6383 U-007-307 .4

ELECTROFISHING SURVEY OF THE GREAT MIAMI RIVER SEPTEMBER 1991 ANNUAL REPORT - (USED AS A REFERENCE IN OU5 RI, APPENDIX A AND B)

08/01/92

FEMP/SUB-055 UC-702
DOE-FN
50
REPORT

PA-E-~~005~~ 037 6383

FEMP/SUB - 055
UC-702

OU 5 RI

ELECTROFISHING SURVEY OF THE GREAT MIAMI RIVER SEPTEMBER 1991 ANNUAL REPORT

by

Michael C. Miller, Ph.D.
Lloyd S. Ross
Rebecca Bixby
James Engman
Francisco Gutierrez
William Perry

Department of Biological Sciences
University of Cincinnati, ML 006
Cincinnati, OH 45221
(513) 556-9751

August 1992

Property of
PUBLIC ENVIRONMENTAL INFORMATION CENTER
10845 Hamilton Cleves Highway
Harrison, Ohio 45030
(513) 738-0164

Prepared for the

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Westinghouse Environmental Management Company of Ohio

P. O. BOX 398704
CINCINNATI, OHIO 45239-8704

Property of
PUBLIC ENVIRONMENTAL INFORMATION CENTER
10845 Hamilton Cleves Highway
Harrison, Ohio 45030
(513) 738-0164

UNDER CONTRACT DE-AC05-860R21600

U.S. Department of Energy

FERNALD FIELD OFFICE

000001

PA-37

NOTICE

This report was prepared as an account of work sponsored by an agency of the United States Government. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced from the best available copy.

Available to DOE and DOE contractors from:
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Prices available from:
(615) 576-8401
FTS 626-8401

Available to the public from:
National Technical Information Service, NTIS
U.S. Department of Commerce
5285 Port Royal Rd.
Springfield, VA 22161

Price: Printed Copy A04
Microfiche A01

000002

6383

FEMP/SUB-055
UC-702

ELECTROFISHING SURVEY OF THE GREAT MIAMI RIVER SEPTEMBER, 1991 ANNUAL REPORT

by

Michael C. Miller, Ph.D.
Lloyd S. Ross
Rebecca Bixby
James Engman
Francisco Gutierrez
William Perry

Department of Biological Sciences
University of Cincinnati, ML 006
Cincinnati, OH 45221
(513) 556-9751

August 1992

Prepared for the
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO
P.O. BOX 398704
CINCINNATI, OH 45239-8704

Under Contract DE-AC05-86OR21600
U.S. Department of Energy
Fernald Field Office

Approved: Michael C. Miller, Ph.D.
M. C. Miller, Associate Professor

Approved: L. S. Farmer
L. S. Farmer, Mgr., Environmental Mgt., WEMCO

CONTENTS

EXECUTIVE SUMMARY v

INTRODUCTION 1

METHODS 1

SITE DESCRIPTION 3

RESULTS AND DISCUSSION 4

CONCLUSIONS 9

REFERENCES CITED 11

Figure 1. Map of sampling sites on the Great Miami River, 1991. 12

Figure 2. Frequency of fish weight categories for all sites from the Great Miami River, 1991 13

Figure 3. Cumulative proportion of fish weight for all sites from the Great Miami River, 1991. 14

Figure 4. Frequency of fish length categories for all sites from the Great Miami River, 1991. 15

Figure 5. Cumulative proportion of fish length from all sites in the Great Miami River, 1991. 16

Figure 6. Gizzard shad length/weight relationship of four sites from the Great Miami River, 1991. 17

Figure 7 Weight/Length relationship of all gizzard shad collected at three sites from the Great Miami River, from 1984 to 1991. 18

Figure 8. Longear sunfish length/weight relationship for all sites from the Great Miami River, 1991. 19

Figure 9. Smallmouth bass length/weight relationship for all sites from the Great Miami River, 1991. 20

Figure 10. Northern hogsucker length/weight relationship for all sites from the Great Miami River, 1991. 21

Figure 11. Largemouth bass length/weight relationship from for all sites the Great Miami River, 1991. 22

Figure 12. Drum length/weight relationship for all sites from the Great Miami River, 1991. 23

Figure 13. Channel catfish length/weight relationship for all sites from the Great Miami River, 1991. 24

Figure 14. Carp length/weight relationship for all sites from the Great Miami River, 1991. 25

Table 1. Physical and chemical parameters of four sites sampled in the Great Miami River, 1991. 26

Table 2. Species and number of fish captured from four sites in the Great Miami River, 1991. 27

Table 3. The number of fish captured per hour and number of species, by site and year, from the Great Miami River, 1984-1991. 28

Table 4. Shannon Diversity, H max and evenness for four sites from the Great Miami River, 1991. 28

Table 5. Species diversity and evenness using information index (log base 2), by site and year, from the Great Miami River, 1984-1991. 29

Table 6. Community coefficients for four sites from the Great Miami River, 1991 29

Table 7. Percent similarity for four sites from the Great Miami River, 1991. . . 29

Table 8. Weight frequency distribution of all fish caught from four sites in the Great Miami River, 1991. 30

Table 9. Length frequency distribution of all fish caught in the Great Miami River, 1991. 31

Table 10. Average length, weight, and standard deviations for all species of fish from four sites on the Great Miami River, 1991. 32

Table 11. Average weight, length, standard deviation and standard error of gizzard shad at four sites on the Great Miami River, 1991. 34

000005

Table 12. Matrix of pairwise comparison probabilities (Tukey HSD) for average weight of gizzard shad between sites from the Great Miami River, 1991. Non-shaded comparisons are significant at or less than a p value of 0.05. 34

Table 13. Matrix of pairwise comparison probabilities (Tukey HSD) for average length of gizzard shad between sites from the Great Miami River, 1991. Non-shaded comparisons are significant at or less than a p value of 0.05. 34

Table 14. Average weight of gizzard shad in the Great Miami River from 1984 to 1991, represented by three sites. 35

Table 15. Yearly comparison (Tukey HSD, p value) of the weight (g) of gizzard shad in the Great Miami River, represented by three sites. Non-shaded comparisons are significant at or less than a p value of 0.05. 35

Table 16. Average length of gizzard shad in the Great Miami River from 1984 to 1991, represented by three sites. Samples from 1989 are standard length measurements, all other dates are total length. 36

Table 17. Yearly comparison (Tukey HSD, p value) of the length (cm) of gizzard shad in the Great Miami River, represented by three sites. Samples from 1989 were standard length measurements and thus are not comparable to the total length measurements. Non-shaded comparisons are significant at or less than a p value of 0.05. 36

Table 18. ANCOVA of length/weight regressions of gizzard shad. 37

Table 19. Species Occurrences in Electroshocking Samples taken from the Great Miami River between 1984 and 1991. 38

Appendix A. List of common names, family and species from the Great Miami River, 1991. . . . . A-1

Appendix B. List of the weight, length, and gender of fish captured at Site I of the Great Miami River, 1991. . . . . B-1

Appendix C. List of the weight, length, and gender of fish captured at Site II of the Great Miami River, 1991. . . . . C-1

Appendix D. List of the weight, length, and gender of fish captured at Site III of the Great Miami River, 1991. . . . . D-1

Appendix E. List of the weight, length, and gender of fish captured at Site IV of the Great Miami River, 1991. . . . . E-1

EXECUTIVE SUMMARY:

This 1991 report is a continuation to our report on the status of the fishery of the Great Miami River in September 1990. The samples were collected for analysis of uranium content in fish fillets and whole fish. The fisheries analysis contained in this report focuses on the areas that are upstream of the Fernald Environmental Management Project (FEMP) outfall line, and those sites downstream of the outfall potentially impacted by FEMP effluents.

Fish were collected by electroshocking. The fish were identified to species, weighed, measured; their gender was determined and external abnormalities are noted. Modified filets and remaining parts are frozen for shipment to the specified lab.

Four sites, spanning 18.7 river miles, on the Great Miami River were used for electrofishing in 1991. Three of the sites (Site II, III, and IV) have been sampled annually at the same time of year since 1984. The fourth site (Site I) was added as an additional upstream control. Samples were collected on the 13, 17 and 23 September, 1991.

Sites I and III had the highest diversity and the lowest gizzard shad populations. Site IV is a nursery for young-of-year Y-O-Y gizzard shad and had the lowest diversity and evenness. The Y-O-Y gizzard shad at Site IV also influenced statistically different mean weights, lengths and length/weight regressions between Site IV and the remaining three sites.

Site I is a population isolated from potential upstream migration by two dams. Sites II, III, and IV can be influenced by effluents from the city of Hamilton effluents and the Ohio River. Except for fin rot noted on two specimens from Site II, no indicators examined show any sign of differential pollution stress among the lower three sites. In this regard, there are no discernible effects of the FEMP on the numbers, condition or species richness of the fish communities in the Great Miami River in 1991.

INTRODUCTION

This 1991 report is a continuation to our report on the status of the fishery of the Great Miami River in September 1990. A complete historical perspective is contained in Miller et al. (1987). This report will emphasize the comparison among the years, sites and on the status of the fishery in terms of numbers, condition, species richness, and diversity. The collection has been performed in late summer for the last eight years. Therefore, with eight years of data we should be able to follow trends in the river biota. If abnormalities occur, they may be apparent as changes in species composition or redundancy, changes in mean or modal length and weight, or as deviations in growth rates as observed in length-weight distributions between sites.

The samples were collected and analyzed for uranium content of fish fillets and whole fish. They were shipped as per instructions by Westinghouse Environmental Management Company of Ohio (WEMCO) to Ecotek LSI, Atlanta, Georgia. The fisheries analysis contained in this report focuses on the areas that are upstream of the Fernald Environmental Management Project (FEMP) outfall line, and those sites downstream of the outfall potentially impacted by FEMP effluents.

METHODS

Electrofishing with pulsed DC is among the most efficient method of collecting unbiased samples with respect to fish size and species (Gammon, 1976). Fish were electroshocked with a 240 volt, pulsed direct current transformer at 60 cycles per second aboard a five-meter flat-bottom boat. The anode is located at the end of a three-meter boom and consists of 2-6 vertical cables, extending 10-13 centimeters beneath the surface of the water. The cathode, which is composed of five one-meter long cables, extends well under the bow of the boat. The electroshocking transformer is powered by a gasoline driven ONAN® generator, delivering 3,500-watts of 120-volt AC at 29-amperes. The shocker delivers about 3.6-4.2-amperes, depending on the conductivity of the water. Two persons standing behind a railing on the bow caught fish with three-meter long dip nets. The netters are in control of the electroshocker with a foot-operated "dead-man" switch. The fish lose their equilibrium momentarily in a small area of electrical field near the anode, allowing them to be netted.

Thus, the effective area and depth for stunning fish may be dependent upon the species and their size. Large fish are reported to be the most sensitive to the electric field. Almost all fish recover in an aerated, central well within five minutes (Vibert, 1967). Some of the larger game fish (large mouth bass, small mouth bass and striped bass) caught were identified, measured and released immediately after gill motion and equilibrium appeared normal, as specified in our State of Ohio Scientific Collecting Permit.

The fish collected for uranium analysis are placed on ice immediately after a shocking sequence and brought back to a radiation-free laboratory at the University of Cincinnati. The fish are identified to species, weighed, measured and their gender are determined (Clay, 1975; Pflieger 1975; Smith, 1979; Trautman, 1981). Any external abnormalities, such as fin rot, diseases or fungus, are noted. They are then decapitated, eviscerated and definned to make a modified filet with scales, skin and some bones. These modified filets are approximately what a fisherman would consume were he to take these fish. In order to determine the full body burden of the common species/trophic groups, heads fins and internal organs for known numbers of fish were bagged. The sum of parts and modified filets equals the body burden of the fish. Modified filets or remaining parts from each species or trophic status are adjusted to greater than or equal to 400 grams wet weight, labeled and sealed into resealable plastic bags. Fish from each collection site were processed as a group. The area was then cleaned and fish from the next site were processed completely so that contamination between stocks would not occur.

Physical-chemical measurements from each site included: 1) temperature (C°), 2) dissolved oxygen (ppm O_2 at 0.25 m) both with a YSI Model 57 meter (Yellow Springs Instruments Co.), 3) percent oxygen saturation (assumes 1 atm. of pressure at the ambient river temperature taken from Table 6-1 in Wetzel and Likens (1989)) and 4) conductivity (micromhos per centimeter) determined with a YSI Model 33.

000009

Statistical analysis was performed using the statistical package Systat for DOS, Systat Inc., 1800 Sherman Avenue, Evanston, Illinois, 60201. Multiple pairwise comparisons were performed using Tukey HSD post f test. All statistically significant results are p values less than or equal to 0.05.

SITE DESCRIPTION

Four sites on the Great Miami River were used for electrofishing in 1991. Three of which have been sampled annually at the same time of year since 1984. In this sampling year, a fourth site was added upstream as an additional control. The original three sites are connected by free flowing river with no effective barriers to fish movement between sites. The new site is isolated from the downstream sites by two dams, thus preventing any migration of fish upstream from the FEMP area during a majority of the year. The river levels this year were low, prohibiting boat travel between sites or upstream movement by fish to Site I.

Site I is at River Mile 38, the confluence of Talawanda Creek and the Great Miami River, north of Hamilton. The riparian community is relatively undisturbed, and the habitat provided by fallen trees, rocky shoals, and pools increases habitat heterogeneity. The site is just below an inlet of a smaller stream. A reach of 700 meters of the river was sampled. All sites are sampled and standardized by total shocking time to maintain continuity with the sampling methods of previous years. An additional sample was collected within a kilometer of the first Hamilton dam and is grouped with Site I samples.

Site II is at River Mile 28 near the City of Cincinnati's Bolton Water Works, upstream of any FEMP effluent. The site is a straight section of shallow pool below a sharp curve and above a small rapids. A backwater thumb projects from the section of pool behind a bar above the rapids. The shores of the thumb and river on both sides are covered with overhanging riparian vegetation, with many treefalls in the river. The average pool depth was 1.1 meters. Several snags on the bottom make this the best habitat for fish based on the criteria of Gammon (1973) found on the Wabash and the Ohio Rivers. The pool is cobble

covered, and the sides are moderately steep and rocky on the eastern shore. The current here is faster than that found at Site IV and slower than Site III. A reach of 400 meters of the river was sampled.

Site III is located at River Mile 24 near Stricker's Grove Park and the outfall pipe from the FEMP. The mixing zone is a deep, fast section of river with strong eddy currents just below the outfall pipe. This site is on the outside of a long curve on the western shore. It is steep-sided with a fairly rapid current. Some riparian trees, either standing or fallen, provide good cover and high fish species diversity. The average pool depth here is 1.8 meters. This site has had the fastest current every year sampled. A reach of 500 meters of the river was sampled.

Site IV is found at River Mile 19.3, the outfall of Paddy's Run, which is the historic drainage route of the FEMP facility. It is a pool created by 25 years of dredging by Welch's Sand and Gravel Co. The western shore is unaffected by the dragline operations and contains many submerged and emergent macrophytes, which provide excellent cover for young fish. The eastern shore is steep gravel without vegetation and is unattractive to most fish. The average pool depth is about 2 meters. The current is the slowest at this site and the river is pond-like in many respects. A reach of 550 meters of the river was sampled.

Samples were collected on the 13 (small sample size, directly above dam) and 23 September, 1991 at Site I, 23 September at Site II, and 17 September at Sites III and IV (Table 1, Figure 1).

RESULTS AND DISCUSSION

Physical and chemical data for the four sites show an increase in conductivity from upriver to Paddy's Run (Table 1), but the samples are spaced over a period of six days. This increase was caused by decreases in discharge over the six days and by active dredging of Welches sand and gravel operation above Site IV. The oxygen concentrations and the percent oxygen saturation were lower at morning sampling sites due to diurnal variation in

000011

photosynthesis and respiration of the seston and benthos. Most fish captured at Site III were below the riffle area where the oxygen level was higher.

This year 526 fish, from 33 species in 8 families from the four sites, were gathered collectively (Table 2, 10). The most diverse family was the Cyprinidae with 7 species. Centrarchidae was represented by 6 species this year, compared to 1 species last year. The number of different species per site ranged from 14 (at Site II) to 18 (Site I). The most numerous species was the gizzard shad (Clupeidae) with 247 individuals followed by freshwater drum (Sciaenidae) with 57 individuals, small mouth bass (Centrarchidae) with 43 individuals (31 from Site I) and northern hogsucker (Catostomidae) with 23 individuals. Using one-way ANOVA, the number of species caught does not differ statistically between the three traditional sites with years as replicates but does vary significantly between years ($p = 0.010$) (Table 3) using the three sites as replicates. A Tukey HSD post f test showed that 1990 was lower in the average number of species captured than 1985 ($p = 0.041$), 1986 ($p = 0.013$), and 1991 ($p = 0.041$). This may have been caused by the late sampling period of the 1990 collections.

The sites were electroshocked for 104, 40.5, 45.6 and 75.1 minutes at Sites I, II, III, and IV, respectively (Table 1). The fish diversity and density varies with habitat complexity: topography of the shore, the depth of the pool, the nature of the current and with the amount of vegetation in and over the water (Gammon et al, 1983, Yoder and Gammon, 1976). We collected 67, 225, 172, and 101 fish per hour from the respective sites (Table 1). The low numbers of individuals at Site I, the Hamilton pool, is likely caused by the restriction of fish migration resulting from the two downstream dams. Species diversity is likely reduced by municipal and industrial point source pollution up river. The resulting eutrophication causes diurnal variation in oxygen in the Hamilton pool. The second sampling farther upstream proved to be a much more productive sampling site (17 Sept.), even though it was still in a pool of the upper Hamilton dam. The higher numbers from Sites II and III are thought to be due to the lower water levels allowing for increased maneuverability and capture efficiency. Using one-way ANOVA, the number of fish caught per hour does not differ statistically

between the three traditional sites with years as replicates nor between the years using the sites as replicates (Table 3).

