10/
Odonata											
Zygoptera											
Argia apicalis	37	32	36	2	4	32	56	4	12	9	4
Anisoptera											
Gomphus vastus	3	4	14			16	16				
G. crassus			14								
Erpetogomphus		1									
Neurocordulia sp.	2	2	4								
Coleoptera											
Stenelmis sexlineata	8	7	8	2	4	56	8		76	1	
Helodidae					8						
Dineutus sp.						8					
Crustacea											
Isopoda											
Asellus sp.		1						4	12		
Decapoda											
Orconectes rusticus	1					8					
O. propinquus		1		2							
Oligochaeta	3	6	16	35		2568	984	2524	4		44
Hirudinea											
Dina sp.		1							4		
Turbellaria	4	5	12	17	20	64	192	12	44	45	28
Mollusca											
Gastropoda											
Viviparus intertextus?		1			8			4			
Physa sp.							16	4			
Pelecypoda											
Sphaerium sp.	4	9	12	1							
Bryozoa											
Plumatella repens			X	X			X	X		X	X
Pectinatella magnifica						X	X	X		S	X
Lophopodella carteri	X	X	X	X			X				S
Urnatella gracilis					X	X	X	X		X	X
Coelenterata											
Cordylophora lacustris	X										
Diptera											
Empididae											
Hemerodromia sp.										1	4
Total Individuals	1152	607	698	208	3386	15082	15904	3774	1362	1333	4514
Total Taxa	27	32	22	19	15	14	15	16	17	23	19

X=present

S=statoblast

TABLE III. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-MONTHLY VALUES 1963

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s. thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
ALLEGHENY RIVER													
	Min	24.0	7.4	5.0	2.0	23.0	7.2	6.7	1.8	20.0	7.4	6.8	1.6
Pittsburgh	Mean	25.6	7.8	6.4	3.0	24.8	7.6	6.8	2.3	22.3	7.9	6.9	1.8
	Max	27.0	8.0	7.1	4.7	27.0	8.0	6.9	3.3	25.0	8.6	7.1	2.2
MONONGAHELA RIVER													
	Min	24.6	--	5.1	2.6	26.0	--	4.3	2.8	21.4		4.9	2.3
Pittsburgh	Mean	28.2	--	7.8	3.0	26.5	--	4.5	4.8	23.9	0.0 *	5.7	2.9
	Max	32.0	--	6.3	3.2	27.0	--	4.6	9.8	26.2		6.4	3.8
OHIO RIVER													
	Min												
Pittsburgh	Mean												
	Max												
	Min	25.5	--	6.8	4.8	24.5	--	6.8	5.0	22.5	--	6.7	3.8
Toronto	Mean	26.1	--	6.9	5.6	26.4	--	6.9	7.4	23.6	--	6.8	4.6
	Max	27.5	--	7.0	6.5	28.0	--	7.0	13.8	25.0	--	6.8	5.5
	Min	27.0	7.2	7.3	--	24.1	5.5	7.2	--	22.0	6.3	7.2	--
Addison	Mean	27.6	7.4	7.4	--	26.2	6.3	7.5	--	24.3	6.5	7.3	--
	Max	28.8	7.6	7.6	--	27.8	6.8	7.7	--	27.0	6.7	7.6	--
	Min	25.6	4.0	6.9	9.0	--	3.5	--	7.6	--	1.4	--	7.6
Huntington	Mean	27.0	4.2	7.0	13.2	--	3.5	--	11.5	--	2.5	--	10.2
	Max	28.0	5.0	7.2	21.5	--	3.5	--	15.1	--	3.5	--	11.6
	Min	25.5	6.0	7.4	--	24.2	2.6	7.0	--	22.2	5.3	7.2	--
Cincinnati	Mean	26.7	6.7	7.6	--	26.1	4.8	7.1	--	24.3	6.2	7.4	--
	Max	27.8	7.5	7.8	--	27.7	5.8	7.2	--	25.7	7.3	7.5	--

* One Reading

TABLE III. CHEMICAL & PHYSICAL DATA 1963

(Continued)

