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DRAFT

Biological Survey of the East Fork Little Miami River and O'Bannon Creek, Clermont County, Ohio, 2005

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EXECUTIVE SUMMARY

A biological (fish and macroinvertebrates), habitat, and water quality survey was conducted in the East Fork Little Miami River (EFLMR) and O'Bannon Creek in Clermont County, Ohio. Sampling was conducted at six EFLMR mainstem locations from River Mile (RM) 44.1 to RM 4.4, and at two O'Bannon Creek locations (Figure 1). Collections were made during the periods of 20-24 July and 12-16 September 2006 following standard Ohio EPA guidelines. These periods coincided with the time period recommended by Ohio EPA for such studies.

FISH

A total of 12,136 fish representing 61 species and hybrid sunfish was collected in 2005, including nine darter species. Numerically, the combined catch was dominated by central stoneroller (18 percent), emerald shiner (17 percent), bluntnose minnow (15 percent), and greenside darter (6 percent). No threatened or endangered species were collected. However, river redhorse, which is listed by Ohio Department of Natural Resources as a species of "special concern", was collected in the EFLMR downstream of the Middle East Fork (MEF) WWTP. Most sampling locations in 2005 contained very good to exceptional fish communities based on species richness, species composition, and fish community indices. All locations were in full attainment (i.e., both IWBmod and/or IBI scores met their respective WWH/EWH criterion), except EFRM 11.3 which attained the IBI criterion but failed to attain the IWBmod criterion. Based on species richness, species composition, and community indices, the fish communities downstream of the LEF and MEF WWTPs were comparable to those upstream. Similarly, the fish community of the EFLMR, upstream of William Harsha Lake, appears to be as good or better downstream of Pleasant Run (EFRM 42.8) as it is upstream (EFRM 44.1). Thus, the differences in species richness, species composition, and community indices, though generally slight, appear to be related to stream size and habitat quality.

Percent DELT anomalies were generally low at all locations (range 0.0 to 0.2), except at EFRM 42.8 in September when the affliction rate was moderate (0.6 percent). Lesions and eroded fins were the most common DELT anomalies observed.

MACROINVERTEBRATES

One hundred thirteen taxa were collected at the six EFLMR locations in 2005, including 30 EPT taxa (Table 8). The most diverse taxonomic groups in the EFLMR were Chironomidae (midges, 35 taxa), Trichoptera (caddisflies, 15 taxa), Ephemeroptera (mayflies, 14 taxa), and Coleoptera (beetles, 11 taxa). Collectively, these groups comprised 75 of the 113 (66 percent) total taxa. Based on the ICI, the quality of the benthic community was fair at EFRM 4.4, marginally good at EFRMs 44.1, 42.8, and 11.3, good at EFRM 12.7, and very good at EFRM 5.4. However, all locations failed to attain the ICI EWH criterion of 46, except EFRM 5.4.

Collectively, 66 taxa were collected from the two locations in O'Bannon Creek in 2005, including 15 EPT taxa (Table 10). Taxa richness was greatest among the following taxonomic groups: Diptera (true flies and midges, 21 taxa), Ephemeroptera (mayflies, 8 taxa), Trichoptera (caddisflies, 7 taxa), and Coleoptera (beetles, 7 taxa). Based on taxa richness measures and

community index scores (i.e., ICI and/or QCTV scores), the quality of the benthic community was good to excellent at RM 4.3 and fair to good at RM 2.5 in O'Bannon Creek. Based on these parameters, the benthic community at RM 4.3 met the WWH designated use. Attainment at RM 2.5 could not be determined based on the QCTV score alone as a valid HD was not collected at this site.

HABITAT

Qualitative Habitat Evaluation Index (QHEI) scores indicate that the habitat quality was good to excellent at all sampling locations in 2005. Habitat quality was better at EFRM 12.7 (QHEI score = 82.3), upstream of MEF WWTP, than the remaining seven locations, where the habitat quality was quite similar (QHEI scores ranged from 66.8 to 74.5). The higher QHEI score at EFRM 12.7 was due, in part, to better cover, riffle/run, and gradient metric scores compared to the other seven locations.

1. INTRODUCTION

Clermont County is conducting an ongoing program to manage and protect the environmental resources of its rivers and streams. The program was initiated to better understand the biological and water quality condition of the watershed, and to identify and address any discernable problems. The fish and macroinvertebrate studies described herein are part of that program.

The East Fork Little Miami River (EFLMR) is a major tributary to the Little Miami River and is Ohio's largest Exceptional Warmwater Habitat (EWH) stream. Approximately half (243 square miles) of the EFLMR watershed lies within the boundaries of Clermont County with the remainder (256 square miles) located upstream in four other Ohio Counties: Brown, Clinton, Highland, and Warren. Land use within the EFLMR watershed in Clermont County consists of agriculture (66 percent), forest (20 percent), and urban areas (12 percent).

Clermont County operates two wastewater treatment plants (WWTP) on the EFLMR, one is located within the Middle East Fork (MEF) at RM 12.6 and the other is within the Lower East Fork (LEF) at RM 4.8. A third Clermont County WWTP is located at RM 2.6 on O'Bannon Creek in O'Bannonville, OH. In addition, the cities of Williamsburg, Batavia, and Milford operate WWTPs on the EFLMR at RMs 35.3, 13.5, and 1.3, respectively.

While not located within the EFLMR watershed, O'Bannon Creek is a major stream draining parts of Wayne, Goshen and Miami Townships in northern Clermont County before discharging into the Little Miami River in Loveland, Ohio. The basin is a mix of forest, row crop and pasture lands, and suburban residential properties.

The principal objective of this study was to determine whether the EFLMR and O'Bannon Creek were attaining their designated aquatic life uses as contained in the State of Ohio Water Quality Standards, and, if not, what factors might be causing the non-attainment.

2. METHODS

2.1 OVERVIEW

2.1.1 Locations

Water quality, habitat, fish, and macroinvertebrates were assessed at six EFLMR locations and two O'Bannon Creek locations (Figure 1):

East Fork Mainstem

EFRM 44.1	Between Fivemile Creek and Blue Sky Parkway Bridge; upstream end of zone N39°06.933' W84°01.502, downstream end of zone N39°06.853' W84°01.488'
EFRM 42.8	Immediately downstream of Pleasant Run; upstream end of zone N39°06.473' W84°02.212', downstream end of zone N39°06.368' W84°02.190'
EFRM 12.7	Immediately upstream of MEF WWTP discharge
EFRM 11.3	Downstream of the MEF WWTP; upstream end of zone N39°06.156' W84°11.773', downstream end of zone N39°06.243' W84°11.654'
EFRM 5.4	Upstream of the LEF WWTP; upstream end of zone N39°08.748' W84°14.962', downstream end of zone N39°08.631' W84°15.264'
EFRM 4.4	Downstream of LEF WWTP and upstream of Eastman Drive Bridge; upstream end of zone N39°09.192' W84°15.434', downstream end of zone N39°09.446' W84°15.683'

O'Bannon Creek

RM 4.3	At Gibson Road Bridge, sampled approximately 100 m upstream and 100 m downstream of bridge; upstream end of zone N39°14.953' W84°12.026', downstream end of zone N39°15.013' W84°12.122'
RM 2.5	200 m zone which began 350 m downstream of the O'Bannon WWTP discharge and ended 150 m downstream of said discharge.

All zones were marked using a Magellan 330M hand held GPS, based on WGS84 Datum. However, coordinates for EFRM 12.7 and O'Bannon Creek RM 2.5 were lost due to a corrupted file. Stations in O'Bannon Creek are standard wading sites, whereas EFRM 5.4 and EFRM 4.4 are boat sites. EFRM 44.1 and 42.8, which are upstream of William H. Harsha Lake, and EFRMs 12.7 and 11.3 were sampled by wading methods, i.e., pram or longline. All EFLMR mainstem stations are classified as Exceptional Warmwater Habitat (EWH), while O'Bannon

Creek is classified as Warmwater Habitat (WWH).

2.1.2 Environmental Conditions

Mid to late summer was chosen for sampling because flows are usually low during this period. Flows were generally low (90-175 cfs in the EFLMR at Perintown, OH) and only slightly above historic median flows during the July fish survey and slightly lower in September 2005.

The sampling crew started the first survey at the upstream O'Bannon Creek site on the afternoon of 20 July. That evening, the area received moderate to heavy rainfall resulting in increased flows and turbidity levels that made electrofishing impractical in both O'Bannon Creek and East Fork mainstem sites the following day. Electrofishing resumed on 22 July when sampling conditions improved dramatically.

Although precipitation and stream flows were relatively stable throughout much of the benthic macroinvertebrate colonization period, gauge data suggest that there were notable fluctuations immediately after the samplers were deployed and just before the samplers were retrieved.

2.2 FISH

2.2.1 Field

Two collections were made at each location during the periods 20-24 July and 12-16 September 2005. Electrofishing zones of 200 m were established at the various wading stations. All boat electrofishing zones were 500 m long. All zones were measured with a hip chain and/or GPS and all start and endpoints were marked with flagging and/or by GPS. In each zone, fish were collected according to standard Ohio EPA electrofishing procedures (OEPA 1989a). Boat zones were sampled by a pulsed DC, boat-mounted electrofisher. Output was controlled by a Smith Root Type VI A electrofisher. Power was supplied by a 5000 watt generator. Depending on water levels, wading zones were sampled by either pram or longline electrofishing:

	East Fork Little Miami River												O'Bannon Creek			
	RM 4.4		RM 5.4		RM 11.3		RM 12.7		RM 42.8		RM 44.1		RM 2.5		RM 4.3	
	Jul	Sep	Jul	Sep	Jul	Sep	Jul	Sep	Jul	Sep	Jul	Sep	Jul	Sep	Jul	Sep
Boat	X	X	X	X												
Pram					X	X	X	X	X	X	X		X	X		
Longline												X			X	X

Pram electrofishing consisted of one member of the field crew using a hand-held electrode to dip fish that were stunned by the electrode, which were then transferred to a live well to be processed later. Pram electrofishing was conducted with an 1800-watt generator and a Coffelt Model 2C variable voltage pulsator (VVP) that provided pulsed DC output. This system is the equivalent to Ohio EPA's Sport Yak. Longline electrofishing is similar to the pram method, however, the electrodes were connected via a 100 m long cable to a Model 2C VVP which was typically stationary at the mid-point of the zone. The longline method was also powered by an 1800 watt generator

All fish collected were identified, counted, batch weighed and examined for DELT anomalies (deformities, erosions, lesions, and tumors; Ohio EPA 1987, 1989a). The following is a review of DELT anomalies and their causes in freshwater fishes (OEPA 1989b):

1) *Deformities* - These anomalies can affect the head, spine, fins, and have a variety of causes including toxic chemicals, viruses, bacteria (e.g., *Mycobacterium* sp.), and protozoan parasites (e.g., *Myxosoma cerebalis*) (OEPA 1989b).

2) *Eroded fins* - These are the result of chronic disease principally caused by flexibacteria invading the fins causing a necrosis of the tissue (Post 1983). Necrosis of the fins may also be caused by gryodactylids, a small trematode parasite (OEPA 1989b). For this study, fin erosion was separated into three categories: slight erosion -<1/3 of fin eroded; moderate erosion -1/3 -2/3 of fin eroded, and severe erosion ->2/3 of fin eroded (App. F).

3) *Lesions and Ulcers* - These appear as open sores or exposed tissue and can be caused by viral (e.g., *Lymphocystis* sp.) or bacterial (e.g., *Flexibacter columnaris*, *Aeromonas* spp., *Vibrio* sp.) infections (OEPA 1989b).

4) *Tumors* - These result from the loss of carefully regulated cellular proliferative growth in tissue and are generally referred to as neoplasia. In wild fish populations tumors can be the result of exposure to toxic chemicals. Baumann et al. (1987) identified polynuclear aromatic hydrocarbons (PAHs) as the cause of hepatic tumors in brown bullheads in the Black River (Ohio). Viral infections (e.g., Lymphocystis) can also cause tumors. Parasites (e.g., *Glugea anomala* and *Ceratomyxa shasta*; Post 1983) may cause tumor-like masses, but these should not be counted as tumors. Parasite masses can be squeezed and broken between the thumb and forefinger whereas true tumors are firm and not easily broken (OEPA 1989b). Only those anomalies visible to the naked eye were recorded. The exact counts of anomalies present (i.e., the number of tumors, lesions, etc. per fish) were not recorded. An external anomaly is defined as the presence of externally visible skin or subcutaneous disorders, and is expressed as percent of affected fish among all fish processed (OEPA 1989b).

The numbers of fish (mainly stonerollers) encountered in O'Bannon Creek at the downstream location were so high that all specimens stunned could not be dipped in a reasonable amount of time. In these situations, we collected all uncommon species and took a representative cross section of the common to abundant species.

2.2.2 Laboratory

Whenever possible, fish were identified in the field and released. However, fish of uncertain identity were preserved in 10% formalin and returned to the EA lab for further examination. Laboratory fish were processed in the same manner as those collected in the field.

2.2.3 Data Analyses

All fish data was entered into a SAS database and printouts of that database were compared against the original data sheets to check for data entry errors. After any errors were corrected, summary tables were prepared and index scores calculated. The fish community indices that were used were the Index of Biotic Integrity (IBI) and the Modified Index of Well-being (IWBmod). Ohio EPA's IBI (OEPA 1987 plus errata, 1989a) is a multi-metric index patterned after the IBI originally described by Karr (1981) and Fausch et al. (1984). The IBI uses 12 metrics to assess the health of the fish community. Metrics include such variables as number of species collected, catch rate, number of sunfish species, etc. Each metric receives a score of 1, 3, or 5; thus the total score can range from 12 to 60. The IWBmod is a measure of fish community abundance and diversity using number and weight information; it is Ohio EPA's modification (OEPA 1987 plus errata, 1989a) of the original Index of Well-being developed for the Wabash River in Indiana (Gammon 1976; Gammon et al. 1981). EA has computer programs that calculate these scores using Ohio EPA protocols and which have successfully duplicated scores calculated by Ohio EPA at a number of sites. In addition to IBI and IWBmod scores, EA calculated catch-per-unit-effort (number of fish per 300 m), species richness, and percent composition.

2.3 MACROINVERTEBRATES

Macroinvertebrates were surveyed quantitatively and qualitatively at each location using OEPA methodologies (OEPA 1989b). Quantitative collections were made with modified Hester-Dendy artificial substrate samplers (HD). HDs were set on 20-22 July and retrieved on 12-15 September. HDs were collected from all sampling sites in 2005, except O'Bannon Creek RM 2.5 where the samplers apparently were vandalized or swept away during high flow conditions. Qualitative samples were collected by kick netting and handpicking during the HD retrieval at all sites.

2.3.1 Quantitative Sampling

Each modified Hester-Dendy artificial substrate sampler consisted of eight 3x3 inch plates constructed from 1/8 inch tempered hardboard and twelve 1/16 inch plastic spacers. The plates and spacers were arranged on a 1/4 inch eye bolt so that each sampler had three 1/8 inch spaces, three 1/4 inch spaces, and one 3/8 inch space among the plates. The total surface area of a single sampler, excluding the eye bolt, was 1.01 square feet. A single sample consisted of five HDs attached to a concrete block. Duplicate HD sets were deployed at each location to minimize the loss of samplers. Where possible, samplers were placed in run habitats or at least in areas with the highest current velocity. The HD samplers remained in place for a seven to eight-week colonization period. Although OEPA recommends a six-week colonization period (OEPA 1987), high flows postponed retrieval by one to two weeks, depending on the location. Retrieval of the HDs was accomplished by placing a benthos sieve in the water just downstream of the sampler and then carefully lifting the sampler and the sieve simultaneously to the surface. The HDs were then cut from the block above the sieve to reduce the loss of organisms. All five HDs and material from the sieve were placed in a single labeled container and preserved with 10% formalin.