The diversity of fish at each site was measured by the Shannon (H') index based on the information theory using log base 2 (Krebs, 1989). This index of diversity is increased by the number of species in a sample and the relative uniformity of the numbers of individuals of each species. The maximal diversity (H'max) that can be attained in any sample is fixed by the number of species, assuming equal numbers of individuals in all species. Gizzard shad dominated the fish community at Sites II, III, and IV and their numbers had the greatest effect on the diversity of Sites II and IV (Table 4). At Sites I and III, gizzard shad accounted for 13.7% and 29.5% of all fish collected, but at Sites II and IV, the gizzard shad comprised 65.1% and 73.8% of all fish sampled. Site I had the highest diversity (H' = 3.110, E = 0.45)(Table 4) and was dominated by small mouth bass. The highest evenness was at Site III (E = 0.58)(Table 4), which had the second highest diversity (H' = 2.82). The observed diversity values are not statistically different from previous years for the three traditional sites. The 8 year mean for H' and evenness shows a trend of III > II > IV (Table 5). The one-way ANOVA reveals a significant difference in mean evenness between sites ($p=0.005$, Table 5). The eight-year mean evenness at Site IV is statistically lower than Site III. This is due to the high proportion of gizzard shad that are present at Site IV.

Differences in community structure can be seen by comparing the similarity of species composition from the three sites. The community coefficient (CC) is a measure of the proportion of species shared by any two locations. It is calculated as two times the number of shared species (c) divided by the sum of all the species found at the two sites (a and b).

$$\textbf{Community Coefficient} = 2c / a+b$$

000013

A CC of 1.0 indicates that the two sites have identical species composition, while a CC of 0.0 means there are no shared species (Krebs 1989). A low CC may reflect differences of habitat due to geographical separation or a pollution gradient. The percent similarity takes into account not only the presence/absence of a species but also the proportions that each species is observed. It is calculated by summing the minimum proportion of each species shared between the two communities being compared.

$$\textbf{Percent Similarity} = \Sigma \text{ min. Pi of a, b}$$

where Pi is the proportion of species, and a and b are the two communities of concern.

The community coefficient between Site I and the downstream sites are similar (II and III, 0.45 and IV, 0.48) (Table 6). The degree of similarity between Site I and the downstream sites are low (Site II, 24%; Site III, 27%; Site IV, 26%) (Table 7). Among Sites II, III, and IV, all community coefficients were greater than 0.57 (Table 6). Percent similarity between Sites II and IV suggests that they are extremely similar (79%) (Table 7). It has been shown that a community may only score 85% similarity to replicate samples of the same community. Site III compared to Sites II and IV show some similarity (II-III, 50%; III-IV, 41%).

The weight and length frequency distributions were calculated (Tables 8 and 9). The modal weight is observed to be between 25 to 50 grams for fishes caught at Site I, 125 to 150 grams for fishes from Site II and 50 to 75 grams for fishes from Sites III and IV (Figure 2). Observation of weight distribution as the cumulative proportion of fish reveals that the slope of the line from each site increases with of the abundance of a particular weight class (Figure 3). Site IV has the greatest initial slope due to the predominance of small shad (>85% of fish < 100 gms). Site I and III show very similar lines with nearly 75% and 65% of these fish weighing less than 100 gms. Site I had several young black redhorse, northern hogsuckers, and small mouth bass and Site III had several young drum. Site II has the lowest slope as result of the absence of young-of-year (Y-O-Y) fish.

The length frequency distributions (Figure 4) show the modal length of fishes at Site I (10-12 cm) was the smallest, due to the young black redhorse, northern hogsuckers, and small mouth bass. Site II had the highest modal length (24-26 cm). Site III appears to have a bimodal distribution (14-16 cm and 24-26 cm). Site IV modal length distribution is 14-16 cm. The cumulative percent frequency by length diagram (Figure 5) is a sigmoidal plot since few fish under 10 cm were netted. These curves show that Site IV has 85% of the fish under 20 cm, while Site II only has 25% of the fish measuring under 20 cm.

The mean weight and length of fish by species (Table 10) were examined. Gizzard shad were singled out for additional analysis due to their high numbers and presence at all sites and over all of the sampling years.

One-way ANOVA and subsequent Tukey HSD test of the mean weight and mean length of gizzard shad (Table 11) collected in 1991 identified a significant difference in mean weight and length between Site IV and all other sites (Table 12 and 13). Site IV has a high number of Y-O-Y gizzard shad and the difference is not a reflection of the health of the site.

Examination of the mean weight (Table 14) and mean length (Table 16) of gizzard shad captured over the years in the Great Miami River, represented by the three lower sites, reveals a statistical difference between 1987 weights and lengths with all other years with the exception of 1990 lengths. The 1987 samples may have had fewer Y-O-Y fish collected. This year's samples are only different in length between 1987 and 1990. This can also be attributed to the number of Y-O-Y which were captured and the late 1990 sampling (17 Oct 1990).

Although the sex of mature fish was noted when discernible (Appendix B-E), the sample size for any species at any site is too small for meaningful interpretation of sex ratio bias.

000015

We have determined that the four sites vary in the size of fish and that there is some overlap in the species present at the sites. In order to determine if the fish are growing at the same rate at all sites, the length/weight plots of the most common species or families at all sites are generated. This length to weight relationship is a condition factor or "fatness factor" per unit length. Fish in poor condition will be longer per unit weight than fish in good condition. Among small fish, especially Y-O-Y, the probability of overwinter survival is a function of condition. If one site had fish below the length/weight plots of the other sites, then it could be inferred that growth conditions were not as optimal because of the lack of food or pollution stress.

Examining the gizzard shad by site from 1991 (Figure 6) show that most if not all Y-O-Y captured were from Site IV. An examination and analysis of the length/weight regressions among the 1991 sites (Table 18) indicates that Site IV gizzard shad have a significantly higher rate of growth in length than the gizzard shad from other upstream sites. This is due to the higher proportion of Y-O-Y gizzard shad at site IV. Y-O-Y gizzard shad grow one (1) mm/day in Lake Erie (Vondracek and LeHew, 1992).

No significant differences were found when comparing slopes of the length/weight regressions between the years using the three traditional sites as representing the Great Miami River (Figure 7).

Visual observation of the length/weight plots of longear sunfish (Figure 8) shows variability in the curve but this variability is shared among the three sites. Small mouth bass (Figure 9), northern hogsuckers (Figure 10), large mouth bass (Figure 11), drum (Figure 12), channel catfish (Figure 13) and carp (Figure 14) do not show any obvious deviations between sites.

CONCLUSIONS

The fishery of the Great Miami River has been stable over the last eight years, 1984-1991. Over the 8 years of sampling, 49 species have been recorded.

Site I is protected from the upstream migration of fish by the two dams at Hamilton. The effect of the dam can be seen in differences in community composition, having black redhorse and northern hogsuckers, typical for midsize streams prior to cultural development. The absence of striped bass at Site I also suggests that the two dams are successful barriers to the upstream migration of fish. The lower sites are influenced by the backwater species, which migrate up from the flow-controlled Ohio River. Fish from Site I could have originated from upstream of Hamilton, from Site I or migrated up river during a previous year or during the spring prior to the low flow conditions which made the Hamilton dams barriers to fish migration

The diversity and evenness of the sites are highly influenced by the numbers of gizzard shad. Sites I and III had the highest diversity and the lowest gizzard shad populations. Site IV is a nursery for Y-O-Y gizzard shad and had the lowest diversity and evenness. The Y-O-Y gizzard shad at Site IV also influenced statistically different mean weights, lengths and length/weight regressions between Site IV and the remaining three. Other fish species appear to be the same condition of health, independent from site, as seen in the length/weight plots.

In conclusion, Site I is a population isolated from downstream activity. Sites II, III and IV can be influenced by effluents from the city of Hamilton and the Ohio River. Except for fin rot noted on two specimens from Site II (Appendix C), no indicators examined show any sign of differential pollution stress among the lower three sites. In this regard, there are no discernible effects of the FEMP on the numbers, condition or species richness of the fish communities in the Great Miami River in 1991.

000017

REFERENCES CITED

Clay, W.M. 1975. The fishes of Kentucky. Kentucky Dept. of Fish & Wildlife Resources, Frankfort, Ky. p 416.

Gammon, J.R. 1973. The effect of thermal inputs on the populations of fish and macroinvertebrates in the Wabash River. Purdue Univer. Water Research Center Tech. Rept. no. 86.

Gammon, J.R. 1976. The fish population of the middle 340 km of the Wabash River. Purdue Univer. Water Research Center Tech. Rept. No. 32.

Gammon, J.R., M.D. Johnson, C.E. Mays, D.A. Schiappa, W.L. Fisher and B. L. Pearman. 1983. Effects of Agriculture on Stream Fauna in Central Indiana. USEPA. EPA-600/S3-83-020. 5p.

Krebs, C.J. 1989. Ecological Methods. Harper and Row, N.Y. 654p.

Miller, M. C., G. Gibeau, M. Kelly, J. Schneider, and T. Linnabary. 1987. Fish of the Great Miami River 10 September 1987. Draft Report, Westinghouse Materials Company of Ohio, Cincinnati, OH. p. 39.

Pflieger, W.L. 1975. The fishes of Missouri. Missouri Dept. of Conservation. 342p.

Smith, P.W. 1979. The fishes of Illinois. U. of Illinois Press, Urbana.Ill. 413p.

Trautman, M. B. 1981. The fishes of Ohio. Ohio State U. Press. 782p.

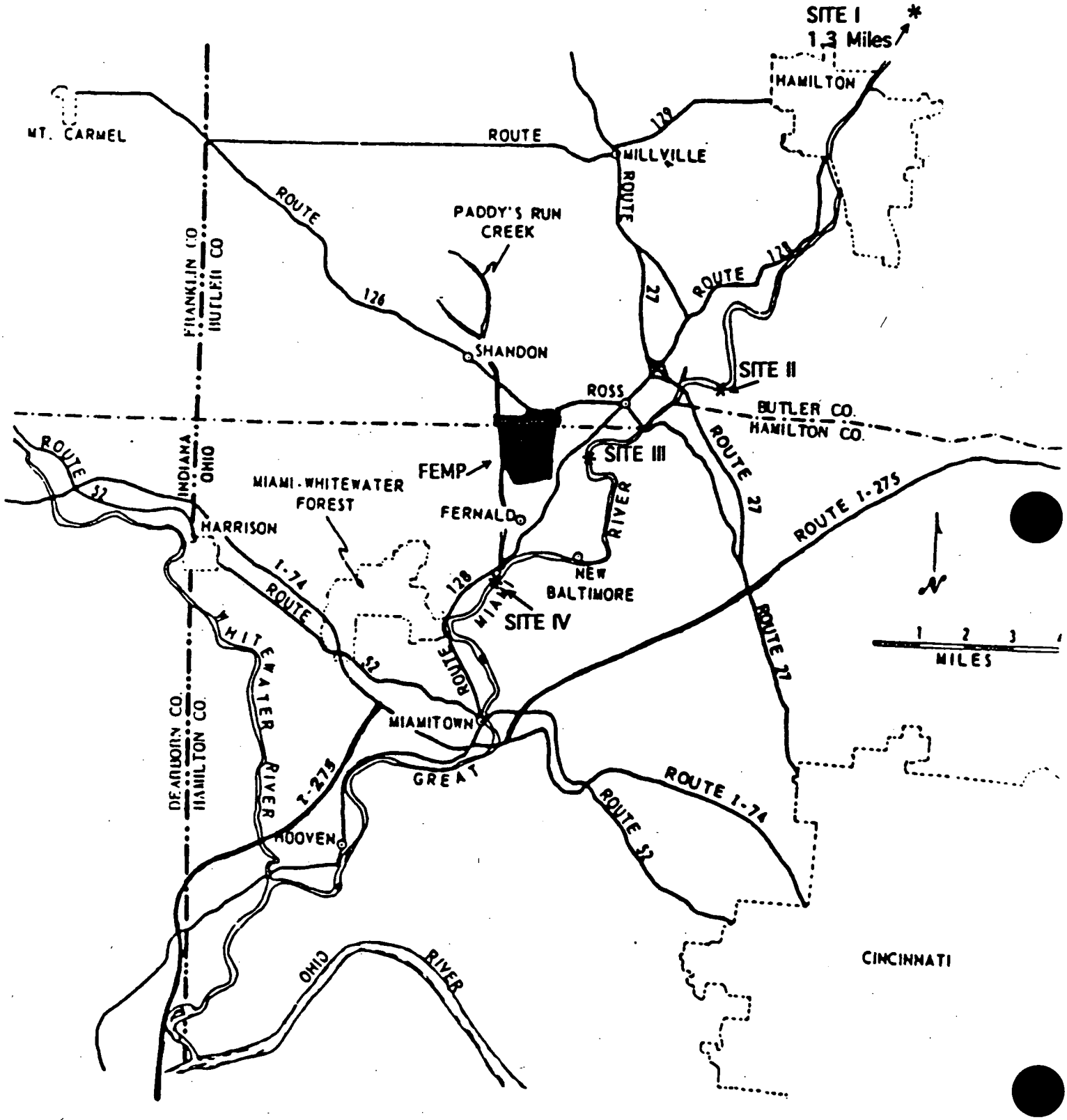
Vibert, R.(ed.). 1967. Fishing with electricity. F.A.O. United Nations. 276p.

Vondracek, B. and Robert LeHew. 1992. Population dynamics and ecology of Lake Erie gizzard shad. In "Ohio Cooperative Fish and Wildlife Research Unit, 1991 Annual Report", ODW, OSU, USFWS and WMI. pp 54.

Wetzel. R. and G.E. Likens. 1989. Limnological Analyses. Second Edition. Springer-Verlag, New York 391p.

Yoder, C.O. and J.R. Gammon. 1976. Spatial and temporal distributions and abundance of fishes in the Middle Ohio River. Rept. for Dayton Power and Light Co. 113p.

Figure 1. Map of sampling sites on the Great Miami River, 1991



000019

6383

000020

Figure 2. Frequency of fish weight categories for all sites from the Great Miami River, 1991.

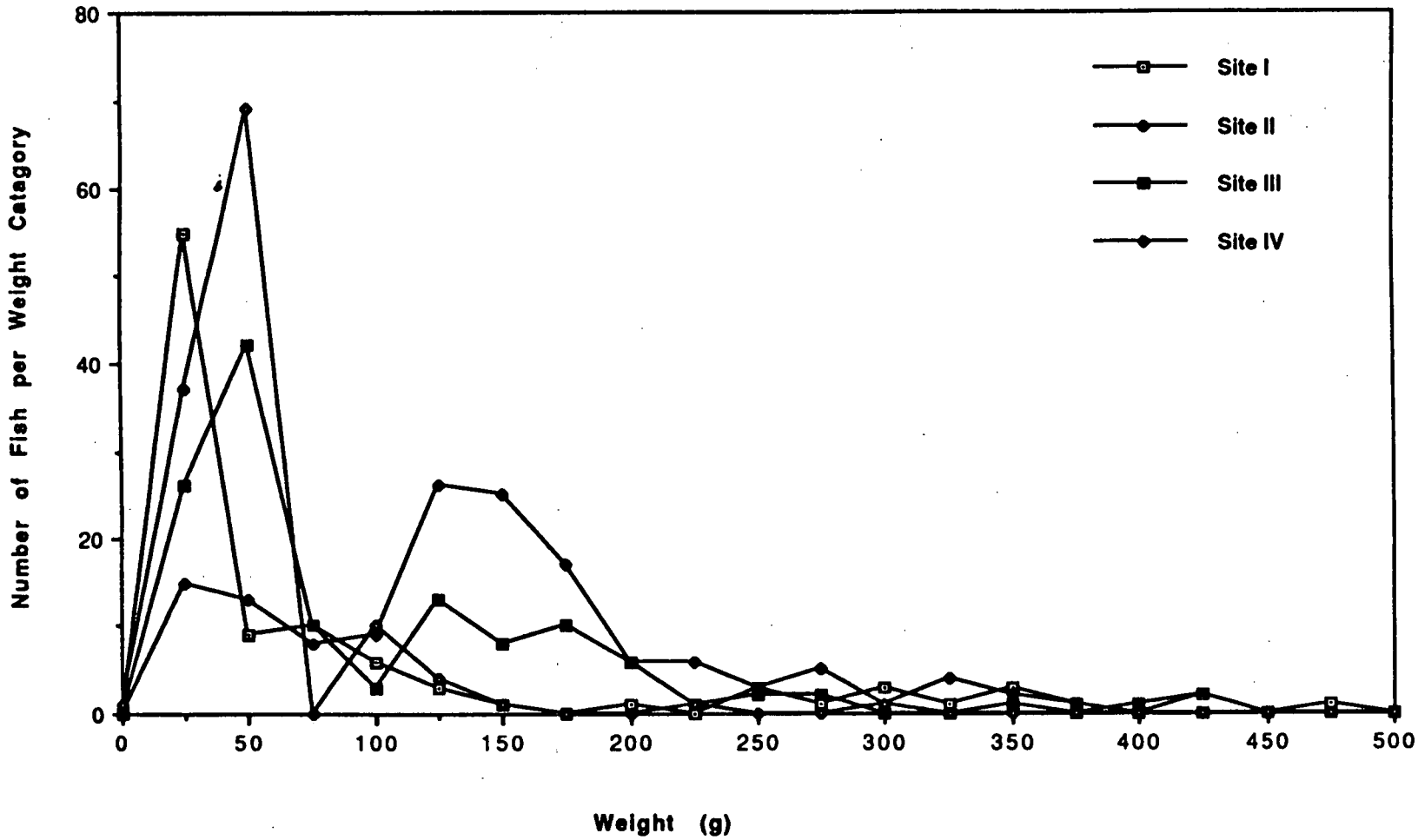
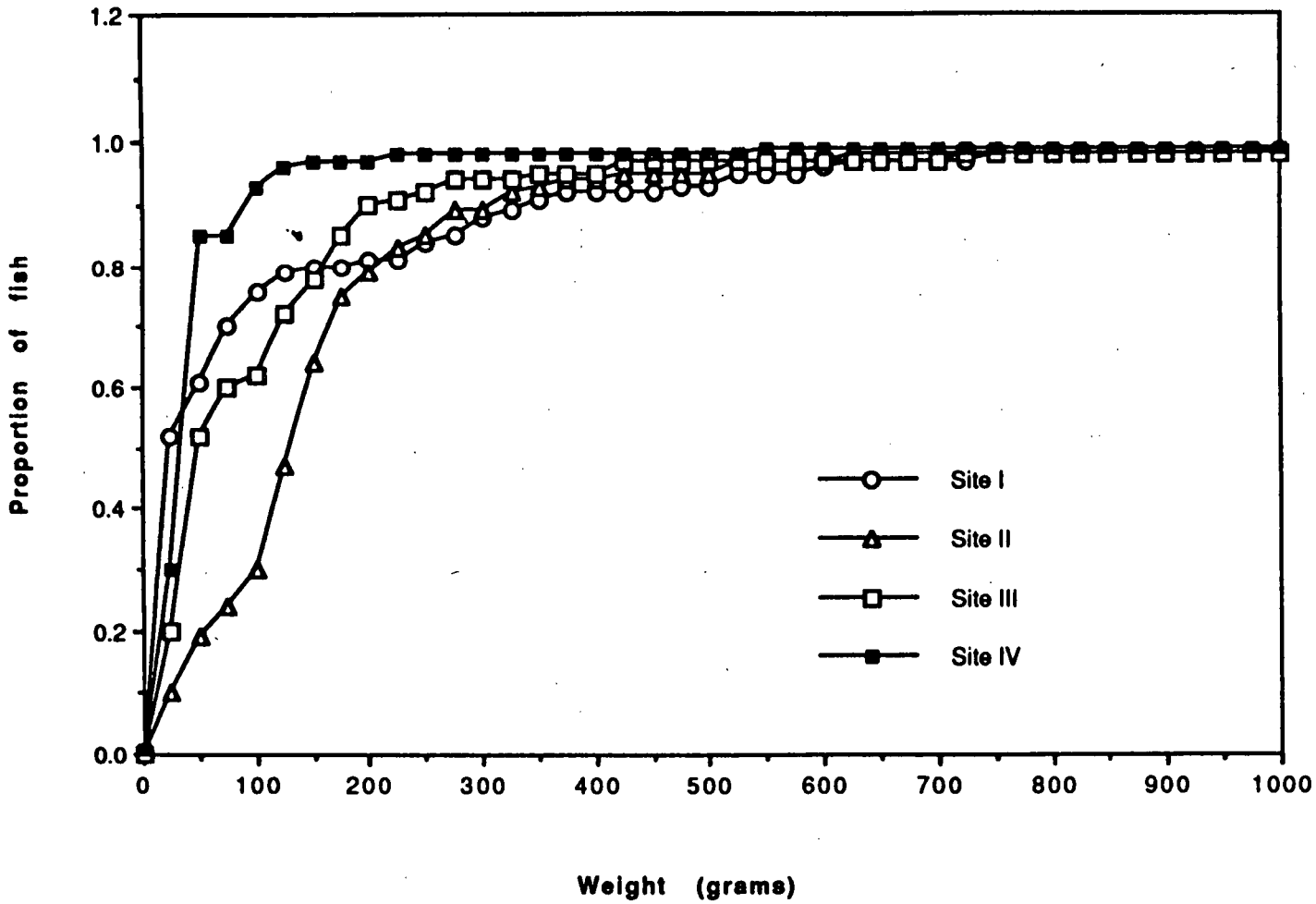