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
Louisville	Min	26.1	6.4	7.4	9.8	26.6	7.0	7.5	9.2	21.7	6.6	7.2	8.0
	Mean	26.7	8.4	7.6	16.2	27.6	7.8	7.7	22.3	24.1	7.2	7.4	11.7
	Max	27.7	10.6	7.9	19.8	28.9	8.9	7.8	44.9	26.1	8.6	7.5	19.0
Evansville	Min	25.0	7.5	7.6	28.0	28.0	0.0	8.0	24.0				
	Mean	27.0	8.3	7.8	28.0	28.5	9.0	8.1	24.0				
	Max	28.0	9.0	8.1	28.0	29.0	9.0	8.1	24.0				
Cairo	Min	28.0	6.1	7.5	91.5	26.2	5.2	7.5	73.7	24.0	6.5	7.5	41.6
	Mean	28.5	7.1	7.6	106.9	28.0	6.5	7.5	93.3	26.1	7.1	7.5	67.6
	Max	29.0	7.5	7.9	124.0	29.5	7.2	7.5	119.0	27.4	8.0	7.6	83.8
KANAWHA RIVER													
Winfield Dam	Min	27.0	0.0	7.0	2.5	26.0	1.5	6.6	2.4	24.0	0.0	6.7	1.8
	Mean	28.5	0.9	7.4	3.5	27.0	1.5	6.8	2.6	25.3	0.0	6.8	2.2
	Max	29.0	2.3	7.5	5.6	28.0	1.5	6.9	2.8	27.0	0.0	6.8	2.6
WABASH RIVER													
New Harmony	Min	25.0	4.9	7.8	7.2	--	--	8.5	6.2	22.0	5.9	7.5	3.7
	Mean	26.0	7.4	8.2	10.0	--	--	8.5	6.4	22.5	6.6	7.8	4.3
	Max	27.0	9.8	8.6	14.8	--	--	8.5	6.6	23.0	7.3	8.0	4.9

TABLE III. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-MONTHLY VALUES 1964

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s. thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
ALLEGHENY RIVER													
	Min	26.0	6.6	4.9	2.7	23.0	7.2	5.9	3.7	19.0	7.8	5.6	1.8
Pittsburgh	Mean	27.0	7.5	6.4	6.4	24.5	7.9	6.7	7.1	22.4	8.3	6.7	2.5
	Max	28.0	8.4	7.0	17.8	26.0	8.3	7.4	15.8	24.0	8.6	7.1	4.2
MONONGAHELA RIVER													
	Min	26.8	--	6.0	2.8	26.5	--	5.3	2.6	25.4	--	6.4	1.6
Pittsburgh	Mean	28.1	--	6.4	3.9	27.0	--	5.0	3.0	28.0	--	6.9	1.9
	Max	30.0	--	6.7	5.7	27.4	--	6.0	3.5	32.0	--	7.1	2.3
OHIO RIVER													
	Min	--	--	--	--	--	--	--	--	24.0	6.0	6.9	4.1
Pittsburgh	Mean	--	--	--	--	--	--	--	--	24.0	6.3	7.1	4.1
	Max	--	--	--	--	--	--	--	--	25.0	6.5	7.2	4.1
	Min	27.7	--	6.9	6.0		--			26.0	--	6.8	5.7
Toronto	Mean	27.8	--	6.9	6.2		--			26.0	--	6.8	5.7
	Max	27.8	--	6.9	6.5	26.0*	--	6.9	8.2	26.0	--	6.8	5.7
	Min	26.2	5.9	7.1	--	25.0	6.7	7.0	--	22.2	4.8	7.3	--
Addison	Mean	27.7	6.4	7.3	--	26.8	6.9	7.2	--	24.9	5.5	7.4	--
	Max	29.5	7.1	7.6	--	28.8	7.1	7.6	--	26.8	6.2	7.5	--
	Min	--	4.5	--	12.7	--	4.3	--	13.5	--	5.2	--	7.8
Huntington	Mean	--	5.6	--	16.2	--	5.0	--	20.7	--	5.3	--	13.3
	Max	--	6.4	--	21.7	--	5.2	--	31.1	--	5.5	--	20.1
	Min	25.7	6.3	7.5	--	25.0	5.1	7.2	--	21.7	4.4	7.2	--
Cincinnati	Mean	27.3	6.6	7.7	--	26.8	5.9	7.3	--	24.8	5.5	7.3	--
	Max	29.1	7.0	7.9	--	29.4	6.8	7.6	--	26.6	6.3	7.4	--

* One Reading

TABLE III. CHEMICAL & PHYSICAL DATA 1964

(Continued)

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
	Min	27.8	5.8	7.5	9.9	26.1	5.6	7.3	9.7	22.2	5.9	7.1	8.1
Louisville	Mean	28.2	7.3	7.7	17.5	27.8	7.3	7.5	15.8	24.6	6.2	7.2	9.1
	Max	29.4	9.2	7.9	29.7	30.0	10.4	7.8	29.8	27.2	6.6	7.3	10.5
	Min	--	--	--	20.0				12.0	25.0	8.6	8.0	10.0
Evansville	Mean	--	--	--	25.0				21.0	25.8	9.4	8.2	14.7
	Max	--	--	--	35.0	24.1*	9.2	8.2	30.0	26.9	10.2	8.4	21.0
	Min	27.0	6.7	2.5	64.0	21.0	5.8	7.5	74.0	25.0	6.7	7.5	47.2
Cairo	Mean	27.9	7.6	6.6	90.7	26.4	6.7	7.5	84.6	26.3	7.2	7.5	68.0
	Max	29.5	8.5	7.8	112.0	30.5	7.9	7.5	93.8	28.0	7.6	7.5	99.5
KANAWHA RIVER													
	Min	30.2	0.0	6.8	1.6	28.0	0.0	6.4	2.2	25.6	0.0	6.7	1.7
Winfield Dam	Mean	31.2	0.0	6.8	2.8	29.7	0.0	6.7	2.7	26.6	0.2	6.9	7.5
	Max	32.5	0.0	6.8	5.4	31.0	0.0	6.8	3.4	28.4	0.6	7.0	20.1
WABASH RIVER													
	Min	27.0	7.2	7.4	9.2	26.0	7.9	7.2	4.0	27.0	6.7	7.8	3.3
New Harmony	Mean	27.5	7.4	7.8	11.8	26.0	7.9	7.5	4.9	27.0	6.7	8.0	3.6
	Max	28.0	7.5	8.2	14.4	26.0	7.9	7.7	5.8	27.0	6.7	8.1	3.9