2.3.2 Qualitative Sampling

Qualitative samples were collected concurrent with retrieval of the HDs in adjacent wadable areas. All discernable habitats were sampled using a No. 30-mesh delta net (kicks and sweeps) and by handpicking selected substrates for 60-120 person-minutes per location, depending on organism and habitat diversity. Collected organisms were placed in labeled jars and preserved with 10% formalin.

2.3.3 Laboratory Processing

Upon arrival at the laboratory, the samples were logged in and accounted for. Based on velocity and condition of the samplers as observed upon retrieval, one of the two HD arrays from each location was initially processed. If available, the second HD array was kept as a backup. The five HDs from each array were disassembled in a water filled enamel pan and cleaned of organisms and debris. This mixture was then passed through a No. 60 (250 µm openings) U.S. Standard Testing Sieve and preserved in labeled containers containing 10% formalin. Sorting of each HD and qualitative sample was conducted in a white enamel pan under a magnifier lamp and stereo-zoom dissecting microscope . HD samples were initially pre-picked to remove any large or rare taxa prior to subsampling. When necessary, a Folsum sample splitter was used to subsample until a manageable number of organisms was achieved. A minimum of 250 organisms was removed from the fractionated samples. Qualitative samples were picked with the emphasis on removing the maximum number of taxa especially those generally considered sensitive to physical and chemical impacts [Ephemeroptera, Plecoptera, Trichoptera (EPT taxa), and Tanytarsini Chironomidae]. Organisms from both sample types were sorted to higher taxonomic levels (generally Class or Order level) and preserved separately in labeled vials containing 70% ethyl alcohol. Sorted samples were routinely checked by senior EA personnel to assure a consistent level of quality and sorting efficiency.

Macroinvertebrate identifications were made to the lowest practical taxonomic level using the most current literature available. Whenever possible, the level of identifications followed those recommended by the OEPA (1987, plus errata). Chironomidae larvae were cleared in 10% potassium hydroxide and permanently mounted in CMC-10 prior to identification. For both sample types, specimens were enumerated, coded and recorded on a standard laboratory bench sheet for data processing.

2.3.4 Data Analyses

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the OEPA, the ICI is a modification of the Index of Biotic Integrity for fish (OEPA 1987 plus errata; DeShon 1995). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa.

The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by OEPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

Due to the loss of the HD sample at O'Bannon Creek RM 2.5, the benthic macroinvertebrate data from O'Bannon Creek were analyzed using OEPA's Qualitative Community Tolerance Values (QCTV). Unlike the more intensive Invertebrate Community Index (ICI), which incorporates data from both an artificial substrate and qualitative sample at a given site, the QCTV uses information only from qualitative samples. The QCTV assesses the environmental tolerance or sensitivity of the macroinvertebrate community using tolerance values that are assigned to each taxon. OEPA derived these values by calculating the abundance-weighted average of all ICI scores from locations where a particular taxon was collected (DeShon 1995). Taxa that are typically abundant at least disturbed sites have a lower tolerance value while those taxa that are generally abundant at highly disturbed sites have a higher tolerance value. As such, the range of tolerance values, 0=poor to 60=excellent, is the same as the ICI scoring range. Only taxa that are represented by five or more observations in the OEPA database are used to determine the QCTV score at a given site. The QCTV score for a given site is expressed as the median of tolerance values for all taxa observed at the site that are also represented by five or more observations in OEPA's database (Mr. Jeffrey DeShon-OEPA, pers. comm.).

In addition to the ICI and QCTV, total taxa richness, Ephemeroptera+Plecoptera+Trichoptera (EPT) richness, and the number of tolerant (moderately tolerant and tolerant) and intolerant (moderately intolerant and intolerant) taxa were used to assist the evaluation of each site.

2.4 BIOLOGICAL ASSESSMENT

In this report, we followed Ohio EPA guidance in determining attainment or non-attainment of each applicable biocriterion. Assessment of biological community health was based primarily on Ohio EPA index scores (i.e., IBI, IWBmod, ICI, and QCTV scores). Comparisons were made both among sampling locations and against the Interior Plateau (IP) ecoregion biocriteria. To account for biological variability, Ohio EPA considers IBI and ICI scores within 4 units of the biocriterion and IWBmod scores within 0.5 units of the biocriterion to meet the criterion (this is referred to as the Area of Insignificant Departure).

In Ohio, attainment of the benthic community can only be determined by calculating the ICI. However, for the QCTV, OEPA has calculated the upper 25th percentile and lower 75th percentile of the scores for each ecoregion representing Excellent to Good sites and Fair to Poor sites, respectively. For the IP, the QCTV percentile thresholds are:

Percentile	Interior Plateau QCTV Thresholds
25th – Excellent-Good	39.20
75th – Fair-Poor	34.85

A QCTV score that exceeds the 25th percentile suggests that the site is in attainment of its Warmwater Habitat (WWH) designated use while a QCTV score less than the 75th percentile suggests that the site is not attaining its designated use. Sites with QCTV scores that fall near these thresholds were evaluated using additional parameters to assist in determining whether the site was in attainment. QCTV scores that clearly fall between the two thresholds were considered undetermined (Mr. Jeffrey DeShon-OEPA, pers. comm.). An area of insignificant departure has not been defined by OEPA for the QCTV.

2.5 HABITAT

Habitat was evaluated using Ohio EPA's QHEI (Qualitative Habitat Evaluation Index) (Rankin 1989, 1995). Methods for calculating the QHEI are described in detail in Volume III of Ohio EPA's User Manual (OEPA 1989b) and therefore are not discussed in detail here. Principal components (metrics) that are used to develop the QHEI score are:

- substrate
- cover
- channel morphology
- riparian zone and bank erosion
- pool, riffle, run quality
- stream gradient

QHEI scores from hundreds of segments around the State of Ohio have indicated that values greater than 60 are generally conducive to the existence of warmwater faunas, whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the Warmwater Habitat (WWH) biological criteria (OEPA 1987). Support or non-support is independent of water quality, i.e., even if water quality is compliant with applicable standards, a stream with QHEIs <45 usually will not support warmwater aquatic communities.

2.6 WATER QUALITY

In conjunction with fish sampling, EA measured water temperature, dissolved oxygen (DO), specific conductance, pH, and water clarity. Temperature, DO, and conductance were measured with a YSI Model 85 water quality meter. The meter was calibrated prior to each measurement as well as compared to a Winkler titration once during each trip. pH was measured with a Oakton pHTester 3+ pH meter that was calibrated before each measurement. In addition, water clarity was measured at all sampling locations with a Secchi disk.

3. RESULTS AND DISCUSSION

3.1 FISH

3.1.1 Fish Composition and Diversity

The two sampling passes at the eight stations yielded 12,136 fish representing 61 species and hybrid sunfish (Table 1). Numerically, the combined catch was dominated by central stoneroller (18 percent), emerald shiner (17 percent), bluntnose minnow (15 percent), and greenside darter (6 percent), as indicated in Figure 2 below and in Table 2.

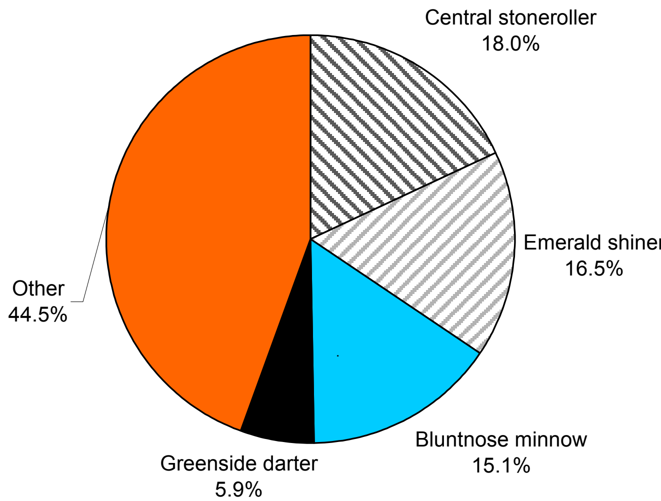

Figure 2. Relative abundance of the dominant species collected in the East Fork Little Miami River and O'Bannon Creek, 2005.

In addition, spotfin shiner, sand shiner, steelcolor shiner, northern hog sucker, golden redhorse, longear sunfish, and rainbow darter each composed 3 percent of the total catch. No threatened or endangered species were collected. However, river redhorse, which is listed by Ohio Department of Natural Resources as a species of "special concern", was collected in the EFLMR downstream of the MEF WWTP. Scarlet shiner (*Lythrurus fasciolaris*), which was collected in both the EFLMR and O'Bannon Creek, was formerly snynonymized under the name rosefin shiner (*L. ardens*) and is now recognized as a valid species (Dimmick et.al 1996). We have adopted the common name scarlet shiner to be consistent with Nelson et. al 2004. Similarly, smallmouth redhorse (*Moxostoma breviceps*), formerly considered an Ohio River basin subspecies of the shorthead redhorse (*M. macrolepidotum*), has been elevated to species status (Nelson et.al 2004).

Species richness was higher in September than July among EFLMR locations downstream of William Harsha Lake and generally comparable between the two months at the other locations (Tables 3 and 4). Spatially, species richness (both trips combined) among EFLMR locations was fairly similar but richness was slightly higher upstream of William Harsha Lake at RMs 42.8 and 44.1 (39 and 41 species, respectively) than downstream of it (range 33 to 40 species). As expected, species richness in O'Bannon Creek was lower than that of the EFLMR, but exceptional for a stream of its size (Table 4).

3.1.1.1 East Fork Little Miami River

The quality of the fish community in the EFLMR was exceptional throughout most of the study area, based on species composition and community indices (see Section 3.2). A total of 8,000 fish comprised of 58 species was collected during the two surveys, including several intolerant species such as black redhorse, river redhorse, silver shiner, mimic shiner, stonecat, banded darter, and slenderhead darter (Table 2). Minnows (16 species) and darters (9 species) were particularly well represented, composing 25 of the 58 species collected (43 percent). Although a variety of highly tolerant species were collected (common carp, golden shiner, bluntnose minnow, fathead minnow, creek chub, yellow bullhead, and green sunfish), only bluntnose minnow composed an appreciable percent (16) of the total catch (Table 2). Collectively, all tolerant species, excluding bluntnose minnow, composed only 2.2 percent of the total EFLMR catch (Table 2). As indicated in the Figure 3 below and in Table 2, the total catch was dominated numerically by emerald shiner (22.5 percent), bluntnose minnow (16.2 percent), central stoneroller (6.4 percent), greenside darter (4.8 percent), spotfin shiner (4.4. percent), longear sunfish and sand shiner (4.3 percent each), and steelcolor shiner and golden redhorse (4.1 percent each):

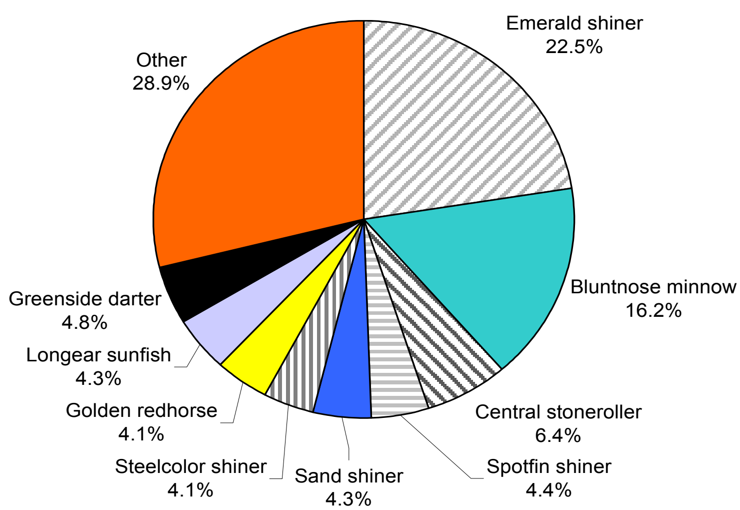

Figure 3. Relative abundance of the dominant species collected in the East Fork Little Miami River, 2005.

As indicated in Table 3, species richness was generally higher upstream of William Harsha Lake (34 to 37 species/location) than downstream of it (25 to 34 species/location). Species richness and CPEs were comparable to, or higher, downstream of the LEF and MEF WWTPs (RMs 4.8 and 12.6, respectively) compared to upstream of them. For example, in the LEF, both species richness and CPEs in July were slightly higher at EFRM 4.4 (27 species and 412 fish/km, respectively), downstream of the LEF WWTP, than at EFRM 5.4 (25 species and 382 fish/km, respectively), upstream of it (Table 3). Species richness and CPEs were similar among the LEF locations in September (34 species and 1622 fish/km, respectively upstream; 32 species and 1504 fish/km downstream). At the MEF locations, upstream and downstream values were similar both in July (27 species and 1021 fish/300 m upstream; 26 species and 1054 fish/300 m downstream) and September (29 species and 867 fish/300 m upstream; 29 species and 751 fish/300 m downstream). Species richness and CPEs were similar at EFRMs 42.8 and 44.1, upstream of William Harsha Lake, during both sampling trips (Table 3).

Generally, catches among EFLMR locations were comparable in terms of species richness and CPEs, however, shifts in species composition were apparent spatially. For example, longnose gar, skipjack herring, fathead minnow, bullhead minnow, river carpsucker, highfin carpsucker, smallmouth buffalo, bigmouth buffalo, river redhorse, white bass, rock bass, black crappie, sauger, and freshwater drum were restricted to the location(s) downstream of William Harsha Lake (Figure 1 and Table 3). All of these are primarily medium to large river species. In contrast, silverjaw minnow, scarlet shiner, golden shiner, yellow bullhead, stonecat, orangespotted sunfish, and blackside darter were collected only at EFRM 44.1 and/or EFRM 42.8, upstream of William Harsha Lake. In addition, the number of darter species declined from upstream (8 species) to downstream (4 species) within the EFLMR study reach (Table 3). In contrast, the number of sucker species generally increased from upstream (6) to downstream (9), yet the percentage of round bodied suckers (an IBI metric among boat sites) declined. As discussed in more detail in the following section, these community shifts were likely caused by differences in stream size and habitat quality, particularly substrate quality and riffle/run quality.