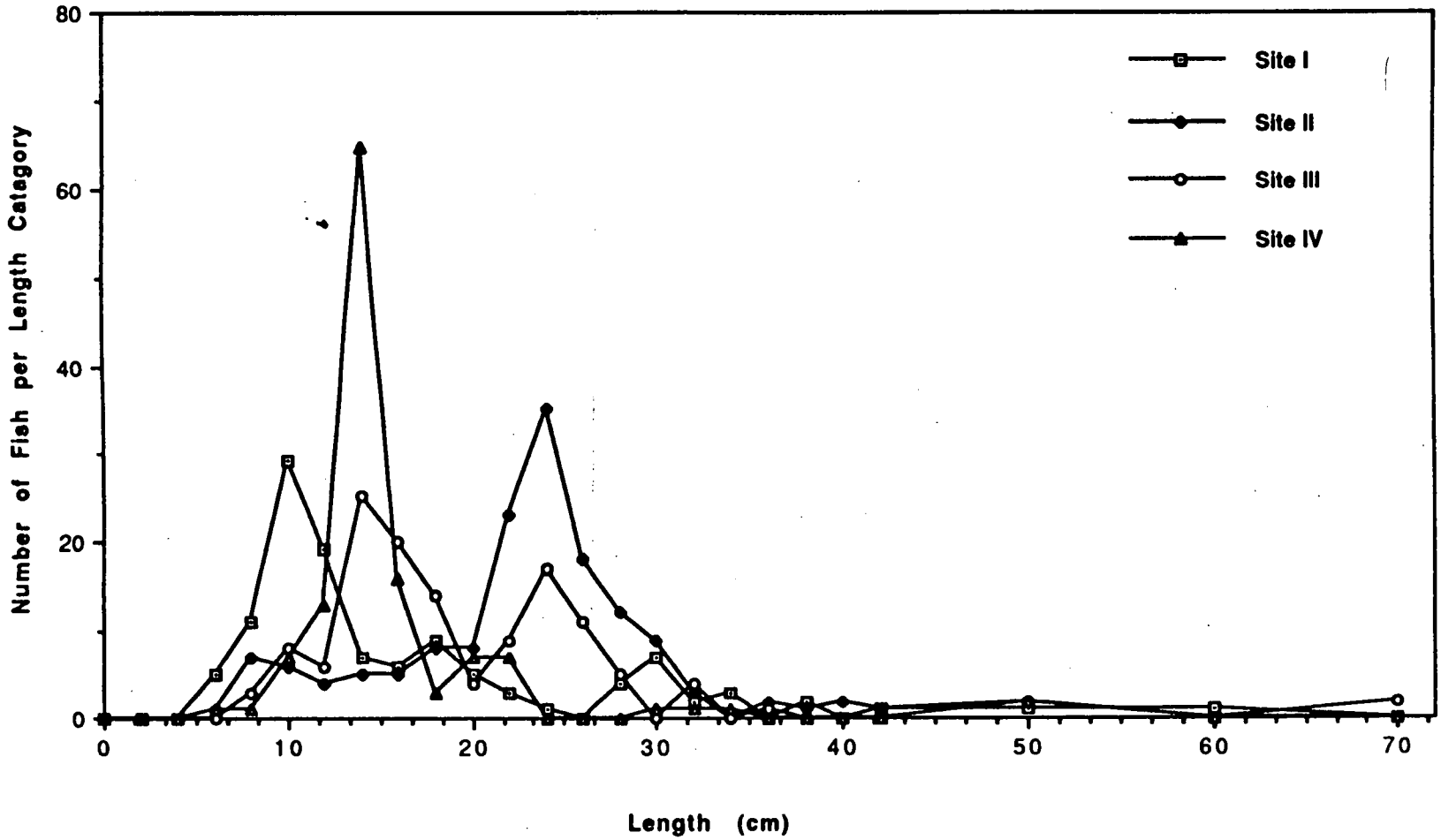
Figure 3. Cumulative proportion of fish weight for all sites from the Great Miami River, 1991.



000021

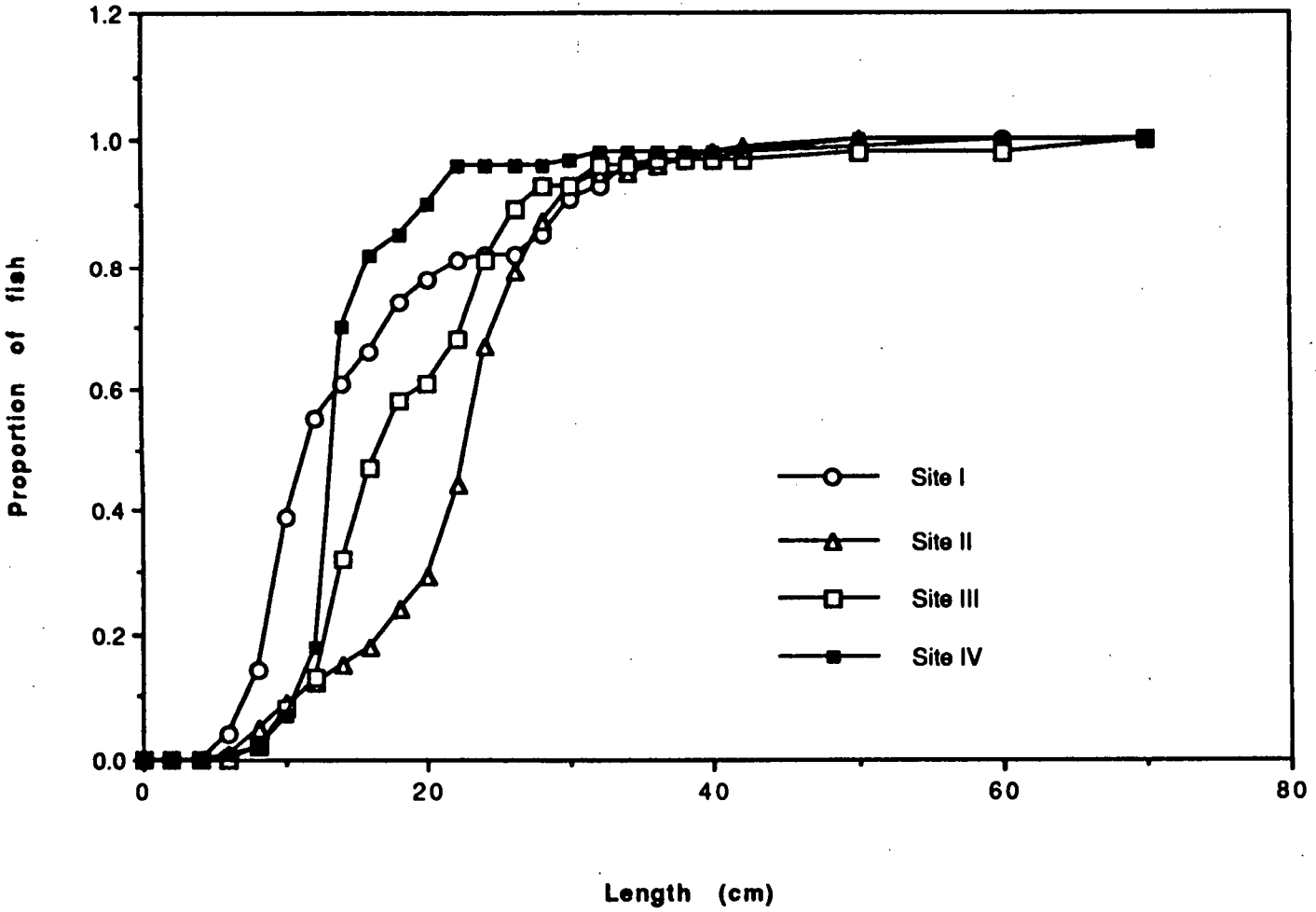
6383

Figure 4. Frequency of fish length categories for all sites from the Great Miami River, 1991.



0000022

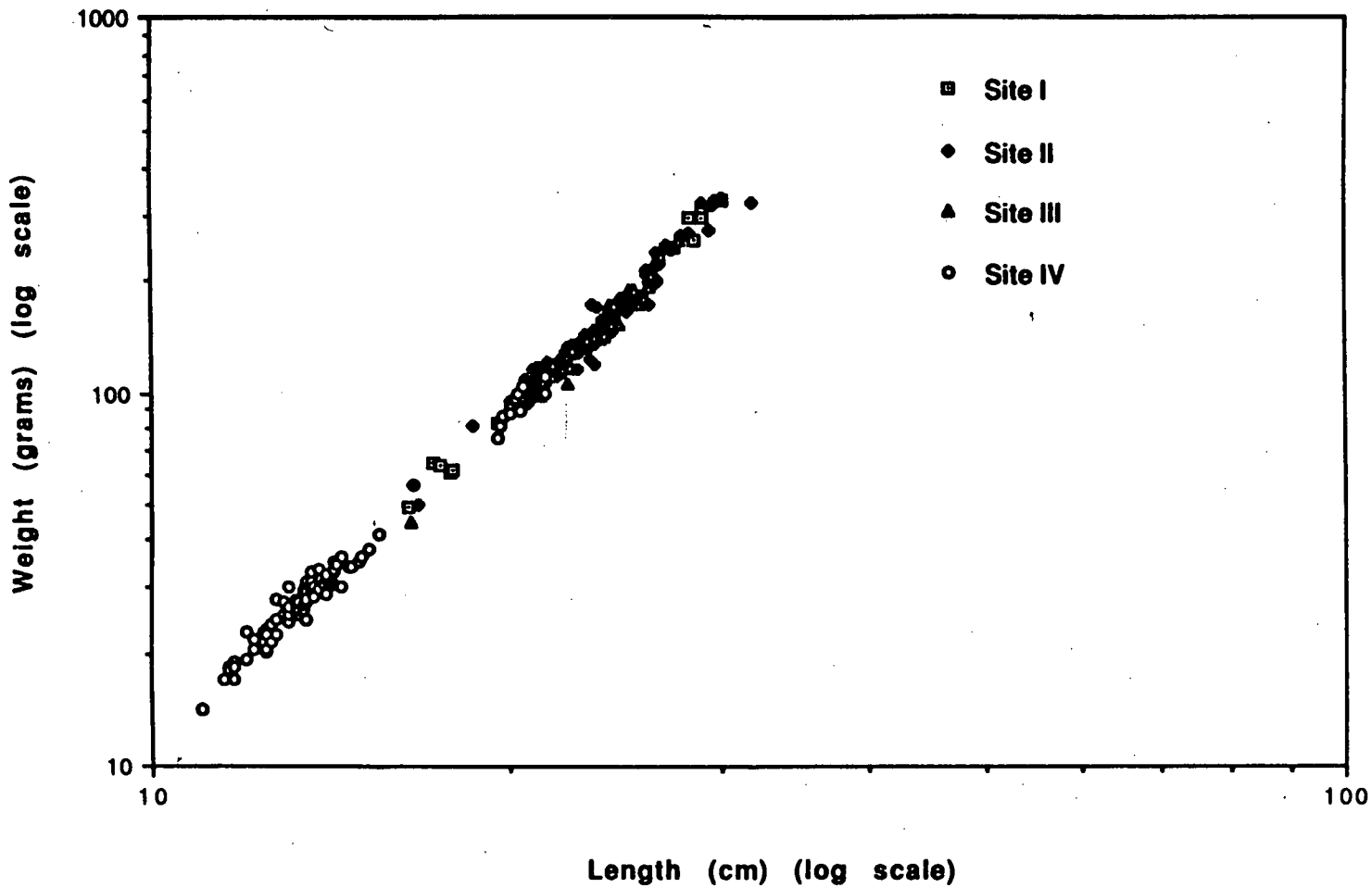
Figure 5. Cumulative proportion of fish length from all sites in the Great Miami River, 1991.



0000023

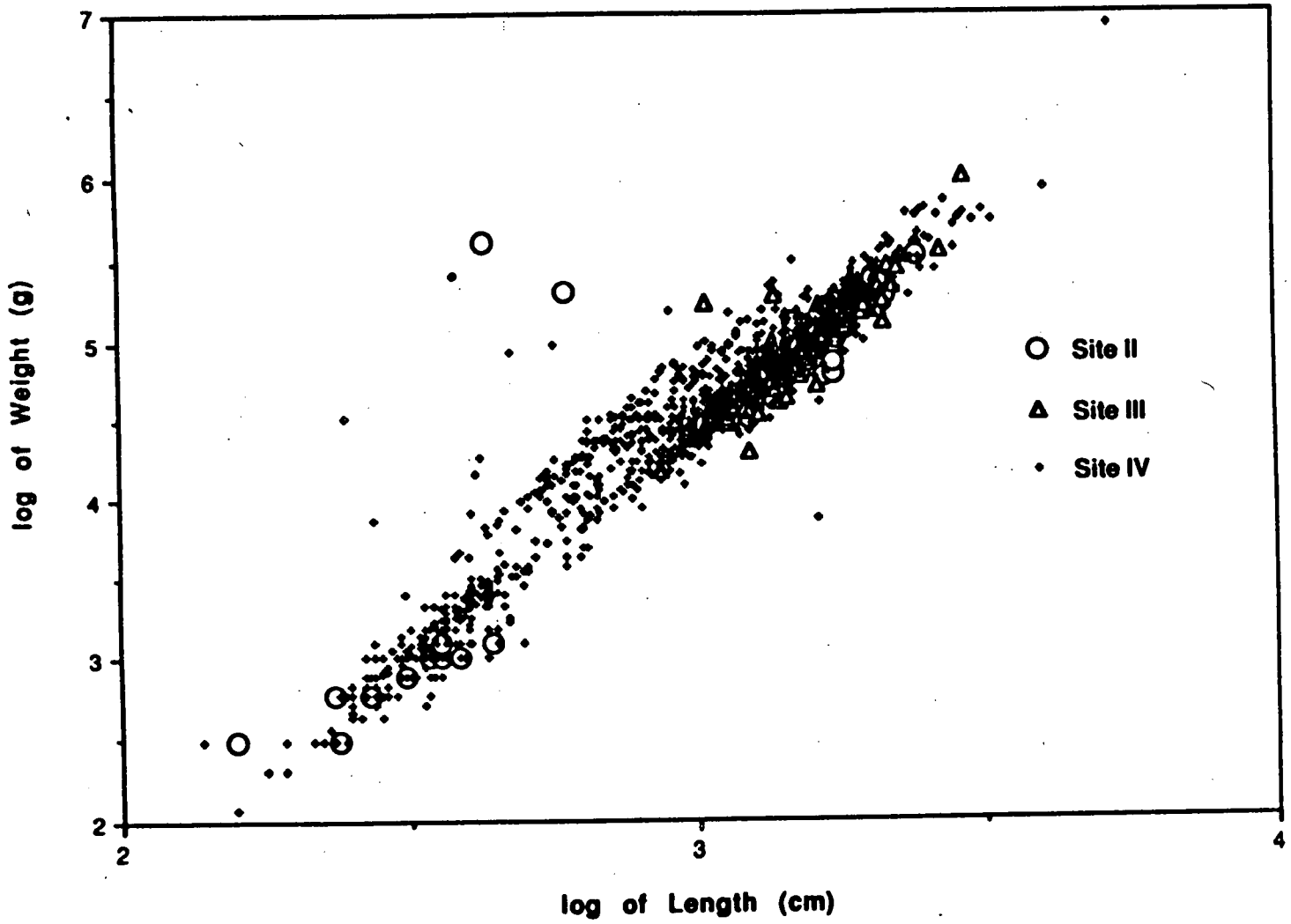
6383

Figure 6. Gizzard shad length/weight relationship of four sites from the Great Miami River, 1991.



