EA Project 61898.01

# DRAFT

# Biological Survey of Seven Headwater Sites in Clermont County, Ohio, 2004

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# 1. INTRODUCTION

Clermont County is conducting an ongoing program to manage and protect the environmental resources of the East Fork of the Little Miami River (EFLMR) and its tributaries. The program was initiated to better understand the biological and water quality conditions of the watershed, and to identify and address any discernable problems. The fish and macroinvertebrate studies described herein are part of that program.

Miamiville Creek, Hall Run, Horner Run, Shayler Run, and Wolfpen Run are headwater tributaries to the EFLMR, which is Ohio's largest Exceptional Warmwater Habitat (EWH) stream and a major tributary to the Little Miami River. Approximately half (243 square miles) of the EFLMR watershed lies within the boundaries of Clermont County with the remaining (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 agricultural (66 percent), forested (20 percent), and urban areas (12 percent).

The principal objective of this study was to determine whether Miamiville Creek (two sampling sites), East Branch Miamiville Creek, Hall Run, Horner Run, Shayler Run, and Wolfpen Run were attaining their designated aquatic life uses as defined in the State of Ohio Water Quality Standards, and, if not, what factors might be causing the non-attainment. All of the aforementioned streams are classified by OEPA as headwater streams (i.e., they have drainage areas $<20$ mi$^2$).

# 2. METHODS

## 2.1 OVERVIEW

### 2.1.1 Locations

Water quality, habitat, fish, and macroinvertebrates were assessed at seven EFLMR tributary locations (Figures 1 and 2):

| | |
|---|---|
| Upper Miamiville Crk., RM 1.0 | Immediately upstream of Lewis Road; upstream end of zone N39°13.144' W84°17.692', Downstream end of zone N39°13.104' W84°17.768' |
| Miamiville Crk., RM 0.2 | Upstream of Loveland-Miamiville Road and Wards Corner WWTP; upstream end of zone N39°12.873' W84°17.490', downstream end of zone N39°12.878' W84°17.408' |
| East Branch Miamiville Crk., RM 0.5 | Upstream of Ibold Road; upstream end of zone N39°13.091' W84°17.178', downstream end of zone N39°13.001' W84°17.254' |
| Hall Run, RM 0.6 | Upstream of Round Bottom Rd; upstream end of zone N39°08.309' W84°15.744', downstream end of zone N39°08.356' W84°15.624' |
| Horner Run, RM 0.8 | Upstream of Ibold Road; upstream end of zone N39°12.450' W84°16.065', downstream end of zone N39°12.379' W84°16.150' |
| Shayler Run, RM 1.7 | Downstream of Baldwin Road; upstream end of zone N39°07.098' W84°12.982', downstream end of zone N39°07.153' W84°12.886' |
| Wolfpen Run, RM 0.1 | Immediately upstream of U.S. Route 50; upstream end of zone N39°08.742' W84°14.495', downstream end of zone N39°08.611' W84°14.515' |

All zones were marked using a Magellan 330M GPS, based on WGS84 Datum. Based on drainage area, all seven locations sampled in 2004 are classified by Ohio EPA as headwater sites (i.e., drainage area <20 $mi^2$). In addition, all seven locations are 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 low and stable during all sampling efforts at all locations in 2004**,** except at Shayler Run in July when isolated thunderstorms the night before sampling caused the stream to rise slightly with increased turbidity.

## 2.2 FISH

### 2.2.1 Field

Two collections were made at each location in 2004, during the periods 30 June-2 July and 15-16 September. Electrofishing zones of 200 m were established at each location. All zones were measured with a hip chain and/or GPS and all start and endpoints were marked with flagging and by GPS. Within each zone, fish were collected according to standard Ohio EPA electrofishing procedures (OEPA 1989a). All zones were sampled by backpack electrofishing, except Shayler Creek in June, which was sampled by longline electrofishing. Gear selection was based primarily on stream size and flow conditions.

Longline electrofishing was conducted with an 1800-watt generator and a Coffelt Model 2C variable voltage pulsator (VVP) that provided pulsed DC output. Longline 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 via the second field crew member. The electrode was connected via a 100 m long cable to the VVP, which was situated at the mid-point of the zone. Backpack electrofishing was conducted using a battery powered Smith-Root Model 12 electroshocker.

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).

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).

### 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 were entered into a SAS database and printouts of that database were compared against the original data sheets to check for entry errors. After any errors were corrected, summary tables were prepared and index scores calculated. Fish community health was assessed using the Index of Biotic Integrity (IBI). 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, number of darter/sculpin species, percent insectivores, etc. Each metric receives a score of 1, 3, or 5; thus the total score can range from 12 to 60. EA has computer programs that calculate IBI scores using Ohio EPA protocols and which have successfully duplicated scores calculated by Ohio EPA at a number of sites. In addition to IBI scores, EA calculated catch-per-unit-effort (number of fish per 300 m), species richness, and percent composition.

## 2.3 MACROINVERTEBRATES

### 2.3.1 Field

Benthic macroinvertebrates were sampled qualitatively at each location in conjunction with the two fish sampling passes. The collections were made during 30 June-1 July and 15-16 September 2004. Qualitative sampling was conducted in all discernable habitats using a No. 30-mesh delta net (kicks and sweeps) and by handpicking selected substrates for 35-55 person-minutes per location, depending on organism and habitat diversity. Collected organisms were placed in labeled jars and preserved with 10% formalin.

### 2.3.2 Laboratory

Upon arrival at the laboratory, the samples were logged in and accounted for. The samples were sorted to separate the taxa collected from the debris retained in the samples. Specimen identifications were made to the lowest practical taxonomic level using the most current literature available. Whenever possible, the level of identification followed those recommended by the OEPA (1989b plus errata). Chironomidae larvae were cleared in 10% potassium hydroxide and permanently mounted in CMC-10 prior to identification. All specimens identified in each sample were coded and recorded on a standard laboratory bench sheet for data processing and preserved in 70% ethyl alcohol. No attempt was made to quantify the number of specimens for any particular taxon.

### 2.3.3 Data Analyses

The benthic macroinvertebrate data 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 higher tolerance value while those taxa that are generally abundant at highly disturbed sites have a lower 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 give 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 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 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 scores within 4 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. Nonetheless, for the QCTV, OEPA has calculated the upper 25$^{th}$ percentile and lower 75$^{th}$ 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 likely 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 at each sampling location during both trips 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 maintenance of warmwater faunas, whereas scores less than 45 generally cannot support a warmwater assemblage consistent with Warmwater Habitat (WWH) biological criteria (OEPA 1997). 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 COMPOSITION AND DIVERSITY

The two sampling passes at the seven locations yielded 5126 fish representing 24 species and hybrid sunfish (Tables 1 and 2). The combined catch included several sensitive species (northern hog sucker, smallmouth bass, longear sunfish, greenside darter, rainbow darter, and banded darter), but more highly tolerant species (white sucker, blacknose dace, creek chub, fathead minnow, bluntnose minnow, yellow bullhead, and green sunfish)(OEPA 1987 and 1989a). Numerically, the combined catch was dominated by creek chub (34 percent), blacknose dace (26 percent), and central stoneroller (24 percent). No threatened or endangered species were collected. Spatially, species richness (both trips combined) was highest in Shayler Run (21 species), lowest in East Branch Miamiville Creek (4 species), and intermediate at all remaining locations (range = 10 to 16 species). Shayler Run, which produced 21 of 24 total species encountered in 2004, ranked second to last in terms of numbers of individuals collected (Table 2). Temporally, catches were generally better in September than June/July in terms of species richness (Table 3). In general, the three Miamiville Creek watershed locations, which were more heavily dominated by highly tolerant species, produced fewer species compared to other locations.

#### 3.1.1.1 Upper Miamiville Creek

The fish community in upper Miamiville Creek was fair based on the two sampling efforts conducted in 2004. As indicated in Figure 3 below, the total catch was dominated numerically by creek chub (50 percent), blacknose dace (26 percent), central stoneroller (13 percent), white sucker (7 percent), and green sunfish (3 percent):

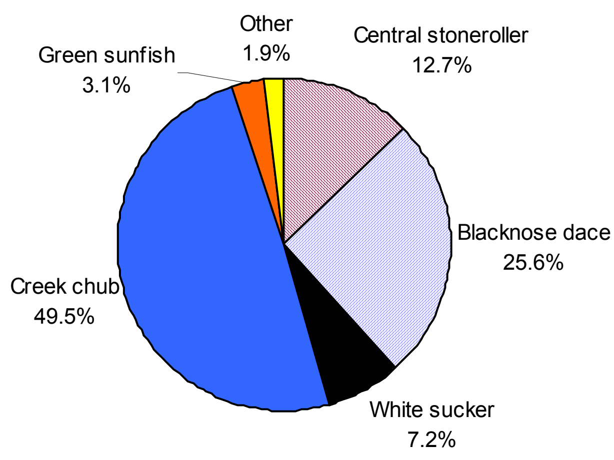


Figure 3. Relative abundance of the dominant species collected in upper Miamiville Creek, 2004.

For the two trips combined, the single sampling location in upper Miamiville Creek yielded 802 fish comprised of 10 species. The catch was dominated by highly tolerant species and no sensitive species were collected in upper Miamiville Creek in 2004. In fact, except for the East Branch Miamiville Creek location, upper Miamiville Creek was the only location where no darters were collected. Thus, four of the five most abundant species and 86 percent of all fish collected in upper Miamiville Creek are highly tolerant (Table 2). As indicated in Table 3, species richness (8 to 9 species) and CPEs (536 to 668 fish/300 m) were similar between trips. Only three species: striped shiner, bluntnose minnow, and bluegill were not collected during both trips. Striped shiner and bluegill were collected only in September, whereas bluntnose minnow was collected only in July (Table 3).

### 3.1.1.2 Miamiville Creek

Similar to upper Miamiville Creek, the Miamiville Creek fish community was also fair based on the two sampling passes in 2004. For the two trips combined, the Miamiville Creek location produced 665 fish comprised of hybrid sunfish and 11 species, including six highly tolerant species (bluntnose minnow, blacknose dace, creek chub, white sucker, yellow bullhead, and green sunfish) but only one sensitive species (rainbow darter). The total catch was dominated by creek chub (67 percent), blacknose dace (19 percent), central stoneroller (6 percent), and white sucker (2 percent) (Table 2 and Figure 4).

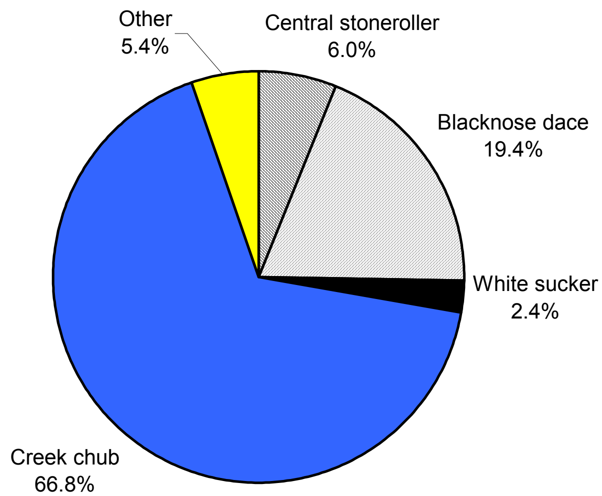


**Figure 4. Relative abundance of the dominant species collected in Miamiville Creek, 2004.**

Ninety-three percent of all fish collected in Miamiville Creek in 2004 are highly tolerant (Table 2). Temporal differences were slight (Table 3). For example, CPEs were nearly identical in July and September (498 and 500 fish/300 m, respectively) and species richness was only slightly higher in September (10 species) than July (eight species).

### 3.1.1.3 East Branch Miamiville Creek

East Branch Miamiville Creek contained a poor fish community in 2004, with comparatively few fish (414) comprised of only four species: central stoneroller, blacknose dace, creek chub, and bluegill (Table 2). Two of the four species encountered (blacknose dace and creek chub) are highly tolerant and represented 95 percent of the total catch. No sensitive species were collected, and, as previously mentioned, East Branch Miamiville Creek is one of only two locations sampled in 2004 where no darters were collected (Table 2). As indicated below in Figure 5 and in Table 2, the total catch was dominated by blacknose dace (75 percent), creek chub (20 percent), and central stoneroller (5 percent):

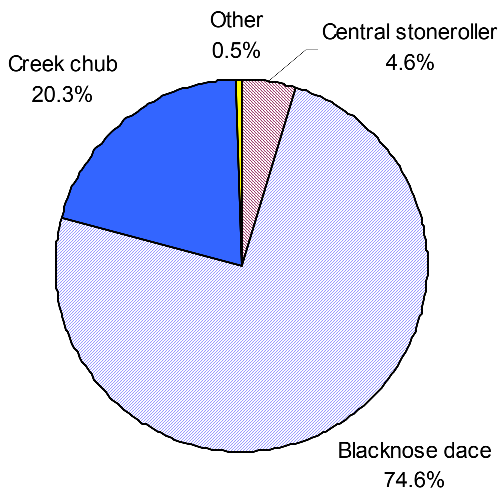


**Figure 5. Relative abundance of the dominant species collected in East Branch Miamiville Creek, 2004.**

CPEs and species richness were low in both July and September (Table 3).