3.1.1.2 O’Bannon Creek

The fish community in O’Bannon Creek was very good to exceptional at the two locations sampled near the O’Bannon Creek WWTP. A total of 4,136 fish comprised of 32 species was collected for both trips combined, including seven darter species and 13 minnow species (Tables 2 and 4). The diverse ichthyofauna observed in O’Bannon Creek is impressive for a third order stream. As seen below in Figure 4, the catch was dominated by central stoneroller (40.4 percent), bluntnose minnow (13.0 percent), greenside darter (8.0 percent), emerald shiner (5.1 percent), and northern hog sucker (3.8 percent):

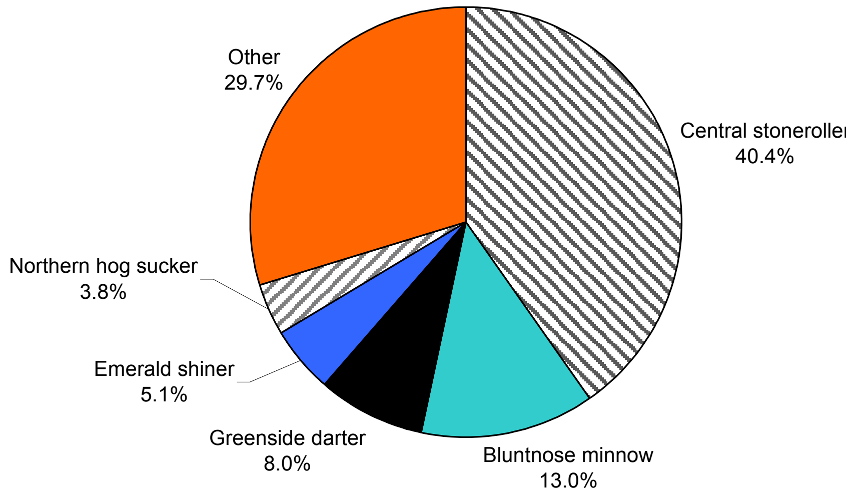

Figure 4. Relative abundance of the dominant species collected in O'Bannon Creek, 2005.

Spatially, the fish community in O'Bannon Creek appears to be as good, or better, downstream of the WWTP compared to upstream of it. For example, species richness and numbers of fish were higher downstream, at RM 2.5, than upstream at RM 4.3, during both sampling trips (Table 4). Twelve hundred fifty-eight fish comprised of 29 species were collected downstream in July compared to 763 fish/22 species collected upstream. Similarly, in September, 1,468 fish/25 species were collected downstream compared to only 647 fish/21 species upstream (Table 4). In addition, twice as many intolerant species were collected downstream of the O'Bannon Creek WWTP (4) than upstream of it (2). And lastly, mean IBI and IWBmod values, which will be discussed in greater detail in Section 3.2.1, were very similar upstream and downstream of the O'Bannon Creek WWTP.

3.1.2 Fish Community Indices

3.1.2.1 IBI

Mean IBI scores ranged from 46 to 54, indicating a very good to exceptional fish community at all sampling stations (Tables 5 and 6) (OEPA 1987). Mean IBI scores were higher (range 50 to 54) among EFLMR wading sites (EFRMs 11.3, 12.7, 42.8, and 44.1) than elsewhere (range 46 to 47).

Collectively, the LEF boat sites, i.e. EFRMs 5.4 and 4.4, consistently scored a 5 for the following metrics: number of species, percent insectivores, and percent DELT anomalies (Table 5). In contrast, although suckers were well represented at both of these sites (5 to 9 species), typically resulting in a metric score of 5, few of the sucker species collected were round bodied suckers, resulting in consistently poor scores (1 for all trips) for the percent round bodied sucker metric (Table 5). In addition, the LEF sites scored only fair (1 or 3) for percent top carnivores metric. Even so, the LEF fish community was very good based on IBI scores. As discussed in greater detail in Section 3.3, the poor representation of round bodied suckers is likely due to comparatively poor habitat quality, particularly substrate and riffle/run quality.

Mean IBI scores were exceptional at all EFLMR wading sites, particularly at EFRM 12.7 (Table 6). These locations (EFRMs 11.3, 12.7, 42.8, and 44.1) scored a 3 or a 5 for all metrics and scored particularly well (i.e., 5 for both trips) for number of species and the percent insectivores metrics (Table 6). EFRM 12.7 was the only wading site to consistently score a 5 for all seven proportion metrics. Other metrics that scored very well (i.e., typically a 5) among EFLMR wading sites include number of sucker species, number of darter species, number of individuals, and percent DELT anomalies.

Mean IBI scores at the two O'Bannon Creek locations were similar (46 at RM 2.5; 47 at RM 4.3), and comparable to those of the LEF (Tables 5 and 6). The O'Bannon Creek sites scored very well (i.e., typically a 5) for the following metrics: the number of species, number of darter species, number of individuals, percent tolerant species, and percent omnivores metrics (Table 6). The O'Bannon Creek sites scored a 3 or a 5 for all metrics, except for the number of intolerant species, which were comparatively few (1 to 3 species), resulting in a metric scores of 1 or 3 (Table 6).

Similar to species richness values, mean IBI scores were comparable to or higher downstream of the various WWTPs than upstream of them (Tables 5 and 6). Similarly, the mean IBI score at EFRM 42.8 (51) was slightly higher than the value observed at EFRM 44.1 (50), upstream of Pleasant Run.

Percent DELT anomalies were generally low at all locations (range 0.0 to 0.2), except at EFRM 42.8 in September (Tables 5 and 6). For unknown reasons, the affliction rate of DELT anomalies at EFRM 42.8 in September was 0.6 percent, significantly higher than the percent (0.0) observed at EFRM 44.1, upstream of Pleasant Run. However, both locations scored a 3 for the percent DELT anomalies metric. In fact, all locations scored a 3 or a 5 for this metric (Tables 5 and 6). The percentage DELT anomalies was similar upstream and downstream of the LEF and MEF WWTPs (Tables 5 and 6). Lesions and eroded fins were the most common DELT anomalies observed (Appendix A). Common causes of DELT anomalies include the effects of bacterial, viral, fungal, and parasitic infections, neoplastic diseases, and chemicals (OEPA 1987). An increase in the affliction rate of DELT anomalies usually indicates stress and environmental degradation. In Ohio, the highest incidence of DELT anomalies occurs in fish communities downstream from discharges of industrial and municipal wastewater and combined sewer outfalls (OEPA 1987).

Each 2005 IBI value and appropriate criterion is provided below:

Location/RM	Sampling Method	IBI Criterion	IBI Score July	IBI Score Sept	IBI Score Avg.	Attainment Achieved?
EFRM 44.1	Wading	50 (EWH)	50	50	50	Yes
EFRM 42.8	Wading	50 (EWH)	48	54	51	Yes
EFRM 12.7	Wading	50 (EWH)	54	54	54	Yes
EFRM 11.3	Wading	50 (EWH)	50	52	51	Yes
EFRM 5.4	Boat	48 (EWH)	46	46	46	Yes*
EFRM 4.4	Boat	48 (EWH)	48	46	47	Yes*
O'Bannon Crk/4.3	Wading	40 (WWH)	48	46	47	Yes
O'Bannon Crk/2.5	Wading	40 (WWH)	50	42	46	Yes

* = Within 4 units of the IBI criterion (i.e., within OEPA's Area of Insignificant Departure).

As can be seen above, the appropriate IBI criterion was attained at all stations. EFRMs 5.4 and 4.4 met the IBI criterion of 48 when the Area of Insignificant Departure is considered (see Section 2.3). Mean IBI scores for this study were comparable to or, in most cases, higher than those reported historically by EA and/or Ohio EPA:

Location	EA 2005	EA 2001[1]	OEPA 1998	OEPA 2002
EFRM 44.1	50	48	40 (RM 44.2)[2]	46[2]
EFRM 42.8	51	46	--	--
EFRM 12.7	54	47 (RM 13.7)	46[2]	--
EFRM 5.4	46	46 (RM 6.6)	43 (RM 5.5)[2]	--
EFRM 4.4			45 (RM 4.8)[2]	--
O'Bannon Crk. RM 4.3	47	51	44[3]	--
O'Bannon Crk. RM 2.6	46	--	35[3]	--

(1) EA 2002
(2) OEPA, unpublished biological data from the ECOS database
(3) OEPA 2000

3.1.2.2 IWBmod

Mean IWBmod scores were good at EFRM 11.3 (8.4) and O'Bannon Creek RM 4.3 (8.5), and exceptional at all remaining sampling locations (range 9.4 to 10.1) (Table 7).

IWBmod criteria and actual IWBmod scores are compared below:

Location/RM	Sampling Method	IWBmod Criterion	IWBmod Score July	Sept	Avg.	Attainment Achieved?
EFRM 44.1	Wading	9.4 (EWH)	9.1	9.9	9.5	Yes
EFRM 42.8	Wading	9.4 (EWH)	10.3	9.8	10.1	Yes
EFRM 12.7	Wading	9.4 (EWH)	9.3	9.4	9.4	Yes
EFRM 11.3	Wading	9.4 (EWH)	7.1	9.7	8.4	No
EFRM 5.4	Boat	9.6 (EWH)	9.5	9.2	9.4	Yes*
EFRM 4.4	Boat	9.6 (EWH)	8.9	9.8	9.4	Yes*
O'Bannon Crk/4.3	Wading	8.1 (WWH)	8.5	8.5	8.5	Yes
O'Bannon Crk/2.5	Wading	8.1 (WWH)	9.6	9.3	9.5	Yes

* = Within 0.5 units of the IWBmod criterion (i.e., within OEPA's Area of Insignificant Departure).

Attainment was achieved at all locations, except at EFRM 11.3 in July. The lower IWBmod score at EFRM 11.3 in July is puzzling considering this location scored exceptionally in September. EFRMs 5.4 and 4.4 met the EWH criterion of 9.6 (boat sites) when considering the Area of Insignificant Departure (see Section 2.3).

The observed differences in species richness, species composition, and community indices, though generally slight, appear to be related to two factors: (1) stream size and (2) habitat quality. In wadable streams, there is a well established, direct relationship between stream size and species richness (OEPA 1987). Thus, one would expect fewer species at those locations with smaller drainage areas (e.g., headwater sites) and more species at downstream locations. Thus, the lower number of species at O'Bannon Creek, i.e., 21 to 29 species/location compared to 25 to 35 species/location in the EFLMR, is likely due, in part, to stream size. Conversely, the higher species totals and shifts in composition observed at EFLMR stations are the result of larger stream size and the proximity of a given location to the Little Miami River. Thus, species preferring large streams and rivers (e.g., longnose gar, skipjack herring, fathead minnow, bullhead minnow, river carpsucker, highfin carpsucker, smallmouth buffalo, bigmouth buffalo, river redhorse, white bass, rock bass, black crappie, sauger, and freshwater drum) were restricted to or much more abundant at EFLMR locations downstream of William Harsha Lake than upstream of the lake.

As discussed in greater detail in section 3.3, habitat quality likely affected the distribution of fishes. For example, EFRM 12.7 had the best habitat (i.e., highest QHEI score) and also had an exceptional mean IBI score of 54, three points higher than any other location. In addition, the LEF locations, i.e., EFRMs 5.4 and 4.4, contained poorer substrate and lower riffle/run quality. Perhaps as a result, these locations generally produced fewer round bodied suckers and fewer darter species compared to other EFLMR locations.

In summary, based on species composition, relative abundance, and community indices, all stations sampled in 2005 contained good to exceptional fish communities. All IBI and nearly all IWBmod scores met or exceeded their respective EWH/WWH criterion. For example, all locations were in full attainment (i.e., both IBI and IWBmod scores met their respective criterion), except EFRM 11.3. Based on the aforementioned parameters, the fish communities downstream of the LEF and MEF WWTPs were comparable to those upstream. Similarly, the fish community of the EFLMR, upstream of William Harsha Lake, appears to be as good or better downstream of Pleasant Run (EFRM 42.8) as it is upstream (EFRM 44.1).

3.2 MACROINVERTEBRATES

3.2.1 East Fork Little Miami River

One hundred thirteen taxa were collected at the six EFLMR locations in 2005, including 30 EPT taxa (Table 8). EPT is comprised of three major benthic groups: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These taxa are considered relatively intolerant of environmental disturbance (OEPA 1989a and 1989b). Therefore, a high EPT richness generally reflects better water quality. The most diverse taxonomic groups in the EFLMR were Chironomidae (midges, 35 taxa), Trichoptera (caddisflies, 15 taxa), ephemeroptera (mayflies, 14 taxa), and Coleoptera (beetles, 11 taxa). Collectively, these groups comprised 75 of the 113 (66 percent) total taxa (Table 8). Generally, Chironomidae are considered tolerant of environmental perturbation and often comprise a significant portion of the benthic collections using OEPA methodology (OEPA 1987). However, several intolerant taxa were collected among this group, including *Labrundinia pilosella*, *Nilotanypus fimbriatus*, *Corynoneura "taris"*, *C. celeripes*, *Microtendipes*, *Nilothauma*, *Rheotanytarsus*, *Tanytarsus glabrescens* grp, and *T. guerlus* grp.

Total taxa richness (qualitative and quantitative collections combined) per location was generally similar and ranged form 43 (EFRM 42.8) to 61 taxa (EFRM 12.7). No consistent longitudinal pattern was apparent based on total taxa richness. For example, as indicated in Table 8, taxa richness was lower at EFRM 11.3 (52 taxa) downstream of the MEF WWTP compared to EFRM 12.7 (61 taxa) upstream of it, but higher **downstream** of the LEF WWTP (60 taxa) than upstream of it (48 taxa). In contrast to total richness, twice the number of EPT taxa were collected upstream of both the LEF and MEF WWTPs compared to downstream (Table 8). Furthermore, although substantially more taxa were collected downstream of the LEF WWTP than upstream, nearly four times as many tolerant taxa (those taxa listed as very tolerant, tolerant, or moderately tolerant by OEPA) were collected downstream of LEF WWTP compared to upstream. Total taxa and EPT taxa at EFRMs 42.8 and 44.1, upstream of William Harsha Lake, were within the ranges observed at other EFLMR locations (Table 8).

As indicated below, EPT taxa richness, and to a lesser extent, total taxa richness/location varied considerably by sampling type and location:

	EPT Taxa	
Location	**HDs**	**Qual**
4.4	3	6
5.4	9	12
11.3	4	10
12.7	8	16
42.8	9	9
44.0	11	10

EPT taxa richness was generally lower, and at times substantially so, among quantitative collections compared to qualitative collections. The greatest variability in EPT taxa richness occurred at EFRMs 4.4, 11.3, and 12.7 where, at best, only half the number of EPT taxa were collected from the HDs compared to the qualitative samples. Nonetheless, regardless of collection method, EPT taxa richness was consistently lower downstream of the LEF and MEF WWTPs than upstream.

The difference in EPT richness between the HD and qualitative results may be due, in part, to variability in stream flow. As alluded to in Section 2.1.2 and illustrated below, EFLMR flows were relatively stable through much of the colonization period but varied considerably, particularly near the beginning and end of the colonization period.