000024

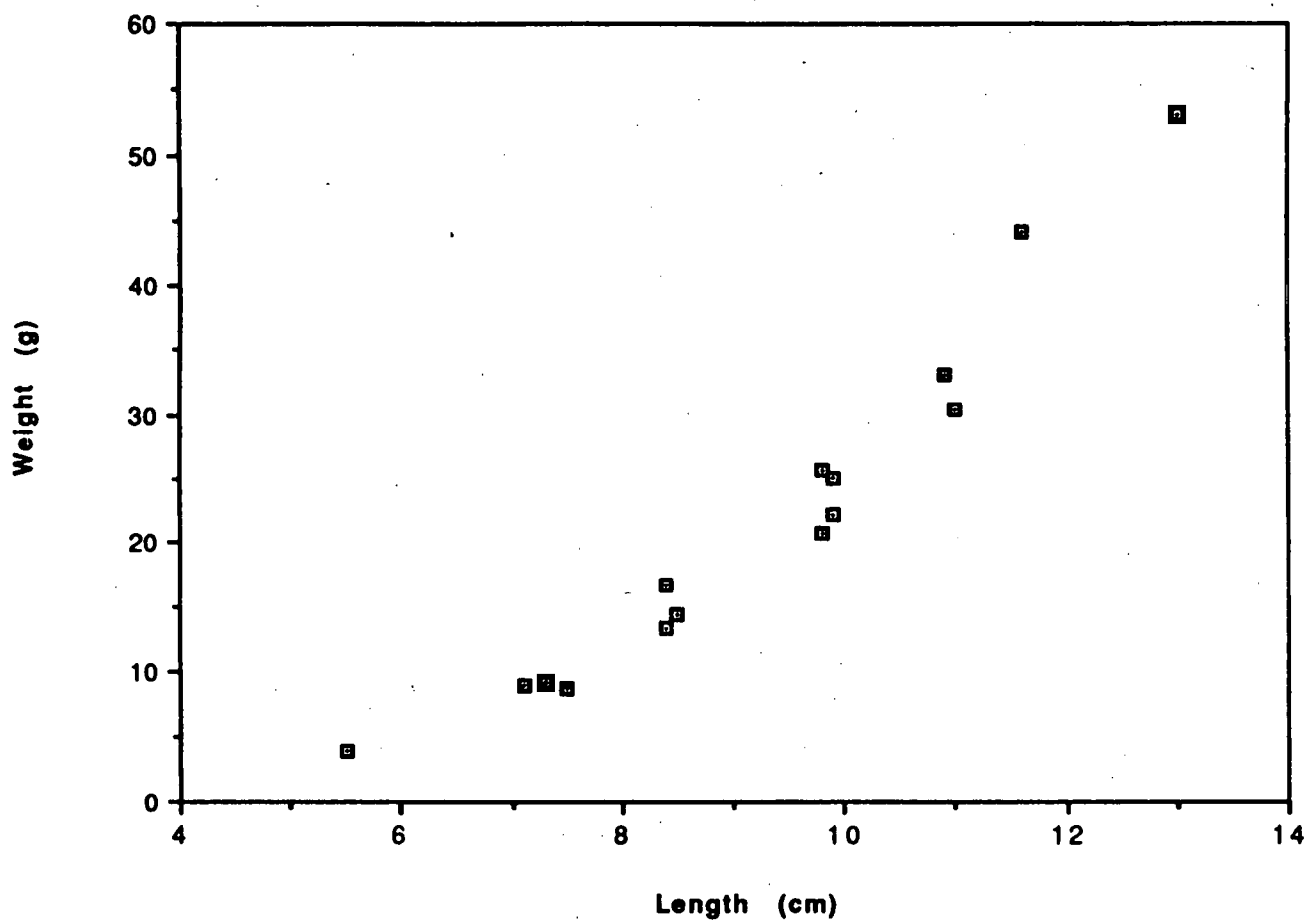
Figure 7. Weight/length relationship of all gizzard shad collected from three sites from the Great Miami River, from 1984 to 1991.



000025

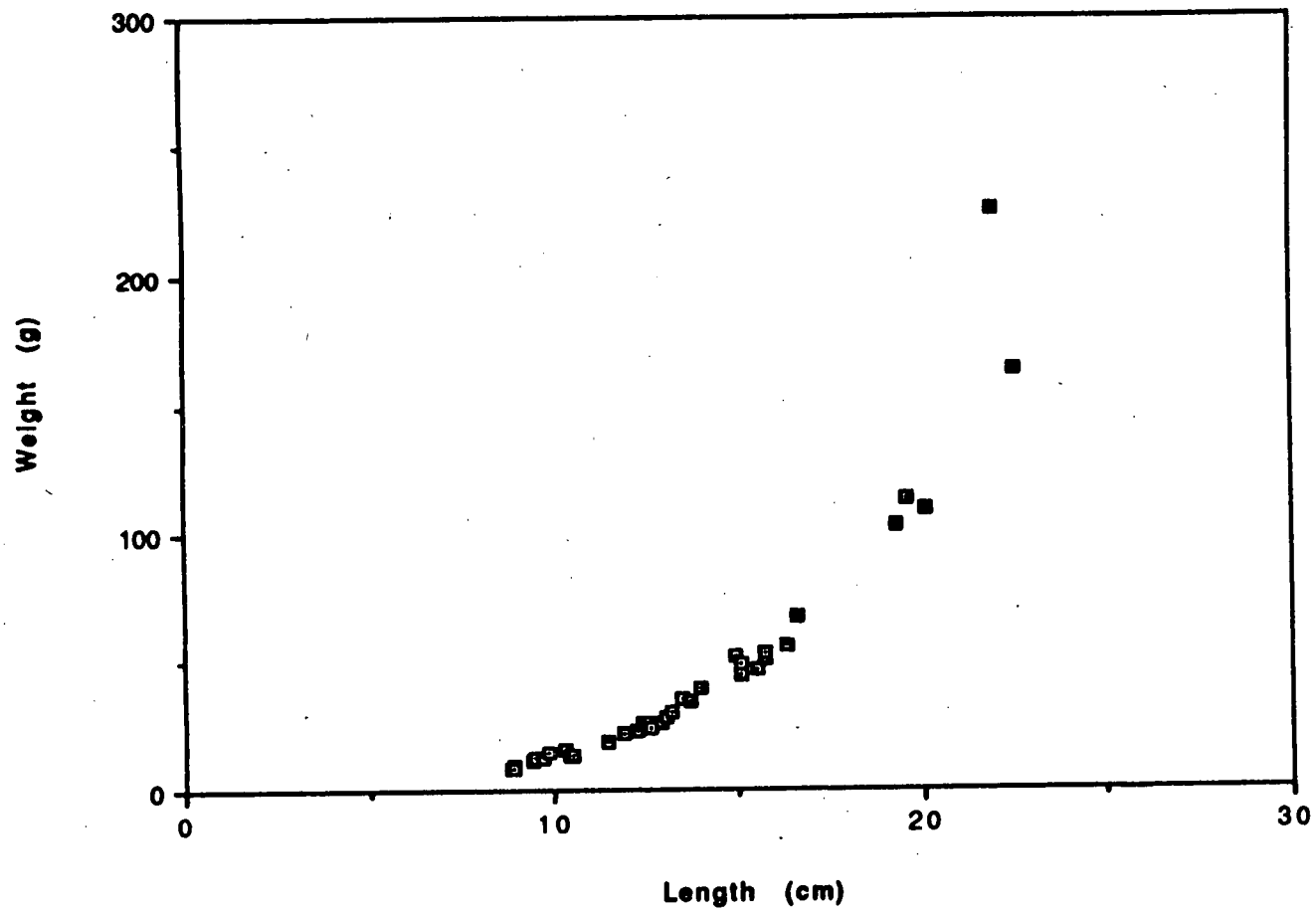
6383

Figure 8. Longear sunfish length/weight relationship for all sites from the Great Miami River, 1991.



000026

Figure 9. Small mouth bass length/weight relationship for all sites from the Great Miami River, 1991.



000027

6383

000028

Figure 10. Northern hogsucker length/weight relationship for all sites from the Great Miami River, 1991.

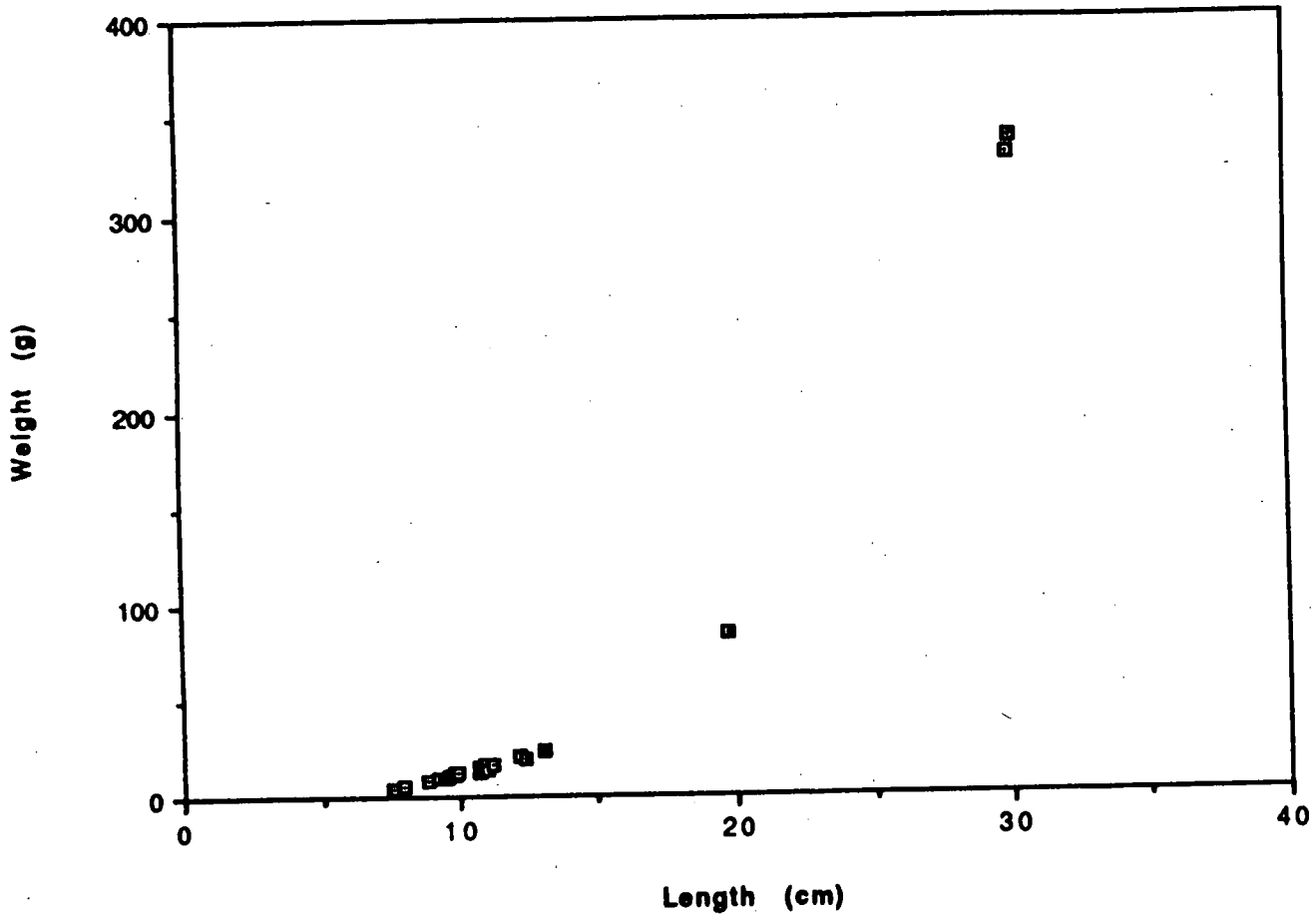
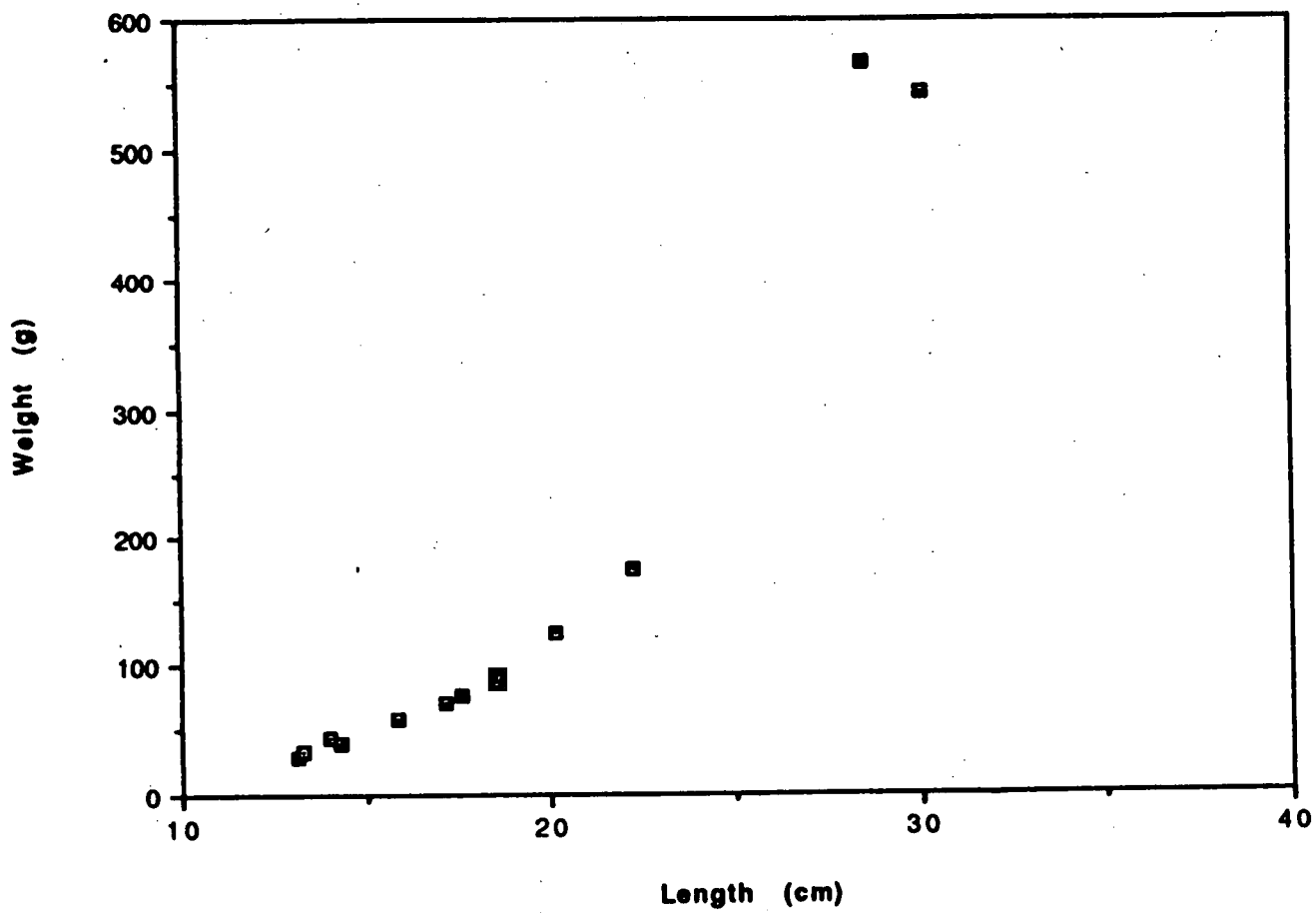


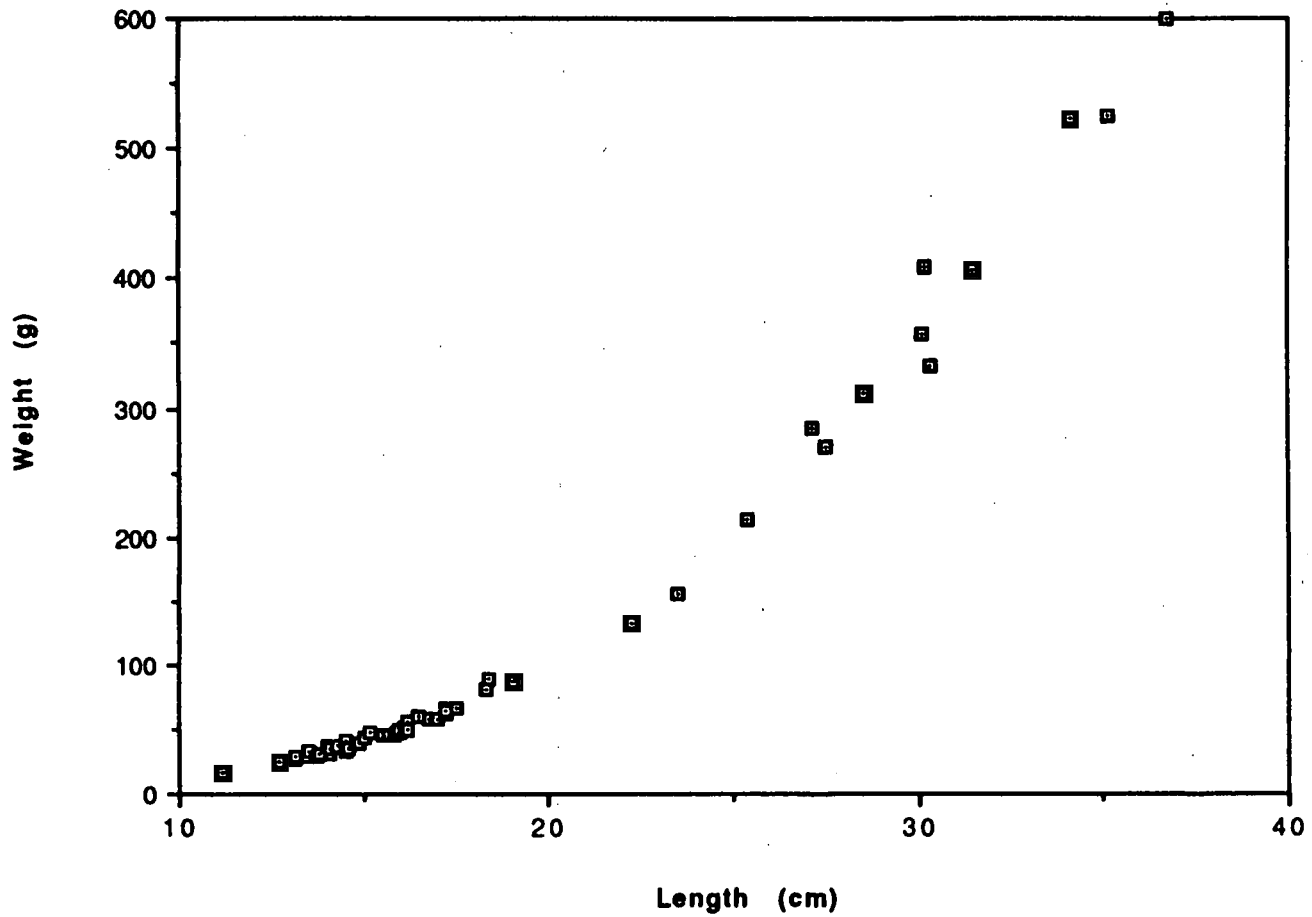
Figure 11. Large mouth bass length/weight relationship for all sites from the Great Miami River, 1991.