### 3.1.1.4 Hall Run

The fish community in Hall Run, upstream of Round Bottom Road, was good in 2004. This location improved considerably from 2003 (EA 2004) to 2004. A total of 893 fish comprised of 16 species was collected from Hall Run in 2004 (Table 2). As indicated in Table 2 and Figure 6, the total catch was dominated by central stoneroller (49 percent), creek chub (22 percent), blacknose dace (17 percent), rainbow darter (4 percent), and green sunfish (2 percent):

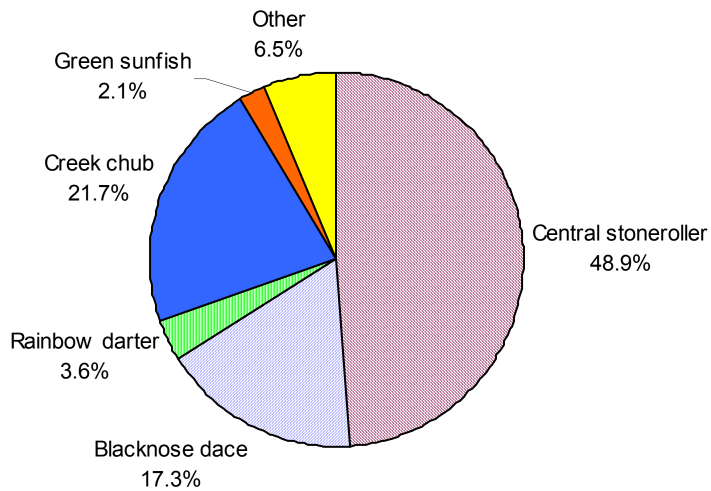


**Figure 6. Relative abundance of the dominant species collected in Hall Run, 2004.**

All seven highly tolerant species collected during the 2004 survey (see Section 3.1.1) were represented at Hall Run (Table 2). However, highly tolerant species were less abundant in Hall Run (43 percent of the total catch) than all other locations except Shayler Run (Table 2). In addition, smallmouth bass and rainbow darter, both sensitive species, were collected at this location. As indicated in Table 3, CPEs were similar between July and September (665 and 675 fish/300 m), whereas species richness was higher in September (16 species) than July (11 species).

### 3.1.1.5 Horner Run

Horner Run also produced a good fish community, based on the July and September surveys. A total of 986 fish (the most of any location) comprised of 15 species was collected in 2004 (Table 2). The total catch was dominated by central stoneroller (34 percent), blacknose dace (29 percent), creek chub (24 percent), rainbow darter (4 percent), and fantail darter (4 percent):

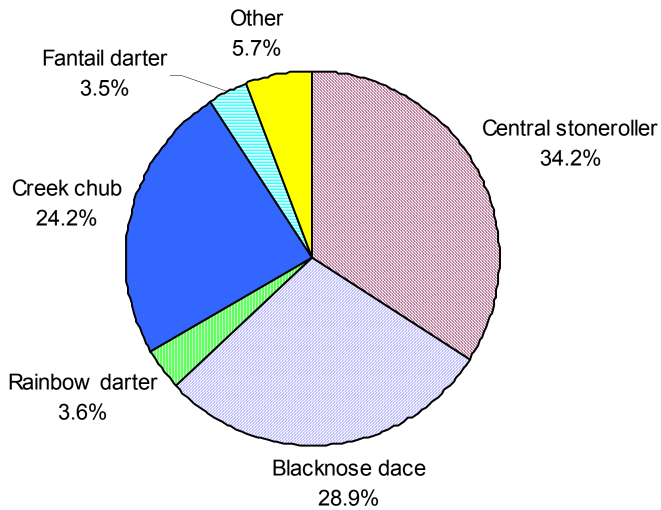


**Figure 7. Relative abundance of the dominant species collected in Horner Run, 2004.**

Tolerant species, primarily blacknose dace and creek chub, comprised 58 percent of the total catch as indicated in Figure 7. Two sensitive species: northern hog sucker and rainbow darter were collected in 2004. Catches were moderately better in September than July (Table 3). For example, both CPEs and species richness were higher in September (812 fish/300 m and 14 species, respectively) than July (668 fish/300 m and 11 species, respectively). Horner Run produced the only specimen of silverjaw minnow collected in the 2004 study (Table 2). The silverjaw minnow will inhabit medium to large rivers but is most abundant in brooks and small streams of moderate gradient with predominantly free flowing sand substrate. It has a high tolerance to turbidity, and domestic and industrial pollutants (Trautman 1981). Although Horner Run was one of a few locations that contained sand as one of the dominant substrate types (Appendix B), the high gradient of all locations sample in 2004 may be the limiting factor for this species throughout the study area.

### 3.1.1.6 Shayler Run

The fish community in Shayler Run was very good; clearly better than all other locations sampled in 2004, based on species composition and IBI scores (Section 3.1.2). A total of 641 fish comprised of 21 species was collected during the two sampling passes, including all six sensitive species (northern hog sucker, longear sunfish, smallmouth bass, greenside darter, rainbow darter, and banded darter) collected throughout the 2004 study (Table 2). As indicated in Table 2 and in Figure 8 below, the total catch was dominated by central stoneroller (41 percent), rainbow darter (16 percent), creek chub (11 percent), fantail darter (9 percent), blacknose dace (3 percent), and white sucker (3 percent):

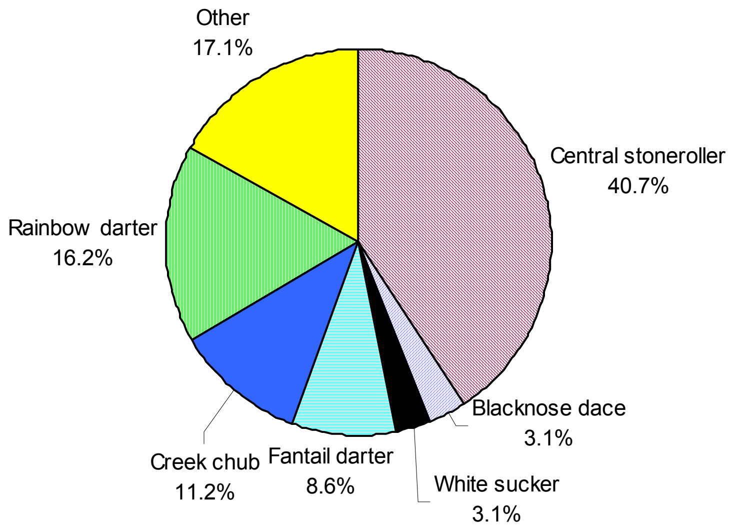


**Figure 8. Relative abundance of the dominant species collected in Shayler Run, 2004.**

Shayler Run produced 21 of 24 total species collected during the entire 2004 study, significantly higher than all other locations. Rock bass, johnny darter, and banded darter were only collected from Shayler Run in 2004 (Table 2), likely due, in part, to its larger size. In addition, Shayler Run was the only location that produced all six darter species. Darters comprised nearly 30 percent of the total catch at that location. Tolerant species, though present, represented only 22 percent of the total catch, about half the value of any other location (Table 2). Temporally, catches varied considerably but no consistent trend was apparent. CPEs were nearly 2 fold higher in July (635 fish/300 m) than September (327 fish/300 m); conversely, species richness was moderately higher in September (20 species) than July (16 species) (Table 3). The greater species richness observed in September was due, almost entirely, to the addition of non-headwater species or medium to large river inhabitants including: spotfin shiner, yellow bullhead, rock bass, smallmouth bass, and banded darter (Table 3). The influx of such species may have occurred as a result of high water conditions preceding the September sampling event, causing these larger river species to move upstream.

### 3.1.1.7 Wolfpen Run

Both sampling trips combined, Wolfpen Run produced 725 fish comprised of 16 species (second highest overall), resulting in a marginally good fish community (Table 2). The total catch was dominated by creek chub (45 percent), blacknose dace (30 percent), white sucker (9 percent), and central stoneroller (8 percent), as indicated in Table 2 and Figure 9 below:

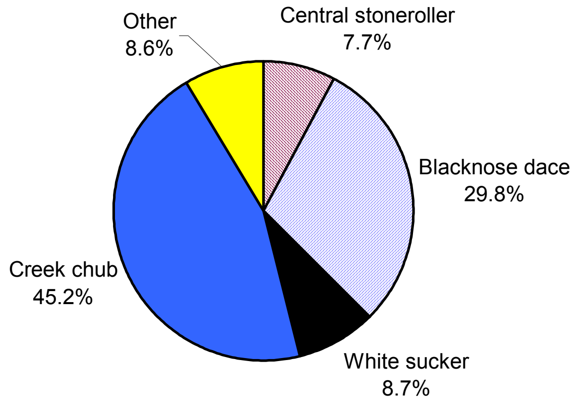


**Figure 9. Relative abundance of the dominant species collected in Wolfpen Run, 2004.**

Three of the four most abundant species and 90 percent of all fish collected in Wolfpen Run are highly tolerant (Table 2). However, three sensitive species (longear sunfish, smallmouth bass, and rainbow darter) were also collected at Wolfpen Run, second only to the six sensitive species collected in Shayler Run (Table 2). Wolfpen Run produced the only specimen of redear sunfish collected in the 2004 study. Redear sunfish are not native to Clermont County, Ohio. This species has been widely and successfully reintroduced outside its native range. Redear sunfish typically inhabit non-flowing waters and congregate near cover: aquatic vegetation, brush, stumps, and logs (Trautman 1981). Instream cover in Wolfpen Run was as good or better than the other sampling locations (Appendix B). The June and September sampling trips produced somewhat different results (Table 3). CPEs were higher in June (627 fish/300 m) compared to September (461 fish/300 m), but species richness in September (15 species) was nearly twice the value reported in June (9 species). The majority of the species which were present in the September catch, but absent in June (e.g., bluegill, longear sunfish, redear sunfish, smallmouth bass, and largemouth bass), were members of the sunfish family Centrarchidae. Centrarchids are typically not a major component of headwater streams, which may explain why all of the aforementioned species were represented by only a single specimen, except bluegill (Table 3). Nonetheless, the reason(s) for the increased sunfish catch in September is unknown.

The observed differences in species richness and the abundance of individual species appear to be related to three factors: (1) stream size, (2) habitat quality, and possibly (3) water quality. In wadeable streams, there is a well established, direct relationship between stream size and species richness (OEPA 1987). Thus, one would expect fewer species at smaller headwater sites and more species at locations with larger drainage areas. Thus, the comparatively low number of species at the Miamiville Creek locations (all with drainage areas <2 sq. mi.) is likely due, in part, to stream size and the intermittent nature of these streams. Conversely, the higher species total at Shayler Run, which contains the largest drainage area of all the locations and represents a greater than 6 fold increase compared to any of the Miamiville Creek locations, is partially the result of the larger size of this stream. Thus, species preferring larger streams (e.g., northern hog sucker, rock bass, greenside darter, banded darter, and most Centrarchids) were restricted to, or much more abundant, at Shayler Run than the other locations sampled in 2004 (Table 2).

As discussed in greater detail in section 3.3, habitat quality also affected the distribution of fishes. For example, East Branch Miamiville Creek had the worst habitat (i.e., lowest QHEI score) of all locations sampled in 2004 and also had the lowest IBI scores (see Section 3.2 below), as well as the lowest species richness and number of individuals. Conversely, Horner Run, Shayler Run, and Wolfpen Run, which had better overall habitat quality than the other locations, had higher IBI scores, generally contained more species, and more individuals. In particular, Horner Run, Shayler Run, and Wolfpen Run generally supported more darter and Centrarchid species, likely due to the increased habitat complexity at these locations. Hall Run was somewhat contrary to the expected trend; it ranked only fifth in habitat quality, yet had the third best IBI scores (see Section 3.1.2 below). In addition, Hall Run produced the second highest species richness value and total number of fish collected. Hall Run also produced a good number of darter species, likely as a result of the excellent substrate quality observed at this location in 2004. Finally, water quality may have been a factor in the quantity and distribution of fish in upper Miamiville Creek and Miamiville Creek (see Section 3.4). DO values in upper Miamiville Creek in September (5.2 mg/l) and Miamiville Creek in July and September (4.7 and 5.6 mg/l, respectively) were lower than the DO values in the other tributary locations.

### 3.1.2 IBI SCORES

Mean IBI scores among the three Miamiville Creek watershed locations (i.e., upper Miamivlle Creek, Miamiville Creek, and the East Branch Miamiville Creek) were similar, ranging from 27 to 30 indicating a poor to fair fish community at these locations (Tables 4). All three locations in the Miamiville Creek watershed scored a 1 or a 3 for all metrics except number of headwater species, percent pioneering species, percent omnivores, number of simple lithophilic species, and percent DELT anomalies (Table 4). Given the overall poor IBI scores at these sites, likely driven by the fairly poor habitat quality, it is somewhat surprising that some metrics scored exceptionally well. For example, East Branch Miamiville Creek and Miamiville Creek scored a 5 (both trips) for percent omnivores and percent DELT anomalies. In addition, East Branch Miamiville Creek scored a 5 (both trips) for percent pioneering species (Table 4).