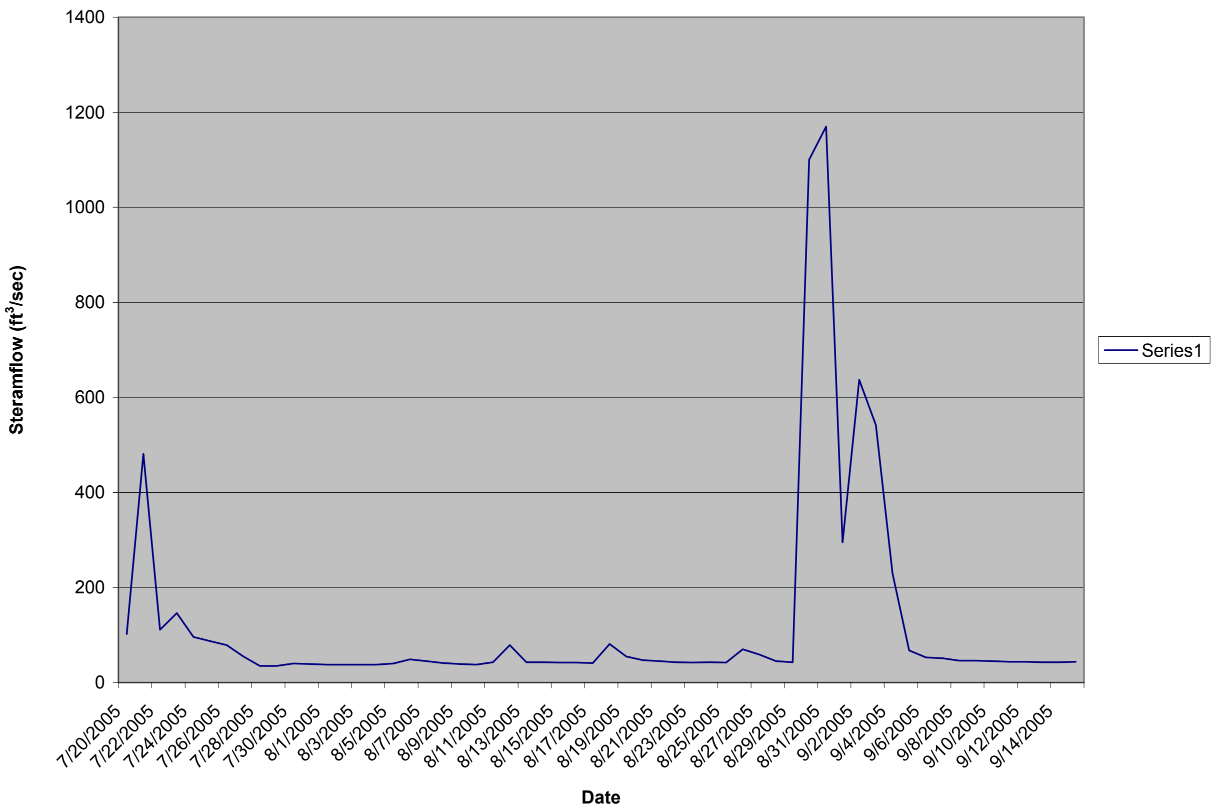

Figure 5. EFLMR flows recorded at the Perintown, OH gage (03247500) during the HD colonization period.

Flow changes of this magnitude (an increase by a factor of 27 within 24-36 hours) can have a significant impact on the colonization of artificial substrate samplers. For example, Gersich and Brusven (1981) estimated that it would take nearly 20 days longer for their test substrates to reach carry capacity under fluctuating flow conditions compared to stable flow conditions. In addition, episodic high flow events may result in the loss of organisms via scour. Therefore, the fluctuating flow conditions and high flow events observed in the EFLMR during the HD sampling period may have adversely affected not only colonization and taxa richness but ICI scores overall.

ICI scores ranged from 22 at EFRM 4.4 to 42 at EFRM 5.4 in the EFLMR (Table 9). ICI scores were identical at EFRMs 44.1 and 42.8 (28), upstream of William Harsha Lake; and were comparable to the two MEF locations (Table 9). Based on OEPAs narrative quality ranges for biocriteria (OEPA 1987), ICI scores indicate that the benthic community was fair at EFRM 4.4, marginally good at EFRMs 11.3, 42.8, and 44.1, good at EFRM 12.7, and very good at EFRM 5.4 (Table 9). As indicated above, the benthic community was fair downstream of the LEF WWTP and very good upstream of it. The variability in ICI scores in the LEF can be attributed to several key ICI metrics. For example, as indicated in Table 9, percent caddisfly composition was significantly lower at EFRM 4.4 (6 percent-metric score of 2) compared to EFRM 5.4 (39 percent-metric score of 6). Similarly, the two negative metrics, percent other Diptera and percent tolerant organisms showed very noticeable shifts from upstream (31 percent other Diptera/metric score of 4 and 1 percent tolerants/metric score of 6, respectively) to downstream (90 percent other Diptera/metric score of 0 and 8 percent tolerants/metric score of 2, respectively). EFRM 4.4 in the LEF scored a 0 or a 2 for all metrics except total taxa and number of dipteran taxa which scored a 4 and 6 respectively (Table 9).

ICI index scores and appropriate criterion are summarized below:

EFRM	ICI Score	EWH Biocriterion	Criterion Attained?
EFRM 44.1	28	46	No
EFRM 42.8	28	46	No
EFRM 12.7	32	46	No
EFRM 11.3	28	46	No
EFRM 5.4	42	46	Yes*
EFRM 4.4	22	46	No

* = Within 4 units of the ICI criterion (i.e., within OEPA's Area of Insignificant Departure).

In contrast to attainment being met virtually across the board for fish, all locations failed to attain the EWH benthic criterion of 46, except EFRM 5.4. EFRM 5.4 met the ICI criterion of 46 when the Area of Insignificant Departure is considered (see Section 2.3). All locations attained the WWH benthic criterion of 30, except EFRM 4.4. ICI scores for this study were consistently lower than those reported historically by Ohio EPA:

Location	EA 2005	OEPA 1998	OEPA 2002
EFRM 44.1	28	--	38
EFRM 12.7	32	48	--
EFRM 5.4	42	50	--

Although habitat quality and low current velocity do not appear to have been negative factors affecting the benthic results, as discussed previously in this section, the flow regime of the EFLMR during the colonization period may have contributed to the lower ICI scores throughout the study area in 2005.

3.2.2 O'Bannon Creek

ICI scores were calculated for RM 4.3, upstream of the O'Bannon Creek WWTP, but not downstream as no valid HDs were retrieved from RM 2.5. Therefore, QCTV scores were calculated at both sites for comparative purposes.

Collectively, 66 taxa were collected from the two locations in O'Bannon Creek in 2005, including 15 EPT taxa (Table 10). Taxa diversity was greatest among the following taxonomic groups: Diptera (true flies and midges, 21 taxa), Ephemeroptera (mayflies, 8 taxa), Tricoptera (caddisflies, 7 taxa), and Coleoptera (beetles, 7 taxa).

Derived solely from the qualitative collections, EPT taxa richness was similar at RM 2.5 (9 taxa) and RM 4.3 (10 taxa), but total taxa was not. As indicated in Table 10, total taxa richness was notably higher **downstream** of the O'Bannon Creek WWTP (46 taxa) than upstream of it (29 taxa). However, similar to the LEF, the number of tolerant taxa was more than 2 fold higher downstream of the O'Bannon Creek WWTP (10 taxa) compared to upstream of it (4 taxa).

Based on the total taxa richness metric criterion from the ICI (Metric 1), total richness would be rated as good upstream of the O'Bannon Creek WWTP and excellent downstream. EPT taxa richness at both sites would be rated as good using the Qualitative EPT metric criterion from the ICI (Metric 10).

QCTV scores were moderately higher at RM 4.3, upstream of the WWTP, than at RM 2.5 (median scores 41.7 and 35.8, respectively) (Table 10). The upstream QCTV score of 41.7 was higher than the 25th percentile of 39.20 for the IP ecoregion, while the downstream QCTV score of 35.8 was between the 75th percentile of 34.85 and the 25th percentile of 39.20. These scores indicate that the quality of the benthic community in O'Bannon Creek was fair downstream of the WWTP and good to excellent upstream of it. Based on ICI and QCTV scores (40 and 41.7, respectively), the benthic community at RM 4.3 met the WWH designated use. Attainment at RM 2.5, on the other hand, can not be determined based on the QCTV score of 35.8, which falls between the 25th and 75th percentiles.

In summary, most locations sampled in 2005 contained at least marginally good benthic communities based on taxa richness, taxa composition, and community indices. However, the EWH ICI criterion of 46 was met only at EFRM 5.4, upstream of the LEF WWTP. QCTV scores suggest that the benthic community in O'Bannon Creek was in attainment of the WWH use designation upstream of the O'Bannon Creek WWTP but could not be determined downstream. The benthic communities were consistently poorer than the resident fish communities at all locations, particularly so at EFRMs 44.1, 42.8, and 4.4 where the fish communities were very good to exceptional compared to benthic communities that were fair to marginally good. In contrast to the fish community indices, the ICI declined dramatically from upstream of the LEF WWTP (42) to downstream of it (22). In addition, the relative abundance of tolerant taxa at EFRM 4.4 was substantially greater than any other location. Collectively, these data suggest that adverse conditions may have existed in the lower reaches of the LEF during the sample period.

3.3 HABITAT

QHEI scores are summarized below:

Station	QHEI Score
EFRM 44.1	71.3
EFRM 42.8	74.5
EFRM 12.7	82.3
EFRM 11.3	67.5
EFRM 5.4	66.8
EFRM 4.4	67.5
O'Bannon Creek RM 4.3	75.3
O'Bannon Creek RM 2.5	72.5

The habitat quality was good to excellent at all sampling locations in 2005. Habitat quality was better at EFRM 12.7 (upstream of MEF WWTP) than the remaining seven locations, where the habitat quality was quite similar (QHEI scores ranged from 66.8 to 75.3). The higher QHEI score at EFRM 12.7 was due, in part, to better cover, riffle/run, and gradient metric scores compared to the other seven locations (Table 11 and Appendix B). In particular, this location generally contained more instream cover of varying types (e.g., undercut banks, overhanging vegetation, pools, boulders, and woody debris) and better (i.e. deeper and more stable) riffle/run habitat compared to other locations (Appendix B). Furthermore, all metrics scored well at EFRM 12.7. For example, EFRM 12.7 was the only location that scored the highest or second highest for every QHEI metric (Table 11). Thus, it is not surprising that the mean IBI score at this location was impressive (54), and three points higher than any other location. Although QHEI scores were similar among the remaining locations, individual metrics varied. For example, substrate quality and riffle/run quality were generally poorer in the LEF (i.e., EFRMs 5.4 and 4.4) compared to other locations (Table 11). In particular, these locations contained more silt and less cobble than other locations (Appendix B). As a result, species that require clean, hard, substrates with well developed riffles (most darter species and round bodied suckers) were less abundant in the LEF than elsewhere in the EFLMR (Table 3).

3.4 WATER QUALITY

Water temperature, dissolved oxygen, specific conductance, water clarity, and pH were measured at each station in conjunction with fish and macroinvertebrate sampling.

Water temperatures during the study ranged from 20.8 to 29.9 C (Table 12). Temporal changes in water temperature conformed to expected patterns; on average, water temperatures were 5.0 C cooler in September than in July 2005 (Table 12). The greatest temperature difference between trips (8.3 C) occurred at EFRM 12.7. Water temperatures were quite variable spatially as well. For example, water temperatures were generally higher (0.6 – 3.3 C) downstream of WWTPs than upstream of them, except in O'Bannon Creek were the downstream temperature was 2.1 (September) to 4.4 C (July) cooler than the upstream temperature (Table 12). No consistent thermal pattern was evident in the EFLMR above William H. Harsha Lake (i.e., at EFRMs 44.1 and 42.8). For example, in July, water temperatures were noticeably cooler at EFRM 42.8 (downstream of Pleasant Run) compared to EFRM 44.1, but in September, water temperatures were significantly warmer at EFRM 42.8 compared to 44.1 (Table 12). Water temperatures at all stations were within ranges easily tolerated by warmwater fishes.

DO values ranged from 4.8 (EFRM 42.8 in July) to 9.4 mg/l (EFRM 4.4 in July) during the 2005 study (Table 12). With the exception of EFRM 42.8 and 5.4, DO values were generally comparable both spatially and temporally. In fact, mean DO values were identical (7.5 mg/l) in July and September (Table 12). For unknown reasons, the DO value at EFRM 42.8 was significantly lower in July (4.8 mg/l) than in September (7.7 mg/l), and may have had an effect on the IBI at this location. All DO concentrations met their respective minimum WWH and EWH DO criterion of 4 ppm and 5 ppm, respectively, except EFRM 42.8 in July.

Specific conductance values were generally lower in September than July (mean 333 and 577 µScm, respectively) and varied considerably among locations (Table 12). For example, in September, conductance values ranged from 312 (EFRM 12.7) to 1265 µScm (O'Bannon Creek RM 2.5). The higher specific conductance value observed at RM 2.5 in O'Bannon Creek was likely due to the proximity of this location to the O'Bannon WWTP (Table 12).

Water clarity (i.e., Secchi reading) was measured at all sampling locations. However, insufficient water depth precluded an accurate measurement at both O'Bannon Creek locations in September (Table 12). Nonetheless, water clarity was good enough at these locations to see to the bottom of the stream (Secchi readings >70 cm). Water clarity was good to excellent (42 to >100 cm) at all locations in September and most (EFRMs 4.4, 11.3, 12.7, and both O'Bannon Creek locations) locations in July. Water clarity was fair/good (32 to 36 cm) in the East Fork mainstem upstream of William H. Harsha Lake (i.e., EFRMs 42.8 and 44.1) in July.

As indicated in Table 12, pH values were similar spatially and temporally (range = 7.8 to 8.3).

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Figure 1. 2005 Clermont County Biological Sampling Locations

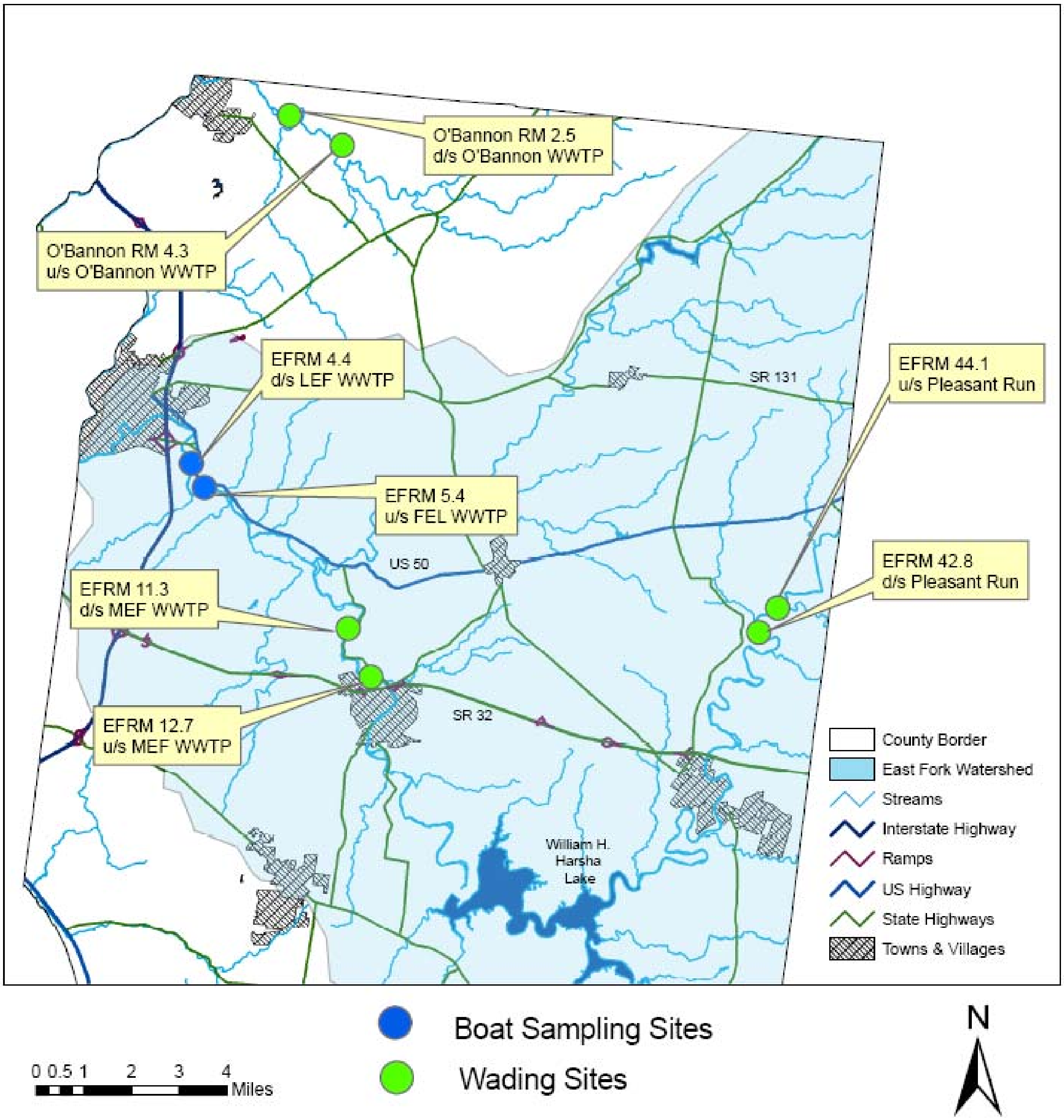

TABLE 1. SPECIES ENCOUNTERED FROM OBANNON CREEK AND EAST FORK LITTLE MIAMI RIVER, JULY AND SEPTEMBER 2005.