000029

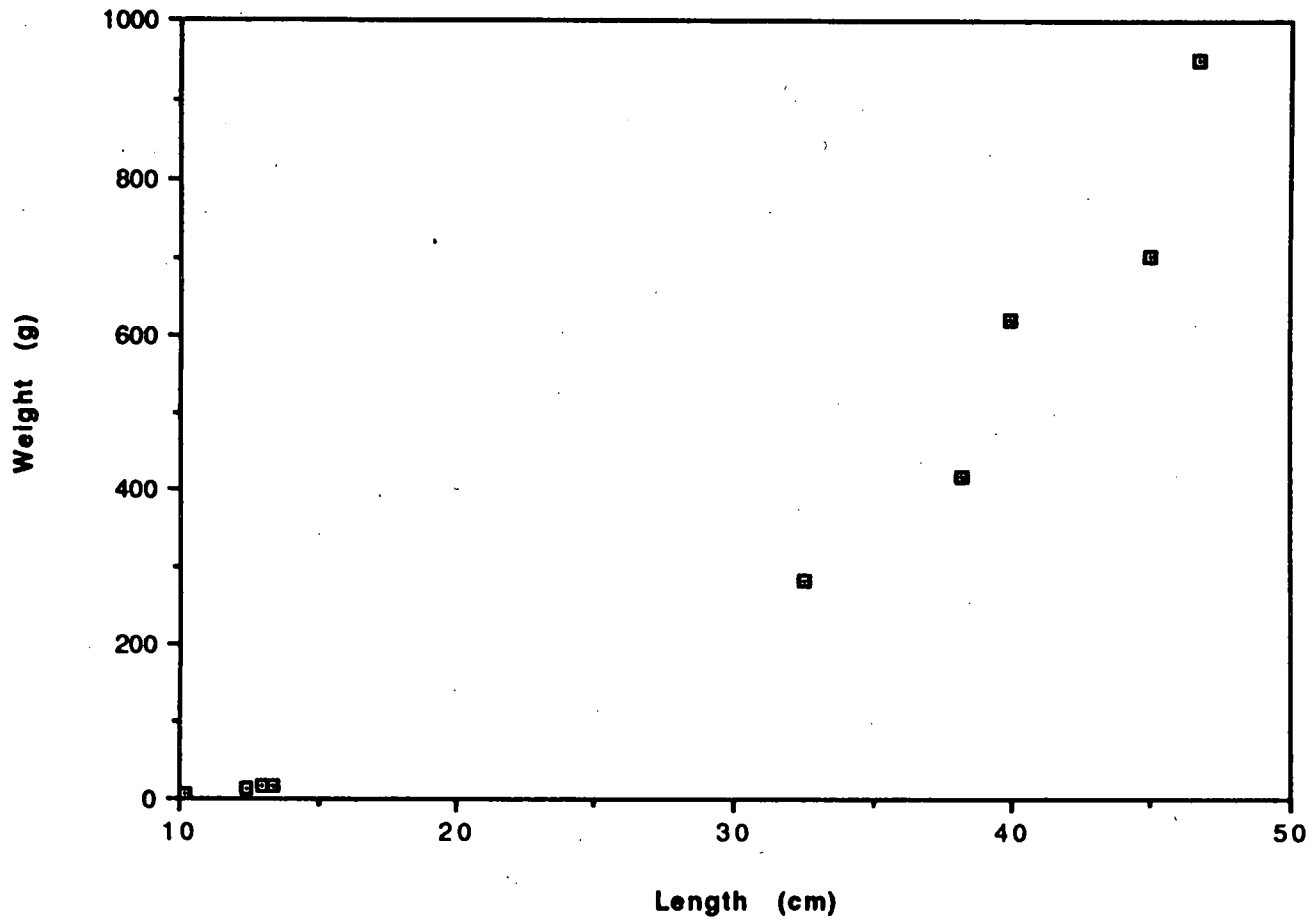
6388

Figure 12. Drum length/weight relationship for all sites from the Great Miami River, 1991.



000030

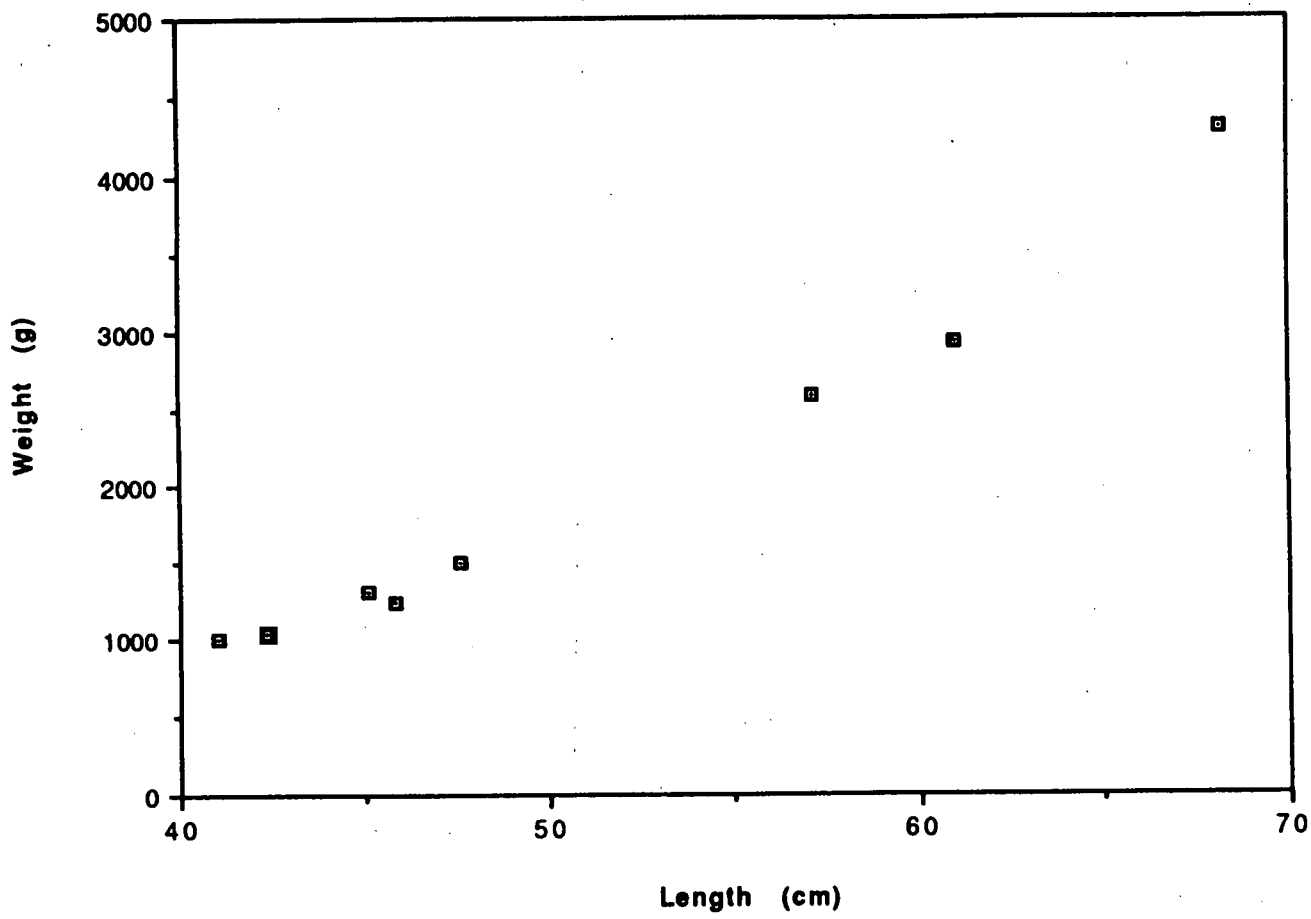
Figure 13. Channel catfish length/weight relationships for all sites from the Great Miami River, 1991.



000031

6383

Figure 14. Carp length/weight relationships for all sites from the Great Miami River, 1991.



000032

Table 1. Physical and chemical parameters of four sites sampled in the Great Miami River, 1991.

SITE	DATE	TIME (24H)	TEMP (C°)	OXYGEN (PPM)	%O_2 SATURATION	CONDUCTIVITY (UMHOS/CM)	SHOCK TIME (mins)	#OF FISH	FISH PER HOUR
I	23 Sept.	09:00	17.6	8.2	84.19	466	104	116	66.92
II	23 Sept	11:30	19.9	10.5	112.3	426	40.5	152	225.19
III	17 Sept	09:00	26.0	5.72	39.12	702	45.6	132	173.67
IV	17 Sept	13:30	27.0	13.15	89.95	907	75.1	126	100.67

000033

Table 2. Species and number of fish captured from four sites in the Great Miami River, 1991.

COMMON NAME/SITE	I	II	III	IV	Sum
BLACK BUFFALO	0	0	1	0	1
BLACK BULLHEAD	0	0	1	0	1
BLACK CRAPPIE	1	0	0	0	1
BLACK REDHORSE	21	1	0	0	22
BLUNTNOSE MINNOW	1	0	0	0	1
BLACKSIDE DARTER	0	0	0	1	1
BLUEGILL SUNFISH	0	0	0	2	2
BLUEGILL/RED HYBRID	0	3	0	0	3
CARP	2	3	2	1	8
CHANNEL CATFISH	1	2	5	1	9
DRUM	0	14	40	3	57
EMERALD SHINER	0	1	0	0	1
FLATHEAD CATFISH	0	2	1	0	3
GIZZARD SHAD	16	99	39	93	247
GOLDEN REDHORSE	2	0	0	0	2
GREEN SUNFISH	0	5	0	2	7
LARGE MOUTH BASS	6	4	1	5	16
LONGEAR SUNFISH	4	5	0	6	15
LONGNOSE GAR	0	0	0	1	1
NORTHERN HOGSUCKER	19	0	4	0	23
OHIO LOGPERCH DARTER	0	0	1	3	4
QUILLBACK CARPSUCKER	1	0	9	0	10
RED EAR SUNFISH	1	3	0	0	4
SAUGER	0	6	12	1	19
SKIPJACK HERRING	0	0	0	1	1
SMALL MOUTH BASS	31	0	8	4	43
STRIPED BASS	0	4	5	2	11
SUCKERMOUTH MINNOW	0	0	3	0	3
BULLHEAD MINNOW	1	0	0	0	1
FATHEAD MINNOW	2	0	0	0	2
SHINNER ?	2	0	0	0	2
SPOTFIN/STEELCOLOR	4	0	0	0	4
SUCKER UNKNOWN	1	0	0	0	1
TOTAL # OF FISH	116	152	132	126	526

Table 3. The number of fish captured per hour and number of species, by site and year, from the Great Miami River, 1984-1991.

	Number of Fish per hour				Number of Species		
YEAR	SITE II	SITE III	SITE IV		SITE II	SITE III	SITE IV
1984					15	12	15
1985	104	84	314		11	19	16
1986	98	79	266		12	15	16
1987	73	75	102		10	11	10
1988	146	195	154		15	12	15
1989	120	69	136		13	12	16
1990	65	60	119		8	10	7
1991	225	174	100		14	15	15
MEAN	117	105	170		12.3	13.3	13.8

ONE-WAY ANOVA COMPARISONS BY YEAR AND BY SITE

VARIABLE	F RATIO	PROBABILITY
HOUR X YEAR	0.925	0.506
HOUR X SITE	1.901	0.178
SPECIES X YEAR	4.066	0.010
SPECIES X SITE	0.530	0.596

Table 4. Shannon Diversity, H max and evenness for four sites from the Great Miami River, 1991.

Site	H'	H' Max	Evenness
I	3.110	6.960	0.450
II	2.100	4.460	0.470
III	2.820	4.850	0.580
IV	1.750	5.510	0.320

000035

Table 5. Species diversity and evenness using information index (log base 2), by site and year, from the Great Miami River, 1984-1991.

	Shannon Diversity			Evenness		
YEAR	SITE II	SITE III	SITE IV	SITE II	SITE III	SITE IV
1984	2.24	1.70	2.06	0.58	0.48	0.53
1985	2.93	3.82	1.28	0.85	0.90	0.32
1986	2.62	3.40	2.20	0.73	0.87	0.55
1987	1.68	2.33	2.78	0.51	0.89	0.40
1988	2.23	2.33	2.78	0.57	0.75	0.71
1989	2.18	2.43	1.96	0.59	0.68	0.49
1990	2.33	2.03	1.04	0.78	0.61	0.37
1991	2.10	2.82	1.75	0.47	0.58	0.32
MEAN	2.289	2.608	1.981	0.635	0.720 *	0.461 *

* Evenness is statistically different between sites ($p = 0.005$)

ONE-WAY ANOVA COMPARISONS BY YEAR AND SITE

VARIABLE	F RATIO	PROBABILITY
H' X YEAR	0.742	0.641
H' X SITE	2.290	0.126
EVENNESS X YEAR	0.663	0.700
EVENNESS X SITE	6.776	0.005

Table 6. Community coefficients for four sites from the Great Miami River, 1991.

SITE	I	II	III	IV
I	1.00	0.450	0.450	0.480
II	0.450	1.00	0.570	0.620
III	0.450	0.570	1.00	0.620
IV	0.480	0.620	0.620	1.00

Table 7. Percent similarity for four sites from the Great Miami River, 1991.

SITE	I	II	III	IV
I	1.000	0.240	0.270	0.260
II	0.240	1.000	0.500	0.790
III	0.270	0.500	1.000	0.410
IV	0.260	0.790	0.410	1.000

Table 8. Weight frequency distribution of all fish caught from four sites in the Great Miami River, 1991.

Grams	Site I	Site II	Site III	Site IV
0.00	0	0	0	1
25.00	55	15	26	37
50.00	9	13	42	69
75.00	10	8	10	0
100.00	6	9	3	10
125.00	3	26	13	4
150.00	1	25	8	1
175.00	0	17	10	0
200.00	1	6	6	0
225.00	0	6	1	1
250.00	3	3	2	0
275.00	1	5	2	0
300.00	3	1	0	1
325.00	1	4	0	0
350.00	3	2	1	0
375.00	1	1	0	0
400.00	0	0	1	0
425.00	0	2	2	0
450.00	0	0	0	0
475.00	1	0	0	0
500.00	0	0	0	0
525.00	2	2	0	0
550.00	0	0	0	1
575.00	0	0	0	0
600.00	1	1	0	0
625.00	1	1	0	0
650.00	0	0	0	0
675.00	0	0	0	0
700.00	0	0	0	0
725.00	0	0	1	0
750.00	1	0	0	0
775.00	0	0	0	0
800.00	0	0	0	0
825.00	0	0	0	0
850.00	0	0	0	0
875.00	0	0	0	0
900.00	0	0	0	0
925.00	0	0	0	0
950.00	0	0	1	0
975.00	0	0	0	0
1000.00	0	1	0	0
1250.00	0	1	0	1
1500.00	1	1	0	0
1750.00	0	0	0	0
2000.00	0	0	0	0
3000.00	1	0	1	0
3500.00	0.00	0.00	1.00	0.00
TOTAL #	105.00	150.00	131.00	126.00

000037

Table 9. Length frequency distribution of all fish caught in the Great Miami River, 1991.

cm	Site 1	Site 2	Site 3	Site 4
0.00	0	0	0	0
2.00	0	0	0	0
4.00	0	0	0	0
6.00	5	1	0	1
8.00	11	7	3	1
10.00	29	6	8	7
12.00	19	4	6	13
14.00	7	5	25	65
16.00	6	5	20	16
18.00	9	8	14	3
20.00	5	8	4	7
22.00	3	23	9	7
24.00	1	35	17	0
26.00	0	18	11	0
28.00	4	12	5	0
30.00	7	9	0	1
32.00	2	3	4	1
34.00	3	0	0	1
36.00	0	2	1	0
38.00	2	1	0	0
40.00	0	2	0	0
42.00	1	1	0	0
50.00	1	2	2	2
60.00	1	0	0	0
70.00	0	0	2	0
TOTAL #	116.00	152.00	131.00	125.00

Table 10. Average length, weight, and standard deviations for all species of fish from four sites on the Great Miami River, 1991.