Mean IBI scores were higher at the remaining four headwater sites: Wolfpen Run, Hall Run, Horner Run, and Shayler Run (Table 4). Mean IBI scores were marginally good at Wolfpen Run (38), good at Hall Run and Horner Run (42 and 40, respectively), and very good at Shayler Run (49). Shayler Run scored at least a 3 for all metrics; and scored particularly well (score of 5 for both trips) for six of 12 metrics: number of species, number of darter/sculpin species, percent pioneering species, percent omnivores, number of simple lithophilic species, and percent DELT anomalies (Table 4). Hall Run and Horner Run, which contained good fish communities, scored a 3 or 5 for all metrics except: number of sensitive species, percent tolerant species (Horner Run only), and percent insectivorous species (Table 4). Horner Run and Hall Run scored particularly poor (1 for both trips) for percent insectivorous species. However, this does not appear to be related to benthic community quality as both Hall Run and Horner Run exhibited fair to good benthic results (see Sections 3.2.4 and 3.2.5). Wolfpen Run, which supported a marginally good fish community, scored very well (i.e., 5 for both trips) for the following metrics: total number of species, number of minnow species, number of simple lithophilic species, and percent DELT anomalies (Table 4). In contrast, very poor metric scores (i.e., 1 for both trips) were observed at Wolfpen Run for the number of headwater species, percent tolerant species, and percent insectivorous species.

Percent DELT anomalies, which consisted of deformities and eroded fins (Appendix A) were very low or non-existent at all locations during all trips (range = 0.0 to 0.5 percent affliction), except in upper Miamivillle Creek in July (Table 4). DELT anomalies were only slightly higher in upper Miamiville Creek in July (0.8 percent affliction) than elsewhere. As a result, all sampling locations consistently scored a 5 for the percent DELT anomalies metric, except upper Miamiville Creek in July, which scored a 3 (Table 4).

Although habitat scores were among the lowest at the Miamiville watershed locations and likely contributed to the overall poor fish community observed at these sites, it appears that the fish community is limited by more than habitat quality. Based on Yoder and Rankin (1995), two types of stressors, complex toxic and CSO toxic may produce results similar to those observed at the Miamiville sites. However, streams affected by complex toxics, which frequently cause serious chemical water quality impairments, fish kills, or severe sediment contamination, generally have lower IBI scores (≤ 22) and higher incidence of DELT anomalies (10-20%) than were seen at the Miamiville watershed locations. As stated above, the incidence of DELT anomalies at the three Miamiville locations ranged from 0.0 to 0.5 percent and mean IBI scores ranged from 27 to 30. These results appear to be more consistent with streams affected by CSO toxics rather than complex toxics. Since stressor identification remains a largely speculative exercise, it should be used with the thorough understanding of its limitations.

Each 2004 IBI value and appropriate criterion are provided below:

| Location/RM | Sampling Method | IBI Criterion | 2004 IBI Score Jul/Jun | 2004 IBI Score Sept | 2004 IBI Score Avg. | Attainment Achieved? |
|---|---|---|---|---|---|---|
| Upper Miamiville Crk. | Wading | 40 (WWH)* | 26 | 34 | 30 | No |
| Miamiville Crk. | Wading | 40 (WWH)* | 28 | 32 | 30 | No |
| E. Br. Miamiville Crk. | Wading | 40 (WWH)* | 28 | 26 | 27 | No |
| Hall Run | Wading | 40 (WWH) | 38 | 46 | 42 | Yes |
| Horner Run | Wading | 40 (WWH)** | 36 | 44 | 40 | Yes |
| Shayler Crk. | Wading | 40 (WWH) | 50 | 48 | 49 | Yes |
| Wolfpen Run | Wading | 40 (WWH) | 34 | 42 | 38 | Yes |

* No historic data are available for this stream, therefore, WWH was assigned as the default use designation.
** Use designation assigned by OEPA based on 1978 data.

As can be seen above, the fish community was in attainment at all locations except those within the Miamiville Creek watershed. IBI scores in Miamiville Creek, East Branch, and upper Maimiville Creek (July) were well below the criterion of 40 for WWH. However, the IBI score in upper Miamiville Creek in September was only slightly below the criterion of 40 when the Area of Insignificant Departure is considered (see Section 2.4).

In summary, based on species composition, relative abundance, and IBI scores, the majority of locations sampled in 2004 (i.e., Hall Run, Horner Run, Shayler Run, and Wolfpen Run) contained marginally good to very good fish communities. However, the fish community in the Miamiville Creek watershed (i.e., upper Miamiville Creek, Miamiville Creek, and East Branch Miamiville Creek) was poor to fair. The poor fish community at the Miamiville Creek watershed locations may be due to a combination of poor habitat quality and CSO toxics, based on IBI metric scores. Hall Run, Horner Run, Shayler Run and Wolfpen Run all met the WWH IBI criterion of 40, whereas none of the Miamiville Creek locations did.

## 3.2 MACROINVERTEBRATES

Overall, the two sampling events among the seven locations yielded 79 total taxa and 15 EPT taxa (Tables 5 and 6). 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 taxa rich groups in the study streams were Diptera (flies, 35 taxa), Coleoptera (beetles, nine taxa), Trichoptera (nine taxa), and Odonata (dragonflies and damselflies, seven taxa). The majority of the Diptera collected were taxa in the family Chironomidae (midges). As a group, Chironomidae are generally considered tolerant of perturbation. However, as demonstrated by the QCTV values listed for the taxa in Tables 5 and 6, the Chironomidae collected among the seven sites exhibit a wide tolerance range, from highly tolerant (*Tropisternus,* QCTV=10.2) to the relatively intolerant (*Ceratopsyche morosa,* QCTV=45.4). The number of taxa classified by OEPA as being moderately tolerant (MT) to tolerant (T) or moderately intolerant (MI) to intolerant (I) of environmental disturbance (OEPA Unpublished Data) was nearly identical with 15 and 14 taxa, respectively (Tables 5 and 6). However, the majority of the taxa collected in 2004 are classified as facultative (F).

### 3.2.1 UPPER MIAMIVILLE CREEK

The two benthic macroinvertebrate collections from upper Miamiville Creek yielded 31 total taxa and two EPT taxa (Table 5). The July sampling event yielded 23 total taxa and two EPT taxa while the September collections were similar with 18 total and two EPT taxa. Based on the total taxa richness metric criterion from the ICI (Metric 1), total richness would be rated as fair. Overall, total richness observed during each sampling event and for the two sampling events combined at upper Miamiville Creek was similar to the other two Miamiville locations. However, EPT taxa richness at the upper Miamiville Creek location was the lowest recorded among the seven locations sampled in 2004. Using the Qualitative EPT metric criterion from the ICI (Metric 10), EPT richness at the upper Miamiville location would be rated as poor.

Tolerant taxa richness (moderately tolerant and tolerant taxa) decreased slightly between the two sampling events from five taxa in July to two taxa in September whereas intolerant (moderately intolerant and intolerant) taxa richness was identical during both sampling events with two taxa

(Table 5). During both sampling events, Diptera was the most taxa rich group with 11 and eight taxa in July and September, respectively. Again, the majority of these taxa were of the family Chironomidae. No other major group was represented by more than two taxa in July or September.

As was observed with the number of tolerant taxa, QCTV scores improved slightly between sampling events (Table 5). In July, the QCTV score at the upper Miamiville Creek location was 33.8 while the QCTV score in September was 36.8. For the IP ecoregion, the July QCTV score was slightly below the 75$^{th}$ percentile (34.85) while the September QCTV was slightly higher than the 75$^{th}$ percentile. These scores indicate that the quality of the benthic community in upper Miamiville Creek was fair to poor.

As with the fish results, most of parameters suggest that the benthic community at the upper Miamiville Creek site was relatively poor in 2004. Except for QCTV and tolerant taxa richness, all parameters were generally similar between July and September. As the QCTV is directly linked to benthic community tolerance, the increase in QCTV score during September is likely the result of fewer tolerant taxa in the September sample. Based on the richness measures and QCTV, the benthic community in the upper Miamiville Creek likely did not meet the WWH designated use in July. Although the September QCTV score was slightly above the 75$^{th}$ percentile (fair to poor) threshold, the score remained relatively low for the IP Ecoregion. Due to the fact that the QCTV score was between the upper (25$^{th}$) and lower (75$^{th}$) thresholds, it is difficult to ascertain attainment status based on the September benthic community. However, based on the individual parameters, the upper Miamiville Creek benthic community was fair to poor in September. Overall, given the low number of EPT and intolerant taxa, as well as the relatively low QCTV scores during both periods, it appears that the quality of the benthic community at the upper Miamiville Creek site was poor in 2004.

### 3.2.2 MIAMIVILLE CREEK

The July and September collections combined from the Miamiville Creek site yielded 29 total taxa and four EPT taxa (Table 5). As was observed at the upper Miamiville Creek site, both total and EPT richness at the Miamiville Creek site decreased in September relative to July. The July sampling event yielded 26 total taxa and four EPT taxa, whereas the September collections yielded 16 total and two EPT taxa. The July total richness was the highest observed among the three Miamiville Creek sites while the two EPT taxa observed in September matched the lowest observed for any single sampling event among the seven sites. Based on the ICI metrics, total richness would be rated as fair during both sampling events while EPT richness would be rated as fair in July but poor during September.

The number of tolerant and intolerant taxa was the same, with three taxa each during both July and September (Table 5). During both the July and September collections, Diptera was the most taxa rich group with 10 and seven taxa, respectively. Again, the majority of these taxa were members of the family Chironomidae. No other major group was represented by more than four taxa in July and two taxa in September.

Although there was no change in the number of tolerant taxa and intolerant taxa from July to September and EPT richness actually decreased between sampling events, the QCTV increased from 36.8 in July to 39.3 in September (Table 5). The July QCTV score was approximately two units higher than the 75$^{th}$ percentile (34.85) while the September QCTV was slightly higher than the 25$^{th}$ percentile (39.20). The mean QCTV score for the two periods (36.05) was slightly lower than the 25$^{th}$ percentile threshold. These scores suggest that the quality of the benthic community in Miamiville Creek was fair to good.

Overall, the benthic results from the Miamiville Creek site indicate that benthic community quality is similar to that of the fish community. Although all of the richness parameters decreased or remained unchanged between July and September, a slight shift in composition (i.e., fewer taxa with lower tolerance values) has resulted in a higher QCTV during September. Due to the fact that the QCTV score in July was between the upper and lower thresholds, attainment status based on the July benthic community could not be deduced. However, based on total and EPT richness, it appears that the Miamiville Creek benthic community was at least fair in July. In contrast, the September QCTV score suggests that the benthic community would meet the WWH designated use. Although the noticeably lower total and EPT richness values during September may be attributable to seasonal variation since a similar trend was observed at several sites, the difference between July and September may also be the result of other limiting factors beyond the scope of this study. Given the number of tolerant taxa compared to intolerant taxa, the number of EPT taxa in July, and the relatively high QCTV score in September, it appears that the quality of the benthic community at the Miamiville Creek site was at least fair and possibly good in 2004.

### 3.2.3 EAST BRANCH MIAMIVILLE CREEK

The 2004 benthic collections from the East Branch Miamiville Creek site yielded 30 total taxa and six EPT taxa (Table 5). The July sampling event yielded 20 total taxa and five EPT taxa while the September collections were similar with 19 total and six EPT taxa. Based on the total taxa and EPT taxa richness metric criterion from the ICI, total and EPT richness would be rated as fair for both July and September. Overall, total richness observed during each sampling event and for the two sampling events combined at East Miamiville Creek was similar to the other two Miamiville locations. However, the five EPT taxa observed in July and the six EPT taxa observed in September were the highest recorded among the three Miamiville locations.

Tolerant taxa and intolerant taxa richness were identical in July with five taxa each (Table 5). In addition, both parameters decreased slightly in September when three tolerant taxa and four intolerant taxa were observed. As with the other Miamiville sites, Diptera was the most taxa rich group with six taxa in July and September. However, in contrast to the previous two locations, other groups contributed similar numbers of taxa. In July, five Tricoptera taxa were collected while in September, Ephemeroptera and Trichoptera combined accounted for six taxa.

As with the majority of the parameters examined for the East Branch Miamiville site, QCTV scores were nearly identical between July and September (Table 5). In July, the QCTV score at the East Branch Miamiville Creek location was 39.7 while the QCTV score in September was

39.6. The QCTV for both sampling events was slightly greater than the 25th percentile (39.2). These scores indicated that the quality of the benthic community in the East Branch Miamiville Creek was good.

In contrast to the poor fish community at the East Branch Miamiville Creek site described in Section 3.1.1.3 and despite relatively poor habitat as described in Section 3.3, most of the parameters suggest that the benthic community in the East Branch Miamiville Creek was good in 2004. Virtually every parameter exhibited results that were either similar to or better than the other Miamiville Creek sites. These results suggest that the benthic community in the East Branch Miamiville Creek likely met the WWH designated use during both July and September, and that the quality of the benthic community at the East Branch Miamiville Creek site was good in 2004.

### 3.2.4 HALL RUN

During 2004, Hall Run yielded 43 total taxa and 12 EPT taxa (Table 6). Total taxa and EPT taxa richness decreased between June and September, although the difference in total richness was more pronounced. In June, 33 total taxa and 10 EPT taxa were observed. Both of these were the highest richness values observed during the study. In contrast, the September collections yielded 25 total and eight EPT taxa. However, despite being lower, even the September richness values were as high or higher than the majority of the sites studied in 2004. Based on the ICI metrics for total and EPT richness, total richness would be rated as good in June and fair in September whereas EPT richness would be rated as excellent in June and good in September.