COMMON NAME	SCIENTIFIC NAME
LONGNOSE GAR	Lepisosteus osseus
SKIPJACK HERRING	Alosa chrysochloris
GIZZARD SHAD	Dorosoma cepedianum
CENTRAL STONEROLLER	Campostoma anomalum
SPOTFIN SHINER	Cyprinella spiloptera
STEELCOLOR SHINER	Cyprinella whipplei
COMMON CARP	Cyprinus carpio
STRIPED SHINER	Luxilus chrysocephalus
SCARLET SHINER	Lythurus fasciolaris
EMERALD SHINER	Notropis atherinoides
SILVERJAW MINNOW	Notropis buccatus
GOLDEN SHINER	Notemigonus crysoleucas
SILVER SHINER	Notropis photogenis
ROSYFACE SHINER	Notropis rubellus
SAND SHINER	Notropis stramineus
MIMIC SHINER	Notropis volucellus
SUCKERMOUTH MINNOW	Phenacobius mirabilis
BLUNTNOSE MINNOW	Pimephales notatus
FATHEAD MINNOW	Pimephales promelas
BULLHEAD MINNOW	Pimephales vigilax
CREEK CHUB	Semotilus atromaculatus
RIVER CARPSUCKER	Carpiodes carpio
QUILLBACK	Carpiodes cyprinus
HIGHFIN CARPSUCKER	Carpiodes velifer
WHITE SUCKER	Catostomus commersonii
NORTHERN HOG SUCKER	Hypentelium nigricans
SMALLMOUTH BUFFALO	Ictiobus bubalus
BIGMOUTH BUFFALO	Ictiobus cyprinellus
SPOTTED SUCKER	Minytrema melanops
SILVER REDHORSE	Moxostoma anisurum
SMALLMOUTH REDHORSE	Moxostoma breviceps
RIVER REDHORSE	Moxostoma carinatum
BLACK REDHORSE	Moxostoma duquesnei
GOLDEN REDHORSE	Moxostoma erythrurum
UNID MOXOSTOMA	Moxostoma sp.
YELLOW BULLHEAD	Ameiurus natalis
CHANNEL CATFISH	Ictalurus punctatus
STONECAT	Noturus flavus
FLATHEAD CATFISH	Pylodictis olivaris
BROOK SILVERSIDE	Labidesthes sicculus
WHITE BASS	Morone chrysops
YELLOW BASS	Morone mississippiensis
ROCK BASS	Ambloplites rupestris
GREEN SUNFISH	Lepomis cyanellus
ORANGESPOTTED SUNFISH	Lepomis humilis
BLUEGILL	Lepomis macrochirus
LONGEAR SUNFISH	Lepomis megalotis
HYBRID SUNFISH	Lepomis hybrid
UNID LEPOMIS	Lepomis sp.
SMALLMOUTH BASS	Micropterus dolomieu
SPOTTED BASS	Micropterus punctulatus
LARGEMOUTH BASS	Micropterus salmoides
BLACK CRAPPIE	Pomoxis nigromaculatus
GREENSIDE DARTER	Etheostoma blennioides
RAINBOW DARTER	Etheostoma caeruleum
FANTAIL DARTER	Etheostoma flabellare
JOHNNY DARTER	Etheostoma nigrum
ORANGETHROAT DARTER	Etheostoma spectabile
BANDED DARTER	Etheostoma zonale
LOGPERCH	Percina caprodes
BLACKSIDE DARTER	Percina maculata
SLENDERHEAD DARTER	Percina phoxocephala
SAUGER	Sander canadensis
FRESHWATER DRUM	Aplodinotus grunniens

TABLE 2. NUMBER AND RELATIVE ABUNDANCE OF FISH COLLECTED FROM OBANNON CREEK AND EAST FORK LITTLE MIAMI RIVER, JULY AND SEPTEMBER, 2005.

SPECIES	E.F. LITTLE MIAMI RIVER		OBANNON CREEK		SITES COMBINED	
	#	%	#	%	#	%
LONGNOSE GAR	10	0.13	--	--	10	0.08
SKIPJACK HERRING	1	0.01	--	--	1	0.01
GIZZARD SHAD	61	0.76	--	--	61	0.50
CENTRAL STONEROLLER	512	6.40	1,669	40.35	2,181	17.97
COMMON CARP	25	0.31	--	--	25	0.21
SILVERJAW MINNOW	6	0.08	72	1.74	78	0.64
SCARLET SHINER	16	0.20	9	0.22	25	0.21
GOLDEN SHINER	1	0.01	--	--	1	0.01
EMERALD SHINER	1,796	22.45	209	5.05	2,005	16.52
STRIPED SHINER	8	0.10	74	1.79	82	0.68
SILVER SHINER	44	0.55	--	--	44	0.36
ROSYFACE SHINER	--	--	25	0.60	25	0.21
SPOTFIN SHINER	352	4.40	65	1.57	417	3.44
SAND SHINER	340	4.25	6	0.15	346	2.85
MIMIC SHINER	64	0.80	74	1.79	138	1.14
STEELCOLOR SHINER	328	4.10	31	0.75	359	2.96
SUCKERMOUTH MINNOW	81	1.01	--	--	81	0.67
BLUNTNOSE MINNOW	1,292	16.15	536	12.96	1,828	15.06
FATHEAD MINNOW	1	0.01	--	--	1	0.01
BULLHEAD MINNOW	10	0.13	2	0.05	12	0.10
CREEK CHUB	8	0.10	87	2.10	95	0.78
RIVER CARPSUCKER	6	0.08	--	--	6	0.05
QUILLBACK	4	0.05	--	--	4	0.03
HIGHFIN CARPSUCKER	2	0.03	--	--	2	0.02
WHITE SUCKER	--	--	46	1.11	46	0.38
NORTHERN HOG SUCKER	231	2.89	156	3.77	387	3.19
SMALLMOUTH BUFFALO	25	0.31	--	--	25	0.21
BIGMOUTH BUFFALO	1	0.01	--	--	1	0.01
SPOTTED SUCKER	1	0.01	--	--	1	0.01
SILVER REDHORSE	17	0.21	--	--	17	0.14
SMALLMOUTH REDHORSE	76	0.95	--	--	76	0.63
RIVER REDHORSE	1	0.01	--	--	1	0.01
BLACK REDHORSE	35	0.44	--	--	35	0.29
GOLDEN REDHORSE	328	4.10	24	0.58	352	2.90
UNID MOXOSTOMA	22	0.28	2	0.05	24	0.20
YELLOW BULLHEAD	1	0.01	10	0.24	11	0.09
CHANNEL CATFISH	17	0.21	--	--	17	0.14
STONECAT	13	0.16	--	--	13	0.11
FLATHEAD CATFISH	20	0.25	--	--	20	0.16
BROOK SILVERSIDE	22	0.28	--	--	22	0.18
WHITE BASS	6	0.08	--	--	6	0.05
YELLOW BASS	--	--	1	0.02	1	0.01
ROCK BASS	21	0.26	39	0.94	60	0.49
GREEN SUNFISH	137	1.71	76	1.84	213	1.76
ORANGESPOTTED SUNFISH	14	0.18	--	--	14	0.12
BLUEGILL	22	0.28	130	3.14	152	1.25
LONGEAR SUNFISH	346	4.33	38	0.92	384	3.16
HYBRID SUNFISH	23	0.29	8	0.19	31	0.26
UNID LEPOMIS	9	0.11	--	--	9	0.07
SMALLMOUTH BASS	138	1.73	51	1.23	189	1.56
SPOTTED BASS	145	1.81	3	0.07	148	1.22
LARGEMOUTH BASS	7	0.09	13	0.31	20	0.16
BLACK CRAPPIE	3	0.04	--	--	3	0.02
GREENSIDE DARTER	387	4.84	332	8.03	719	5.92
RAINBOW DARTER	271	3.39	132	3.19	403	3.32
FANTAIL DARTER	169	2.11	96	2.32	265	2.18
JOHNNY DARTER	55	0.69	54	1.31	109	0.90
ORANGETHROAT DARTER	8	0.10	6	0.15	14	0.12
BANDED DARTER	239	2.99	44	1.06	283	2.33
LOGPERCH	115	1.44	16	0.39	131	1.08
BLACKSIDE DARTER	7	0.09	--	--	7	0.06
SLENDERHEAD DARTER	22	0.28	--	--	22	0.18
SAUGER	2	0.03	--	--	2	0.02
FRESHWATER DRUM	76	0.95	--	--	76	0.63
TOTAL FISH	8,000	100.00	4,136	100.00	12,136	100.00
TOTAL SPECIES	58		32		61	

TABLE 3. NUMBER, CPE, AND RELATIVE ABUNDANCE OF FISH COLLECTED FROM EAST FORK LITTLE MIAMI RIVER, JULY AND SEPTEMBER 2005.

	4.4						5.4						11.3					
	JULY EFBOAT			SEPTEMBER EFBOAT			JULY EFBOAT			SEPTEMBER EFBOAT			JULY EFPRAM			SEPTEMBER EFPRAM		
SPECIES	NO.	CPE	%	NO.	CPE	%	NO.	CPE	%	NO.	CPE	%	NO.	CPE	%	NO.	CPE	%
LONGNOSE GAR	1	2.0	0.5	2	4.0	0.3	3	6.0	1.6	1	2.0	0.1	1	1.5	0.1	1	1.5	0.2
SKIPJACK HERRING	--	--	--	--	--	--	--	--	--	--	--	--	1	1.5	0.1	--	--	--
GIZZARD SHAD	8	16.0	3.9	20	40.0	2.7	--	--	--	21	42.0	2.6	--	--	--	4	6.0	0.8
CENTRAL STONEROLLER	2	4.0	1.0	4	8.0	0.5	--	--	--	3	6.0	0.4	12	18.0	1.7	13	19.5	2.6
COMMON CARP	3	6.0	1.5	--	--	--	3	6.0	1.6	7	14.0	0.9	2	3.0	0.3	2	3.0	0.4
SILVERJAW MINNOW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SCARLET SHINER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GOLDEN SHINER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EMERALD SHINER	104	208.0	50.5	298	596.0	39.6	28	56.0	14.7	394	788.0	48.6	373	559.5	53.1	162	243.0	32.3
STRIPED SHINER	--	--	--	1	2.0	0.1	--	--	--	--	--	--	--	--	--	--	--	--
SILVER SHINER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPOTFIN SHINER	9	18.0	4.4	8	16.0	1.1	13	26.0	6.8	11	22.0	1.4	90	135.0	12.8	10	15.0	2.0
SAND SHINER	13	26.0	6.3	22	44.0	2.9	9	18.0	4.7	7	14.0	0.9	--	--	--	--	--	--
MIMIC SHINER	2	4.0	1.0	22	44.0	2.9	6	12.0	3.1	5	10.0	0.6	1	1.5	0.1	14	21.0	2.8
STEELCOLOR SHINER	--	--	--	--	--	--	4	8.0	2.1	3	6.0	0.4	12	18.0	1.7	14	21.0	2.8
SUCKERMOUTH MINNOW	3	6.0	1.5	--	--	--	1	2.0	0.5	1	2.0	0.1	2	3.0	0.3	1	1.5	0.2
BLUNTNOSE MINNOW	11	22.0	5.3	189	378.0	25.1	16	32.0	8.4	49	98.0	6.0	83	124.5	11.8	70	105.0	14.0
FATHEAD MINNOW	--	--	--	1	2.0	0.1	--	--	--	--	--	--	--	--	--	--	--	--
BULLHEAD MINNOW	1	2.0	0.5	--	--	--	--	--	--	8	16.0	1.0	1	1.5	0.1	--	--	--
CREEK CHUB	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RIVER CARPSUCKER	2	4.0	1.0	2	4.0	0.3	2	4.0	1.0	--	--	--	--	--	--	--	--	--
QUILLBACK	--	--	--	1	2.0	0.1	1	2.0	0.5	--	--	--	--	--	--	--	--	--
HIGHFIN CARPSUCKER	1	2.0	0.5	1	2.0	0.1	--	--	--	--	--	--	--	--	--	--	--	--
NORTHERN HOG SUCKER	7	14.0	3.4	18	36.0	2.4	11	22.0	5.8	31	62.0	3.8	4	6.0	0.6	20	30.0	4.0
SMALLMOUTH BUFFALO	3	6.0	1.5	18	36.0	2.4	4	8.0	2.1	--	--	--	--	--	--	--	--	--
BIGMOUTH BUFFALO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1.5	0.2
SPOTTED SUCKER	--	--	--	--	--	--	--	--	--	1	2.0	0.1	--	--	--	--	--	--
SILVER REDHORSE	1	2.0	0.5	4	8.0	0.5	1	2.0	0.5	3	6.0	0.4	--	--	--	--	--	--
SMALLMOUTH REDHORSE	2	4.0	1.0	3	6.0	0.4	4	8.0	2.1	17	34.0	2.1	--	--	--	31	46.5	6.2
RIVER REDHORSE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1.5	0.2
BLACK REDHORSE	--	--	--	2	4.0	0.3	--	--	--	--	--	--	2	3.0	0.3	5	7.5	1.0
GOLDEN REDHORSE	4	8.0	1.9	66	132.0	8.8	11	22.0	5.8	81	162.0	10.0	1	1.5	0.1	6	9.0	1.2
UNID MOXOSTOMA	1	2.0	0.5	--	--	--	3	6.0	1.6	--	--	--	4	6.0	0.6	--	--	--
YELLOW BULLHEAD	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHANNEL CATFISH	3	6.0	1.5	--	--	--	3	6.0	1.6	1	2.0	0.1	--	--	--	--	--	--
STONECAT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FLATHEAD CATFISH	2	4.0	1.0	2	4.0	0.3	2	4.0	1.0	1	2.0	0.1	--	--	--	--	--	--
BROOK SILVERSIDE	--	--	--	--	--	--	--	--	--	1	2.0	0.1	3	4.5	0.4	--	--	--
WHITE BASS	--	--	--	--	--	--	--	--	--	6	12.0	0.7	--	--	--	--	--	--
ROCK BASS	--	--	--	--	--	--	--	--	--	1	2.0	0.1	1	1.5	0.1	1	1.5	0.2
GREEN SUNFISH	2	4.0	1.0	2	4.0	0.3	2	4.0	1.0	5	10.0	0.6	--	--	--	4	6.0	0.8
ORANGESPOTTED SUNFISH	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BLUEGILL	--	--	--	1	2.0	0.1	1	2.0	0.5	--	--	--	--	--	--	--	--	--
LONGEAR SUNFISH	4	8.0	1.9	12	24.0	1.6	35	70.0	18.3	102	204.0	12.6	22	33.0	3.1	46	69.0	9.2
HYBRID SUNFISH	--	--	--	1	2.0	0.1	1	2.0	0.5	4	8.0	0.5	1	1.5	0.1	2	3.0	0.4
UNID LEPOMIS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SMALLMOUTH BASS	1	2.0	0.5	1	2.0	0.1	--	--	--	3	6.0	0.4	13	19.5	1.8	11	16.5	2.2
SPOTTED BASS	8	16.0	3.9	17	34.0	2.3	5	10.0	2.6	15	30.0	1.8	4	6.0	0.6	4	6.0	0.8
LARGEMOUTH BASS	--	--	--	--	--	--	--	--	--	1	2.0	0.1	--	--	--	--	--	--
BLACK CRAPPIE	1	2.0	0.5	1	2.0	0.1	1	2.0	0.5	--	--	--	--	--	--	--	--	--
GREENSIDE DARTER	--	--	--	--	--	--	--	--	--	1	2.0	0.1	14	21.0	2.0	3	4.5	0.6
RAINBOW DARTER	--	--	--	--	--	--	--	--	--	--	--	--	28	42.0	4.0	36	54.0	7.2
FANTAIL DARTER	--	--	--	--	--	--	--	--	--	--	--	--	5	7.5	0.7	--	--	--
JOHNNY DARTER	--	--	--	--	--	--	--	--	--	1	2.0	0.1	--	--	--	2	3.0	0.4
ORANGETHROAT DARTER	--	--	--	1	2.0	0.1	--	--	--	1	2.0	0.1	--	--	--	1	1.5	0.2
BANDED DARTER	--	--	--	2	4.0	0.3	--	--	--	8	16.0	1.0	15	22.5	2.1	6	9.0	1.2
LOGPERCH	--	--	--	7	14.0	0.9	--	--	--	5	10.0	0.6	4	6.0	0.6	26	39.0	5.2
BLACKSIDE DARTER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SLENDERHEAD DARTER	1	2.0	0.5	5	10.0	0.7	--	--	--	9	18.0	1.1	3	4.5	0.4	2	3.0	0.4
SAUGER	--	--	--	1	2.0	0.1	1	2.0	0.5	--	--	--	--	--	--	--	--	--
FRESHWATER DRUM	6	12.0	2.9	17	34.0	2.3	20	40.0	10.5	3	6.0	0.4	1	1.5	0.1	2	3.0	0.4
TOTAL FISH	206	412.0	100.0	752	1,504.0	100.0	191	382.0	100.0	811	1,622.0	100.0	703	1,054.5	100.0	501	751.5	100.0
TOTAL SPECIES	27			32			25			34			26			29		