Site	COMMON NAME	N	Average Length	Standard Deviation	Average Weight	Standard Deviation
	CATOSTOMIDAE					
II	BLACK REDHORSE	1	11.40	n = 1	14.93	n = 1
I	BLACK REDHORSE	21	20.10	12.08	202.84	258.98
I	GOLDEN REDHORSE	2	27.20	1.13	239.00	57.98
III	NORTHERN HOGSUCKER	4	11.75	1.08	17.28	5.27
I	NORTHERN HOGSUCKER	19	12.47	6.68	49.67	102.20
III	QUILLBACK	9	8.89	1.71	10.53	5.79
I	QUILLBACK	1	14.90	n = 1	45.30	n = 1
I	SUCKER UNKNOWN	1	11.90	n = 1	21.99	n = 1
	CENTRARCHIDAE					
IV	BLUEGILL SUNFISH	2	11.60	8.63	72.00	96.10
II	BLUEGILL/RED SUNFISH	3	14.10	3.68	78.82	62.29
IV	GREEN SUNFISH	2	9.30	0.28	17.92	2.21
II	GREEN SUNFISH	5	7.52	1.51	9.85	6.83
IV	LARGE MOUTH BASS	5	22.06	7.12	270.98	262.22
III	LARGE MOUTH BASS	1	14.30	n = 1	39.45	n = 1
II	LARGE MOUTH BASS	4	16.33	4.06	77.69	65.51
I	LARGE MOUTH BASS	6	12.03	6.33	78.31	8.70
I	LONGEAR SUNFISH	4	8.60	3.17	19.78	22.55
II	LONGEAR SUNFISH	5	8.96	1.47	19.55	9.45
IV	LONGEAR SUNFISH	6	9.90	1.48	25.31	11.67
II	REDEAR SUNFISH	3	7.57	0.49	9.36	1.69
I	REDEAR SUNFISH	1	7.70	n = 1	9.02	n = 1
IV	SMALL MOUTH BASS	4	14.33	3.53	46.59	44.57
I	SMALL MOUTH BASS	31	11.75	3.63	34.29	28.63
III	SMALL MOUTH BASS	8	15.61	4.22	73.71	77.53
	CLUPEIDAE					
IV	GIZZARD SHAD	93	14.13	2.42	35.32	22.01
II	GIZZARD SHAD	39	23.53	2.97	154.97	62.23
III	GIZZARD SHAD	99	23.34	2.09	142.69	39.41
I	GIZZARD SHAD	16	23.08	5.13	166.75	106.03
IV	SKIPJACK HERRING	1	17.90	n = 1	47.80	n = 1
	CYPRINIDAE					
I	BLUNTNOSE MINNOW	1	8.00	n = 1	4.67	n = 1
I	BULLHEAD MINNOW	1	7.90	n = 1	5.23	n = 1
II	CARP	3	44.80	3.41	1247.40	249.48
III	CARP	2	64.60	5.09	3619.73	981.48
IV	CARP	1	42.30	n = 1	1032.00	n = 1
I	CARP	2	51.10	8.49	1950.48	898.08
II	EMERALD SHINER	1	7.50	n = 1	3.01	n = 1
I	FATHEAD MINNOW	2	10.00	0.14	10.25	0.29
I	SHINER UNKNOWN	2	6.71	2.40	7.15	1.92
I	SPOTFIN/STEELCOLOR SHINNER	4	7.73	1.55	4.49	2.82
III	SUCKER MOUTHED MINNOW	3	9.20	0.75	8.89	2.82

000039

Table 10 cont. Average length, weight, and standard deviations for all species of fish from the Great Miami River, 1991.

Site	COMMON NAME	N	Average Length	Standard Deviation	Average Weight	Standard Deviation
	ICTALURIDAE					
3	BLACK BULLHEAD	1	9.50	n = 1	8.71	n = 1
2	CHANNEL CATFISH	2	39.05	1.20	519.00	140.01
4	CHANNEL CATFISH	1	32.50	n = 1	282.34	n = 1
1	CHANNEL CATFISH	1	10.20	n = 1	6.62	n = 1
3	CHANNEL CATFISH	5	26.10	18.04	340.48	451.81
3	FLATHEAD CATFISH	1	34.50	n = 1	396.00	n = 1
2	FLATHEAD CATFISH	2	17.40	12.16	89.69	116.47
	LEPISOSTEIDAE					
4	LONGNOSE GAR	1	50.00	n = 1	220.00	n = 1
	PERCIDAE					
4	BLACKSIDE DARTER	1			11.90	n = 1
4	OHIO LOGPERCH DARTER	3	10.07	0.83	9.20	3.10
3	OHIO LOGPERCH DARTER	1	14.00	n = 1	29.07	n = 1
3	SAUGER	12	17.79	4.38	53.23	57.00
2	SAUGER	6	17.28	1.09	42.94	8.30
4	SAUGER	1	16.30	n = 1	30.99	n = 1
	SCIAENIDAE					
2	DRUM	14	24.99	7.90	257.49	200.46
3	DRUM	40	16.42	4.40	69.60	82.95
4	DRUM	3	15.47	0.84	43.82	7.39
3	STRIPED BASS	5	16.50	8.14	105.61	169.57
2	STRIPED BASS	4	12.63	1.29	29.67	6.23
4	STRIPED BASS	2	12.80	3.39	28.65	18.95

Table 11. Average weight, length, standard deviation and standard error of gizzard shad at four sites on the Great Miami River, 1991.

SITE	N	Average Weight	Standard Deviation	Standard Error	Average Length	Standard Deviation	Standard Error
I	16	166.75	106.033	26.51	23.075	5.125	1.28
II	99	154.970	62.230	6.25	23.527	2.967	0.30
III	39	142.695	39.405	6.31	23.336	2.091	0.33
IV	94	35.455	21.298	2.20	14.169	2.441	0.25

Table 12. Matrix of pairwise comparison probabilities (Tukey HSD) for average weight of gizzard shad between sites from the Great Miami River, 1991. Non-shaded comparisons are significant at or less than a p value of 0.05.

SITE	I	II	III	IV
I	1.000			
II	0.832	1.000		
III	0.397	0.591	1.000	
IV	0.000	0.000	0.000	1.000

Table 13. Matrix of pairwise comparison probabilities (Tukey HSD) for average length of gizzard shad between sites from the Great Miami River, 1991. Non-shaded comparisons are significant at or less than a p value of 0.05.

SITE	I	II	III	IV
I	1.000			
II	0.935	1.000		
III	0.990	0.985	1.000	
IV	0.000	0.000	0.000	1.000

Table 14. Average weight of gizzard shad in the Great Miami River from 1984 to 1991, represented by three sites.

YEAR	N	WEIGHT (G)	STANDARD DEVIATION	STANDARD ERROR
1984	321.00	109.79	66.60	3.72
1985	147.00	88.33	96.71	7.98
1986	144.00	105.55	58.94	4.91
1987	138.00	151.47	46.77	3.98
1988	173.00	113.83	67.33	5.12
1989	195.00	95.84	37.20	2.66
1990	136.00	118.71	53.19	4.56
1991	231.00	104.73	73.34	4.83

Table 15. Yearly comparison (Tukey HSD, p value) of the weight (g) of gizzard shad in the Great Miami River, represented by three sites. Non-shaded comparisons are significant at or less than a p value of 0.05.

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
1984	1.000							
1985	0.021	1.000						
1986	0.998	0.318	1.000					
1987	0.000	0.000	0.000	1.000				
1988	0.998	0.011	0.951	0.000	1.000			
1989	0.260	0.965	0.876	0.000	0.139	1.000		
1990	0.883	0.002	0.692	0.001	0.998	0.035	1.000	
1991	0.986	0.247	1.000	0.000	0.861	0.855	0.489	1.000

Table 16. Average length of gizzard shad in the Great Miami River from 1984 to 1991, represented by three sites. Samples from 1989 are standard length measurements, all other dates are total length.

YEAR	N	LENGTH (cm)	STANDARD DEVIATION	STANDARD ERROR
1984	322.00	20.86	5.58	0.31
1985	147.00	18.33	5.13	0.42
1986	144.00	20.94	4.05	0.34
1987	138.00	23.40	2.96	0.25
1988	173.00	20.81	5.79	0.44
1989	195.00	18.22	2.43	0.17
1990	136.00	22.48	3.66	0.31
1991	231.00	19.71	5.28	0.35

Table 17. Yearly comparison (Tukey HSD, p value) of the length (cm) of gizzard shad in the Great Miami River, represented by three sites. Samples from 1989 were standard length measurements and thus are not comparable to the total length measurements. Non-shaded comparisons are significant at or less than a p value of 0.05.

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
1984	1.000							
1985	0.000	1.000						
1986	1.000	0.000	1.000					
1987	0.000	0.000	0.000	1.000				
1988	1.000	0.000	1.000	0.000	1.000			
1989								
1990	0.017	0.000	0.111	0.735	0.040		1.000	
1991	0.085	0.098	0.209	0.000	0.283		0.000	1.000

000043

Table 18. ANCOVA of length/weight regressions of gizzard shad.

There are no significant differences in the slope of length (dependent)/weight regressions among the years at any of the three traditional sites.

Regression statistics for length (dependent)/weight relationship of gizzard shad from four sites from the Great Miami River, 1991.

SITE	N	SQUARED MULTIPLE R	SLOPE	Y-INTEREPT
I	16	0.994	0.319	1.554
II	99	0.967	0.321	1.557
III	39	0.968	0.306	1.639
IV	94	0.976	0.341	1.464

Comparison of length/weight regression slopes of all gizzard shad from four sites from the Great Miami River, 1991. Non-shaded comparisons are significantly different.

SITE	I	II	III	IV
I	1.000	0.843	0.271	0.031
II	0.843	1.000	0.268	0.015
III	0.271	0.268	1.000	0.009
IV	0.031	0.015	0.009	1.000

Site IV is expected to have gizzard shad which are increasing in length at a greater rate than the other stations due to the high proportion of Y-O-Y which are present at Site IV.

Table 19: Species Occurences in Electroshocking Samples taken from the Great Miami River between 1984 and 1991.

YEAR	1984			1985			1986			1987			1988			1989			1990			1991			SUM
COMMON NAME/ SITE	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	
BLACK BUFFALO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	0	4
BLACK BULLHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
BLACK CRAPPIE	0	0	0	0	0	1	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	6
BLACK REDHORSE	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0	1	2	0	1	0	0	8
BLACKSIDE DARTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
BLUE CATFISH	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
BLUEGILL SUNFISH	6	0	11	8	1	6	0	1	7	1	0	0	2	6	14	0	0	1	0	0	0	0	0	2	66
BLUEGILL/ RED SUNFISH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3
BROWN BULLHEAD	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CARP	3	3	13	15	3	3	31	12	1	6	3	3	7	8	2	2	2	9	0	1	2	3	2	1	135
CHANNEL CATFISH	1	2	2	1	4	2	7	13	2	0	3	1	2	6	40	5	10	3	0	2	3	2	5	1	117
CHANNEL MIMIC SHIN	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	13
DRUM	2	1	0	2	1	1	2	6	5	0	18	0	3	0	3	0	0	0	2	2	2	14	40	3	107
EMERALD SHINER	2	4	9	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	20
FLATHEAD CATFISH	0	0	0	0	2	1	0	0	0	0	0	0	1	1	0	0	2	0	0	0	0	2	1	0	10
GIZZARD SHAD	65	85	171	7	9	131	17	13	114	36	11	93	54	65	54	60	35	100	31	27	78	99	39	93	1487
GOLDEN REDHORSE	0	0	0	0	2	2	0	5	8	0	6	0	1	0	0	1	9	1	0	0	0	0	0	0	35
GREEN SUNFISH	5	2	8	0	0	0	2	1	1	0	0	0	0	0	4	0	0	2	0	0	0	5	0	2	32
HIGHFIN CARPSUCKER	1	0	1	0	2	1	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	10
LARGE MOUTH BASS	1	0	12	8	1	3	2	1	16	2	0	2	3	6	12	5	0	1	0	1	0	4	1	5	86
LARGEMOUTH BUFFALO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
LONGEAR SUNFISH	7	0	23	1	4	3	3	7	9	0	0	0	0	0	40	6	0	4	0	0	0	5	0	6	118
LONGFIN CARPSUCKER	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
LONGNOSE GAR	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	4	2	1	3	1	0	0	0	1	15
MINNOW?	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
MOONEYE	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NORTHERN HOGSUCKER	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	6
OHIO LOGPERCH DARTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4
PIMEPALES	1	0	2	0	0	0	0	6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	10
PUMPKINSEED	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
QUILLBACK	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	2	1	0	3	3	0	0	9	0	21
RED EAR SUNFISH	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	9
REDHORSE	2	3	0	0	0	0	0	0	0	0	0	0	0	7	14	0	0	0	0	0	0	0	0	0	26
RIVER CARPSUCKER	1	1	2	1	1	1	2	8	2	0	2	1	1	1	9	8	1	7	7	0	7	0	0	0	63
ROCK BASS	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	1	0	0	0	0	0	0	5
SAUGER	0	2	0	0	0	0	0	0	1	1	2	0	0	0	1	1	0	3	1	0	0	6	12	1	31
SHORTHEAD REDHORSE	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
SILVER REDHORSE	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
SKIPJACK HERRING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	3

000045

Table 19 cont. Species Occurences in Electroshocking Samples taken from the Great Miami River between 1984 and 1991.

YEAR	1984			1985			1986			1987			1988			1989			1990			1991			SUM
COMMON NAME	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	II	III	IV	
SMALL MOUTH BASS	4	6	4	0	0	1	1	0	0	1	2	0	1	3	9	1	0	3	0	0	0	0	8	4	48
SMALLMOUTH BUFFALO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
SPOTTED BASS	0	0	0	1	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	6
STRIPED BASS	0	0	0	0	0	0	0	0	0	1	7	2	0	0	0	0	0	0	0	0	1	4	5	2	22
SUCKERMOUTH MIN	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	3	0	7
SUNFISH?	0	0	0	4	0	0	4	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	11
WARMOUTH BASS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
WHITE BASS	3	3	2	0	1	0	0	0	7	0	0	0	3	3	8	1	1	7	0	1	0	0	0	0	40
WHITE CRAPPIE	0	1	1	0	0	0	0	0	3	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	7
YELLOW BULLHEAD	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL FISH RECOVERED	104	113	263	52	40	160	73	79	180	51	56	122	85	111	217	97	69	145	49	42	94	152	131	126	2612

6383

000046

Appendix A. List of common names, family and species of fish from the Great Miami River, 1991.

Common Names	Family	Species
Black Buffalo	Catostomidae	Ictiobus niger
Black Bullhead	Ictaluridae	Ictalurus melas
Black Crappie	Centrarchidae	Pomoxis nigromaculatus
Black Redhorse	Catostomidae	Moxostoma duquesnei
Blackside Darter	Percidae	Percina maculata
Bluegill Sunfish	Centrarchidae	Lepomis macrochirus
Bluegill/Red Sunfish Hybrid	Centrarchidae	Lepomis
Bluntnose Minnow	Cyprinidae	Pimephales notatus
Bullhead Minnow	Cyprinidae	Pimephales vigilax
Carp	Cyprinidae	Cyprinus carpio
Channel Catfish	Ictaluridae	Ictalurus punctatus
Drum	Sciaenidae	Aplodinatus gunniens
Emerald Shiner	Cyprinidae	Notropis atherinoides
Fathead Minnow	Cyprinidae	Pimephales promelas
Flathead Catfish	Ictaluridae	Pylodictis olivaris
Flathead Catfish	Ictaluridae	Pylodictis olivaris
Gizzard Shad	Clupeidae	Dorosoma cepedianum
Golden Redhorse	Catostomidae	Moxostoma erythrurum
Green Sunfish	Centrarchidae	Lepomis cyanellus
Highfin	Catostomidae	Carpiodes velifer
Large Mouth Bass	Centrarchidae	Micropterus salmoides
Lg Mouth Buffalo	Catostomidae	Ictiobus cyprinellus
Longear Sunfish	Centrarchidae	Lepomis megalotis
Longnose Gar	Lepisosteidae	Lepisosteus osseus
Northern Hogsucker	Catostomidae	Hypentelium nigricans
Ohio Logperch Darter	Percidae	Percina caprodes caprodes
Quillback	Catostomidae	Carpiodes cyprinus
Redear Sunfish	Centrarchidae	Lepomis microlophus
River Carpsucker	Catostomidae	Carpiodes carpio
Rock Bass	Centrarchidae	Ambloplites rupestris
Sauger	Percidae	Stizostedion canadense
Shiner Unknown	Cyprinidae	Notropis
Silver Redhorse	Catostomidae	Moxostoma anisurum
Skipjack Herring	Clupeidae	Alosa chrysochloris
Small Mouth Bass	Centrarchidae	Micropterus dolomieui
Sm.Mouth Buffalo	Catostomidae	Ictiobus bubalus
Spotfin/Steelcolor Shinner	Cyprinidae	Notropis
Striped Bass	Serranidae	Morone saxatilis
Sucker Mouthed Minnow	Cyprinidae	Phenacobius mirabilis
White Bass	Serranidae	Marone chrysops

Appendix B. List of weight, length, and gender of fish captured at Site I of the Great Miami River, 1991.