In contrast to the positive results observed in the richness values, the number of tolerant taxa was noticeably higher than the number intolerant taxa during both of the sampling events (Table 6). In June, four tolerant taxa were observed compared to one intolerant taxon. Likewise, in September seven tolerant taxa were collected compared to three intolerant taxa. Diptera was the most taxa rich group with 12 and eight taxa, respectively. As with the other sites, the majority of these Diptera were Chironomidae. In addition to Diptera, Trichoptera comprised a fair number of taxa during both sampling periods with seven and five taxa in June and September, respectively.

In contrast to total and EPT richness, the QCTV increased somewhat between June and September (Table 6). In June, the QCTV score was 33.6 while the QCTV score in September was 36.3. The QCTV from June was the lowest observed among the seven sites in 2004 and was below the 75th percentile (34.85). Despite the higher score in September, the QCTV for Hall Run was only slightly higher than the 75th percentile. These scores suggest that the quality of the benthic community in the Hall Run was fair to poor.

The 2004 benthic macroinvertebrate results from Hall Run, like the fish results, represented a substantial improvement over the 2003 collections for nearly every parameter (EA 2004). Despite these improvements, the benthic community continued to have QCTV scores that suggest that Hall Run is not meeting the WWH designated use. The QCTV results suggest that the Hall Run benthic community is poor to fair. Conversely, total and EPT richness values during both sampling periods indicate that the Hall Run benthic community is fair to excellent. The relatively low mean QHEI score from Hall Run (see Section 3.3) suggests that habitat may be affecting the structure and quality of the benthic community to some extent. However, the mean QHEI score from Hall Run was greater than the East Branch Miamiville Creek QHEI score, a site where the benthic community appeared to attain its designated use in 2004. Therefore, it would seem that habitat is not the only explanation for the relatively low QCTVs from Hall Run. Although these results are mixed, given the relatively high number of total and EPT taxa as well as the QCTV above the 75$^{th}$ percentile in September, it would seem appropriate to characterize the benthic community in Hall Run as fair. Nonetheless, these data indicate that other factors beyond the scope of this study may be limiting the biological community (i.e., fish and benthos) in Hall Run.

### 3.2.5 HORNER RUN

The 2004 benthic collections from Horner Run yielded 31 total taxa and seven EPT taxa (Table 6). The July sampling event yielded 28 total taxa and six EPT taxa while the September total richness (13 taxa) was only about half the July total. However, EPT richness in September was similar with five taxa. The 13 total taxa observed in September were the lowest number of total taxa observed for any sample period among the seven sites. Based on the ICI total taxa and EPT taxa richness metrics, total richness would be rated as good in July and fair in September whereas EPT richness would be rated as fair for both sampling periods.

Tolerant taxa and intolerant taxa richness were nearly identical in July with four tolerant and five intolerant taxa (Table 5). In addition, both parameters decreased in September. However, tolerant taxa richness was reduced to zero while intolerant richness decreased to three taxa in September. Although Diptera was clearly the most taxa rich group in July with 13 taxa, in September, Diptera and Trichoptera each had four taxa.

In contrast to total richness, QCTV scores were nearly identical between July and September (Table 6). In July, the QCTV score at Horner Run was 39.4 while in September it was 39.7. The QCTV for both sampling events was slightly greater than the 25$^{th}$ percentile (39.2) suggesting that the quality of the benthic community in Horner Run was good.

As with the fish data, most of parameters suggest that the benthic community in Horner Run was good in 2004. Despite the substantial decline in total taxa richness in September, the total number of taxa in July and the number of intolerant taxa relative to tolerant taxa during both sampling periods indicate a healthy benthic community. The difference in total richness between the two sampling periods appears to be the result of a noticeable decrease in the number of Chironomidae taxa in September. The QCTV results from both July and September suggest that the benthic community is meeting the WWH biocriterion. Overall, the QCTV and richness parameters suggest that the quality of the Horner Run benthic community was good in 2004.

### 3.2.6 SHAYLER RUN

The July and September collections combined yielded 39 total taxa and eight EPT taxa from the Shayler Run (Table 6). Both total and EPT richness exhibited notable decreases between July and September. The July sampling event yielded 33 total taxa and eight EPT taxa whereas the September collections yielded 20 total and four EPT taxa. Based on ICI richness metrics, total richness would be rated as good during July but fair in September while EPT richness would be rated as good in July but poor during September.

The number of tolerant and intolerant taxa was nearly the same for both parameters with five tolerant and six intolerant taxa during July and two taxa each in September (Table 6). During the July collections, Diptera was the most taxa rich group with 15 taxa. However, in September, Trichoptera was the most taxa rich group with four taxa.

Contrary to the dramatic reduction observed between July and September for the various richness measures at Shayler Run, QCTV scores were relatively similar between the two sampling events (Table 6). In July, the QCTV result was 39.7, while a slightly lower QCTV of 38.4 was observed in September. The July QCTV score was slightly higher than the 25$^{th}$ percentile (39.20) while the September QCTV was slightly lower than the 25$^{th}$ percentile. These scores suggest that the quality of the benthic community in Shayler Run was fair to good.

Overall, the results from the benthic community generally agree with the fish community results. The fish community clearly attained the WWH biocriterion and as a result was characterized as very good (see Section 3.1.1.6). Although the benthic data provided more mixed results compared to the fish data, several parameters indicate that Shayler Run contains a healthy benthic community as well. Richness values clearly rate the benthic community as good in July. In addition, the QCTV from July suggests that the Shayler Run benthic community met the WWH designated use. Furthermore, despite substantial decreases in total and EPT richness during September, the QCTV remained relatively high and only slightly below the 25$^{th}$ percentile threshold. The reason for the lower richness values in September is uncertain and may simply be the result of seasonal variation. Overall, it seems appropriate to characterize the Shayler Run benthic community as good in 2004.

### 3.2.7 WOLFPEN RUN

The two benthic macroinvertebrate collections from Wolfpen Run yielded 32 total taxa and eight EPT taxa (Table 6). The June sampling event yielded 26 total taxa and seven EPT taxa. As with most of the locations, total and EPT richness values sampled in 2004 decreased in September. The September collections yielded 15 total taxa and four EPT taxa. Overall, taxa richness values from Wolfpen Run were within the range of values observed at the majority of sites sampled in 2004. Based on the total and EPT taxa richness metrics from the ICI, total richness would be rated as fair during both sampling periods while EPT richness would be characterized as good in June but fair in September.

Tolerant taxa richness at the Wolfpen Run site decreased from four taxa in June to zero in September (Table 6). In contrast, intolerant taxa richness was similar between the two sampling events with three taxa during June and two taxa in September. As was observed at most of the other sampling locations, Diptera was the most taxa rich group with 11 taxa in June and nine taxa in September.

Probably due to the decrease in the number of tolerant taxa, QCTV scores improved slightly between sampling events (Table 6). In June, the QCTV score at Wolfpen Run was 33.8 while the QCTV score in September was 38.1. The June QCTV score was slightly below the 75$^{th}$ percentile (34.85) while the September QCTV was slightly below the 25$^{th}$ percentile. These scores indicate that the quality of the benthic community in Wolfpen Run was poor to fair.

Although EPT richness was good in June and tolerant taxa were entirely absent from the September collections, most parameters suggest that the benthic community in Wolfpen Run is fair. Since the QCTV is the median of all tolerance values for taxa observed in a sample, it is not surprising the QCTV improved with the decrease in tolerant taxa between June and September. Based on the QCTV, the benthic community in Wolfpen Run likely did not meet the WWH designated use in either June or September. Although the September QCTV was only slightly below the 25$^{th}$ percentile, the QCTV in June was well below the 75$^{th}$ percentile, total richness was fair during both sampling events, and EPT richness was fair during September. These results suggest that the benthic community in Wolfpen Run was fair in 2004.

## 3.3 HABITAT

Mean QHEI scores are summarized below:

| Location | RM | QHEI Score |
|---|---|---|
| Miamiville Crk. | 0.2 | 61.3 |
| Upper Miamiville Crk. | 1.0 | 59.0 |
| East Br. Miamiville Crk. | 3.0 | 56.0 |
| Hall Run | 0.4 | 59.8 |
| Horner Run | 0.8 | 67.0 |
| Shayler Run | 1.7 | 64.0 |
| Wolfpen Run | 0.1 | 68.0 |

Overall, the habitat quality was fair to good at the seven headwater locations sampled in 2004. Habitat quality was better at Wolfpen Run, Horner Run, and Shayler Run (mean QHEI scores of 68.0, 67.0, and 64, respectively), than the remaining four locations, where the habitat quality was quite similar (mean QHEI scores ranged from 56.0 to 61.3). The higher QHEI scores at Wolfpen Run, Horner Run, and Shayler Run were generally due to better substrate, pool/current, and riffle/run metric scores than the other four locations (Table 7 and Appendix B). In particular, these locations contained more hard substrates (i.e., cobble/gravel) with less silt and deeper riffle/run/pool complexes (Table 7 and Appendix B). Despite lower values for some metrics, Hall Run contained excellent substrate quality. As a result, species that require clean, hard, substrates with well developed riffles (most darter species and some minnow species) and deep pools (most Centrarchids) were more abundant at Wolfpen Run, Horner Run, Hall Run, and Shayler Run than the Miamiville Creek sites (Table 2).

## 3.4 WATER QUALITY

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

Water temperatures ranged from 18.6 (upper Miamiville Creek) to 25.8 C (Shayler Run) in June/July compared to 18.9 (upper Miamiville Creek) to 24.6 C (Hall Run) in September (Table 8). Water temperatures were warmer in September than in June/July at all locations, except in Shayler Run where water temperature was significantly warmer in July (25.8 C) than September (19.4 C). This is somewhat puzzling considering isolated thunderstorms in the area dropped enough rain the night before the July sampling, causing the stream to rise and become more turbid. Water temperatures were within ranges easily tolerated by warmwater fishes at all locations.

As indicated in Table 8, DO values varied among locations and trips (range = 4.7 to 10.5 mg/l). In July, the DO in Miamiville Creek (4.7 mg/l) was nearly half that of the other sampling locations, which were fairly similar (Table 8). In contrast, the DO in Horner Run in September (10.5 mg/l) was greater than twice the September value observed in upper Miamiville Creek (5.2 mg/l). On average, the mean DO value for the locations was slightly higher in June/July (7.9 mg/l) than September (7.5 mg/l). All DO concentrations met their respective minimum WWH DO criterion of 4 ppm.

On average, specific conductance values were higher in September than June/July (916 µS/cm and 803 µS/cm, respectively). Specific conductance values varied considerably among locations and trips. For example, specific conductance values ranged from 378 µS/cm (Shayler Run) to 1149 µS/cm (East Branch Miamiville Creek) in June/July, and from 494 µS/cm (Hall Run) to 1520 µS/cm (Miamiville Creek) in September (Table 8). Temporally, specific conductance values varied the most at Miamiville Creek, Hall Run, and upper Miamiville Creek (Table 8).

Water clarity (i.e., Secchi reading) was measured at all sampling locations. However, insufficient water depth precluded an accurate measurement at all locations, except Shayler Run in July (Table 8). Nonetheless, water clarity was good enough (Secchi readings >100 cm) to see to the bottom of the stream at these sampling locations. Water clarity in Shayler Run was fair/poor (Secchi reading of 24 cm) in July due to moderate rainfall the night before sampling.

As indicated in Table 8, pH values varied slightly spatially and temporally (range = 7.7 to 9.3).