TABLE 3 (cont.)

SPECIES	12.7 JULY EFBOAT NO.	CPE	%	12.7 SEPTEMBER EFBOAT NO.	CPE	%	42.8 JULY EFBOAT NO.	CPE	%	42.8 SEPTEMBER EFBOAT NO.	CPE	%	44.1 JULY EFPRAM NO.	CPE	%	44.1 SEPTEMBER EFPRAM NO.	CPE	%
LONGNOSE GAR	1	1.5	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SKIPJACK HERRING	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GIZZARD SHAD	5	7.5	0.7	2	3.0	0.3	--	--	--	--	--	--	--	--	--	1	1.5	0.1
CENTRAL STONEROLLER	80	120.0	11.7	4	6.0	0.7	95	142.5	10.9	31	46.5	4.5	78	117.0	9.2	190	285.0	16.2
COMMON CARP	--	--	--	5	7.5	0.9	--	--	--	1	1.5	0.1	2	3.0	0.2	--	--	--
SILVERJAW MINNOW	--	--	--	--	--	--	4	6.0	0.5	--	--	--	1	1.5	0.1	1	1.5	0.1
SCARLET SHINER	--	--	--	--	--	--	5	7.5	0.6	5	7.5	0.7	5	7.5	0.6	1	1.5	0.1
GOLDEN SHINER	--	--	--	--	--	--	--	--	--	--	--	--	1	1.5	0.1	--	--	--
EMERALD SHINER	235	352.5	34.5	201	301.5	34.8	1	1.5	0.1	--	--	--	--	--	--	--	--	--
STRIPED SHINER	--	--	--	5	7.5	0.9	--	--	--	1	1.5	0.1	1	1.5	0.1	--	--	--
SILVER SHINER	1	1.5	0.1	--	--	--	20	30.0	2.3	8	12.0	1.2	13	19.5	1.5	2	3.0	0.2
SPOTFIN SHINER	37	55.5	5.4	8	12.0	1.4	71	106.5	8.2	23	34.5	3.3	53	79.5	6.3	19	28.5	1.6
SAND SHINER	7	10.5	1.0	--	--	--	31	46.5	3.6	49	73.5	7.1	43	64.5	5.1	159	238.5	13.5
MIMIC SHINER	3	4.5	0.4	10	15.0	1.7	--	--	--	--	--	--	1	1.5	0.1	--	--	--
STEELCOLOR SHINER	17	25.5	2.5	21	31.5	3.6	93	139.5	10.7	29	43.5	4.2	79	118.5	9.3	56	84.0	4.8
SUCKERMOUTH MINNOW	5	7.5	0.7	1	1.5	0.2	7	10.5	0.8	12	18.0	1.7	13	19.5	1.5	35	52.5	3.0
BLUNTNOSE MINNOW	24	36.0	3.5	48	72.0	8.3	186	279.0	21.4	119	178.5	17.3	237	355.5	27.9	260	390.0	22.1
FATHEAD MINNOW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BULLHEAD MINNOW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CREEK CHUB	--	--	--	1	1.5	0.2	3	4.5	0.3	--	--	--	2	3.0	0.2	2	3.0	0.2
RIVER CARPSUCKER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
QUILLBACK	--	--	--	--	--	--	1	1.5	0.1	--	--	--	1	1.5	0.1	--	--	--
HIGHFIN CARPSUCKER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NORTHERN HOG SUCKER	12	18.0	1.8	30	45.0	5.2	19	28.5	2.2	31	46.5	4.5	20	30.0	2.4	28	42.0	2.4
SMALLMOUTH BUFFALO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BIGMOUTH BUFFALO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPOTTED SUCKER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SILVER REDHORSE	--	--	--	--	--	--	2	3.0	0.2	2	3.0	0.3	--	--	--	4	6.0	0.3
SMALLMOUTH REDHORSE	--	--	--	3	4.5	0.5	7	10.5	0.8	5	7.5	0.7	2	3.0	0.2	2	3.0	0.2
RIVER REDHORSE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BLACK REDHORSE	6	9.0	0.9	4	6.0	0.7	8	12.0	0.9	3	4.5	0.4	3	4.5	0.4	2	3.0	0.2
GOLDEN REDHORSE	4	6.0	0.6	9	13.5	1.6	15	22.5	1.7	73	109.5	10.6	11	16.5	1.3	47	70.5	4.0
UNID MOXOSTOMA	--	--	--	--	--	--	10	15.0	1.2	--	--	--	4	6.0	0.5	--	--	--
YELLOW BULLHEAD	--	--	--	--	--	--	--	--	--	--	--	--	1	1.5	0.1	--	--	--
CHANNEL CATFISH	--	--	--	--	--	--	1	1.5	0.1	7	10.5	1.0	--	--	--	2	3.0	0.2
STONECAT	--	--	--	--	--	--	2	3.0	0.2	2	3.0	0.3	1	1.5	0.1	8	12.0	0.7
FLATHEAD CATFISH	1	1.5	0.1	1	1.5	0.2	4	6.0	0.5	3	4.5	0.4	2	3.0	0.2	2	3.0	0.2
BROOK SILVERSIDE	--	--	--	--	--	--	10	15.0	1.2	1	1.5	0.1	5	7.5	0.6	2	3.0	0.2
WHITE BASS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ROCK BASS	9	13.5	1.3	9	13.5	1.6	--	--	--	--	--	--	--	--	--	--	--	--
GREEN SUNFISH	16	24.0	2.3	3	4.5	0.5	28	42.0	3.2	35	52.5	5.1	24	36.0	2.8	16	24.0	1.4
ORANGESPOTTED SUNFISH	--	--	--	--	--	--	1	1.5	0.1	10	15.0	1.5	1	1.5	0.1	2	3.0	0.2
BLUEGILL	1	1.5	0.1	--	--	--	1	1.5	0.1	5	7.5	0.7	6	9.0	0.7	7	10.5	0.6
LONGEAR SUNFISH	24	36.0	3.5	16	24.0	2.8	5	7.5	0.6	30	45.0	4.4	9	13.5	1.1	41	61.5	3.5
HYBRID SUNFISH	1	1.5	0.1	3	4.5	0.5	3	4.5	0.3	3	4.5	0.4	2	3.0	0.2	2	3.0	0.2
UNID LEPOMIS	--	--	--	7	10.5	1.2	--	--	--	--	--	--	2	3.0	0.2	--	--	--
SMALLMOUTH BASS	37	55.5	5.4	41	61.5	7.1	8	12.0	0.9	13	19.5	1.9	1	1.5	0.1	9	13.5	0.8
SPOTTED BASS	--	--	--	--	--	--	10	15.0	1.2	26	39.0	3.8	14	21.0	1.7	42	63.0	3.6
LARGEMOUTH BASS	--	--	--	--	--	--	4	6.0	0.5	1	1.5	0.1	--	--	--	1	1.5	0.1
BLACK CRAPPIE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GREENSIDE DARTER	28	42.0	4.1	6	9.0	1.0	72	108.0	8.3	77	115.5	11.2	80	120.0	9.4	106	159.0	9.0
RAINBOW DARTER	78	117.0	11.5	68	102.0	11.8	12	18.0	1.4	10	15.0	1.5	13	19.5	1.5	26	39.0	2.2
FANTAIL DARTER	9	13.5	1.3	4	6.0	0.7	46	69.0	5.3	24	36.0	3.5	50	75.0	5.9	31	46.5	2.6
JOHNNY DARTER	--	--	--	4	6.0	0.7	13	19.5	1.5	18	27.0	2.6	5	7.5	0.6	12	18.0	1.0
ORANGETHROAT DARTER	1	1.5	0.1	1	1.5	0.2	1	1.5	0.1	--	--	--	1	1.5	0.1	1	1.5	0.1
BANDED DARTER	32	48.0	4.7	25	37.5	4.3	45	67.5	5.2	12	18.0	1.7	51	76.5	6.0	43	64.5	3.7
LOGPERCH	5	7.5	0.7	12	18.0	2.1	22	33.0	2.5	15	22.5	2.2	9	13.5	1.1	10	15.0	0.9
BLACKSIDE DARTER	--	--	--	--	--	--	2	3.0	0.2	2	3.0	0.3	1	1.5	0.1	2	3.0	0.2
SLENDERHEAD DARTER	--	--	--	1	1.5	0.2	--	--	--	1	1.5	0.1	--	--	--	--	--	--
SAUGER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FRESHWATER DRUM	2	3.0	0.3	25	37.5	4.3	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL FISH	681	1,021.5	100.0	578	867.0	100.0	868	1,302.0	100.0	687	1,030.5	100.0	848	1,272.0	100.0	1,174	1,761.0	100.0
TOTAL SPECIES	27			29			36			34			37			35		

NOTE: CPE FOR EFBOAT=NO. PER KM; CPE FOR EFPRAM=NO. PER 300M.

TABLE 4. NUMBER, CPE (No. per 300m), AND RELATIVE ABUNDANCE OF FISH COLLECTED FROM OBANNON CREEK, JULY AND SEPTEMBER 2005.

SPECIES	2.5						4.3					
	JULY EFPRAM			SEPTEMBER EFPRAM			JULY EFLONG			SEPTEMBER EFLONG		
	NO.	CPE	%	NO.	CPE	%	NO.	CPE	%	NO.	CPE	%
CENTRAL STONEROLLER	457	685.5	36.3	640	960.0	43.6	321	481.5	42.1	251	376.5	38.8
SILVERJAW MINNOW	9	13.5	0.7	14	21.0	1.0	24	36.0	3.1	25	37.5	3.9
SCARLET SHINER	6	9.0	0.5	2	3.0	0.1	1	1.5	0.1	--	--	--
EMERALD SHINER	167	250.5	13.3	42	63.0	2.9	--	--	--	--	--	--
STRIPED SHINER	11	16.5	0.9	32	48.0	2.2	14	21.0	1.8	17	25.5	2.6
ROSYFACE SHINER	17	25.5	1.4	8	12.0	0.5	--	--	--	--	--	--
SPOTFIN SHINER	23	34.5	1.8	42	63.0	2.9	--	--	--	--	--	--
SAND SHINER	2	3.0	0.2	4	6.0	0.3	--	--	--	--	--	--
MIMIC SHINER	2	3.0	0.2	72	108.0	4.9	--	--	--	--	--	--
STEELCOLOR SHINER	13	19.5	1.0	18	27.0	1.2	--	--	--	--	--	--
BLUNTNOSE MINNOW	105	157.5	8.3	292	438.0	19.9	38	57.0	5.0	101	151.5	15.6
BULLHEAD MINNOW	2	3.0	0.2	--	--	--	--	--	--	--	--	--
CREEK CHUB	12	18.0	1.0	13	19.5	0.9	25	37.5	3.3	37	55.5	5.7
WHITE SUCKER	18	27.0	1.4	19	28.5	1.3	5	7.5	0.7	4	6.0	0.6
NORTHERN HOG SUCKER	37	55.5	2.9	48	72.0	3.3	36	54.0	4.7	35	52.5	5.4
GOLDEN REDHORSE	2	3.0	0.2	9	13.5	0.6	4	6.0	0.5	9	13.5	1.4
UNID MOXOSTOMA	--	--	--	--	--	--	2	3.0	0.3	--	--	--
YELLOW BULLHEAD	2	3.0	0.2	3	4.5	0.2	--	--	--	5	7.5	0.8
YELLOW BASS	--	--	--	--	--	--	--	--	--	1	1.5	0.2
ROCK BASS	18	27.0	1.4	19	28.5	1.3	--	--	--	2	3.0	0.3
GREEN SUNFISH	11	16.5	0.9	5	7.5	0.3	44	66.0	5.8	16	24.0	2.5
BLUEGILL	94	141.0	7.5	35	52.5	2.4	1	1.5	0.1	--	--	--
LONGEAR SUNFISH	10	15.0	0.8	14	21.0	1.0	7	10.5	0.9	7	10.5	1.1
HYBRID SUNFISH	6	9.0	0.5	2	3.0	0.1	--	--	--	--	--	--
SMALLMOUTH BASS	26	39.0	2.1	17	25.5	1.2	4	6.0	0.5	4	6.0	0.6
SPOTTED BASS	--	--	--	--	--	--	3	4.5	0.4	--	--	--
LARGEMOUTH BASS	2	3.0	0.2	2	3.0	0.1	8	12.0	1.0	1	1.5	0.2
GREENSIDE DARTER	99	148.5	7.9	105	157.5	7.2	87	130.5	11.4	41	61.5	6.3
RAINBOW DARTER	97	145.5	7.7	--	--	--	35	52.5	4.6	--	--	--
FANTAIL DARTER	6	9.0	0.5	4	6.0	0.3	58	87.0	7.6	28	42.0	4.3
JOHNNY DARTER	1	1.5	0.1	7	10.5	0.5	30	45.0	3.9	16	24.0	2.5
ORANGETHROAT DARTER	2	3.0	0.2	--	--	--	3	4.5	0.4	1	1.5	0.2
BANDED DARTER	1	1.5	0.1	--	--	--	1	1.5	0.1	42	63.0	6.5
LOGPERCH	--	--	--	--	--	--	12	18.0	1.6	4	6.0	0.6
TOTAL FISH	1,258	1,887.0	100.0	1,468	2,202.0	100.0	763	1,144.5	100.0	647	970.5	100.0
TOTAL SPECIES	29			25			22			21		

TABLE 5. IBI METRICS AND SCORES FOR BOAT ELECTROSHOCKING SITES ON THE EAST FORK LITTLE MIAMI RIVER, JULY AND SEPTEMBER 2005.