13 AND 23 SEPT 1991

COMMON NAME	FAMILY	LENGTH (cm)	WEIGHT (gm)	GENDER	NOTES
SMALL MOUTH BASS	CENTRARCHIDAE	7		U	
SMALL MOUTH BASS	CENTRARCHIDAE	11		U	
SMALL MOUTH BASS	CENTRARCHIDAE	10		U	
LARGE MOUTH BASS	CENTRARCHIDAE	6		U	
SMALL MOUTH BASS	CENTRARCHIDAE	8		U	
LARGE MOUTH BASS	CENTRARCHIDAE	8		U	
SMALL MOUTH BASS	CENTRARCHIDAE	9		U	
LARGE MOUTH BASS	CENTRARCHIDAE	5		U	
SMALL MOUTH BASS	CENTRARCHIDAE	9		U	
SMALL MOUTH BASS	CENTRARCHIDAE	5		U	
BLACK CRAPPIE	CENTRARCHIDAE	11		U	
GIZZARD SHAD	CLUPEIDAE	29	292	I	
GIZZARD SHAD	CLUPEIDAE	30	328	F	
GIZZARD SHAD	CLUPEIDAE	28.3	295	M	
GIZZARD SHAD	CLUPEIDAE	28.5	256	M	
GIZZARD SHAD	CLUPEIDAE	26.6	229	M	
GIZZARD SHAD	CLUPEIDAE	21.1	109	F	
GIZZARD SHAD	CLUPEIDAE	22.4	131	M	
GIZZARD SHAD	CLUPEIDAE	20.6	95	F	
GIZZARD SHAD	CLUPEIDAE	19.5	83	F	
GIZZARD SHAD	CLUPEIDAE	17.9	62	I	
GIZZARD SHAD	CLUPEIDAE	16.4	49	I	
GIZZARD SHAD	CLUPEIDAE	17.8	61	I	
GIZZARD SHAD	CLUPEIDAE	17.5	64	I	
GIZZARD SHAD	CLUPEIDAE	17.2	65	I	
SMALL MOUTH BASS	CENTRARCHIDAE	19.3	102.26	M	
SMALL MOUTH BASS	CENTRARCHIDAE	14.9	52.27	I	
SMALL MOUTH BASS	CENTRARCHIDAE	15.1	49.04	M	
SMALL MOUTH BASS	CENTRARCHIDAE	15.7	52.9	I	
SMALL MOUTH BASS	CENTRARCHIDAE	16.3	56.42	I	
SMALL MOUTH BASS	CENTRARCHIDAE	16.6	67.2	I	
SMALL MOUTH BASS	CENTRARCHIDAE	15.5	46.39	I	
SMALL MOUTH BASS	CENTRARCHIDAE	15.1	44.54	I	
SMALL MOUTH BASS	CENTRARCHIDAE	13	28.38	I	
SMALL MOUTH BASS	CENTRARCHIDAE	14	39.22	I	
SMALL MOUTH BASS	CENTRARCHIDAE	11.4	18.68	I	
SMALL MOUTH BASS	CENTRARCHIDAE	12.4	25.82	I	
SMALL MOUTH BASS	CENTRARCHIDAE	10.3	15.34	I	
SMALL MOUTH BASS	CENTRARCHIDAE	9.8	14.21	I	
SMALL MOUTH BASS	CENTRARCHIDAE	9.7	11.94	I	

SMALL MOUTH BASS	CENTRARCHIDAE	9.7	12.31	I
SMALL MOUTH BASS	CENTRARCHIDAE	10.4	13.34	I
SMALL MOUTH BASS	CENTRARCHIDAE	8.9	8.66	I
SMALL MOUTH BASS	CENTRARCHIDAE	9.4	11.59	I
SMALL MOUTH BASS	CENTRARCHIDAE	8.8	8.67	I
SMALL MOUTH BASS	CENTRARCHIDAE	9.5	12.26	I
SMALL MOUTH BASS	CENTRARCHIDAE	10.5	13.35	I
SMALL MOUTH BASS	CENTRARCHIDAE	8.9	9.17	I
LARGE MOUTH BASS	CENTRARCHIDAE	18.5	87.94	M
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.5	9.59	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.2	9.08	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.8	11.24	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.4	9.75	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	10.9	16	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.6	11.19	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	10.8	14.57	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	10.7	14.62	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.8	11.47	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.8	11.82	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	8.8	7.83	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	8	5.92	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	9.9	12.58	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	11.2	16.91	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	12.1	20.43	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	19.7	84.78	M
NORTHERN HOGSUCKER	CATOSTOMIDAE	30.1	339.7	F
NORTHERN HOGSUCKER	CATOSTOMIDAE	30	331.43	F
BLACK REDHORSE	CATOSTOMIDAE	42	741	F
BLACK REDHORSE	CATOSTOMIDAE	33.7	521	F
BLACK REDHORSE	CATOSTOMIDAE	37.6	596	F
BLACK REDHORSE	CATOSTOMIDAE	31	356	M
BLACK REDHORSE	CATOSTOMIDAE	33.7	502	F
BLACK REDHORSE	CATOSTOMIDAE	33.3	456	F
BLACK REDHORSE	CATOSTOMIDAE	29	235	M
BLACK REDHORSE	CATOSTOMIDAE	19.4	77	I
LONGEAR SUNFISH	CENTRARCHIDAE	13	53.12	F
LONGEAR SUNFISH	CENTRARCHIDAE	8.4	13.28	I
LONGEAR SUNFISH	CENTRARCHIDAE	5.5	3.94	I
QUILLBACK	CATOSTOMIDAE	14.9	45.3	I
CHANNEL CATFISH	ICTALURIDAE	10.2	6.62	I
FATHEAD MINNOW	CYPRINIDAE	9.9	10.45	I
FATHEAD MINNOW	CYPRINIDAE	10.1	10.04	I
NORTHERN HOGSUCKER	CATOSTOMIDAE	7.6	4.84	I
BLUNTNOSE MINNOW	CYPRINIDAE	8	4.67	I
BULLHEAD MINNOW	CYPRINIDAE	7.9	5.23	I
SHINER UNKNOWN	CYPRINIDAE	8.4	5.79	I

BLACK REDHORSE	CATOSTOMIDAE	10.3	13.73	I
BLACK REDHORSE	CATOSTOMIDAE	10.2	10.89	I
BLACK REDHORSE	CATOSTOMIDAE	10.3	11.31	I
BLACK REDHORSE	CATOSTOMIDAE	9.7	9.43	I
BLACK REDHORSE	CATOSTOMIDAE	9.1	7.33	I
BLACK REDHORSE	CATOSTOMIDAE	10	11.93	I
BLACK REDHORSE	CATOSTOMIDAE	10	12.45	I
BLACK REDHORSE	CATOSTOMIDAE	12.5	19.94	I
SPOTFIN/STEELCOLOR SHINN	CYPRINIDAE	9.2	7.12	I
SPOTFIN/STEELCOLOR SHINN	CYPRINIDAE	8.9	6.73	I
SPOTFIN/STEELCOLOR SHINN	CYPRINIDAE	6.1	1.9	I
CARP	CYPRINIDAE	57.1	2585.52	F
CARP	CYPRINIDAE	45.1	1315.44	M
GIZZARD SHAD	CLUPEIDAE	27.4	245	M
GIZZARD SHAD	CLUPEIDAE	29	304	M
SMALL MOUTH BASS	CENTRARCHIDAE	20.1	109	M
LARGE MOUTH BASS	CENTRARCHIDAE	17.6	76	I
LARGE MOUTH BASS	CENTRARCHIDAE	17.1	71	I
GOLDEN REDHORSE	CATOSTOMIDAE	28	280	M
GOLDEN REDHORSE	CATOSTOMIDAE	26.4	198	M
BLACK REDHORSE	CATOSTOMIDAE	36.5	616	F
BLACK REDHORSE	CATOSTOMIDAE	10.2	13.08	
BLACK REDHORSE	CATOSTOMIDAE	13.1	25.8	
BLACK REDHORSE	CATOSTOMIDAE	10.1	12.53	
BLACK REDHORSE	CATOSTOMIDAE	10.5	11.19	
SUCKER UNKNOWN	CATOSTOMIDAE	11.9	21.99	
LONGEAR SUNFISH	CENTRARCHIDAE	7.5	8.76	
REDEAR SUNFISH	CENTRARCHIDAE	7.7	9.02	
SPOTFIN/STEELCOLOR SHINN	CYPRINIDAE	6.7	2.19	
SHINER UNKNOWN	CYPRINIDAE	5.01	8.5	
	MEAN	16.88	139.79	

Appendix C. List of weight, length, and gender of fish captured at Site II of the Great Miami River, 1991.
23-Sep-91

COMMON NAME	FAMILY	LENGTHcm	WEIGHT gm	GENDER	NOTES
STRIPED BASS	SERRANIDAE	13			
STRIPED BASS	SERRANIDAE	11			
GIZZARD SHAD	CLUPEIDAE	29	321.88	M	
GIZZARD SHAD	CLUPEIDAE	25	174.16	F	
GIZZARD SHAD	CLUPEIDAE	31.9	323.46	M	
GIZZARD SHAD	CLUPEIDAE	30	333.41	F	
GIZZARD SHAD	CLUPEIDAE	29.5	317.44	F	
GIZZARD SHAD	CLUPEIDAE	29.7	328.44	M	
GIZZARD SHAD	CLUPEIDAE	29.3	270.51	F	
GIZZARD SHAD	CLUPEIDAE	29.4	274.48	F	
GIZZARD SHAD	CLUPEIDAE	28.1	265.13	M	
GIZZARD SHAD	CLUPEIDAE	26.5	238.45	M	
GIZZARD SHAD	CLUPEIDAE	27	248.88	M	
GIZZARD SHAD	CLUPEIDAE	28.3	269.31	F	
GIZZARD SHAD	CLUPEIDAE	27.8	263.82	F	
GIZZARD SHAD	CLUPEIDAE	21.7	119.87	M	
GIZZARD SHAD	CLUPEIDAE	24.3	145.49	M	
GIZZARD SHAD	CLUPEIDAE	23.7	150.72	F	
GIZZARD SHAD	CLUPEIDAE	22.5	115.37	I	
GIZZARD SHAD	CLUPEIDAE	26.4	215.07	M	
GIZZARD SHAD	CLUPEIDAE	22.3	132.42	I	
GIZZARD SHAD	CLUPEIDAE	23.5	147.67	M	
GIZZARD SHAD	CLUPEIDAE	22	111.54	M	
GIZZARD SHAD	CLUPEIDAE	23.3	123.88	F	
GIZZARD SHAD	CLUPEIDAE	22.2	127.51	M	
GIZZARD SHAD	CLUPEIDAE	26.3	210.21	F	
GIZZARD SHAD	CLUPEIDAE	23.7	145.11	M	
GIZZARD SHAD	CLUPEIDAE	24.3	160.27	F	
GIZZARD SHAD	CLUPEIDAE	21.1	104.81	F	
GIZZARD SHAD	CLUPEIDAE	23.6	169.57	F	
GIZZARD SHAD	CLUPEIDAE	23.1	134.87	I	
GIZZARD SHAD	CLUPEIDAE	23.5	135.4	I	
GIZZARD SHAD	CLUPEIDAE	21	114.74	I	
GIZZARD SHAD	CLUPEIDAE	22	114.53	I	
GIZZARD SHAD	CLUPEIDAE	19.8	86.79	I	
GIZZARD SHAD	CLUPEIDAE	20.6	108.51	I	
GIZZARD SHAD	CLUPEIDAE	25.1	164.9	I	
GIZZARD SHAD	CLUPEIDAE	21.6	113.07	M	
GIZZARD SHAD	CLUPEIDAE	25.2	172.04	I	
GIZZARD SHAD	CLUPEIDAE	26.5	198.85	M	
GIZZARD SHAD	CLUPEIDAE	23.1	136.22	M	
GIZZARD SHAD	CLUPEIDAE	21.1	117.9	I	

GIZZARD SHAD	CLUPEIDAE	25.5	178.3	M
GIZZARD SHAD	CLUPEIDAE	23.2	131.2	I
GIZZARD SHAD	CLUPEIDAE	22.2	116.82	I
GIZZARD SHAD	CLUPEIDAE	24.5	161.03	I
GIZZARD SHAD	CLUPEIDAE	21	108.86	I
GIZZARD SHAD	CLUPEIDAE	26.2	197.53	F
GIZZARD SHAD	CLUPEIDAE	26.7	219.39	F
GIZZARD SHAD	CLUPEIDAE	24.3	170.58	I
GIZZARD SHAD	CLUPEIDAE	26	213.48	I
GIZZARD SHAD	CLUPEIDAE	22.6	133.44	I
GIZZARD SHAD	CLUPEIDAE	22.2	123.14	I
GIZZARD SHAD	CLUPEIDAE	20.9	116	M
GIZZARD SHAD	CLUPEIDAE	26.2	171.07	F
GIZZARD SHAD	CLUPEIDAE	26	207.1	F
GIZZARD SHAD	CLUPEIDAE	20.9	101.16	I
GIZZARD SHAD	CLUPEIDAE	23.1	142.95	I
GIZZARD SHAD	CLUPEIDAE	20.7	94	I
GIZZARD SHAD	CLUPEIDAE	20	95.46	I
GIZZARD SHAD	CLUPEIDAE	22.6	126.67	I
GIZZARD SHAD	CLUPEIDAE	22.7	114.99	I
GIZZARD SHAD	CLUPEIDAE	23.4	138.75	F
GIZZARD SHAD	CLUPEIDAE	22.6	134.28	I
GIZZARD SHAD	CLUPEIDAE	22.9	135.99	M
GIZZARD SHAD	CLUPEIDAE	21.4	111.32	I
GIZZARD SHAD	CLUPEIDAE	22	122.03	I
GIZZARD SHAD	CLUPEIDAE	24.1	158.89	M
GIZZARD SHAD	CLUPEIDAE	21.4	106.29	I
GIZZARD SHAD	CLUPEIDAE	21.1	98.02	I
GIZZARD SHAD	CLUPEIDAE	22.2	128.57	F
GIZZARD SHAD	CLUPEIDAE	22.6	132.34	I
GIZZARD SHAD	CLUPEIDAE	23.4	142.12	F
GIZZARD SHAD	CLUPEIDAE	24.8	180.82	M
GIZZARD SHAD	CLUPEIDAE	24.5	160.82	M
GIZZARD SHAD	CLUPEIDAE	22.5	134.06	I
GIZZARD SHAD	CLUPEIDAE	23	132.52	M
GIZZARD SHAD	CLUPEIDAE	20.7	101.86	I
GIZZARD SHAD	CLUPEIDAE	22.4	126.52	I
GIZZARD SHAD	CLUPEIDAE	23.1	133.16	F
GIZZARD SHAD	CLUPEIDAE	20.7	102	I
GIZZARD SHAD	CLUPEIDAE	22.7	125.8	F
GIZZARD SHAD	CLUPEIDAE	20.9	115.6	F
GIZZARD SHAD	CLUPEIDAE	23.5	119.14	M
GIZZARD SHAD	CLUPEIDAE	20.3	93.69	I
GIZZARD SHAD	CLUPEIDAE	21.4	108.82	I
GIZZARD SHAD	CLUPEIDAE	21.5	120.59	M
GIZZARD SHAD	CLUPEIDAE	22.3	123.27	M

ZZARD SHAD	CLUPEIDAE	20.8	96.65	M	
GIZZARD SHAD	CLUPEIDAE	22.2	128.67	I	
GIZZARD SHAD	CLUPEIDAE	24.8	168.64	F	
GIZZARD SHAD	CLUPEIDAE	23.4	171.47	M	
GIZZARD SHAD	CLUPEIDAE	24.5	160.65	M	
GIZZARD SHAD	CLUPEIDAE	26.5	199.34	F	
GIZZARD SHAD	CLUPEIDAE	27.3	241.4	M	
GIZZARD SHAD	CLUPEIDAE	23.9	156.33	F	
GIZZARD SHAD	CLUPEIDAE	25.8	183.32	F	ROT ABDOMEN AND ANA
GIZZARD SHAD	CLUPEIDAE	18.6	81.59	I	
GIZZARD SHAD	CLUPEIDAE	16.6	56.6	I	
GIZZARD SHAD	CLUPEIDAE	14.2	30.44	I	
GIZZARD SHAD	CLUPEIDAE	16.7	49.77	I	
SAUGER	PERCIDAE	18.6	50.04	I	
SAUGER	PERCIDAE	17.7	52.48	I	
SAUGER	PERCIDAE	16.8	41.4	I	
SAUGER	PERCIDAE	18.3	47.01	I	
SAUGER	PERCIDAE	16.5	33.29	I	
SAUGER	PERCIDAE	15.8	33.41	I	
STRIPED BASS	SERRANIDAE	14.1	34.07	I	
STRIPED BASS	SERRANIDAE	12.4	25.26	I	
RGE MOUTH BASS	CENTRARCHIDAE	15.8	58.8	I	
ARGE MOUTH BASS	CENTRARCHIDAE	14	42.99	I	
LARGE MOUTH BASS	CENTRARCHIDAE	13.3	34.2	I	
LARGE MOUTH BASS	CENTRARCHIDAE	22.2	174.75	F	SUNFISH IN GUT
DRUM	SCIAENIDAE	30.1	357.61	M	
DRUM	SCIAENIDAE	36.7	599	F	
DRUM	SCIAENIDAE	34.1	524	F	
DRUM	SCIAENIDAE	35.1	525	F	
DRUM	SCIAENIDAE	31.5	406	F	
DRUM	SCIAENIDAE	27.1	283.65	M	
DRUM	SCIAENIDAE	28.5	311.24	F	
DRUM	SCIAENIDAE	25.4	212.85	F	
DRUM	SCIAENIDAE	18.4	88.86	I	
DRUM	SCIAENIDAE	18.3	81.33	I	
DRUM	SCIAENIDAE	17.2	62.82	I	
DRUM	SCIAENIDAE	16.1	51.45	I	
DRUM	SCIAENIDAE	15.2	48.51	I	
DRUM	SCIAENIDAE	16.1	52.48	I	
CARP	CYPRINIDAE	45.8	1247.4	F	
CARP	CYPRINIDAE	47.6	1496.88	F	
CARP	CYPRINIDAE	41	997.92	F	
CHANNEL CATFISH	ICTALURIDAE	39.9	618	M	
ANNEL CATFISH	ICTALURIDAE	38.2	420	M	
LATHEAD CATFISH	ICTALURIDAE	26	172.05	M	
FLATHEAD CATFISH	ICTALURIDAE	8.8	7.33	I	

BLUEGILL/RED SUNFISH HYB	CENTRARCHIDAE	18.2	149.02	F	
BLUEGILL/RED SUNFISH HYB	CENTRARCHIDAE	13	57.27	I	HOLE IN DORSAL. SPINES
BLUEGILL/RED SUNFISH HYB	CENTRARCHIDAE	11.1	30.16		
REDEAR SUNFISH	CENTRARCHIDAE	7.8	9.94	I	
REDEAR SUNFISH	CENTRARCHIDAE	7.9	10.68	I	
REDEAR SUNFISH	CENTRARCHIDAE	7	7.46	I	
LONGEAR SUNFISH	CENTRARCHIDAE	10.9	32.97	I	
LONGEAR SUNFISH	CENTRARCHIDAE	9.9	24.89	I	
LONGEAR SUNFISH	CENTRARCHIDAE	8.4	16.56	I	
LONGEAR SUNFISH	CENTRARCHIDAE	8.5	14.42	I	
GREEN SUNFISH	CENTRARCHIDAE	8.8	14.35	I	
GREEN SUNFISH	CENTRARCHIDAE	6.5	5.28	I	
GREEN SUNFISH	CENTRARCHIDAE	7	7.25	I	
LONGEAR SUNFISH	CENTRARCHIDAE	7.1	8.92	I	
GREEN SUNFISH	CENTRARCHIDAE	5.9	2.97	I	
GREEN SUNFISH	CENTRARCHIDAE	9.4	19.42	I	
BLACK REDHORSE	CATOSTOMIDAE	11.4	14.93	I	
EMERALD SHINER	CYPRINIDAE	7.5	3.01		
	MEAN	21.79	166.42		

Appendix D. List of weight, length, and gender of fish captured at Site III of the Great Miami River, 1991.
17-Sep-91