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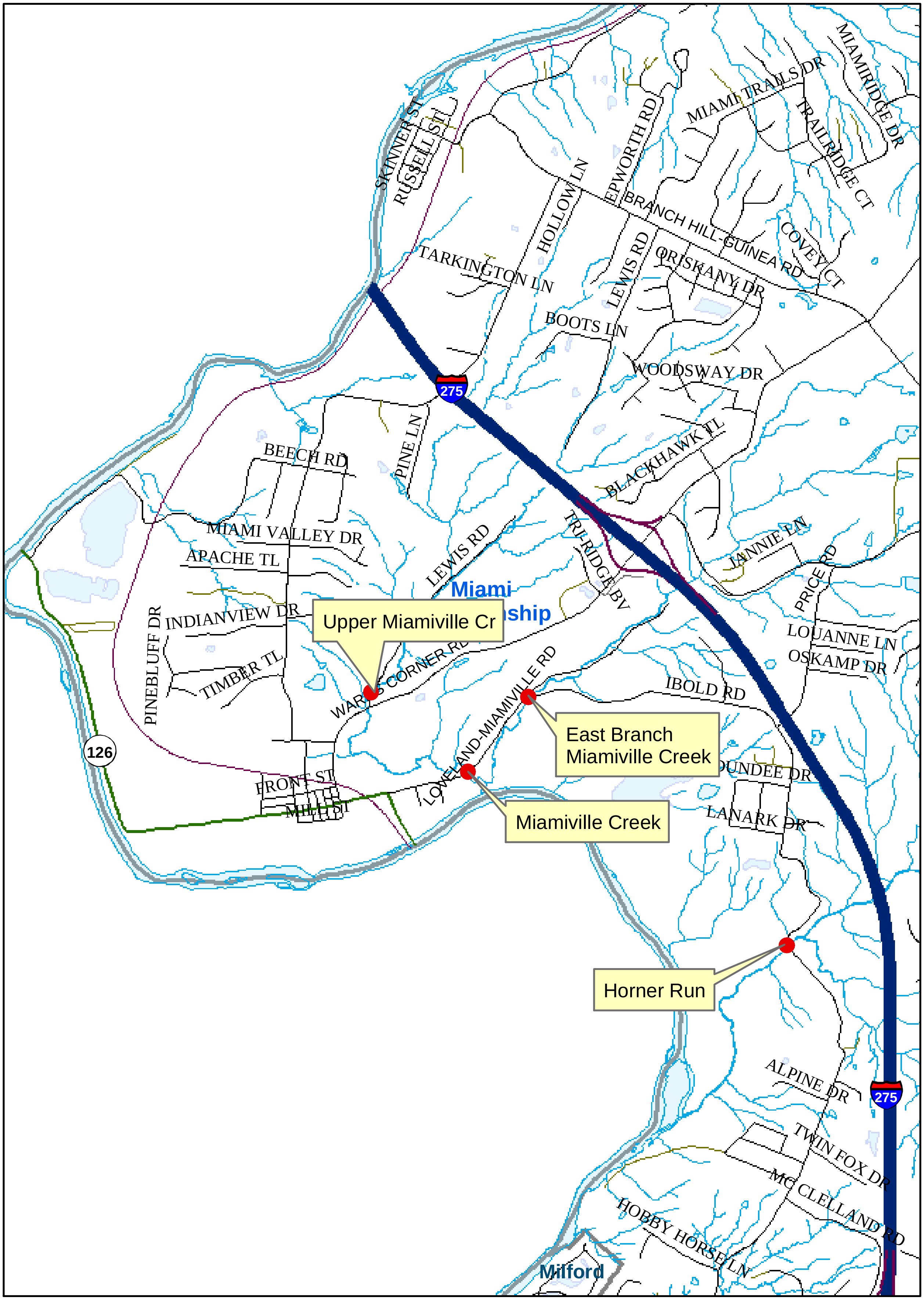
Figure 1: Miamiville Area Stream Sampling Locations
Clermont County, 2004



# Figure 2: Stream Sampling Locations in Hall Run, Shayler Run and Wolfpen Run, Clermont County 2004

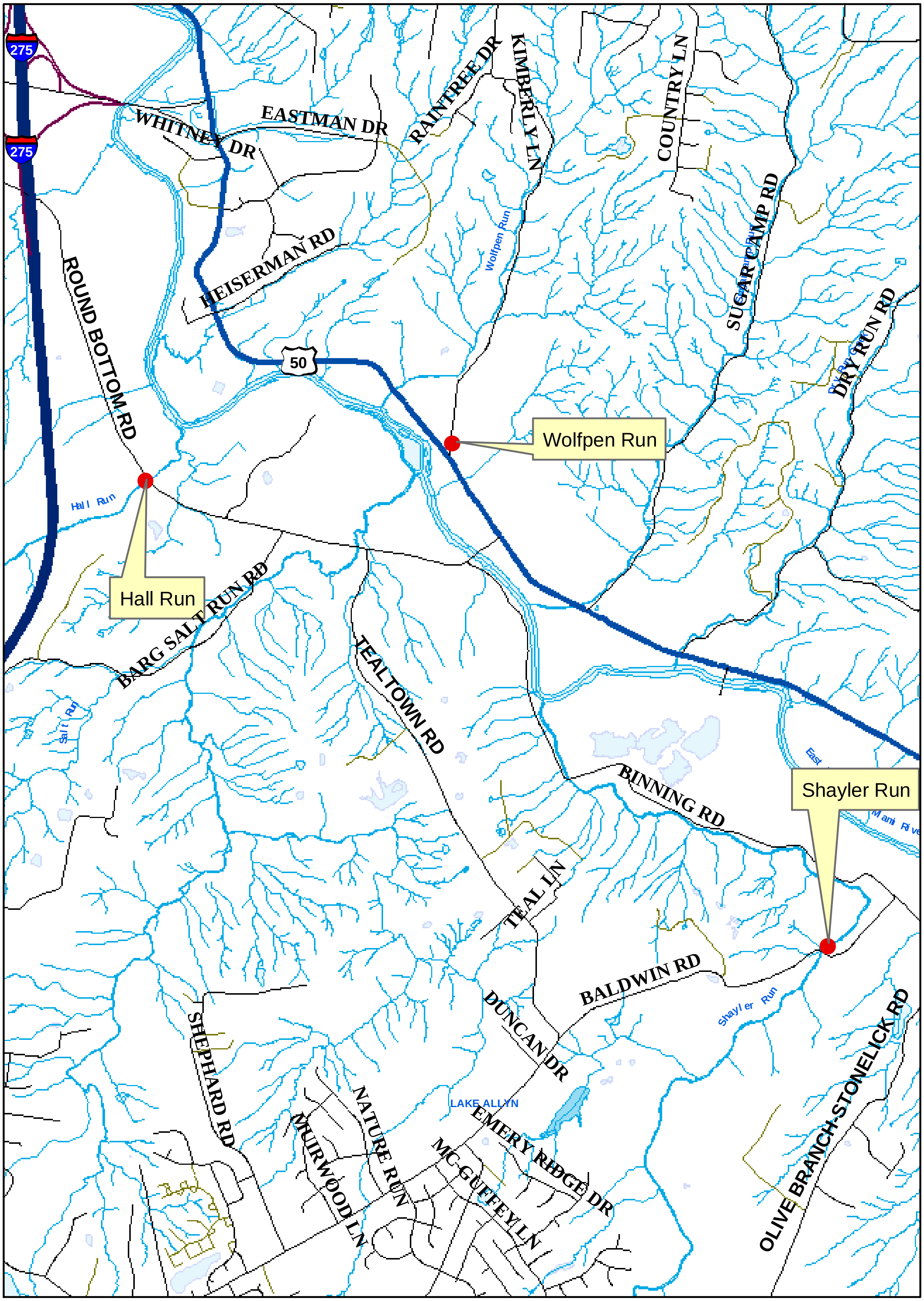


TABLE 1. SPECIES ENCOUNTERED FROM MIAMIVILLE CREEK, EAST BRANCH MIAMIVILLE CREEK, HALL RUN, HORNER RUN, SHAYLER RUN, AND WOLFPEN RUN, JUNE/JULY AND SEPTEMBER 2004.

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| CENTRAL STONEROLLER | Campostoma anomalum |
| SPOTFIN SHINER | Cyprinella spiloptera |
| STRIPED SHINER | Luxilus chrysocephalus |
| SILVERJAW MINNOW | Notropis buccata |
| BLUNTNOSE MINNOW | Pimephales notatus |
| FATHEAD MINNOW | Pimephales promelas |
| BLACKNOSE DACE | Rhinichthys atratulus |
| CREEK CHUB | Semotilus atromaculatus |
| WHITE SUCKER | Catostomus commersoni |
| NORTHERN HOG SUCKER | Hypentelium nigricans |
| YELLOW BULLHEAD | Ameiurus natalis |
| ROCK BASS | Ambloplites rupestris |
| GREEN SUNFISH | Lepomis cyanellus |
| BLUEGILL | Lepomis macrochirus |
| LONGEAR SUNFISH | Lepomis megalotis |
| REDEAR SUNFISH | Lepomis microlophus |
| HYBRID SUNFISH | Lepomis hybrid |
| SMALLMOUTH BASS | Micropterus dolomieu |
| LARGEMOUTH BASS | Micropterus salmoides |
| GREENSIDE DARTER | Etheostoma blennioides |
| RAINBOW DARTER | Etheostoma caeruleum |
| FANTAIL DARTER | Etheostoma flabellare |
| JOHNNY DARTER | Etheostoma nigrum |
| ORANGETHROAT DARTER | Etheostoma spectabile |
| BANDED DARTER | Etheostoma zonale |

TABLE 2. NUMBER AND RELATIVE ABUNDANCE OF FISH COLLECTED FROM UPPER MIAMIVILLE CREEK, MIAMIVILLE CREEK, EAST BRANCH MIAMIVILLE CREEK, HALL RUN, HORNER RUN, SHAYLER RUN, AND WOLFPEN RUN, JUNE/JULY AND SEPTEMBER 2004.

| SPECIES | UPPER MIAMIVILLE CREEK | | MIAMIVILLE CREEK | | EAST BRANCH MIAMIVILLE CREEK | | HALL RUN | | HORNER RUN | | SHAYLER RUN | | WOLFPEN RUN | | SITES COMBINED | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | # | % | # | % | # | % | # | % | # | % | # | % |
| CENTRAL STONEROLLER | 102 | 12.72 | 40 | 6.02 | 19 | 4.59 | 437 | 48.94 | 337 | 34.18 | 261 | 40.72 | 56 | 7.72 | 1,252 | 24.42 |
| SILVERJAW MINNOW | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0.10 | -- | -- | -- | -- | 1 | 0.02 |
| STRIPED SHINER | 1 | 0.12 | -- | -- | -- | -- | 6 | 0.67 | 7 | 0.71 | 12 | 1.87 | 1 | 0.14 | 27 | 0.53 |
| SPOTFIN SHINER | -- | -- | 1 | 0.15 | -- | -- | 1 | 0.11 | 1 | 0.10 | 1 | 0.16 | -- | -- | 4 | 0.08 |
| BLUNTNOSE MINNOW | 3 | 0.37 | 2 | 0.30 | -- | -- | 4 | 0.45 | 12 | 1.22 | 5 | 0.78 | 9 | 1.24 | 35 | 0.68 |
| FATHEAD MINNOW | -- | -- | -- | -- | -- | -- | 2 | 0.22 | -- | -- | -- | -- | 11 | 1.52 | 13 | 0.25 |
| BLACKNOSE DACE | 205 | 25.56 | 129 | 19.40 | 309 | 74.64 | 154 | 17.25 | 285 | 28.90 | 20 | 3.12 | 216 | 29.79 | 1,318 | 25.71 |
| CREEK CHUB | 397 | 49.50 | 444 | 66.77 | 84 | 20.29 | 194 | 21.72 | 239 | 24.24 | 72 | 11.23 | 328 | 45.24 | 1,758 | 34.30 |
| WHITE SUCKER | 58 | 7.23 | 16 | 2.41 | -- | -- | 8 | 0.90 | 13 | 1.32 | 20 | 3.12 | 63 | 8.69 | 178 | 3.47 |
| NORTHERN HOG SUCKER | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0.10 | 4 | 0.62 | -- | -- | 5 | 0.10 |
| YELLOW BULLHEAD | 2 | 0.25 | 4 | 0.60 | -- | -- | 1 | 0.11 | 1 | 0.10 | 7 | 1.09 | 11 | 1.52 | 26 | 0.51 |
| ROCK BASS | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0.16 | -- | -- | 1 | 0.02 |
| GREEN SUNFISH | 25 | 3.12 | 6 | 0.90 | -- | -- | 19 | 2.13 | 10 | 1.01 | 15 | 2.34 | 11 | 1.52 | 86 | 1.68 |
| BLUEGILL | 3 | 0.37 | 16 | 2.41 | 2 | 0.48 | 8 | 0.90 | 3 | 0.30 | 16 | 2.50 | 7 | 0.97 | 55 | 1.07 |
| LONGEAR SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 14 | 2.18 | 2 | 0.28 | 16 | 0.31 |
| REDEAR SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0.14 | 1 | 0.02 |
| HYBRID SUNFISH | -- | -- | 1 | 0.15 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 0.02 |
| SMALLMOUTH BASS | -- | -- | -- | -- | -- | -- | 1 | 0.11 | -- | -- | 1 | 0.16 | 1 | 0.14 | 3 | 0.06 |
| LARGEMOUTH BASS | 6 | 0.75 | 5 | 0.75 | -- | -- | 5 | 0.56 | -- | -- | 11 | 1.72 | 1 | 0.14 | 28 | 0.55 |
| GREENSIDE DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 0.31 | -- | -- | 2 | 0.04 |
| RAINBOW DARTER | -- | -- | 1 | 0.15 | -- | -- | 32 | 3.58 | 35 | 3.55 | 104 | 16.22 | 1 | 0.14 | 173 | 3.37 |
| FANTAIL DARTER | -- | -- | -- | -- | -- | -- | 14 | 1.57 | 34 | 3.45 | 55 | 8.58 | -- | -- | 103 | 2.01 |
| JOHNNY DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 3 | 0.47 | -- | -- | 3 | 0.06 |
| ORANGETHROAT DARTER | -- | -- | -- | -- | -- | -- | 7 | 0.78 | 7 | 0.71 | 15 | 2.34 | 6 | 0.83 | 35 | 0.68 |
| BANDED DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 0.31 | -- | -- | 2 | 0.04 |
| TOTAL FISH | 802 | 100.00 | 665 | 100.00 | 414 | 100.00 | 893 | 100.00 | 986 | 100.00 | 641 | 100.00 | 725 | 100.00 | 5,126 | 100.00 |
| TOTAL SPECIES | 10 | | 11 | | 4 | | 16 | | 15 | | 21 | | 16 | | 24 | |