TABLE III. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-MONTHLY VALUES 1965

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s. thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
ALLEGHENY RIVER													
	Min	26.0	6.8	6.7	1.9	24.0	7.4	6.9	1.4	22.0	6.8	6.1	1.7
Pittsburgh	Mean	26.0	7.4	7.0	2.4	25.5	7.6	7.0	2.0	23.3	7.9	6.6	3.1
	Max	26.0	8.0	7.2	3.1	27.0	7.8	7.1	3.6	24.0	8.6	6.8	5.4
MONONGAHELA RIVER													
	Min	32.0	--	6.3	1.6	--	--	--	1.6	--	--	--	1.6
Pittsburgh	Mean	32.0	--	6.6	1.7	--	--	--	1.6	--	--	--	1.8
	Max	32.0	--	6.9	1.8	--	--	--	1.7	--	--	--	2.0
OHIO RIVER													
	Min	25.0	6.4	6.7	3.9	27.0	6.2	6.7	2.6	22.0	5.2	6.7	4.0
Pittsburgh	Mean	26.9	7.4	7.0	5.0	27.5	6.4	7.0	4.1	25.0	6.8	7.0	6.2
	Max	28.0	8.5	7.2	6.7	29.0	6.6	7.1	5.4	27.0	8.0	7.2	13.4
	Min	--	--	--	3.9	--	--	--	3.1	--	--	--	11.6
Toronto	Mean	--	--	--	3.9	--	--	--	3.2	--	--	--	11.6
	Max	--	--	--	3.9	--	--	--	3.4	--	--	--	11.6
	Min	27.0	6.1	7.3	--	28.0	5.7	7.3	--	26.0	5.7	7.1	--
Addison	Mean	28.0	6.6	7.5	--	28.7	6.2	7.5	--	26.5	6.4	7.3	--
	Max	29.0	7.6	7.6	--	29.5	6.8	7.7	--	27.1	7.2	7.7	--
	Min	--	3.2	--	11.6	--	3.5	--	7.7	--	4.2	--	9.8
Huntington	Mean	--	3.8	--	15.1	--	4.6	--	24.0	--	4.3	--	10.6
	Max	--	4.0	--	19.3	--	5.7	--	77.7	--	4.3	--	11.5
	Min	27.0	3.7	7.2	--	26.0	4.3	7.3	--	23.0	4.1	7.1	--
Cincinnati	Mean	27.6	4.6	7.3	--	27.1	4.8	7.4	--	24.7	4.6	7.3	--
	Max	28.1	5.6	7.4	--	28.2	5.2	7.4	--	25.5	5.6	7.5	--

TABLE III. CHEMICAL & PHYSICAL DATA 1965

(Continued)

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
Louisville	Min	26.7	5.3	7.3	10.4	26.7	4.4	7.2	5.1	22.8	3.3	7.2	12.6
	Mean	27.5	6.2	7.4	27.8	27.1	5.7	7.3	11.6	24.0	4.4	7.3	39.4
	Max	28.9	7.7	7.5	73.4	27.8	7.5	7.3	19.0	25.0	5.4	7.3	83.7
Evansville	Min	28.0	6.9	7.8	19.0	27.0	7.4	8.1	11.0	22.9	3.7	7.7	18.0
	Mean	28.5	8.1	8.1	26.4	28.5	8.6	8.4	14.1	24.8	6.1	7.8	38.8
	Max	29.0	9.4	8.6	46.0	30.2	9.9	8.8	16.0	26.1	7.8	7.9	60.0
Cairo	Min	27.5	4.3	7.5	87.7	27.0	5.8	7.5	56.2	22.0	4.9	7.4	15.2
	Mean	28.1	5.6	7.6	115.8	27.8	7.6	7.6	73.1	25.0	6.1	7.6	76.8
	Max	29.2	6.1	7.7	143.0	28.5	9.3	7.7	88.3	26.5	7.6	7.8	133.0
KANAWHA RIVER													
Winfield Dam	Min	28.0	0.0	7.1	4.1	28.6	0.0	6.9	1.7	27.0	0.0	6.9	1.4
	Mean	29.0	0.1	7.2	5.0	29.1	0.0	7.3	2.1	28.2	0.3	7.1	2.0
	Max	30.2	0.3	7.2	6.8	29.9	0.1	7.7	2.6	29.6	1.3	7.3	2.8
WABASH RIVER													
New Harmony	Min	28.0	7.4	7.6	7.9	*				21.0	6.5	7.5	4.4
	Mean	28.0	8.2	8.0	12.9					22.5	7.6	7.5	9.8
	Max	28.0	9.1	8.3	19.8	26.0	8.0	7.6	7.0	24.0	8.6	7.5	18.6