COMMON NAME	FAMILY	LENGTHcm	WEIGHT gm	GENDER	NOTES
SMALL MOUTH BASS	CENTRARCHIDAE	21.9	226.8		
CARP	CYPRINIDAE	68.2	4313.74		
GIZZARD SHAD	CLUPEIDAE	21.3	104		
GIZZARD SHAD	CLUPEIDAE	21.2	97		
GIZZARD SHAD	CLUPEIDAE	24.5	171		
GIZZARD SHAD	CLUPEIDAE	22.3	120		
GIZZARD SHAD	CLUPEIDAE	25.9	180		
GIZZARD SHAD	CLUPEIDAE	24	144		
OHIO LOGPERCH DARTER	PERCIDAE	14	29.07	M	
SAUGER	PERCIDAE	16.5	33.86	I	
SAUGER	PERCIDAE	18.5	47.71	I	
SAUGER	PERCIDAE	17	34.37	I	
SAUGER	PERCIDAE	16	30.87	I	
SAUGER	PERCIDAE	16	30.61	I	FISH FOUND IN GUT
SAUGER	PERCIDAE	17.9	44.91	I	
SAUGER	PERCIDAE	18	45.08	I	
SAUGER	PERCIDAE	13.5	20.39	I	
SAUGER	PERCIDAE	17	38.95	I	
SAUGER	PERCIDAE	13.4	18.65	I	
SAUGER	PERCIDAE	19.2	63.37	M	
SAUGER	PERCIDAE	30.5	230	M	
SMALL MOUTH BASS	CENTRARCHIDAE	13.7	34.36	I	
SMALL MOUTH BASS	CENTRARCHIDAE	15.7	50.54	I	
SMALL MOUTH BASS	CENTRARCHIDAE	13.2	30.46	I	
SMALL MOUTH BASS	CENTRARCHIDAE	11.9	21.41	I	
SMALL MOUTH BASS	CENTRARCHIDAE	12.5	26.1	I	
SMALL MOUTH BASS	CENTRARCHIDAE	13.5	35.6	I	FISH IN GUT
SMALL MOUTH BASS	CENTRARCHIDAE	22.5	164.41	M	
LARGE MOUTH BASS	CENTRARCHIDAE	14.3	39.45	I	CRAYFISH IN GUT
STRIPED BASS	SERRANIDAE	11.2	18.32	I	
STRIPED BASS	SERRANIDAE	12.1	22.64	I	
STRIPED BASS	SERRANIDAE	12.5	26.37	I	
STRIPED BASS	SERRANIDAE	16	52.73	M	
STRIPED BASS	SERRANIDAE	30.7	408	M	
DRUM	SCIAENIDAE	14.8	39.31	I	
DRUM	SCIAENIDAE	11.2	16.55	I	
DRUM	SCIAENIDAE	14	37.42	I	
DRUM	SCIAENIDAE	13.1	29.28	I	
DRUM	SCIAENIDAE	13.1	27.57	I	
DRUM	SCIAENIDAE	13.5	33.9	I	
DRUM	SCIAENIDAE	14.6	35.56	I	
DRUM	SCIAENIDAE	13.1	26.25	I	

DRUM	SCIAENIDAE	14.1	30.23	I	
DRUM	SCIAENIDAE	14.3	36.44	I	
DRUM	SCIAENIDAE	15.8	45.45	I	
DRUM	SCIAENIDAE	16.2	49.93	I	
DRUM	SCIAENIDAE	14.1	36.05	I	
DRUM	SCIAENIDAE	14.5	34.17	I	
DRUM	SCIAENIDAE	12.7	25.32	I	
DRUM	SCIAENIDAE	13.7	29.75	I	
DRUM	SCIAENIDAE	13.8	31.82	I	
DRUM	SCIAENIDAE	13.7	29.76	I	
DRUM	SCIAENIDAE	16.2	55.6	I	
DRUM	SCIAENIDAE	16.5	59.23	I	
DRUM	SCIAENIDAE	13.4	28.83	I	
DRUM	SCIAENIDAE	17.5	66.6	I	
DRUM	SCIAENIDAE	14.5	36.51	I	
DRUM	SCIAENIDAE	15.8	44.98	I	
DRUM	SCIAENIDAE	16.8	57.1	I	
DRUM	SCIAENIDAE	14.9	39.11	I	
DRUM	SCIAENIDAE	14.5	41.13	I	
DRUM	SCIAENIDAE	15	42.75	I	
DRUM	SCIAENIDAE	17	58.96	I	
DRUM	SCIAENIDAE	16	49.65	I	
DRUM	SCIAENIDAE	15.7	46.5	I	
DRUM	SCIAENIDAE	17.2	65.9	I	
DRUM	SCIAENIDAE	17.2	64.48	I	
DRUM	SCIAENIDAE	15.5	45.81	I	
DRUM	SCIAENIDAE	19	86.97	F	
DRUM	SCIAENIDAE	22.2	132.29	M	
DRUM	SCIAENIDAE	23.5	156.63	M	
DRUM	SCIAENIDAE	27.5	269.78	M	
DRUM	SCIAENIDAE	30.3	332.29	M	
DRUM	SCIAENIDAE	30.2	408	M	CRAYFISH IN GUT
CHANNEL CATFISH	ICTALURIDAE	46.7	950	M	
CHANNEL CATFISH	ICTALURIDAE	45	702	U	
FLATHEAD CATFISH	ICTALURIDAE	34.5	396		
CARP	CYPRINIDAE	61	2925.72	F	
QUILLBACK	CATOSTOMIDAE	12.4	23.24		
CHANNEL CATFISH	ICTALURIDAE	13	17.09		
CHANNEL CATFISH	ICTALURIDAE	13.4	18.94		
CHANNEL CATFISH	ICTALURIDAE	12.4	14.37		
BLACK BULLHEAD	ICTALURIDAE	9.5	8.71		
NORTHERN HOGSUCKER	CATOSTOMIDAE	11	13.93		
NORTHERN HOGSUCKER	CATOSTOMIDAE	12.3	18.98		
NORTHERN HOGSUCKER	CATOSTOMIDAE	10.7	12.29		
NORTHERN HOGSUCKER	CATOSTOMIDAE	13	23.93		
QUILLBACK	CATOSTOMIDAE	8	6.75		

QUILLBACK	CATOSTOMIDAE	8.3	8.07	
QUILLBACK	CATOSTOMIDAE	10.5	15.65	
QUILLBACK	CATOSTOMIDAE	9.3	11.64	
QUILLBACK	CATOSTOMIDAE	8.6	9.74	
QUILLBACK	CATOSTOMIDAE	7	5.17	
QUILLBACK	CATOSTOMIDAE	7	5.21	
QUILLBACK	CATOSTOMIDAE	8.9	9.33	
SUCKER MOUTHED MINNOW	CYPRINIDAE	10	11.8	
SUCKER MOUTHED MINNOW	CYPRINIDAE	9.1	8.72	
SUCKER MOUTHED MINNOW	CYPRINIDAE	8.5	6.16	
GIZZARD SHAD	CLUPEIDAE	16.5	45.08	I
GIZZARD SHAD	CLUPEIDAE	22.5	131.27	I
GIZZARD SHAD	CLUPEIDAE	25.2	187.65	I
GIZZARD SHAD	CLUPEIDAE	24.2	152.3	I
GIZZARD SHAD	CLUPEIDAE	26.3	208.08	I
GIZZARD SHAD	CLUPEIDAE	22.3	119.47	I
GIZZARD SHAD	CLUPEIDAE	22.4	131.63	I
GIZZARD SHAD	CLUPEIDAE	22.3	105.3	I
GIZZARD SHAD	CLUPEIDAE	23.8	139.9	I
GIZZARD SHAD	CLUPEIDAE	23.5	141.07	I
GIZZARD SHAD	CLUPEIDAE	24.2	171.05	I
GIZZARD SHAD	CLUPEIDAE	21.7	111.11	I
GIZZARD SHAD	CLUPEIDAE	25.7	171.8	I
GIZZARD SHAD	CLUPEIDAE	22	116.4	I
GIZZARD SHAD	CLUPEIDAE	22	114.63	I
GIZZARD SHAD	CLUPEIDAE	24.3	151.72	I
GIZZARD SHAD	CLUPEIDAE	24.2	158.4	I
GIZZARD SHAD	CLUPEIDAE	22.4	118.14	I
GIZZARD SHAD	CLUPEIDAE	26.2	190.44	I
GIZZARD SHAD	CLUPEIDAE	20	89.95	I
GIZZARD SHAD	CLUPEIDAE	21.7	118.66	I
GIZZARD SHAD	CLUPEIDAE	25.4	187.99	I
GIZZARD SHAD	CLUPEIDAE	26.1	194.55	I
GIZZARD SHAD	CLUPEIDAE	22.1	115.78	I
GIZZARD SHAD	CLUPEIDAE	21.6	110.89	I
GIZZARD SHAD	CLUPEIDAE	24.7	151.58	I
GIZZARD SHAD	CLUPEIDAE	22.2	121.84	I
GIZZARD SHAD	CLUPEIDAE	23.2	138.52	I
GIZZARD SHAD	CLUPEIDAE	21.3	106.34	I
GIZZARD SHAD	CLUPEIDAE	24	141.42	I
GIZZARD SHAD	CLUPEIDAE	25.2	189.01	I
GIZZARD SHAD	CLUPEIDAE	24	159.87	I
GIZZARD SHAD	CLUPEIDAE	27.7	257.25	I
	MEAN	17.64	157.21	

Appendix E. List of weight, length, and gender of fish captured at Site IV of the Great Miami River, 1991.
17-Sep-91

COMMON NAME	FAMILY	LENGTHcm	WEIGHT gm	GENDER	NOTES
LARGE MOUTH BASS	CENTRARCHIDAE	28.5	567		
SMALL MOUTH BASS	CENTRARCHIDAE	19.6	113.4		
LARGE MOUTH BASS	CENTRARCHIDAE	30.1	544.32		
LARGE MOUTH BASS	CENTRARCHIDAE	18.5	90.52	I	
LARGE MOUTH BASS	CENTRARCHIDAE	20.1	123.9	M	
LARGE MOUTH BASS	CENTRARCHIDAE	13.1	29.14	I	
SMALL MOUTH BASS	CENTRARCHIDAE	12.2	22.68	I	
SMALL MOUTH BASS	CENTRARCHIDAE	12.6	24	I	
SMALL MOUTH BASS	CENTRARCHIDAE	12.9	26.27	I	
STRIPED BASS	SERRANIDAE	15.2	42.05	I	
BLUEGILL SUNFISH	CENTRARCHIDAE	17.7	139.95	M	
GREEN SUNFISH	CENTRARCHIDAE	9.5	19.48	I	
GREEN SUNFISH	CENTRARCHIDAE	9.1	16.35	I	
LONGEAR SUNFISH	CENTRARCHIDAE	9.9	22.02	I	
LONGEAR SUNFISH	CENTRARCHIDAE	9.8	25.6	I	
LONGEAR SUNFISH	CENTRARCHIDAE	11	30.39	I	
LONGEAR SUNFISH	CENTRARCHIDAE	11.6	44.26	I	
LONGEAR SUNFISH	CENTRARCHIDAE	9.8	20.49	I	
LONGEAR SUNFISH	CENTRARCHIDAE	7.3	9.12	I	
SAUGER	PERCIDAE	16.3	30.99	I	
OHIO LOGPERCH DARTER	PERCIDAE	11	12.72	I	
OHIO LOGPERCH DARTER	PERCIDAE	9.4	6.85	I	
OHIO LOGPERCH DARTER	PERCIDAE	9.8	8.04	I	
DRUM	SCIAENIDAE	14.5	35.3	I	
DRUM	SCIAENIDAE	16	48.53	I	
DRUM	SCIAENIDAE	15.9	47.63	I	
BLUEGILL SUNFISH	CENTRARCHIDAE	5.5	4.05	I	
CHANNEL CATFISH	ICTALURIDAE	32.5	282.34	M	
LONGNOSE GAR	LEPISOSTEIDAE	50	220	M	
CARP	CYPRINIDAE	42.3	1032	M	
SKIPJACK HERRING	CLUPEIDAE	17.9	47.8	I	
GIZZARD SHAD	CLUPEIDAE	19.5	75.78	I	
GIZZARD SHAD	CLUPEIDAE	21.4	110.52	I	
GIZZARD SHAD	CLUPEIDAE	20.4	89.11	I	
GIZZARD SHAD	CLUPEIDAE	20	90.42	I	
GIZZARD SHAD	CLUPEIDAE	21.4	98.96	I	
GIZZARD SHAD	CLUPEIDAE	19.6	81.05	I	
GIZZARD SHAD	CLUPEIDAE	19.7	85.93	I	
GIZZARD SHAD	CLUPEIDAE	20.2	96.84	I	
GIZZARD SHAD	CLUPEIDAE	20.5	104.67	I	
GIZZARD SHAD	CLUPEIDAE	20	87.32	I	
GIZZARD SHAD	CLUPEIDAE	20.3	99.95	I	

GIZZARD SHAD	CLUPEIDAE	13.5	28.57	I
GIZZARD SHAD	CLUPEIDAE	12.4	21.5	I
GIZZARD SHAD	CLUPEIDAE	13.5	29.4	I
GIZZARD SHAD	CLUPEIDAE	15.2	37.83	I
GIZZARD SHAD	CLUPEIDAE	12.7	24.85	I
GIZZARD SHAD	CLUPEIDAE	14.7	33.99	I
GIZZARD SHAD	CLUPEIDAE	14	29.13	I
GIZZARD SHAD	CLUPEIDAE	13	25.65	I
GIZZARD SHAD	CLUPEIDAE	13.4	29.07	I
GIZZARD SHAD	CLUPEIDAE	13.4	27.11	I
GIZZARD SHAD	CLUPEIDAE	15	35.88	I
GIZZARD SHAD	CLUPEIDAE	14.4	30.16	I
GIZZARD SHAD	CLUPEIDAE	15.5	41.26	I
GIZZARD SHAD	CLUPEIDAE	13.3	26.16	I
GIZZARD SHAD	CLUPEIDAE	14.4	36.36	I
GIZZARD SHAD	CLUPEIDAE	12.5	20.57	I
GIZZARD SHAD	CLUPEIDAE	14.3	34.42	I
GIZZARD SHAD	CLUPEIDAE	13.2	25.87	I
GIZZARD SHAD	CLUPEIDAE	14	32	I
GIZZARD SHAD	CLUPEIDAE	14.2	35.29	I
GIZZARD SHAD	CLUPEIDAE	14.6	33.97	I
GIZZARD SHAD	CLUPEIDAE	14	32.43	I
GIZZARD SHAD	CLUPEIDAE	14	31.97	I
GIZZARD SHAD	CLUPEIDAE	14	32.41	I
GIZZARD SHAD	CLUPEIDAE	11.7	18.56	I
GIZZARD SHAD	CLUPEIDAE	13.2	27.75	I
GIZZARD SHAD	CLUPEIDAE	13.6	30.15	I
GIZZARD SHAD	CLUPEIDAE	14	28.84	I
GIZZARD SHAD	CLUPEIDAE	13.7	28.19	I
GIZZARD SHAD	CLUPEIDAE	12.6	23.99	I
GIZZARD SHAD	CLUPEIDAE	13.3	25.35	I
GIZZARD SHAD	CLUPEIDAE	14.2	32.85	I
GIZZARD SHAD	CLUPEIDAE	12.5	23.15	I
GIZZARD SHAD	CLUPEIDAE	11.6	18.46	I
GIZZARD SHAD	CLUPEIDAE	11.6	18.28	I
GIZZARD SHAD	CLUPEIDAE	13.5	24.85	I
GIZZARD SHAD	CLUPEIDAE	13.8	29.67	I
GIZZARD SHAD	CLUPEIDAE	13.5	29.75	I
GIZZARD SHAD	CLUPEIDAE	12.5	20.18	I
GIZZARD SHAD	CLUPEIDAE	13	26.54	I
GIZZARD SHAD	CLUPEIDAE	12.9	25.52	I
GIZZARD SHAD	CLUPEIDAE	13.5	28.2	I
STRIPED BASS	SERRANIDAE	10.4	15.25	I
GIZZARD SHAD	CLUPEIDAE	13.5	27.5	I
GIZZARD SHAD	CLUPEIDAE	14	32.59	I
GIZZARD SHAD	CLUPEIDAE	12.5	22.65	I

GIZZARD SHAD	CLUPEIDAE	14	29.24	I
GIZZARD SHAD	CLUPEIDAE	13.2	27.97	I
GIZZARD SHAD	CLUPEIDAE	13.9	30.48	I
GIZZARD SHAD	CLUPEIDAE	13.2	27.05	I
GIZZARD SHAD	CLUPEIDAE	13.6	30.17	I
GIZZARD SHAD	CLUPEIDAE	13.4	29.44	I
GIZZARD SHAD	CLUPEIDAE	14	31.46	I
GIZZARD SHAD	CLUPEIDAE	14.2	33.72	I
GIZZARD SHAD	CLUPEIDAE	13.5	27.95	I
GIZZARD SHAD	CLUPEIDAE	13	25.46	I
GIZZARD SHAD	CLUPEIDAE	13	24.36	I
GIZZARD SHAD	CLUPEIDAE	14.9	34.81	I
GIZZARD SHAD	CLUPEIDAE	12	19.26	I
GIZZARD SHAD	CLUPEIDAE	13.5	30.43	I
GIZZARD SHAD	CLUPEIDAE	13	24.96	I
GIZZARD SHAD	CLUPEIDAE	11.7	19	I
GIZZARD SHAD	CLUPEIDAE	13.5	30.99	I
GIZZARD SHAD	CLUPEIDAE	12.7	22.64	I
GIZZARD SHAD	CLUPEIDAE	12	22.88	I
GIZZARD SHAD	CLUPEIDAE	12.7	27.94	I
GIZZARD SHAD	CLUPEIDAE	13.4	26.22	I
GIZZARD SHAD	CLUPEIDAE	13	30	I
GIZZARD SHAD	CLUPEIDAE	13.7	30.3	I
GIZZARD SHAD	CLUPEIDAE	11	14.31	I
GIZZARD SHAD	CLUPEIDAE	13.6	33.1	I
GIZZARD SHAD	CLUPEIDAE	12.4	22.98	I
GIZZARD SHAD	CLUPEIDAE	13.6	29.03	I
GIZZARD SHAD	CLUPEIDAE	12.2	20.41	I
GIZZARD SHAD	CLUPEIDAE	12.9	27.61	I
GIZZARD SHAD	CLUPEIDAE	13.6	31.16	I
GIZZARD SHAD	CLUPEIDAE	13.6	31.96	I
GIZZARD SHAD	CLUPEIDAE	11.7	16.97	I
GIZZARD SHAD	CLUPEIDAE	13.8	33.35	I
GIZZARD SHAD	CLUPEIDAE	12.6	21.6	I
GIZZARD SHAD	CLUPEIDAE	13.3	27.54	I
GIZZARD SHAD	CLUPEIDAE	12.2	21.79	I
GIZZARD SHAD	CLUPEIDAE	11.5	16.97	I
BLACKSIDE DARTER	PERCIDAE		11.9	I
	MEAN IV	14.75	55.55	