TABLE 3. NUMBER, CPE (# per 300m), AND RELATIVE ABUNDANCE OF FISH COLLECTED FROM UPPER MIAMIVILLE CREEK, MIAMIVILLE CREEK, EAST BRANCH MIAMIVILLE CREEK, HALL RUN, HORNER RUN, SHAYLER RUN, AND WOLFPEN RUN, JUNE/JULY AND SEPTEMBER 2004.

| | UPPER MIAMIVILLE CREEK | | | | | | MIAMIVILLE CREEK | | | | | | EAST BRANCH MIAMIVILLE CREEK | | | | | | HALL RUN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JULY | | | SEPTEMBER | | | JULY | | | SEPTEMBER | | | JULY | | | SEPTEMBER | | | JULY | | | SEPTEMBER | | |
| SPECIES | NO | CPE | % | NO | CPE | % | NO | CPE | % | NO | CPE | % | NO | CPE | % | NO | CPE | % | NO | CPE | % | NO | CPE | % |
| CENTRAL STONEROLLER | 38 | 57.0 | 10.6 | 64 | 96.0 | 14.4 | 17 | 25.5 | 5.1 | 23 | 34.5 | 6.9 | 14 | 21.0 | 8.1 | 5 | 7.5 | 2.1 | 239 | 358.5 | 54.0 | 198 | 297.0 | 44.0 |
| SILVERJAW MINNOW | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| STRIPED SHINER | -- | -- | -- | 1 | 1.5 | 0.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.2 | 5 | 7.5 | 1.1 |
| SPOTFIN SHINER | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.2 |
| BLUNTNOSE MINNOW | 3 | 4.5 | 0.8 | -- | -- | -- | -- | -- | -- | 2 | 3.0 | 0.6 | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.2 | 3 | 4.5 | 0.7 |
| FATHEAD MINNOW | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 3.0 | 0.4 |
| BLACKNOSE DACE | 79 | 118.5 | 22.1 | 126 | 189.0 | 28.3 | 77 | 115.5 | 23.2 | 52 | 78.0 | 15.6 | 120 | 180.0 | 69.8 | 189 | 283.5 | 78.1 | 42 | 63.0 | 9.5 | 112 | 168.0 | 24.9 |
| CREEK CHUB | 178 | 267.0 | 49.9 | 219 | 328.5 | 49.2 | 228 | 342.0 | 68.7 | 216 | 324.0 | 64.9 | 36 | 54.0 | 20.9 | 48 | 72.0 | 19.8 | 112 | 168.0 | 25.3 | 82 | 123.0 | 18.2 |
| WHITE SUCKER | 33 | 49.5 | 9.2 | 25 | 37.5 | 5.6 | -- | -- | -- | 16 | 24.0 | 4.8 | -- | -- | -- | -- | -- | -- | 6 | 9.0 | 1.4 | 2 | 3.0 | 0.4 |
| NORTHERN HOG SUCKER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| YELLOW BULLHEAD | 1 | 1.5 | 0.3 | 1 | 1.5 | 0.2 | 2 | 3.0 | 0.6 | 2 | 3.0 | 0.6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.2 |
| ROCK BASS | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| GREEN SUNFISH | 21 | 31.5 | 5.9 | 4 | 6.0 | 0.9 | 3 | 4.5 | 0.9 | 3 | 4.5 | 0.9 | -- | -- | -- | -- | -- | -- | 14 | 21.0 | 3.2 | 5 | 7.5 | 1.1 |
| BLUEGILL | -- | -- | -- | 3 | 4.5 | 0.7 | 3 | 4.5 | 0.9 | 13 | 19.5 | 3.9 | 2 | 3.0 | 1.2 | -- | -- | -- | 6 | 9.0 | 1.4 | 2 | 3.0 | 0.4 |
| LONGEAR SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| REDEAR SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| HYBRID SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| SMALLMOUTH BASS | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.2 |
| LARGEMOUTH BASS | 4 | 6.0 | 1.1 | 2 | 3.0 | 0.4 | 1 | 1.5 | 0.3 | 4 | 6.0 | 1.2 | -- | -- | -- | -- | -- | -- | 2 | 3.0 | 0.5 | 3 | 4.5 | 0.7 |
| GREENSIDE DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| RAINBOW DARTER | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 14 | 21.0 | 3.2 | 18 | 27.0 | 4.0 |
| FANTAIL DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6 | 9.0 | 1.4 | 8 | 12.0 | 1.8 |
| JOHNNY DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| ORANGETHROAT DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7 | 10.5 | 1.6 |
| BANDED DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TOTAL FISH | 357 | 535.5 | 100.0 | 445 | 667.5 | 100.0 | 332 | 498.0 | 100.0 | 333 | 499.5 | 100.0 | 172 | 258.0 | 100.0 | 242 | 363.0 | 100.0 | 443 | 664.5 | 100.0 | 450 | 675.0 | 100 |
| TOTAL SPECIES | 8 | | | 9 | | | 8 | | | 10 | | | 4 | | | 3 | | | 11 | | | 16 | | |

TABLE 3 (cont.)

| SPECIES | HORNER RUN | | | | | | SHAYLER RUN | | | | | | WOLFPEN RUN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JULY | | | SEPTEMBER | | | JULY | | | SEPTEMBER | | | JUNE | | | SEPTEMBER | | |
| | NO. | CPE | % | NO. | CPE | % | NO. | CPE | % | NO. | CPE | % | NO. | CPE | % | NO. | CPE | % |
| CENTRAL STONEROLLER | 134 | 201.0 | 30.1 | 203 | 304.5 | 37.5 | 202 | 303.0 | 47.8 | 59 | 88.5 | 27.1 | 20 | 30.0 | 4.8 | 36 | 54.0 | 11.7 |
| SILVERJAW MINNOW | -- | -- | -- | 1 | 1.5 | 0.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| STRIPED SHINER | -- | -- | -- | 7 | 10.5 | 1.3 | 8 | 12.0 | 1.9 | 4 | 6.0 | 1.8 | 1 | 1.5 | 0.2 | -- | -- | -- |
| SPOTFIN SHINER | -- | -- | -- | 1 | 1.5 | 0.2 | -- | -- | -- | 1 | 1.5 | 0.5 | -- | -- | -- | -- | -- | -- |
| BLUNTNOSE MINNOW | 2 | 3.0 | 0.4 | 10 | 15.0 | 1.8 | 1 | 1.5 | 0.2 | 4 | 6.0 | 1.8 | 1 | 1.5 | 0.2 | 8 | 12.0 | 2.6 |
| FATHEAD MINNOW | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7 | 10.5 | 1.7 | 4 | 6.0 | 1.3 |
| BLACKNOSE DACE | 154 | 231.0 | 34.6 | 131 | 196.5 | 24.2 | 8 | 12.0 | 1.9 | 12 | 18.0 | 5.5 | 120 | 180.0 | 28.7 | 96 | 144.0 | 31.3 |
| CREEK CHUB | 95 | 142.5 | 21.3 | 144 | 216.0 | 26.6 | 39 | 58.5 | 9.2 | 33 | 49.5 | 15.1 | 228 | 342.0 | 54.5 | 100 | 150.0 | 32.6 |
| WHITE SUCKER | 7 | 10.5 | 1.6 | 6 | 9.0 | 1.1 | 9 | 13.5 | 2.1 | 11 | 16.5 | 5.0 | 33 | 49.5 | 7.9 | 30 | 45.0 | 9.8 |
| NORTHERN HOG SUCKER | -- | -- | -- | 1 | 1.5 | 0.2 | 2 | 3.0 | 0.5 | 2 | 3.0 | 0.9 | -- | -- | -- | -- | -- | -- |
| YELLOW BULLHEAD | 1 | 1.5 | 0.2 | -- | -- | -- | -- | -- | -- | 7 | 10.5 | 3.2 | -- | -- | -- | 11 | 16.5 | 3.6 |
| ROCK BASS | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.5 | -- | -- | -- | -- | -- | -- |
| GREEN SUNFISH | 2 | 3.0 | 0.4 | 8 | 12.0 | 1.5 | 5 | 7.5 | 1.2 | 10 | 15.0 | 4.6 | 4 | 6.0 | 1.0 | 7 | 10.5 | 2.3 |
| BLUEGILL | 1 | 1.5 | 0.2 | 2 | 3.0 | 0.4 | 10 | 15.0 | 2.4 | 6 | 9.0 | 2.8 | -- | -- | -- | 7 | 10.5 | 2.3 |
| LONGEAR SUNFISH | -- | -- | -- | -- | -- | -- | 6 | 9.0 | 1.4 | 8 | 12.0 | 3.7 | -- | -- | -- | 2 | 3.0 | 0.7 |
| REDEAR SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.3 |
| HYBRID SUNFISH | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| SMALLMOUTH BASS | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 1.5 | 0.5 | -- | -- | -- | 1 | 1.5 | 0.3 |
| LARGEMOUTH BASS | -- | -- | -- | -- | -- | -- | 5 | 7.5 | 1.2 | 6 | 9.0 | 2.8 | -- | -- | -- | 1 | 1.5 | 0.3 |
| GREENSIDE DARTER | -- | -- | -- | -- | -- | -- | 2 | 3.0 | 0.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| RAINBOW DARTER | 27 | 40.5 | 6.1 | 8 | 12.0 | 1.5 | 64 | 96.0 | 15.1 | 40 | 60.0 | 18.3 | -- | -- | -- | 1 | 1.5 | 0.3 |
| FANTAIL DARTER | 18 | 27.0 | 4.0 | 16 | 24.0 | 3.0 | 49 | 73.5 | 11.6 | 6 | 9.0 | 2.8 | -- | -- | -- | -- | -- | -- |
| JOHNNY DARTER | -- | -- | -- | -- | -- | -- | 2 | 3.0 | 0.5 | 1 | 1.5 | 0.5 | -- | -- | -- | -- | -- | -- |
| ORANGETHROAT DARTER | 4 | 6.0 | 0.9 | 3 | 4.5 | 0.6 | 11 | 16.5 | 2.6 | 4 | 6.0 | 1.8 | 4 | 6.0 | 1.0 | 2 | 3.0 | 0.7 |
| BANDED DARTER | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 3.0 | 0.9 | -- | -- | -- | -- | -- | -- |
| TOTAL FISH | 445 | 667.5 | 100.0 | 541 | 811.5 | 100.0 | 423 | 634.5 | 100.0 | 218 | 327.0 | 100.0 | 418 | 627.0 | 100.0 | 307 | 460.5 | 100.0 |
| TOTAL SPECIES | 11 | | | 14 | | | 16 | | | 20 | | | 9 | | | 15 | | |

TABLE 4. IBI METRICS AND SCORES FOR HEADWATER SITES ON UPPER MIAMIVILLE CREEK, MIAMIVILLE CREEK, EAST BRANCH MIAMIVILLE CREEK, HALL RUN, HORNER RUN, SHAYLER RUN, AND WOLFPEN RUN, JUNE/JULY AND SEPTEMBER 2004.