* One Reading

TABLE III. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-MONTHLY VALUES 1966

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s. thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
ALLEGHENY RIVER													
	Min	28.0	6.6	6.8	1.2	26.0	6.8	5.0	1.3	18.0	7.2	6.2	1.5
Pittsburgh	Mean	29.3	7.0	6.8	1.8	27.0	7.3	6.2	2.1	22.5	7.5	6.8	2.2
	Max	31.0	7.8	6.8	2.4	28.0	7.6	6.8	3.4	27.0	7.8	7.1	2.8
MONONGAHELA RIVER													
	Min	--	--	--	1.6	31.7	--	5.1	1.7	--	--	--	--
Pittsburgh	Mean	--	--	--	1.9	32.2	--	5.8	2.4	--	--	--	--
	Max	--	--	--	2.2	32.8	--	6.2	3.9	--	--	--	--
OHIO RIVER													
	Min												
Pittsburgh	Mean												
	Max												
	Min	--	--	--	3.2	--	--	--	3.1	--	--	--	3.8
Toronto	Mean	--	--	--	3.7	--	--	--	4.7	--	--	--	4.9
	Max	--	--	--	4.8	--	--	--	8.3	--	--	--	6.1
	Min	28.0	5.4	7.0	--	27.4	6.3	7.0	--	21.0	6.6	6.9	--
Addison	Mean	29.0	5.7	7.3	--	27.8	6.6	7.2	--	22.9	7.0	6.9	--
	Max	31.0	6.2	7.5	--	28.0	6.9	7.3	--	24.5	7.3	7.0	--
	Min	28.0	5.3	6.9	7.2	27.0	4.8	7.0	7.1	25.0	5.5	7.0	11.8
Huntington	Mean	28.0	6.0	7.0	11.9	27.0	5.8	7.1	12.5	25.5	5.9	7.1	12.0
	Max	28.0	6.9	7.0	18.9	27.0	6.7	7.1	19.1	26.0	6.2	7.1	12.1
	Min	28.2	5.5	7.1	--	24.0	5.5	6.5	--	21.5	5.0	7.2	--
Cincinnati	Mean	28.5	6.0	7.3	--	26.5	6.5	7.2	--	24.0	6.0	7.4	--
	Max	28.8	6.7	7.4	--	27.9	8.4	7.5	--	26.3	6.8	7.6	--

TABLE III. CHEMICAL & PHYSICAL DATA 1966

(Continued)

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
Louisville	Min	28.3	1.7	7.3	16.3	26.7	3.1	7.4	8.7	22.2	4.3	7.4	11.6
	Mean	28.6	3.8	7.5	24.2	27.6	4.3	7.5	21.0	24.5	4.9	7.5	23.5
	Max	28.9	5.1	7.6	40.4	28.3	5.4	7.6	35.0	26.7	5.8	7.5	30.0
Evansville	Min	30.2	7.0	8.2	14.0	27.5	8.5	8.3	18.0	21.8	7.7	7.7	14.0
	Mean	30.6	8.9	8.4	28.3	28.2	8.6	8.4	24.3	24.0	8.2	7.8	29.8
	Max	31.2	10.2	8.6	45.0	28.8	8.7	8.5	35.0	26.5	9.1	7.9	45.0
Cairo	Min	29.0	5.0	7.4	56.5	26.5	6.5	7.3	74.1	22.0	7.2	7.3	70.1
	Mean	29.6	6.1	7.5	75.8	27.2	6.8	7.4	94.4	24.5	8.2	7.3	85.0
	Max	30.2	6.5	7.5	86.3	28.0	6.9	7.5	124.0	27.0	10.2	7.4	113.0
KANAWHA RIVER													
Winfield Dam	Min	29.0	0.0	7.1	1.5	27.0	0.0	6.9	2.2	20.0	0.1	6.9	1.2
	Mean	29.9	0.1	7.2	2.6	29.4	0.1	7.2	3.5	23.5	1.5	7.1	10.9
	Max	30.5	0.2	7.2	3.8	32.0	0.2	7.3	4.3	27.3	3.1	7.1	18.9
WABASH RIVER													
New Harmony	Min	30.0	8.3	7.6	4.2	25.0	7.3	7.7	3.1	21.0	7.1	7.6	3.1
	Mean	30.0	8.5	7.7	5.6	26.5	8.6	7.8	3.7	23.0	7.7	7.7	3.6
	Max	30.0	8.6	7.8	6.3	28.0	9.8	7.8	4.3	25.0	8.3	7.7	4.3

