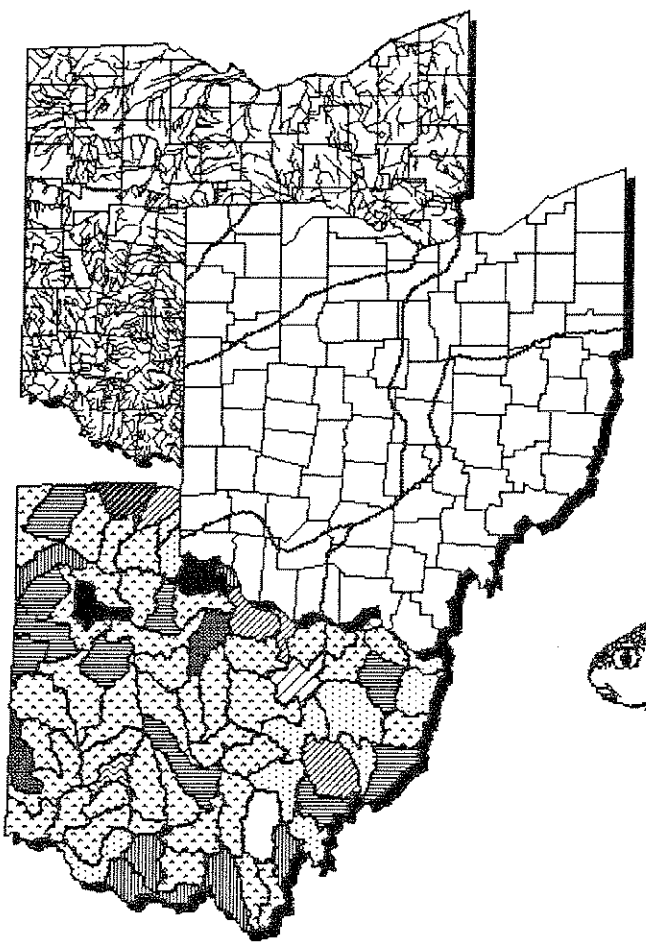
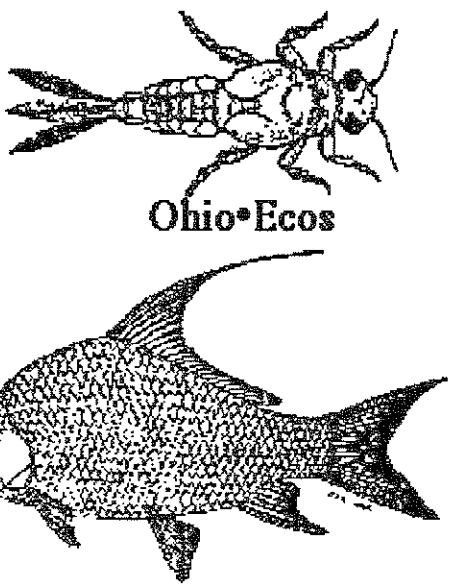
State of Ohio
Environmental Protection Agency

Ecological Assessment Section
Division of Water Quality
Planning & Assessment

Biological Community Status of the Lower Ashtabula River and Harbor Within the Area of Concern (AoC)

Ashtabula County, Ohio





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(Ashtabula County, Ohio)

Technical Report EAS/1992-6-2

prepared by

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Introduction

The Ashtabula River has a long history of environmental impact from industrial activities. Some of these impacts have been abundantly documented by federal and private researchers (US Fish and Wildlife 1984, CH_2M Hill 1985, White and Alldridge (1981), US Army Corps of Engineers 1983, and US EPA 1975) and will not be discussed in this report. Attention, in this report, will be focused on the present day effects of pollution on the biological communities of the Ashtabula River in an effort to develop numerical values to be used in a Natural Resource Damage Assessment (NRDA). Anecdotal information from area residents indicate that biological conditions in the Ashtabula have been much worse in the past especially in the late 1950s and early 1960s. The near complete lack of extensive quantified biological studies prior to White and Alldridge (1981) makes it impossible to do more than speculate that historic impacts were greater than present day impacts.