DATE	LOCATION	GEAR	DRNAREA	IBITOTAL	LOWEND	NUMSPEC	NUMSCORE	SUNFISH	SUNSCORE	SUCKER	SUCSCORE	INTOLNO	INTSCORE	NONTCPE	NONSCORE	TOLPCT	TOLSCORE	RBSCKPCT	RBSCORE	TCARNPCT	TCNSCORE	OMNIPCT	OMISCORE	INSCTPCT	INSCORE	LITHPCT	LITSCORE	DELTAPCT	DELSCORE	TOTCPE
24JUL05	4.4	B	491.0	48		26	5	3	3	7	5	2	3	380.0	3	7.8	5	6.8	1	5.8	3	12.6	5	75.7	5	59.7	5	0.0	5	412.0
14SEP05	4.4	B	491.0	46		32	5	4	5	9	5	4	5	1120.0	5	25.5	3	12.4	1	3.1	1	28.5	1	65.4	5	54.3	5	0.1	5	1504.00
24JUL05	5.4	B	484.0	46		24	5	4	5	7	5	1	1	340.0	3	11.0	5	14.	1	5.8	3	11.5	5	69.6	5	31.4	3	0.0	5	382.0
14SEP05	5.4	B	484.0	46		33	5	3	3	5	3	3	3	1500.0	5	7.5	5	16.4	1	3.5	1	10.5	5	84.7	5	68.1	5	0.1	5	1622.0

TABLE 6. IBI METRICS AND SCORES FOR WADING SITES ON THE EAST FORK LITTLE MIAMI RIVER AND OBANNON CREEK, JULY AND SEPTEMBER 2005.

DATE	LOCATION	GEAR	DRAREA	IBITOTAL	LOWEND	NUMSPEC	NUMSCORE	SUNFISH	SUNSCORE	SUCKER	SUCSCORE	DARTER	DARSCORE	INTOLNO	INTSCORE	NONTCPE	NONSCORE	TOLPCT	TOLSCORE	TCARNPCT	TCNSCORE	OMNIPCT	OMISCORE	INSCTPCT	INSSCORE	LITHPCT	LITSCORE	DELTAPCT	DELSCORE	TOTCPE
E.F. LITTLE MIAMI RIVER																														
24JUL05	11.3	P	375.0	50		25	5	2	3	3	3	6	3	4	3	927.0	5	12.1	5	2.8	3	12.2	5	82.9	5	64.0	5	0.0	5	1054.5
13SEP05	11.3	P	375.0	52		28	5	3	3	6	5	7	5	5	3	637.5	3	15.2	5	3.4	3	15.2	5	78.0	5	59.9	5	0.0	5	751.5
22JUL05	12.7	P	373.0	54		27	5	4	5	3	3	6	3	4	3	961.5	5	5.9	5	7.0	5	4.3	5	76.5	5	59.8	5	0.0	5	1021.5
13SEP05	12.7	P	373.0	54		28	5	3	3	4	3	8	5	4	3	781.5	5	9.9	5	8.8	5	9.5	5	76.0	5	63.3	5	0.0	5	867.0
23JUL05	42.8	P	221.0	48		36	5	4	5	6	5	8	5	4	3	976.5	5	25.0	3	3.0	3	21.5	3	63.7	5	28.6	3	0.1	3	1302.0
15SEP05	42.8	P	221.0	54		33	5	4	5	5	5	8	5	5	3	798.0	5	22.6	3	6.3	5	17.5	5	70.3	5	37.4	5	0.6	3	1030.5
23JUL05	44.1	P	212.0	50		36	5	4	5	5	5	8	5	5	3	871.5	5	31.5	3	2.0	3	28.3	3	60.0	5	26.8	3	0.0	5	1272.0
15SEP05	44.1	L	212.0	50		35	5	4	5	5	5	8	5	4	3	1344.0	5	23.7	3	4.6	3	22.2	3	56.5	5	26.3	3	0.0	5	1761.0
OBANNON CREEK																														
22JUL05	2.5	P	38.0	50		29	5	4	5	3	3	6	5	3	3	1665.0	5	11.8	5	3.7	3	9.9	5	48.6	3	36.3	5	0.2	3	1887.0
16SEP05	2.5	P	38.0	42		25	5	4	5	3	3	3	3	2	1	1704.0	5	22.6	5	2.6	3	21.2	3	31.6	3	18.1	3	0.1	3	2202.0
20JUL05	4.3	L	27.0	48		22	5	3	3	3	5	7	5	1	1	976.5	5	14.7	5	2.0	3	5.6	5	47.1	3	26.2	3	0.0	5	1144.5
12SEP05	4.3	L	27.0	46		21	5	3	3	3	5	6	5	1	1	726.0	3	25.2	5	1.2	3	16.2	5	38.0	3	23.6	3	0.2	5	970.5

TABLE 7. INDEX OF WELL BEING (IWB & IWBmod) SUMMARY FOR THE EAST FORK LITTLE MIAMI RIVER AND OBANNON CREEK, JULY AND SEPTEMBER 2005.

SITE	METHOD	DATE	LOCATION	DISTANCE	IWB	IWBMOD	TOTCNT	TOTWGT	INTCNT	INTWGT	DIVERCNT	DIVERWGT
E.F. LITTLE MIAMI RIVER	BOAT	24JUL05	4.4	500	9.06	8.89	412.00	41.62	380.00	31.80	2.16	2.03
E.F. LITTLE MIAMI RIVER	BOAT	14SEP05	4.4	500	9.94	9.79	1504.00	170.26	1118.00	169.75	2.03	1.69
E.F. LITTLE MIAMI RIVER	BOAT	24JUL05	5.4	500	9.72	9.54	382.00	42.55	338.00	33.91	2.74	2.13
E.F. LITTLE MIAMI RIVER	BOAT	14SEP05	5.4	500	9.57	9.21	1622.00	45.49	1492.00	24.19	2.02	1.94
E.F. LITTLE MIAMI RIVER	WADE	24JUL05	11.3	200	7.78	7.14	1054.50	7.49	925.50	2.38	1.79	1.51
E.F. LITTLE MIAMI RIVER	WADE	13SEP05	11.3	200	9.84	9.71	751.50	33.85	634.50	30.68	2.44	2.33
E.F. LITTLE MIAMI RIVER	WADE	22JUL05	12.7	200	9.36	9.31	1021.50	11.89	960.00	11.61	2.39	2.27
E.F. LITTLE MIAMI RIVER	WADE	13SEP05	12.7	200	9.65	9.37	867.00	28.76	777.00	18.20	2.48	2.12
E.F. LITTLE MIAMI RIVER	WADE	23JUL05	42.8	200	10.48	10.31	1302.00	25.08	972.00	24.07	2.80	2.49
E.F. LITTLE MIAMI RIVER	WADE	15SEP05	42.8	200	10.04	9.77	1030.50	20.63	793.50	15.85	2.93	2.13
E.F. LITTLE MIAMI RIVER	WADE	23JUL05	44.1	200	9.65	9.12	1272.00	8.48	868.50	4.34	2.63	2.38
E.F. LITTLE MIAMI RIVER	WADE	15SEP05	44.1	200	10.06	9.90	1761.00	8.98	1341.00	8.54	2.59	2.63
OBANNON CREEK	WADE	22JUL05	2.5	200	9.69	9.57	1887.00	14.27	1656.00	12.72	2.28	2.31
OBANNON CREEK	WADE	16SEP05	2.5	200	9.51	9.30	2202.00	11.27	1701.00	9.70	2.03	2.42
OBANNON CREEK	WADE	20JUL05	4.3	200	8.69	8.49	1144.50	6.22	976.50	4.90	2.16	2.09
OBANNON CREEK	WADE	12SEP05	4.3	200	8.75	8.48	970.50	6.41	726.00	5.00	2.16	2.22

Table 8. Summary of Hester-Dendy and Qualitative Macroinvertebrate Results for East Fork Little Miami River, September 2005.

	4.4			5.4			11.3			12.7			42.8			44.1		
	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.
Taxa	No.	%		No.	%		No.	%		No.	%		No.	%		No.	%	
COELENTERATA (hydroids)																		
Hydra	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+
PLATYHELMINTHES (flatworms)																		
Turbellaria	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Dugesia	--	--	+	--	--	+	--	--	+	--	--	--	--	--	--	--	--	+
ENTOPROCTA																		
Urnatella gracilis	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	1	0.1	--
ECTOPORCTS (moss animalcules)																		
Plumatella	4	0.8	+	1	0.1	+	--	--	--	1	0.3	+	2	0.3	+	2	0.1	+
ANNELIDA																		
Oligochaeta (aquatic worms)	24	5.0	+	1	0.1	+	92	7.3	+	6	1.5	+	4	0.7	+	2	0.1	+
Hirudinea (leeches)																		
Helobdella	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
CRUSTACEA																		
Isopoda (sow bugs)																		
Caecidotea	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Amphipoda (side swimmers)																		
Crangonyx	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--
Decapoda (crayfish)																		
Orconectes	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Orconectes rusticus	--	--	--	--	--	--	--	--	+	--	--	+	--	--	+	--	--	+
Orconectes virilis	--	--	--	--	--	+	--	--	+	--	--	+	--	--	--	--	--	+
INSECTA																		
Ephemeroptera (mayflies)																		
Isonychia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+
Acentrella	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Baetis intercalaris	3	0.6	+	--	--	+	--	--	+	--	--	+	--	--	--	10	0.6	+
Baetis flavistriga	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	+
Procloeon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.1	--
Callibaetis	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Leucrocuta	--	--	--	--	--	--	--	--	--	1	0.3	--	--	--	--	--	--	--
Stenacron	--	--	+	--	--	--	--	--	+	1	0.3	+	6	1.0	+	1	0.1	+
Stenonema femoratum	--	--	--	1	0.1	+	--	--	--	4	1.0	+	5	0.8	+	1	0.1	+
Stenonema pulchellum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--
Stenonema terminatum	--	--	--	19	1.6	+	--	--	--	6	1.5	+	16	2.6	--	10	0.6	--
Tricorythodes	--	--	--	16	1.3	--	5	0.4	+	1	0.3	--	--	--	--	--	--	--
Caenis	--	--	--	5	0.4	+	--	--	--	--	--	+	10	1.6	+	42	2.7	--
Anthopotamus	--	--	+	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--
Odonata (damselflies and dragonflies)																		
Hetaerina	--	--	+	--	--	+	--	--	+	--	--	+	--	--	--	--	--	+
Argia	9	1.9	+	13	1.1	+	1	0.1	+	5	1.3	+	2	0.3	+	31	2.0	+
Enallagma	--	--	+	--	--	--	--	--	+	--	--	+	--	--	--	--	--	+
Basiaeschna janata	--	--	+	--	--	+	--	--	+	--	--	+	--	--	+	--	--	+
Macromia	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+

Table 8 (cont.)

Taxa (cont.)	4.4			5.4			11.3			12.7			42.8			44.0		
	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.
	No.	%		No.	%		No.	%		No.	%		No.	%		No.	%	
Odonata (cont.)																		
Neurocordulia	--	--	--	--	--	+	--	--	+	1	0.3	+	--	--	--	--	--	--
Epitheca (Epicordulia)	--	--	+	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Plathemis	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Plecoptera (stoneflies)																		
Agnetina	--	--	--	--	--	+	--	--	+	--	--	+	--	--	+	--	--	--
Hemiptera (true bugs)																		
Metrobates	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+
Rhagovelia	--	--	+	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--
Belostoma	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--
Corixidae	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+
Ranatra	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+
Megaloptera (dobsonflies, alderflies, fishflies, & hellgrammites)																		
Corydalus cornutus	--	--	--	--	--	--	--	--	--	--	--	--	11	1.8	+	5	0.3	+
Sialis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--
Trichoptera (caddisflies)																		
Chimarra obscura	--	--	+	26	2.1	+	--	--	+	--	--	--	19	3.1	+	2	0.1	+
Cyrnellus fraternus	19	4.0	--	125	10.3	+	765	61.0	+	93	23.7	--	1	0.2	--	2	0.1	--
Neureclipsis	--	--	--	1	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--
Cheumatopsyche	9	1.9	+	301	24.8	+	6	0.5	+	3	0.8	+	26	4.2	+	83	5.4	+
Hydropsyche orris	--	--	--	--	--	--	--	--	--	--	--	--	1	0.2	--	--	--	--
Hydropsyche dicantha	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+
Hydropsyche simulans	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Ceratopsyche morosa	--	--	+	20	1.6	+	1	0.1	+	--	--	+	3	0.5	--	1	0.1	+
Helicopsyche borealis	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	+
Hydroptila	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--
Neophylax	--	--	--	--	--	+	--	--	+	--	--	+	--	--	--	--	--	--
Pycnopsyche	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Ceraclea	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0.1	--
Oecetis	--	--	--	--	--	--	--	--	--	1	0.3	--	--	--	--	--	--	--
Triaenodes	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Lepidoptera (aquatic moths)																		
Petrophila	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--
Coleoptera (beetles)																		
Celina	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peltodytes	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Dryops	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Ancyronyx variegata	--	--	+	--	--	--	1	0.1	--	--	--	--	--	--	--	5	0.3	--
Dubiraphia	--	--	+	--	--	+	--	--	+	--	--	+	--	--	--	--	--	--
Macronychus glabratus	1	0.2	--	13	1.1	+	8	0.6	+	10	2.5	+	1	0.2	--	2	0.1	--
Microcylloepus pusillus	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Stenelmis	--	--	+	--	--	+	--	--	+	1	0.3	+	--	--	+	2	0.1	+
Tropisternus	--	--	+	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+

Table 8 (cont.)