TABLE III. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-MONTHLY VALUES 1967

Station		JULY Temp. °C	JULY DO Mg/l	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/l	AUGUST pH	AUGUST Flow c.f.s. thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/l	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
ALLEGHENY RIVER													
Pittsburgh	Min												
	Mean												
	Max												
MONONGAHELA RIVER													
Pittsburgh	Min												
	Mean												
	Max												
OHIO RIVER													
Pittsburgh	Min												
	Mean												
	Max												
Toronto	Min												
	Mean												
	Max												
Addison	Min	26.5	7.3	7.3	--	26.0	6.9	6.8	--	22.0	7.4	7.1	--
	Mean	27.0	8.1	7.5	--	26.7	7.2	7.3	--	23.2	7.7	7.2	--
	Max	28.0	9.5	7.7	--	27.5	7.8	7.8	--	23.9	8.4	7.2	--
Huntington	Min	26.0	5.1	6.9	--	25.0	4.5	6.9	--	22.0	7.1	7.0	--
	Mean	26.3	6.2	7.0	--	26.6	6.2	6.9	--	23.3	7.5	7.0	--
	Max	27.0	7.1	7.0	--	28.0	8.2	7.0	--	24.0	8.4	7.0	--
Cincinnati	Min	26.2	4.3	7.1	--	25.6	4.9	7.2	--	23.0	4.9	6.8	--
	Mean	26.7	4.9	7.2	--	26.9	5.6	7.3	--	24.2	6.0	7.0	--
	Max	27.0	5.4	7.4	--	28.0	6.3	7.3	--	24.9	6.9	7.2	--

TABLE III. CHEMICAL & PHYSICAL DATA 1967

(Continued)

Station		JULY Temp. °C	JULY DO Mg/1	JULY pH	JULY Flow c.f.s. thous.	AUGUST Temp. °C	AUGUST DO Mg/1	AUGUST pH	AUGUST Flow c.f.s thous.	SEPTEMBER Temp. °C	SEPTEMBER DO Mg/1	SEPTEMBER pH	SEPTEMBER Flow c.f.s. thous.
Louisville	Min	25.0	2.7	7.4	--	25.0	4.2	7.1	--	23.3	3.3	7.2	--
	Mean	26.1	3.8	7.4	--	26.1	4.3	7.3	--	23.6	4.4	7.3	--
	Max	27.2	5.4	7.5	--	27.8	4.9	7.4	--	23.9	5.8	7.4	--
Evansville	Min	--	--	--	--				--	21.4	5.5	7.5	--
	Mean	--	--	--	--				--	23.0	7.1	7.8	--
	Max	--	--	--	--	23.7 *	7.5 *	7.8 *	--	23.8	7.7	8.0	--
Cairo	Min	24.5	7.3	7.4	--	21.0	8.1	7.4	--	23.0	9.8	7.5	--
	Mean	25.8	8.5	7.5	--	24.9	9.8	7.5	--	23.3	10.3	7.5	--
	Max	26.5	9.6	7.5	--	27.0	10.9	7.5	--	23.5	10.9	7.5	--
KANAWHA RIVER													
Winfield Dam	Min												
	Mean												
	Max												
WABASH RIVER													
New Harmony	Min												
	Mean												
	Max												

* One Reading

TABLE IV. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-YEARLY VALUES (Oct 1-Sept 30)
WATER YEAR 1963

		Temp. °C	DO Mg/1	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/1	Flow c.f.s. thousands
Allegheny Pittsburgh	Min	0.0	7.2	5.0	3	2	98	1.4
	Mean	14.6	10.4	6.8	16	20	234	--
	Max	27.0	14.2	7.2	30	250	398	106.0
Monongahela Pittsburgh	Min	4.5	--	4.2	1	4	130	1.6
	Mean	16.2	0.0*	5.9	4	57	243	--
	Max	32.0	--	7.2	21	1400	494	149.0
Ohio Pittsburgh	Min	--	--	--	--	--	--	3.8
	Mean	--	--	--	--	--	--	--
	Max	--	--	--	--	--	--	211.0
Toronto **	Min	24.5	--	6.7	4	25	200	3.8
	Mean	25.4	--	6.9	10	25	335	--
	Max	28.0	--	7.0	18	25	440	211.0
Marietta	Min	--	--	--	--	--	--	3.6
	Mean	--	--	--	--	--	--	39.7
	Max	--	--	--	--	--	--	337.0
Addison	Min	1.8	5.5	6.8	16	0	136	--
	Mean	15.4	9.5	7.6	27	40	291	--
	Max	28.8	14.2	7.8	40	380	535	355.0
Huntington	Min	0.5	0.4	6.6	21	14	120	5.9
	Mean	12.8	5.8	6.9	32	102	247	65.4
	Max	28.0	13.0	7.3	42	1100	580	468.0