Study Area

(Figures 10 and 11)

The study area for this report consisted of the Ashtabula River from river mile (RM) 10.0 downstream to the mouth and included the harbor area enclosed by the breakwaters (Figure 10). A similar area of Conneaut Creek began at RM 6.7 and ended in a similar harbor area of the creek (Figure 11). A detailed description of the Ashtabula River study area was given by CH_2M Hill (1985) which included physiography, geology, soils, and a general basin description. Conditions in Conneaut Creek are similar to those in the Ashtabula River for the above mentioned factors. Shoreline development in the Ashtabula River estuary has been much greater than that in Conneaut Creek. The lower 0.7 miles of stream channel has been modified for use by international freighters. In Conneaut Creek the lower 0.5 miles have also been developed for such shipping. The channels have been dredged to a depth of approximately 25 feet with the shoreline steel, concrete, or railroad tie vertical bulkhead. Habitat quality for supporting fish communities is very poor in the ship channels. Both the Ashtabula River and Conneaut Creek have coal handling facilities along the shipping channel areas.

Upstream from the ship channels the types of disturbances to the stream channel differ for the two streams. In the Ashtabula River, marina development exists on about 50% of the river's shoreline from RM 0.7 to RM 2.2 with some undisturbed shoreline still present along the east banks. Upstream from RM 2.2 the channel is undisturbed. In Conneaut Creek there are no marinas, but vertical bulkheading adjacent to the railroad tracks on the west shore and bank reshaping from RM 1.0 to 1.5 on the east shore alter instream habitat. Undisturbed shoreline exists upstream from RM 2.0.

Data from other estuary areas have been included in this study to provide comparisons to the Ashtabula River study area. The Maumee River, Black River, and Cuyahoga River have been included as they are the other Areas of Concern (AOC) in Ohio . The Grand River is included as the western adjacent estuary and the Vermilion River is included as an estuary with similar marina development, but lacking the industrial impacts and was chosen as a suitable reference area .

Methods

Fish community sampling followed Ohio EPA (1989a,b) with the following exceptions:

Due to the lack of current in the estuary area (a lentic habitat) outside bends were not the primary criteria for selecting a site. In this study (and other estuary studies) the area of greatest habitat diversity in the river segment was selected. Sites selected to illustrate habitat modification impacts were placed in areas most representative of the habitat modification type present in the different areas of sediment contamination based on U.S. Army Corps of Engineers 1983.

Night sampling of fish communities was conducted to assess temporal variation in use of the Ashtabula River area by fishes. All night samples at individual sampling sites were collected within 24 hours of the day sample collection. Boat mounted flood lights were employed to aid in fish collection. Only the lentic estuary and harbor sites were sampled at night.

Macroinvertebrate community sampling followed Ohio EPA standard methods and included both Hester-Dendy (river sites) and Ponar dredge (harbor sites) sampling as described in Ohio EPA (1989a,b).

Table 1 presents Ohio EPA's index values (IBI - Index of Biotic Integrity, MIwb - Modified Index of well-being, ICI - Invertebrate Community Index) for all areas discussed in this report with their respective attainment status. Table 2 reports the area of degradation values (ADV) for the Ashtabula River and Conneaut Creek study area. Figures 2-9 present the results of this study in graphic form for IBI, MIwb, and ICI.

Interim Lake Erie Estuary WWH Criteria

At present the development of biological criteria for Lake Erie estuary areas has not been completed. An examination of the data available from the Lake Erie estuary areas reveals that an IBI of 32, a MIwb of 7.5, and an ICI of 22 are the levels of attainment that can reasonably be expected at least impacted sites (Thoma unpublished ms). Areas with a

negative deviation from an IBI of 32, a MIwb of 7.5 and an ICI of 22 are classified as impaired and displaying non-attainment of the Warmwater Habitat (WWH) aquatic life use criteria for Lake Erie estuaries. Deviations of four or less points from an expected IBI and ICI value or 0.5 points from an expected MIwb value are considered to be insignificant departures from the expected value and within the range of attainment. These scores are interim criteria and have been set by OEPA as minimal values that are expected to be attained in least impacted estuary areas. Unlike the biological criteria for Ohio's inland rivers and streams these criteria are not codified in the Ohio Water Quality Standards (WQS).

Calculation of Area of Degradation Values (ADV)

The ADVs in this paper are based on measures generated from longitudinal plots of IBI, MIwb, and ICI values versus stream distance (upstream to downstream) in river miles for the respective rivers (Rankin and Yoder 1991). The length or "extent" of degradation or impact to the biological community is simply the distance along the horizontal axis that the index value is less than the criteria for the stream segment as illustrated in Figure 1. The magnitude of impact refers to the vertical distance or how low the index values are. The total area of degradation (ADV) is the area between the criteria value and the actual data values (shaded sections of Fig. 1) weighted by 0.1 times the criteria value. ADVs provide statistics that give a fuller representation of the level of impairment from a pollution impact by combining the degree and extent into one value. As the degree and extent of an impact increases so do the ADV statistics.