| DATE | LOCATION | GEAR | DRAREA | IBITOTAL | NUMSPEC | NUMSCORE | MINNOW | MINSCORE | DARSCULP | DARSCORE | HEADWAT | HEASCORE | SENSITIV | INTSCORE | NONTCPE | NONSCORE | TOLPCT | TOLSCORE | PIONRPCT | PIOSCORE | OMNIPCT | OMISCORE | INSCTPCT | INSSCORE | LITHONO | LITSCORE | DELTAPCT | DELSCORE | TOTCPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER MIAMIVILLE CREEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01JUL04 | 1.0 | K | 1.6 | 26 | 8 | 5 | 4 | 3 | 0 | 1 | 1 | 1 | 0 | 1 | 63.0 | 3 | 88.2 | 1 | 56.6 | 1 | 10.1 | 3 | 6.2 | 1 | 2.0 | 3 | 0.8 | 3 | 535.5 |
| 16SEP04 | 1.0 | K | 1.6 | 34 | 9 | 5 | 4 | 3 | 0 | 1 | 1 | 1 | 0 | 1 | 105.0 | 3 | 84.3 | 1 | 50.1 | 3 | 5.6 | 5 | 2.0 | 1 | 3.0 | 5 | 0.2 | 5 | 667.5 |
| MIAMIVILLE CREEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01JUL04 | 0.2 | K | 1.9 | 28 | 8 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 33.0 | 1 | 93.4 | 1 | 69.6 | 1 | 0.0 | 5 | 2.7 | 1 | 2.0 | 3 | 0.0 | 5 | 498.0 |
| 16SEP04 | 0.2 | K | 1.9 | 32 | 10 | 5 | 5 | 5 | 0 | 1 | 1 | 1 | 0 | 1 | 63.0 | 3 | 87.4 | 1 | 66.4 | 1 | 5.4 | 5 | 5.7 | 1 | 2.0 | 3 | 0.3 | 5 | 499.5 |
| EAST BRANCH MIAMIVILLE CREEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01JUL04 | 0.5 | K | 1.4 | 28 | 4 | 3 | 3 | 3 | 0 | 1 | 1 | 1 | 0 | 1 | 24.0 | 1 | 90.7 | 1 | 20.9 | 5 | 0.0 | 5 | 1.2 | 1 | 1.0 | 1 | 0.0 | 5 | 258.0 |
| 16SEP04 | 0.5 | K | 1.4 | 26 | 3 | 1 | 3 | 3 | 0 | 1 | 1 | 1 | 0 | 1 | 7.5 | 1 | 97.9 | 1 | 19.8 | 5 | 0.0 | 5 | 0.0 | 1 | 1.0 | 1 | 0.0 | 5 | 363.0 |
| HALL RUN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 02JUL04 | 0.6 | K | 4.8 | 38 | 11 | 3 | 5 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 402.0 | 3 | 39.5 | 3 | 28.7 | 5 | 1.6 | 5 | 9.3 | 1 | 4.0 | 3 | 0.0 | 5 | 664.5 |
| 15SEP04 | 0.6 | K | 4.8 | 46 | 16 | 5 | 7 | 5 | 3 | 3 | 2 | 3 | 2 | 3 | 364.5 | 3 | 46.0 | 3 | 22.0 | 5 | 1.6 | 5 | 10.4 | 1 | 5.0 | 5 | 0.0 | 5 | 675.0 |
| HORNER RUN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 02JUL04 | 0.8 | K | 4.8 | 36 | 11 | 3 | 4 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 276.0 | 3 | 58.7 | 1 | 23.1 | 5 | 2.0 | 5 | 11.9 | 1 | 4.0 | 3 | 0.0 | 5 | 667.5 |
| 16SEP04 | 0.8 | K | 4.8 | 44 | 14 | 5 | 7 | 5 | 3 | 3 | 2 | 3 | 2 | 3 | 363.0 | 3 | 55.3 | 3 | 30.7 | 3 | 3.0 | 5 | 8.7 | 1 | 6.0 | 5 | 0.0 | 5 | 811.5 |
| SHAYLER RUN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 02JUL04 | 1.7 | L | 12.3 | 50 | 16 | 5 | 5 | 3 | 5 | 5 | 2 | 3 | 4 | 3 | 541.5 | 3 | 14.7 | 5 | 13.7 | 5 | 2.4 | 5 | 37.6 | 3 | 7.0 | 5 | 0.0 | 5 | 634.5 |
| 15SEP04 | 1.7 | K | 12.3 | 48 | 20 | 5 | 6 | 3 | 5 | 5 | 2 | 3 | 5 | 3 | 211.5 | 3 | 35.3 | 3 | 23.9 | 5 | 6.9 | 5 | 41.7 | 3 | 7.0 | 5 | 0.5 | 5 | 327.0 |
| WOLFPEN RUN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30JUN04 | 0.1 | K | 1.2 | 34 | 9 | 5 | 6 | 5 | 1 | 3 | 1 | 1 | 0 | 1 | 37.5 | 3 | 94.0 | 1 | 58.4 | 1 | 9.8 | 3 | 2.2 | 1 | 4.0 | 5 | 0.0 | 5 | 627.0 |
| 15SEP04 | 0.1 | K | 1.2 | 42 | 14 | 5 | 5 | 5 | 2 | 5 | 1 | 1 | 3 | 5 | 76.5 | 3 | 83.4 | 1 | 39.4 | 3 | 13.7 | 3 | 10.1 | 1 | 4.0 | 5 | 0.0 | 5 | 460.5 |

NOTE: K=BACKPACK ELECTROFISHING; L=LONGLINE ELECTROFISHING.

Table 5. Summary of qualitative macroinvertebrate results for Miamiville Creek and East Branch Miamiville Creek, July and September, 2004. T=Tolerant, MT=Moderately Tolerant, I=Intolerant, MI=Moderately Intolerant, and F=facultative.

| Environ. | | Upper Miamiville Creek | | | | Miamiville Creek | | | | East Branch Miamiville Creek | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | | September | | July | | September | | July | | September | |
| Tolerance | Taxa | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV |
| | **PLATYHELMINTHES (flatworms)** | | | | | | | | | | | | |
| -- | **Turbellaria** | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 |
| | **ANNELIDA** | | | | | | | | | | | | |
| T | **Oligochaeta (aquatic worms)** | + | 14.8 | -- | -- | + | 14.8 | + | 14.8 | + | 14.8 | + | 14.8 |
| | **CRUSTACEA** | | | | | | | | | | | | |
| | **Isopoda (sow bugs)** | | | | | | | | | | | | |
| F | *Lirceus* | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 |
| | **Amphipoda (side swimmers)** | | | | | | | | | | | | |
| MT | *Crangonyx* | + | 20.8 | + | 20.8 | + | 20.8 | + | 20.8 | + | 20.8 | + | 20.8 |
| | **INSECTA** | | | | | | | | | | | | |
| | **Ephemeroptera (mayflies)** | | | | | | | | | | | | |
| F | *Baetis flavistriga* | + | 43.3 | + | 43.3 | -- | -- | -- | -- | -- | -- | + | 43.3 |
| F | *Stenonema femoratum* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 43.5 |
| MI | *Paraleptophlebia* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 44.5 |
| | **Odonata (damselflies and dragonflies)** | | | | | | | | | | | | |
| F | *Calopteryx* | + | 39.3 | + | 39.3 | + | 39.3 | + | 39.3 | -- | -- | + | 39.3 |
| F | *Argia* | -- | -- | -- | -- | + | 32.6 | -- | -- | -- | -- | -- | -- |
| -- | *Enallagma* | -- | -- | + | -- | + | -- | -- | -- | -- | -- | -- | -- |
| F | *Aeshna* | -- | -- | + | 29.8 | + | 29.8 | -- | -- | -- | -- | -- | -- |
| T | *Somatochlora* | + | 18.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | **Hemiptera (true bugs)** | | | | | | | | | | | | |
| -- | *Limnoporus* | + | -- | -- | -- | + | -- | -- | -- | + | -- | + | -- |
| | **Trichoptera (caddisflies)** | | | | | | | | | | | | |
| MI | *Polycentropus* | -- | -- | -- | -- | + | 40.9 | -- | -- | + | 40.9 | -- | -- |
| F | *Diplectrona modesta* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 43.3 |
| F | *Cheumatopsyche* | -- | -- | -- | -- | + | 43.2 | + | 43.2 | + | 43.2 | -- | -- |
| F | *Hydropsyche depravata* grp. | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 |
| MI | *Ceratopsyche morosa* | -- | -- | -- | -- | + | 45.4 | -- | -- | + | 45.4 | + | 45.4 |
| F | *Hydroptila* | -- | -- | -- | -- | -- | -- | -- | -- | + | 41.9 | -- | -- |

Table 5. (cont.)

| Environ. Tolerance | Taxa | Upper Miamiville Creek | | | | Miamiville Creek | | | | East Branch Miamiville Creek | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | | September | | July | | September | | July | | September | |
| | | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV |
| | **Coleoptera (cont.)** | | | | | | | | | | | | |
| **T** | *Laccophilus maculosus* | -- | -- | -- | -- | -- | -- | -- | -- | + | 12.6 | -- | -- |
| **MI** | *Ancyronyx variegata* | + | 39.1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Stenelmis* | + | 42.3 | -- | -- | + | 42.3 | + | 42.3 | + | 42.3 | -- | -- |
| **MI** | *Psephenus herricki* | -- | -- | + | 43.6 | -- | -- | + | 43.6 | + | 43.6 | + | 43.6 |
| | **Diptera (true flies)** | | | | | | | | | | | | |
| **F** | *Anopheles* | -- | -- | -- | -- | + | -- | + | -- | -- | -- | -- | -- |
| **F** | *Simulium* | + | 33.8 | -- | -- | -- | -- | -- | -- | -- | -- | + | 33.8 |
| **F** | *Tipula* | + | 37.5 | + | 37.5 | + | 37.5 | + | 37.5 | -- | -- | -- | -- |
| | **Chironomidae (midges)** | | | | | | | | | | | | |
| **T** | *Natarsia* sp. A | + | 15.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Ablabesmyia mallochi* | + | 33.1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Thienemannimyia* grp. | + | 29.9 | -- | -- | -- | -- | -- | -- | + | 29.9 | -- | -- |
| **MT** | *Cricotopus bicinctus* grp. | + | 23.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Parametriocnemus* | + | 42.9 | -- | -- | -- | -- | -- | -- | + | 42.9 | -- | -- |
| **T** | *Chironomus* | -- | -- | + | 13.5 | -- | -- | + | 13.5 | -- | -- | -- | -- |
| **F** | *Dicrotendipes neomodestus* | -- | -- | + | 33.8 | + | 33.8 | -- | -- | -- | -- | -- | -- |
| **MI** | *Microtendipes* | -- | -- | -- | -- | + | 45.1 | + | 45.1 | + | 45.1 | -- | -- |
| **--** | *Paratendipes* | + | 31.3 | + | 31.3 | + | 31.3 | + | 31.3 | -- | -- | -- | -- |
| **F** | *Polypedilum flavum* | + | 39.4 | -- | -- | -- | -- | + | 39.4 | + | 39.4 | + | 39.4 |
| **T** | *Polypedilum illinoense* | -- | -- | -- | -- | -- | -- | -- | -- | + | 16.5 | + | 16.5 |
| **F** | *Stenochironomus* | -- | -- | -- | -- | + | 39.7 | -- | -- | -- | -- | -- | -- |
| **F** | *Tribelos fuscicorne* | + | 26.7 | -- | -- | + | 26.7 | -- | -- | -- | -- | -- | -- |
| **F** | *Cladotanytarsus mancus* grp. | -- | -- | + | 39.7 | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Paratanytarsus* | + | 36.8 | + | 36.8 | + | 36.8 | -- | -- | -- | -- | + | 36.8 |
| **MI** | *Rheotanytarsus* | -- | -- | + | 44.0 | -- | -- | + | 44.0 | -- | -- | + | 44.0 |
| **MI** | *Tanytarsus* | -- | -- | -- | -- | + | 39.7 | -- | -- | -- | -- | -- | -- |
| **F** | *Tanytarsus glabrescens* grp. | -- | -- | + | 41.1 | + | 41.1 | -- | -- | + | 41.1 | -- | -- |
| **F** | *Tanytarsus guerlus* grp. | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 39.7 |

Table 5. (cont.)

| Environ. Tolerance | Taxa | Upper Miamiville Creek July Qual. | Upper Miamiville Creek July QCTV | Upper Miamiville Creek September Qual. | Upper Miamiville Creek September QCTV | Miamiville Creek July Qual. | Miamiville Creek July QCTV | Miamiville Creek September Qual. | Miamiville Creek September QCTV | East Branch Miamiville Creek July Qual. | East Branch Miamiville Creek July QCTV | East Branch Miamiville Creek September Qual. | East Branch Miamiville Creek September QCTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **MOLLUSCA** | | | | | | | | | | | | |
| | **Gastropoda (snails)** | | | | | | | | | | | | |
| **T** | *Physa* | -- | -- | -- | -- | + | 15.4 | -- | -- | + | 15.4 | -- | -- |
| | **Pelecypoda (clams & mussels)** | | | | | | | | | | | | |
| **F** | *Pisidium* | + | 33.9 | + | 33.9 | + | 33.9 | -- | -- | -- | -- | -- | -- |
| | **TOTAL TAXA RICHNESS** | | 23 | | 18 | | 26 | | 16 | | 20 | | 19 |
| | **EPT TAXA RICHNESS** | | 2 | | 2 | | 4 | | 2 | | 5 | | 6 |
| | **QCTV SCORE** | | 33.8 | | 36.8 | | 36.8 | | 39.3 | | 39.7 | | 39.6 |

Table 6. Summary of qualitative macroinvertebrate results for Hall Run, Horner Run, Shayler Run, and Wolfpen Creek, June/July and September, 2004. T=Tolerant, MT=Moderately Tolerant, I=Intolerant, MI=Moderately Intolerant, F=facultative.

| | | Hall Run | | | | Horner Run | | | | Shayler Run | | | | Wolfpen Run | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Environ. | | June | | September | | July | | September | | July | | September | | June | | September | |
| Tolerance | Taxa | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV |
| | **PLATYHELMINTHES (flatworms)** | | | | | | | | | | | | | | | | |
| **--** | **Turbellaria** | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 | + | 26.8 | -- | -- |
| | **ANNELIDA** | | | | | | | | | | | | | | | | |
| **T** | **Oligochaeta (aquatic worms)** | + | 14.8 | + | 14.8 | + | 14.8 | -- | -- | + | 14.8 | + | 14.8 | + | 14.8 | -- | -- |
| | **CRUSTACEA** | | | | | | | | | | | | | | | | |
| | **Isopoda (sow bugs)** | | | | | | | | | | | | | | | | |
| **F** | *Lirceus* | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 | + | 35.1 |
| | **Amphipoda (side swimmers)** | | | | | | | | | | | | | | | | |
| **MT** | *Crangonyx* | -- | -- | -- | -- | -- | -- | -- | -- | + | 20.8 | -- | -- | + | 20.8 | -- | -- |
| | **Decapoda (crayfish)** | | | | | | | | | | | | | | | | |
| **F** | *Orconectes rusticus* | + | 33.3 | -- | -- | -- | -- | -- | -- | + | 33.3 | + | 33.3 | + | 33.3 | -- | -- |
| | **INSECTA** | | | | | | | | | | | | | | | | |
| | **Ephemeroptera (mayflies)** | | | | | | | | | | | | | | | | |
| **F** | *Baetis intercalaris* | -- | -- | -- | -- | -- | -- | -- | -- | + | 47.0 | -- | -- | -- | -- | + | 47.0 |
| **F** | *Baetis flavistriga* | + | 43.3 | + | 43.3 | + | 43.3 | + | 43.3 | + | 43.3 | -- | -- | + | 43.3 | + | 43.3 |
| **MT** | *Callibaetis* | -- | -- | + | 24.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Stenonema femoratum* | + | 43.5 | + | 43.5 | -- | -- | -- | -- | + | 43.5 | + | 43.5 | -- | -- | -- | -- |
| **F** | *Caenis* | + | 42.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | **Odonata (damselflies and dragonflies)** | | | | | | | | | | | | | | | | |
| **F** | *Calopteryx* | -- | -- | + | 39.3 | -- | -- | -- | -- | -- | -- | + | 39.3 | -- | -- | + | 39.3 |
| **F** | *Argia* | -- | -- | -- | -- | -- | -- | -- | -- | + | 32.6 | + | 32.6 | -- | -- | -- | -- |
| **F** | *Boyeria vinosa* | -- | -- | -- | -- | -- | -- | -- | -- | + | 40.4 | + | 40.4 | -- | -- | -- | -- |
| **T** | *Pachydiplax longipennis* | -- | -- | + | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | **Hemiptera (true bugs)** | | | | | | | | | | | | | | | | |
| **--** | *Metrobates* | -- | -- | -- | -- | + | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **--** | *Limnoporus* | + | -- | -- | -- | + | -- | -- | -- | -- | -- | + | -- | + | -- | -- | -- |
| **--** | *Trepobates* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | -- | -- | -- | -- | -- |
| **F** | *Trichocorixa* | + | 36.9 | -- | -- | + | 36.9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | **Trichoptera (caddisflies)** | | | | | | | | | | | | | | | | |
| **MI** | *Chimarra obscura* | -- | -- | + | 43.7 | -- | -- | + | 43.7 | + | 43.7 | -- | -- | -- | -- | -- | -- |