* <5 readings

** readings July, August and September only Ohio R. - Toronto, Ohio

TABLE IV. CHEMICAL & PHYSICAL DATA 1963

(Continued)

		WATER YEAR						
		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Cincinnati	Min	0.1	2.6	6.9	23	2	138	--
	Mean	14.2	8.5	7.3	38	65	269	--
	Max	27.8	13.3	7.8	54	450	547	531.0
Louisville	Min	1.1	4.5	6.8	39	2	140	6.6
	Mean	15.5	8.5	7.3	57	37	269	94.8
	Max	28.9	12.2	7.9	91	200	544	587.0
Evansville	Min	6.0	0.9	7.2	24	25	--	14.5
	Mean	19.9	9.9	7.6	60	54	290*	109.6
	Max	29.0	14.7	8.3	86	300	--	687.0
Cairo	Min	0.6	1.3	7.2	44	25	--	41.6
	Mean	17.0	9.8	7.5	68	138	--	217.4
	Max	29.5	18.4	8.2	94	800	--	1150.0
Kanawha London	Min	--	--	--	--	--	--	0.7
	Mean	--	--	--	--	--	--	11.5
	Max	--	--	--	--	--	--	133.0
Winfield Dam	Min	1.0	0.0	6.5	7	5	46	1.0
	Mean	14.7	6.7	7.0	44	41	190	14.7
	Max	29.0	13.9	7.6	95	850	435	145.0
Wabash New Harmony	Min	0.0	4.9	7.5	86	5	203	3.0
	Mean	13.5	9.6	8.1	178	70	360	17.4
	Max	29.0	16.5	8.6	238	480	450	152.0

TABLE IV . CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-YEARLY VALUES (Oct 1-Sept 30)
WATER YEAR 1964

		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Allegheny Pittsburgh	Min	0.0	6.6	4.9	2	25	119	1.0
	Mean	14.3	10.2	6.8	16	41	271	16.9
	Max	28.0	14.9	7.6	47	350	483	188.0
Monongahela Pittsburgh	Min	7.5	--	4.1	0	25	124	1.3
	Mean	18.4	--	6.2	6	37	223	10.2
	Max	32.0	--	7.2	16	220	420	105.0
Ohio Pittsburgh	Min	--	--	--	--	--	--	2.3
	Mean	--	--	--	--	--	--	27.8
	Max	--	--	--	--	--	--	295.0
Toronto	Min	2.0	--	4.0	6	25	126	2.3
	Mean	12.3	--	6.8	14	28	229	27.8
	Max	27.8	--	7.4	28	100	450	295.0
Marietta	Min	--	--	--	--	--	--	3.4
	Mean	--	--	--	--	--	--	41.4
	Max	--	--	--	--	--	--	425.0
Addison	Min	1.3	4.8	6.7	15	25	112	--
	Mean	16.1	9.2	7.2	30	38	301	--
	Max	29.5	14.5	7.7	65	300	648	406.0
Huntington	Min	--	3.2	--	--	--	--	4.1
	Mean	--	8.1	--	--	--	--	60.8
	Max	--	12.9	--	--	--	--	455.0

TABLE IV. CHEMICAL & PHYSICAL DATA

(Continued)

WATER YEAR 1964

		Temp. °C	DO Mg/1	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/1	Flow c.f.s. thousands
Cincinnati	Min	0.6	4.4	6.9	22	25	143	--
	Mean	15.6	8.6	7.4	39	49	325	--
	Max	29.4	13.2	8.5	60	320	527	643.0
Louisville	Min	1.7	5.0	6.9	27	25	136	6.4
	Mean	17.1	8.6	7.5	55	56	310	88.7
	Max	30.0	13.3	8.1	80	340	607	780.0
Evansville	Min	4.0**	6.5	7.3	31	25	--	9.5
	Mean	13.8**	9.8	7.7	55	100	--	105.9
	Max	26.9**	13.7	8.4	81	440	--	913.0
Cairo	Min	0.2	5.8	7.1	42	25	--	37.1
	Mean	15.8	9.1	7.4	65	121	--	219.8
	Max	30.5	13.4	7.9	95	1300	--	1,090.0
Kanawha London*	Min	23.7	6.3	7.0	45	--	94	0.7
	Mean	27.5	7.5	7.5	56	--	110	8.8
	Max	30.0	8.8	8.0	64	--	126	99.6
Winfield Dam	Min	1.3	0.0	6.4	32	25	92	1.0
	Mean	16.0	4.4	6.8	61	33	276	11.1
	Max	32.5	13.0	7.1	104	175	508	119.0
Wabash New Harmony	Min	0.0	5.0	7.2	72	25	198	1.7
	Mean	13.9	9.1	7.8	179	107	387	18.2
	Max	28.0	15.6	8.4	250	800	523	149.0

*Reading at mile 74.5 Kanawha River, June-August only.