In this case the computational formula for the ADV value based on IBI scores is:

$$ADV = (\Sigma\,[(pIBI_a + pIBI_b)-(aIBI_a + aIBI_b)]) * (0.1 * (pIBI_a)) * (RM_a - RM_b),\ \text{for a} = 1 \text{ to n}$$

where: $pIBI_a$ = potential IBI at river mile a
$pIBI_b$ = potential IBI at river mile b
$aIBI_a$ = actual IBI at river mile a
$aIBI_b$ = actual IBI at river mile b
RM_a = upstream river mile
RM_b = downstream river mile
n = number of sampling sites

This equation assumes that the average of two sampling points accurately integrates the community health for the distance between the points. Sampling stations were chosen to illustrate changes in the biological communities in a longitudinal direction. Usually, biological communities gradually recover with distance from impacts; the lines drawn in

Figure 1 give a sufficient representation of actual changes in community health and quantifiable departures from ecoregion criteria. In complex areas, more stations would be added to increase longitudinal resolution. In the case of the Ashtabula River, the presence of contaminated sediments and shipping channel modifications are strongly defined, that is, they have well defined edges.

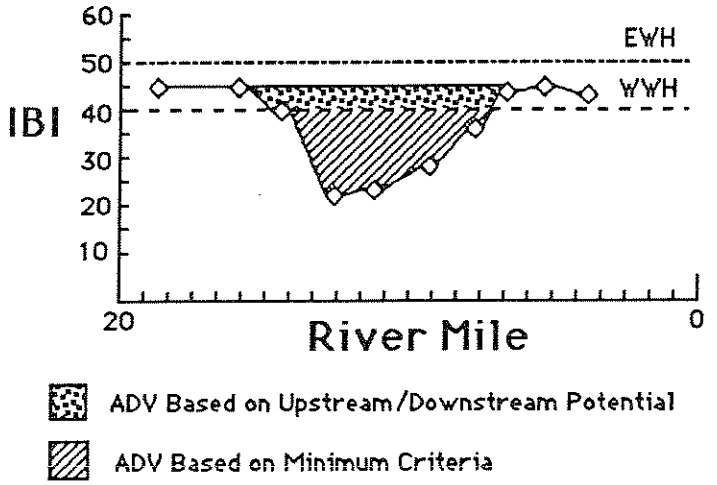

Figure 1. Graphic illustration of the calculation of area of degradation values (ADV) using IBI based on upstream potential and ecoregion WWH criteria. The IBI criteria for exceptional streams in Ohio (EWH) is provided for reference.

Fish Community Status

(Figures 2 -7, Tables 1 - 8)

Evaluation of the Ashtabula River fish community yielded good correlations with the environmental conditions in the system. It was found that four biological areas existed in the Ashtabula River: **AREA 1** (equivalent Conneaut Creek site Rm 2.1 and 6.7) - a minimally impacted area located upstream of the Fields Brook effect beginning at RM 1.8 ; **AREA 2** (equivalent Conneaut Creek site Rm 2.1)- an area dominated by the effect of the Fields Brook associated pollutants from RM. 0.7 to 1.8 ; **AREA 3** (equivalent Conneaut Creek site Rm 0.3) - the habitat modified shipping channel area (where all other environmental effects on community level conditions are subordinate to habitat modification effects) that runs from RM. 0.0 to 0.7 ; and **AREA 4** (equivalent Conneaut Creek harbor site Rm 0.1) - the harbor area were Lake Erie is inclosed by breakwaters . Figures 1 through 6 illustrate the biological condition of fish communities in the Ashtabula River and Conneaut Creek.

AREA 1

Conditions in the upstream area of the Ashtabula River are attaining the WWH criteria

designated for the Erie/Ontario Lake Plain ecoregion by the Ohio EPA. This portion of the study area consisted of two segments, a lotic area (flowing waters) and a lentic area (impounded by Lake Erie with no discernible current). In the lotic area (RM 9.9) community conditions were found to be comparable to those found in Conneaut Creek (the primary comparison stream) at RM 6.7. with the IBI values of 42 and 47.3, respectively, and MIwb values of 8.2 and 8.5, respectively. Comparison of the lentic section of AREA 1 in the Ashtabula River (RM 1.8) to the lentic section of Conneaut Creek (RM 2.1, non-shipping channel area) shows consistently lower index scores in the Ashtabula River. Both day and night samples were taken at these sites and performance differences between sites were consistent. The Ashtabula River results were always lower than the Conneaut Creek results (Table 1).