Taxa (cont.)	4.4			5.4			11.3			12.7			42.8			44.0		
	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.	Hester		Qual.
	No.	%		No.	%		No.	%		No.	%		No.	%		No.	%	
Coleoptera (cont.)																		
Berosus	2	0.4	--	1	0.1	--	--	--	--	--	--	+	--	--	--	--	--	--
Psephenus herricki	--	--	+	--	--	+	--	--	+	--	--	+	--	--	+	--	--	--
Diptera (true flies)																		
Simulium	--	--	+	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Chironomidae (midges)																		
Ablabesmyia mallochi	--	--	+	--	--	--	28	2.2	+	--	--	--	27	4.4	--	--	--	--
Labrundinia pilosella	--	--	+	5	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--
Nilotanypus fimbriatus	3	0.6	--	27	2.2	--	--	--	+	--	--	+	11	1.8	--	--	--	--
Thienemannimyia grp.	19	4.0	+	96	7.9	+	12	1.0	+	2	0.5	--	85	13.9	+	144	9.3	+
Corynoneura "taris"	--	--	--	5	0.4	--	--	--	--	2	0.5	--	13	2.1	--	32	2.1	--
Corynoneura celeripes	--	--	--	--	--	--	--	--	--	2	0.5	--	--	--	--	--	--	--
Thienemanniella xena	--	--	+	--	--	--	--	--	--	--	--	--	3	0.5	--	--	--	--
Cricotopus	--	--	--	--	--	--	--	--	--	6	1.5	+	--	--	--	--	--	--
Cricotopus tremulus grp.	--	--	+	--	--	--	--	--	--	2	0.5	+	--	--	--	--	--	--
Cricotopus bicinctus grp.	3	0.6	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Cricotopus sylvestris grp.	3	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cricotopus vieriensis grp.	--	--	--	11	0.9	--	--	--	--	--	--	--	--	--	--	--	--	--
Nanocladius	--	--	--	5	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--
Nanocladius distinctus	3	0.6	--	--	--	--	4	0.3	--	--	--	--	21	3.4	+	176	11.4	+
Nanocladius minimus	--	--	--	--	--	--	--	--	--	8	2.0	--	--	--	--	--	--	--
Parametriocnemus	--	--	--	--	--	--	4	0.3	--	--	--	--	--	--	--	--	--	--
Chironomus	--	--	+	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Dicrotendipes neomodestus	40	8.3	+	11	0.9	--	12	1.0	--	24	6.1	+	11	1.8	--	144	9.3	--
Dicrotendipes lucifer	48	10.0	--	37	3.0	--	52	4.1	--	--	--	--	3	0.5	--	32	2.1	--
Dicrotendipes simpsoni	--	--	+	--	--	--	--	--	--	20	5.1	--	--	--	--	--	--	--
Glyptotendipes	251	52.2	+	27	2.2	+	--	--	--	--	--	--	77	12.6	--	416	27.0	--
Microtendipes	11	2.3	--	11	0.9	--	4	0.3	--	--	--	--	8	1.3	--	48	3.1	--
Nilothauma	3	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Parachironomus carinatus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	0.5	--
Parachironomus frequens	--	--	+	27	2.2	--	--	--	--	--	--	--	3	0.5	+	8	0.5	--
Parachironomus hirtalatus	3	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Paratendipes	3	0.6	+	--	--	--	4	0.3	--	--	--	--	--	--	--	--	--	--
Phaenopsectra punctipes	3	0.6	--	5	0.4	--	28	2.2	--	--	--	+	--	--	--	--	--	--
Polypedilum flavum	8	1.7	+	59	4.9	+	40	3.2	+	32	8.1	+	85	13.9	+	144	9.3	+
Polypedilum illinoense	--	--	+	5	0.4	+	--	--	+	2	0.5	+	3	0.5	--	--	--	--
Polypedilum scalaenum grp.	3	0.6	+	5	0.4	+	36	2.9	+	2	0.5	--	--	--	--	--	--	--
Stenochironomus	--	--	+	32	2.6	--	4	0.3	--	16	4.1	--	--	--	--	--	--	--
Paratanytarsus	--	--	--	--	--	--	--	--	--	6	1.5	--	--	--	--	--	--	--
Rheotanytarsus	3	0.6	+	213	17.5	+	76	6.1	+	24	6.1	+	16	2.6	--	8	0.5	--
Tanytarsus glabrescens grp.	3	0.6	+	85	7.0	--	48	3.8	+	96	24.4	+	8	1.3	--	168	10.9	--
Tanytarsus guerlus grp.	--	--	+	5	0.4	+	24	1.9	+	--	--	--	11	1.8	--	8	0.5	--

Table 8 (cont.)

Taxa (cont.)	4.4 Hester No.	4.4 Hester %	4.4 Qual.	5.4 Hester No.	5.4 Hester %	5.4 Qual.	11.3 Hester No.	11.3 Hester %	11.3 Qual.	12.7 Hester No.	12.7 Hester %	12.7 Qual.	42.8 Hester No.	42.8 Hester %	42.8 Qual.	44.0 Hester No.	44.0 Hester %	44.0 Qual.
MOLLUSCA																		
Gastropoda (snails)																		
Valvata	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--
Pleurocera	--	--	--	2	0.2	+	--	--	+	15	3.8	+	120	19.6	+	3	0.2	+
Fossaria	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Physa	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gyraulus	--	--	+	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--
Menetus	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--
Ferrissia	--	--	+	--	--	--	--	--	--	--	--	--	1	0.2	--	--	--	--
Pelecypoda (clams & mussels)																		
Corbicula fluminea	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+
Musculium	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--
Sphaeriidae	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL NUMBERS	481	100.0		1,216	100.0		1,255	100.0		393	100.0		613	100.0		1,543	100.0	
TOTAL TAXA RICHNESS	25		48	34		34	23		43	30		49	32		29	33		32
EPT TAXA RICHNESS	3		6	9		12	4		10	8		16	9		9	11		10

TABLE 9. ICI METRICS AND SCORES FOR EAST FORK LITTLE MIAMI RIVER AND OBANNON CREEK, SEPTEMBER 2005.

EAST FORK LITTLE MIAMI RIVER

LOCATION	MONYR	DRAREA	ICITOTAL	TOTNUM	NUMTAXA	TAXSCORE	NUMMAY	MAYSCORE	NUMCAD	CADSCORE	NUMDIPT	DIPSCORE	PERMAY	PMAYSCR	PERCAD	PCADSCR	PERTANY	PTANSCR	PEROTHER	POTHSCR	PERTOLN	PTOLSCR	QUALEPT	EPTSCORE
4.4	SEP05	488.0	22	481	25	4	1	0	2	2	17	6	0.6	2	5.8	2	1.2	2	89.8	0	7.5	2	6	2
5.4	SEP05	484.0	42	1216	34	4	4	2	5	4	19	6	3.4	2	38.9	6	24.9	4	30.6	4	0.5	6	12	4
11.3	SEP05	375.0	28	1255	23	2	1	0	3	4	15	4	0.4	2	61.5	6	11.8	2	25.5	4	7.6	2	10	2
12.7	SEP05	373.0	32	393	30	4	5	2	3	4	15	4	3.3	2	24.7	4	32.1	4	35.6	2	7.1	2	16	4
42.8	SEP05	221.0	28	613	32	4	4	2	5	6	16	4	6.0	2	8.2	2	5.7	2	77.8	0	4.7	4	9	2
44.0	SEP05	212.0	28	1543	33	4	6	4	5	6	13	4	4.2	2	5.8	2	11.9	2	75.2	0	11.5	2	10	2

OBANNON CREEK

LOCATION	MONYR	DRAREA	ICITOTAL	TOTNUM	NUMTAXA	TAXSCORE	NUMMAY	MAYSCORE	NUMCAD	CADSCORE	NUMDIPT	DIPSCORE	PERMAY	PMAYSCR	PERCAD	PCADSCR	PERTANY	PTANSCR	PEROTHER	POTHSCR	PERTOLN	PTOLSCR	QUALEPT	EPTSCORE
2.5	SEP05	38.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	4
4.3	SEP05	27.0	40	190	24	2	6	4	1	2	12	2	41.1	6	1.1	2	28.4	6	26.3	6	2.6	6	10	4

Table 10. Summary of Hester-Dendy and Qualitative Macroinvertebrate Results for O'Bannon Creek, September 2005.

	2.5		4.3			
	Qual.		Hester		Qual.	
Taxa		QCTV	No.	%		QCTV
COELENTERATA (hydroids)						
Hydra	+	31.8	--	--	--	--
PLATYHELMINTHES (flatworms)						
Turbellaria						
Dugesia	+	26.8	--	--	--	--
ECTOPORCTS (moss animalcules)						
Plumatella	--	--	1	0.5	--	--
ANNELIDA						
Oligochaeta (aquatic worms)	+	14.8	1	0.5	+	14.8
Hirudinea (leeches)						
Erpobdella punctata punctata	+	20.1	--	--	--	--
Mooreobdella microstoma	+	18.2	--	--	--	--
CRUSTACEA						
Amphipoda (side swimmers)						
Crangonyx	+	20.8	--	--	--	--
Decapoda (crayfish)						
Orconectes	+	31.1	--	--	--	--
Orconectes virilis	--	--	--	--	+	31.1
INSECTA						
Ephemeroptera (mayflies)						
Baetis intercalaris	+	47.0	1	0.5	--	--
Baetis flavistriga	+	43.3	--	--	+	43.3
Procloeon	--	--	7	3.7	+	43.3
Leucrocuta	--	--	--	--	+	46.5
Stenacron	--	--	8	4.2	+	42.8
Stenonema femoratum	+	43.5	56	29.5	+	43.5
Stenonema terminatum	--	--	1	0.5	--	--
Caenis	+	42.3	5	2.6	+	42.3
Odonata (damselflies and dragonflies)						
Calopteryx	+	39.3	2	1.1	--	--
Hetaerina	+	44.2	--	--	--	--
Argia	+	32.6	3	1.6	+	32.6
Basiaeschna janata	+	--	--	--	--	--
Dromogomphus	--	--	--	--	+	--
Epitheca (Tetragoneuria)	+	--	--	--	--	--
Hemiptera (true bugs)						
Trepobates	+	--	--	--	--	--
Rhagovelia	--	--	--	--	+	--
Corixidae	--	--	--	--	+	43.4
Ranatra	+	--	--	--	--	--
Trichoptera (caddisflies)						
Chimarra obscura	+	43.7	--	--	+	43.7
Polycentropus	--	--	2	1.1	--	--
Cheumatopsyche	+	43.2	--	--	+	43.2
Hydropsyche depravata grp.	+	39.7	--	--	--	--
Ceratopsyche morosa	+	45.4	--	--	+	45.4
Helicopsyche borealis	--	--	--	--	+	37.8
Hydroptila	+	41.9	--	--	--	--
Coleoptera (beetles)						
Hydrovatus	--	--	--	--	+	--
Peltodytes	+	14.6	--	--	--	--
Helichus	+	41.9	--	--	--	--

Table 10 (cont.)

Taxa (cont.)	2.5 Qual.	2.5 Qual. QCTV	4.3 Hester No.	4.3 Hester %	4.3 Qual.	4.3 Qual. QCTV
Coleoptera (cont.)						
Dubiraphia	+	32.6	--	--	--	--
Stenelmis	+	42.3	1	0.5	+	42.3
Berosus	+	22.9	--	--	--	--
Psephenus herricki	+	43.6	--	--	+	43.6
Diptera (true flies)						
Tipula	+	37.5	--	--	--	--
Molophilus	+	--	--	--	--	--
Chironomidae (midges)						
Ablabesmyia mallochi	+	33.1	3	1.6	--	--
Thienemannimyia grp.	+	29.9	3	1.6	--	--
Corynoneura "taris"	--	--	3	1.6	+	39.5
Cricotopus tremulus grp.	+	35.8	--	--	--	--
Cricotopus bicinctus grp.	+	23.2	--	--	--	--
Nanocladius distinctus	--	--	4	2.1	--	--
Chironomus	+	13.5	--	--	+	13.5
Cryptochironomus	--	--	--	--	+	33.2
Dicrotendipes neomodestus	+	33.8	11	5.8	--	--
Microtendipes	--	--	16	8.4	--	--
Paratendipes	--	--	3	1.6	--	--
Polypedilum flavum	+	39.4	3	1.6	+	39.4
Polypedilum illinoense	+	16.5	--	--	+	16.5
Polypedilum scalaenum grp.	--	--	2	1.1	--	--
Cladotanytarsus mancus grp.	--	--	--	--	+	39.7
Paratanytarsus	--	--	3	1.6	--	--
Rheotanytarsus	+	44.0	--	--	+	44.0
Tanytarsus glabrescens grp.	+	41.1	48	25.3	+	41.1
Tanytarsus guerlus grp.	+	39.7	3	1.6	+	39.7
MOLLUSCA						
Gastropoda (snails)						
Pleurocera	--	--	--	--	+	37.6
Fossaria	+	26.4	--	--	--	--
Physa	+	15.4	--	--	--	--
Gyraulus	+	8.4	--	--	--	--
Pelecypoda (clams & mussels)						
Corbicula fluminea	+	40.4	--	--	--	--
TOTAL NUMBERS			190	100.0		
MEDIAN QUAL. QCTV VALUE		35.8				41.7
TOTAL TAXA RICHNESS	46		24		29	
EPT TAXA RICHNESS	9		7		10	

Table 11. Summary of QHEI Metric Scores at Eight Sampling Stations in the East Fork Little Miami River Watershed, 2005.

Stream/Station	Substrate	Cover	Channel	Riparian	Pool/Current	Riffle/Run	Gradient	QHEI Score
East Fork L. Miami River								
RM 44.1	17.5	11	13	7.3	11	3.5	8	71.3
RM 42.8	17.5	14	14	6	10	5	8	74.5
RM 12.7	18	14	15.5	7.3	11	6.5	10	82.3
RM 11.3	9.5	10	12	7.5	12	6.5	10	67.5
RM 5.4	10.5	11	13	6.8	12	3.5	10	66.8
RM 4.4	10	13	12.5	7	12	3	10	67.5
O'Bannon Creek								
RM 4.3	19.5	10	16	6.8	8	5	10	75.3
RM 2.5	18	13	16	7	8	4.5	6	72.5

Table 12. Water Quality Measurements from the East Fork Little Miami River Watershed July/September, 2005.

Stream/Station	Temperature (C)		Dissolved Oxygen (mg/l)		Specific onductance (uS/cn		Secchi (cm)		pH	
	July	Sept	July	Sept	July	Sept	July	Sept	July	Sept
East Fork L. Miami River										
RM 4.4	29.9	23.8	9.4	8.4	433	525	58.0	67.0	8.3	7.9
RM 5.4	26.6	22.1	5.8	6.3	336	398	39.0	68.0	8.0	7.9
RM 11.3	29.7	23.5	7.3	7.7	342	400	58.0	56.0	8.3	8.0
RM 12.7	29.1	20.8	8.2	7.2	320	312	42.0	62.0	-	8.1
RM 42.8	25.2	25.7	4.8	7.7	240	769	32.0	58.0	7.8	8.1
RM 44.1	28.5	20.8	7.5	6.0	253	380	36.0	56.0	8.2	7.8
O'Bannon Creek										
RM 2.5	23.7	21.1	8.2	8.4	450	1265 *	55.0	>70	8.0	7.6
RM 4.3	28.1	23.2	9.1	7.9	292	570	58.0	>100	8.3	7.6
Mean	27.6	22.6	7.5	7.5	333.3	577.4	47.3	61.2	8.1	7.9

(*) Measurement taken approximately 100 m upstream of electrofishing zone.