**Continuous weekly readings not made during all summer months

TABLE IV . CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-YEARLY VALUES (Oct 1-Sept 30)
WATER YEAR 1965

		Temp. °C	DO Mg/1	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/1	Flow c.f.s. thousands
Allegheny Pittsburgh	Min	0.0	6.8	6.1	6	25	120	1.8
	Mean	13.4	10.2	6.9	18	31	259	16.7
	Max	27.0	13.8	7.2	37	110	476	76.8
Monongahela Pittsburgh	Min	8.0	4.4	4.4	0	25	132	1.4
	Mean	21.8	8.7	6.0	5	25	362	10.4
	Max	32.0	14.4	7.1	10	25	669	59.3
Ohio Pittsburgh	Min	0.0	5.2	4.0	0	--	119	2.4
	Mean	15.6	9.4	6.0	9	--	312	27.4
	Max	28.3	14.3	7.1	21	--	531	116.0
Toronto	Min	2.0	--	6.6	1	25	--	2.4
	Mean	14.3	--	6.9	11	26	--	27.4
	Max	27.0	--	7.3	43	35	--	116.0
Marietta	Min	--	--	--	--	--	--	4.4
	Mean	--	--	--	--	--	--	40.7
	Max	--	--	--	--	--	--	168.0
Addison	Min	1.1	5.7	6.8	20	25	136	--
	Mean	16.4	9.2	7.2	31	49	328	--
	Max	29.5	14.0	7.7	50	400	640	183.0
Huntington	Min	2.8	3.2	6.6	14	--	129	7.6
	Mean	15.6	7.7	7.1	26	68*	285	66.5
	Max	27.8	12.7	7.7	38	--	594	302.0

* <5 readings

TABLE IV. CHEMICAL & PHYSICAL DATA

(Continued)

WATER YEAR 1965

		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Cincinnati	Min	0.8	3.7	6.9	20	10	149	--
	Mean	15.6	7.7	7.2	38	82	276	--
	Max	28.2	14.3	7.6	61	420	511	389.0
Louisville	Min	2.2	3.3	7.2	35	25	126	5.1
	Mean	16.2	8.5	7.5	53	94	256	99.5
	Max	28.9	13.3	7.9	66	660	418	463.0
Evansville	Min	5.0	3.7	7.1	35	25	--	11.0
	Mean	18.5	9.3	7.8	57	94	320*	116.4
	Max	30.2	12.3	8.8	76	405	--	487.0
Cairo	Min	0.2	4.3	7.3	46	25	--	44.3
	Mean	16.3	9.1	7.5	64	134	--	249.3
	Max	29.2	13.8	7.8	85	500	--	864.0
Kanawha London **	Min	1.7	7.3	7.3	44	--	88	0.9
	Mean	13.5	6.0	7.5	54	--	107	10.8
	Max	30.6	9.0	7.6	67	--	129	82.3
Winfield Dam	Min	4.8	0.0	6.3	14	25	84	1.2
	Mean	17.7	5.4	7.1	34	36	160	14.7
	Max	30.2	12.0	7.7	70	190	405	120.0
Wabash New Harmony	Min	3.0	5.6	7.2	108	25	271	2.5
	Mean	14.0	9.7	7.8	167	101	371	18.4
	Max	28.0	17.4	8.5	218	400	490	80.8

* <5 readings

** reading at mile 74.5 Kanawha River, June-August only.

TABLE IV. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-YEARLY VALUES (Oct 1-Sept 30)
WATER YEAR 1966

		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Allegheny Pittsburgh	Min	0.0	6.6	5.3	2	25	100	1.0
	Mean	12.9	10.5	6.7	16	30	231	16.9
	Max	31.7	13.8	7.4	35	100	468	154.0
Monongahela Pittsburgh	Min	4.4	--	--	0	25	124	1.2
	Mean	14.4	--	4.5*	5	39	350	8.0
	Max	33.3	--	--	12	140	686	133.0
Ohio Pittsburgh	Min	2.8	--	5.5	2	--	162	3.1
	Mean	12.2	--	6.2	9	--	321	25.2
	Max	23.9	--	6.7	13	--	568	249.0
Toronto	Min	6.0	--	6.8	9	25	126	3.1
	Mean	17.3	--	7.0	15	30	268	25.2
	Max	29.0	--	7.3	24	47	546	249.0
Marietta	Min	--	--	--	--	--	--	4.6
	Mean	--	--	--	--	--	--	37.2
	Max	--	--	--	--	--	--	326.0
Addison	Min	1.2	5.4	6.8	26	25	130	--
	Mean	15.0	9.7	7.2	38	58	311	--
	Max	31.0	13.9	7.5	61	270	582	336.0
Huntington	Min	2.0	3.6	6.8	24	--	248	4.6
	Mean	17.7	8.5	7.0	30	--	412	55.2
	Max	28.0	13.6	7.1	35	--	566	416.0

* <5 readings

TABLE IV CHEMICAL & PHYSICAL DATA

(Continued)