The primary cause of the Ashtabula River's lower index values upstream from Fields Brook is marina development of the shores and associated effects of high boat traffic in the area. Secondary impacts are realized from the Fields Brook associated pollution. Sediment contamination data indicate that any upstream movement of pollutents by seiche activities has not resulted in contamination of this area. Comparison of Ashtabula River and Conneaut Creek to the Vermilion River, a Lake Erie tributary estuary that has marina development similar to Ashtabula River but which has no industrial development, reveals IBI and MIwb scores that are intermediate to Ashtabula River and Conneaut Creek (Table 1). In the absence of the impact from Fields Brook it is expected that the Ashtabula River fish community would have achieved index scores equivalent to the Vermilion River. The differences between the Ashtabula River and Vermilion River is 2 IBI points and 0.5 MIwb points (Vermilion > Ashtabula). This degree of difference is presently considered to be a non-significant departure from the expected value (which would be the Vermilion River index scores). For the purposes of this report an IBI value less than 32 and a MIwb value less than 7.5 are considered impaired (Ohio EPA's interim criteria for Lake Erie estuaries are set at the above values). These values are interim in nature until criteria can be developed from the Ohio EPA Lake Erie estuary database. In the absence of marina development in the Ashtabula River, it would be reasonable to expect index values equivalent to those observed in Conneaut Creek. An ADV of zero was recorded in this Ashtabula segment since both fish community sites were attaining the interim estuary WWH criteria for IBI and MIwb.

AREA 2

The stream segment primarily affected by the Fields Brook discharge (AREA 2, RM 0.7 to 1.7) was found to differ from other estuary areas of similar habitat condition which lacked the chemical impacts that are present in the Ashtabula River. As stated above, this area of the Ashtabula River estuary is expected to achieve at least 32 for IBI and 7.5 for MIwb. The sample site located within the area determined by previous studies to have heavily polluted sediments achieved an IBI of 26 (six points less than the minimum expected for

attainment of WWH criteria) and a MIwb of 5.8 (1.7 point less than the minimum needed for attainment of WWH criteria). These values placed the site at the narrative evaluation of fair. The difference between both index values and the interim criteria exceed non-significant departure from criteria and are therefore considered impaired by sediment contamination at the site. Previous work by White and Alldridge (1981) has demonstrated that there are no biological effects associated with the higher levels of conductivity in the vicinity of Fields Brook. Interestingly enough, the numerically quantified data provided by White and Alldridge (1981) in the form of the Shannon-Wiener diversity index (a component of the MIwb) correlated an impact with the heavily polluted sediments. All three sites located in this area displayed lower diversities than those located outside of the area.

The Ohio EPA has found the Area of Degradation Value (ADV) to be IBI 19.0 (19.0/mile) and MIwb 1.6 (1.6/mile) for this river segment. These values should be used when calculating the loss of community resource value.

AREA 3

The construction of ship docking and loading facilities at the mouth of the Ashtabula River and Conneaut Creek has severely disrupted the potential of the affected stream segments to support fish communities. The number of fish species and individuals were abnormally low at both fish sampling sites (Ashtabula River RM 0.5, Conneaut Creek RM 0.3). Index values at these sites achieve narrative classifications of very poor, the lowest Ohio EPA stream evaluation possible. The fact that both ship channel areas scored the same in polluted and non-polluted waters demonstrates the overriding effect of this type of habitat modification. In the absence of the Fields Brook associated effect the Ashtabula River ship channel area would have still scored approximately the same. For this reason it is not justified to hold the PRPs responsible for any effect in this area. If pollution in the area was shown to prevent the passage of migrating fish, then a measurable damage to the use could be made. The general fisheries data from the Ashtabula River indicate that fish migration in the area is not impeded thus no damage can be assessed for Area 3. Numerous individuals of Lake Erie associated species were found upstream of Area 3. The ADVs for this area are IBI 29.4 (42.0/mile) and MIwb 2.1 (3.0/mile), the largest ADVs in the Ashtabula River/Conneaut Creek study area. In Conneaut Creek ADVs are IBI 22.4 (44.8/mile) and MIwb 1.3 (2.6/mile).