Table 6. (cont.)

| Environ. | | Hall Run | | | | Horner Run | | | | Shayler Run | | | | Wolfpen Run | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | June | | September | | July | | September | | July | | September | | June | | September | |
| Tolerance | Taxa | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV | Qual. | QCTV |
| | **Trichoptera (cont.)** | | | | | | | | | | | | | | | | |
| **F** | *Cyrnellus fraternus* | + | 29.0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Polycentropus* | + | 40.9 | + | 40.9 | + | 40.9 | -- | -- | -- | -- | -- | -- | + | 40.9 | -- | -- |
| **F** | *Diplectrona modesta* | + | 43.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 43.3 | -- | -- |
| **F** | *Cheumatopsyche* | + | 43.2 | + | 43.2 | + | 43.2 | + | 43.2 | + | 43.2 | + | 43.2 | + | 43.2 | + | 43.2 |
| **F** | *Hydropsyche depravata* grp. | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 | + | 39.7 |
| **MI** | *Ceratopsyche morosa* | + | 45.4 | -- | -- | + | 45.4 | + | 45.4 | + | 45.4 | + | 45.4 | + | 45.4 | -- | -- |
| **F** | *Hydroptila* | + | 41.9 | + | 41.9 | + | 41.9 | -- | -- | + | 41.9 | -- | -- | -- | -- | -- | -- |
| **I** | *Neophylax* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 42.0 | -- | -- |
| | **Coleoptera (beetles)** | | | | | | | | | | | | | | | | |
| **F** | *Stenelmis* | -- | -- | -- | -- | + | 42.3 | -- | -- | + | 42.3 | + | 42.3 | -- | -- | -- | -- |
| **MT** | *Tropisternus* | -- | -- | + | 10.2 | + | 10.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **MT** | *Berosus* | + | 22.9 | + | 22.9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Paracymus* | + | 48.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Enochrus* | + | 32.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Ectopria* | -- | -- | -- | -- | -- | -- | + | 40.9 | -- | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Psephenus herricki* | -- | -- | + | 43.6 | + | 43.6 | + | 43.6 | + | 43.6 | + | 43.6 | -- | -- | -- | -- |
| | **Diptera (true flies)** | | | | | | | | | | | | | | | | |
| **F** | *Anopheles* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | -- | -- | -- |
| **F** | *Simulium* | + | 33.8 | + | 33.8 | + | 33.8 | + | 33.8 | + | 33.8 | -- | -- | + | 33.8 | + | 33.8 |
| **F** | *Tipula* | -- | -- | + | 37.5 | -- | -- | -- | -- | + | 37.5 | + | 37.5 | -- | -- | -- | -- |
| **MI** | *Antocha* | -- | -- | -- | -- | + | 46.1 | -- | -- | + | 46.1 | -- | -- | -- | -- | -- | -- |
| **F** | *Pilaria* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | -- | -- | -- |
| **--** | Muscidae | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 27.0 | -- | -- |
| | **Chironomidae (midges)** | | | | | | | | | | | | | | | | |
| **MT** | *Procladius (Holotanypus)* | -- | -- | -- | -- | -- | -- | -- | -- | + | 33.2 | -- | -- | -- | -- | -- | -- |
| **F** | *Ablabesmyia mallochi* | + | 33.1 | + | 33.1 | + | 33.1 | -- | -- | + | 33.1 | -- | -- | -- | -- | + | 33.1 |
| **F** | *Thienemannimyia* grp. | + | 29.9 | -- | -- | + | 29.9 | -- | -- | -- | -- | -- | -- | + | 29.9 | -- | -- |
| **MT** | *Cricotopus bicinctus* grp. | + | 23.2 | -- | -- | + | 23.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Cricotopus trifascia grp.* | -- | -- | -- | -- | + | 39.7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **--** | *Eukiefferiella* | -- | -- | -- | -- | + | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

Table 6. (cont.)

| Environ. Tolerance | Taxa | Hall Run June Qual. | Hall Run June QCTV | Hall Run September Qual. | Hall Run September QCTV | Horner Run July Qual. | Horner Run July QCTV | Horner Run September Qual. | Horner Run September QCTV | Shayler Run July Qual. | Shayler Run July QCTV | Shayler Run September Qual. | Shayler Run September QCTV | Wolfpen Run June Qual. | Wolfpen Run June QCTV | Wolfpen Run September Qual. | Wolfpen Run September QCTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Chironomidae (cont.)** | | | | | | | | | | | | | | | | |
| **T** | *Hydrobaenus* | -- | -- | -- | -- | -- | -- | -- | -- | + | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Parametriocnemus* | -- | -- | -- | -- | -- | -- | -- | -- | + | 42.9 | -- | -- | + | 42.9 | + | 42.9 |
| **MI** | *Rheocricotopus robacki* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 38.1 |
| **T** | *Chironomus* | -- | -- | + | 13.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Cryptochironomus* | + | 33.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Dicrotendipes neomodestus* | + | 33.8 | + | 33.8 | -- | -- | -- | -- | + | 33.8 | -- | -- | -- | -- | -- | -- |
| **F** | *Dicrotendipes fumidus* | + | 21.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Microtendipes* | -- | -- | -- | -- | + | 45.1 | -- | -- | + | 45.1 | -- | -- | -- | -- | -- | -- |
| **--** | *Paratendipes* | + | 31.3 | -- | -- | -- | -- | -- | -- | -- | -- | + | 31.3 | -- | -- | + | 31.3 |
| **F** | *Phaenopsectra punctipes* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 31.0 | + | 31.0 |
| **F** | *Polypedilum fallax* grp. | -- | -- | -- | -- | -- | -- | + | 32.4 | -- | -- | -- | -- | + | 32.4 | + | 32.4 |
| **F** | *Polypedilum flavum* | -- | -- | + | 39.4 | + | 39.4 | + | 39.4 | + | 39.4 | -- | -- | + | 39.4 | -- | -- |
| **T** | *Polypedilum illinoense* | -- | -- | -- | -- | + | 16.5 | -- | -- | + | 16.5 | -- | -- | + | 16.5 | -- | -- |
| **F** | *Stictochironomus* | + | 32.6 | -- | -- | + | 32.6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Tribelos fuscicorne* | + | 26.7 | + | 26.7 | + | 26.7 | + | 26.7 | + | 26.7 | -- | -- | + | 26.7 | + | 26.7 |
| **F** | *Cladotanytarsus mancus* grp. | -- | -- | -- | -- | -- | -- | -- | -- | + | 39.7 | -- | -- | -- | -- | -- | -- |
| **F** | *Paratanytarsus* | + | 36.8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **MI** | *Rheotanytarsus* | -- | -- | -- | -- | + | 44.0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **F** | *Tanytarsus glabrescens* grp. | + | 41.1 | -- | -- | -- | -- | -- | -- | + | 41.1 | -- | -- | -- | -- | -- | -- |
| **F** | *Tanytarsus guerlus* grp. | -- | -- | + | 39.7 | -- | -- | -- | -- | + | 39.7 | + | 39.7 | -- | -- | + | 39.7 |
| | **MOLLUSCA** | | | | | | | | | | | | | | | | |
| | **Gastropoda (snails)** | | | | | | | | | | | | | | | | |
| **MI** | *Elimia* | -- | -- | -- | -- | -- | -- | -- | -- | + | 36.6 | + | 36.6 | -- | -- | -- | -- |
| **T** | *Physa* | + | 15.4 | + | 15.4 | -- | -- | -- | -- | -- | -- | + | 15.4 | + | 15.4 | -- | -- |
| **F** | *Ferrissia* | + | 33.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | **Pelecypoda (clams & mussels)** | | | | | | | | | | | | | | | | |
| **F** | *Pisidium* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | + | 33.9 | -- | -- |
| | **TOTAL TAXA RICHNESS** | | 33 | | 25 | | 28 | | 13 | | 33 | | 20 | | 26 | | 15 |
| | **EPT TAXA RICHNESS** | | 10 | | 8 | | 6 | | 5 | | 8 | | 4 | | 7 | | 4 |
| | **QCTV SCORE** | | 33.6 | | 36.3 | | 39.4 | | 39.7 | | 39.7 | | 38.4 | | 33.8 | | 38.1 |

Table 7. Summary of Mean QHEI Metric Scores at Seven Headwater Sites in Clermont County, Ohio, June/July and September 2004.

| Stream/Station | Substrate | Cover | Channel | Riparian | Pool/Current | Riffle/Run | Gradient | **QHEI Score** |
|---|---|---|---|---|---|---|---|---|
| Upper Miamiville Creek @ Lewis Rd. (RM 1.0) | 13.5 | 10 | 14.5 | 8 | 9 | 0 | 4 | 59.0 |
| Miamiville Creek @ Loveland-Miamiville Rd. (RM 0.2) | 12.5 | 12 | 13.5 | 8.25 | 7 | 0 | 8 | 61.3 |
| East Branch Miamiville Creek @ Ibold Rd. (RM 0.5) | 15 | 6 | 14 | 9 | 8 | 0 | 4 | 56.0 |
| Hall Run @ Round-bottom Rd. (RM 0.4) | 19.5 | 12 | 12 | 7.25 | 5 | 0 | 4 | 59.8 |
| Horner Run @ Ibold Rd. (RM 0.8) | 15.5 | 9.5 | 14.5 | 9.5 | 10 | 4 | 4 | 67.0 |
| Shayler Run @ Baldwin Rd. (RM 1.7) | 13.5 | 11.5 | 14 | 7 | 10 | 4 | 4 | 64.0 |
| Wolfpen Run @ U.S. Rt. 50 (RM 0.1) | 18 | 12 | 15.5 | 6.5 | 8 | 4 | 4 | 68.0 |

Table 8. Water Quality Measurements from Seven Headwater Sites in Clermont County, OH, June/July and September, 2004.

| Stream/Station | Temperature (C) | | Dissolved Oxygen (mg/l) | | Specific Conductance (uS/cm) | | Secchi (cm) | | pH | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Jun/Jul | Sept | Jun/Jul | Sept | Jun/Jul | Sept | Jun/Jul | Sept | Jun/Jul | Sept |
| Upper Miamiville Creek @ Lewis Rd. (RM 1.0) | 18.6 | 18.9 | 9.7 | 5.2 | 830 | 1215 | >100 | >120 | 9.3 | 7.7 |
| Miamiville Creek @ Loveland-Miamiville Rd. (RM 0.2) | 18.8 | 21.2 | 4.7 | 5.6 | 928 | 1520 | >100 | >80 | 8.6 | 7.9 |
| East Branch Miamiville Creek @ Ibold Rd. (RM 0.5) | 21.4 | 22.3 | 7.9 | 8.7 | 1149 | 1000 | >70 | >60 | 8.6 | 8.3 |
| Hall Run @ Round-bottom Rd. (RM 0.4) | 21.3 | 24.6 | 8.4 | 6.5 | 736 | 494 | >90 | >50 | 8.6 | 8.4 |
| Horner Run @ Ibold Rd. (RM 0.8) | 19.7 | 21.2 | 7.6 | 10.5 | 810 | 887 | >90 | >80 | 8.7 | 8.4 |
| Shayler Run @ Baldwin Rd. (RM 1.7) | 25.8 | 19.4 | 8.9 | 7.1 | 378 | 503 | 24 | >100 | 9.0 | - |
| Wolfpen Run @ U.S. Rt. 50 (RM 0.1) | 21.7 | 22.3 | 8.3 | 8.7 | 793 | 793 | >100 | >100 | 8.7 | 8.3 |
| Mean | 21.5 | 21.8 | 7.6 | 7.9 | 799 | 866 | - | - | 8.7 | 8.3 |