WATER YEAR 1966

		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Cincinnati	Min	0.7	4.3	6.5	26	25	127	--
	Mean	14.9	7.8	7.2	45	59	303	--
	Max	28.8	11.8	7.6	61	500	533	464.0
Louisville	Min	0.3	1.7	7.2	46	25	137	7.6
	Mean	14.2	8.5	7.5	66	80	290	80.6
	Max	28.9	12.1	7.9	79	550	478	515.0
Evansville	Min	1.5	7.0	7.3	38	25	--	14.0
	Mean	16.1	9.9	7.9	72	65	--	96.3
	Max	31.2	14.5	8.6	106	310	--	535.0
Cairo	Min	1.5	5.0	6.8	55	25	--	56.5
	Mean	15.7	9.7	7.5	71	100	--	176.9
	Max	30.2	15.3	7.9	85	450	--	679.0
Kanawha London	Min	1.1	--	--	--	--	--	0.8
	Mean	13.5	--	--	--	--	--	7.6
	Max	30.6	--	--	--	--	--	75.9
Winfield Dam	Min	3.6	0.0	6.9	22	25	66	1.1
	Mean	15.3	3.8	7.2	50	50	296	9.2
	Max	30.5	12.3	7.5	78	235	484	93.9
Wabash New Harmony	Min	0.0	8.3	7.4	124	25	291	3.1
	Mean	13.7	11.5	7.7	184	58	373	13.6
	Max	30.0	15.8	8.4	252	160	513	61.8

TABLE IV. CHEMICAL & PHYSICAL DATA OHIO RIVER & TRIBUTARIES-YEARLY VALUES (Oct 1-Sept 30)
WATER YEAR 1967

		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Allegheny Pittsburgh	Min	0.0	6.6	6.0	5	25	115	1.4
	Mean	12.4	9.3	6.8	18	30	212	17.6
	Max	27.0	12.4	7.4	46	70	482	79.4
Monongahela Pittsburgh	Min	--	--	--	0	25	--	1.8
	Mean	--	--	--	2	25	--	12.2
	Max	--	--	--	11	25	--	176.0
Ohio Pittsburgh	Min	--	--	--	--	--	--	4.1
	Mean	--	--	--	--	--	--	30.5
	Max	--	--	--	--	--	--	206.0
Toronto	Min	2.2	--	4.0	0	--	127	4.1
	Mean	15.6	--	6.4	14	25*	245	30.5
	Max	28.0	--	7.6	39	--	554	206.0
Marietta	Min	--	--	--	--	--	--	5.9
	Mean	--	--	--	--	--	--	44.4
	Max	--	--	--	--	--	--	279.0
Addison	Min	3.3	7.0	6.8	22	25	127	20.0
	Mean	15.9	9.7	7.1	35	49	302	--
	Max	28.0	14.0	7.8	59	370	606	338.0
Huntington	Min	4.0	4.5	6.9	--	--	--	12.0
	Mean	16.3	8.9	7.0	--	--	--	75.7
	Max	28.0	13.4	7.1	--	--	--	493.0

* < 5 readings

TABLE IV. CHEMICAL & PHYSICAL DATA 1967

(Continued)

WATER YEAR 1967

		Temp. °C	DO Mg/l	pH	Alk. $CaCO_3$	Turb. JTU	TDS Mg/l	Flow c.f.s. thousands
Cincinnati	Min	2.0	4.3	6.8	29	25	142	--
	Mean	15.1	7.9	7.1	40	51	258	--
	Max	28.0	12.4	7.8	63	500	397	566.0
Louisville	Min	2.2	2.7	7.1	40	25	138	10.9
	Mean	14.9	7.8	7.5	59	115	256	116.5
	Max	27.8	13.3	7.8	88	750	414	642.0
Evansville	Min	3.8	5.5	7.4	38	25	--	16.0
	Mean	13.1	9.5	7.8	57	94	--	136.0
	Max	23.8	12.6	8.3	66	330	--	671.0
Cairo	Min	0.4	7.3	7.3	60	25	146	71.7
	Mean	14.3	12.0	7.5	78	120	218	262.3
	Max	28.0	18.4	8.2	98	400	315	789.0
Kanawha London **	Min	1.1	--	--	--	--	--	1.6
	Mean	14.4	--	--	--	--	--	12.8
	Max	28.9	--	--	--	--	--	106.0
Winfield Dam	Min	2.8	0.0	6.8	3	25	67	2.3
	Mean	15.7	6.9	7.3	29	31	170	16.8
	Max	29.2	12.7	7.9	45	55	342	160.0
Wabash New Harmony	Min	0.0	7.3	6.7	86	520	120	3.0
	Mean	14.4	10.4	7.7	170	25	330	26.6
	Max	28.0	14.9	8.4	320	102	470	133.0

** Some chemical plants at Charleston, W. Va. not in operation during summer.

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6. University of Pittsburgh Neville Island Research Laboratory. 1967. "Intensive study of the water at critical points on the Monongahela, Allegheny, and Ohio Rivers in the Pittsburgh, Pennsylvania area."

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