AREA 4

Community data from the Ashtabula River harbor has been found to be comparable to Conneaut Creek community data for both day and night collections and indicate little or no effect from Fields Brook on community structure. The lower IBI score for the day sample of the Ashtabula River harbor west breakwater site is not considered significantly different

from the Conneaut Creek harbor value. A higher incidence of tumors in brown bullheads (*Ictalurus nebulosus*) was noted here due to a possible impact from the coal handling facility in the immediate area. Coal fines deposits were observed here in the shallower sandy areas. The presence of PAH (poly-aromatic hydrocarbon) compounds in coal (Shorten et al. 1990) has been reported to result in tumorous conditions in fish (Baumann and Harshbarger 1985, Baumann et al. 1987). Because community conditions in Ashtabula River and Conneaut Creek harbors are the same (as measured by IBI and MIwb), no impact at the community level has occurred as a result of the Fields Brook associated pollutants. The contamination of fish tissue in the harbor as well as the upstream areas remains a concern. Since the level of tissue contamination is to be determined by future investigations, it will not be discussed in this report.

Macroinvertebrate Community Status

(Figures 8 -9, Tables 1, 9 -10)

For purposes of comparison, macroinvertebrate sites in the estuary reaches of the Conneaut and Ashtabula were chosen to reflect similar habitat conditions. Thus, the Conneaut site at RM 1.3 was paired with the Ashtabula sites upstream (RM 1.9 **AREA 1** as above) and downstream (RM 1.3 **AREA 2** as above) from Fields Brook while Conneaut Creek at RM 0.4 was most comparable to the Ashtabula River at RM 0.6 (**AREA 3** as above). The upper estuary sites in both streams were characterized by fairly naturally vegetated stream margins, gradually deepening water, and extensive submergent macrophyte growths. The lower site in both estuaries was located in the ship channel and was characterized by little shoreline vegetative growth, deep water off wood, concrete, or metal sea walls, and no submergent macrophytes. Artificial substrates at the lotic sites in the Ashtabula River (RM 10.0) and Conneaut Creek (RM 6.7) were located in run habitat of the free-flowing portions of the two rivers and form the upper portions of **AREA 1**. Two sites in the Ashtabula River harbor and one site in the Conneaut Creek harbor correlated with the fish community sites located in the harbors (**AREA 4**).

AREA 1

Macroinvertebrate community sampling in the lotic segments of the lower Ashtabula River (RM 10.0) and Conneaut Creek (RM 6.7) resulted in Invertebrate Community Index (ICI) scores that easily achieved the macroinvertebrate criterion of 34 established for designated Warmwater Habitat (WWH) streams and rivers in the Erie/Ontario Lake Plain ecoregion of Ohio. Conneaut Creek is currently designated Coldwater Habitat (CWH). No biocriteria have been developed for CWH. However, the CWH use designation for Conneaut Creek has never been verified with survey information and, though only limited data are available, the 1989 results at RM 6.7 suggest Exceptional Warmwater Habitat (EWH) as a more appropriate aquatic life use (at least in this general area of the stream). In any event, the ICI scores of 42 at the Ashtabula site and 52 at the Conneaut site were indicative of high quality

macroinvertebrate communities in the free-flowing stream segments prior to entering the Lake Erie influenced reaches of each stream.

Though ICI scoring is calibrated for lotic habitats and, thus, not directly applicable to the estuarine conditions, the index does have utility for comparison purposes. In Area 1, there was a fairly distinct difference between the Conneaut ICI score (22) and the Ashtabula score (12 RM 1.9). This difference was even more pronounced in the actual raw data collected. The Ashtabula site in Area 1 had a noticeably less diverse macroinvertebrate fauna than the Conneaut site especially with regard to numbers of total taxa collected and kinds of mayflies and midges present. Quantitative and qualitative sampling of Conneaut Creek at RM 1.3 produced 58 different taxa while sampling with similar effort in the Ashtabula at RM 1.9 produced 35 taxa. Five mayfly taxa and 23 midge taxa, including six taxa of the more pollution sensitive Tribe Tanytarsini, were collected in the Conneaut. The Ashtabula site produced only one mayfly taxon, 14 midge taxa, and one type of Tanytarsini midge. ICI metrics determined by these community attributes resulted in the lower ICI value at the Ashtabula site. Thus, it was apparent from the macroinvertebrate data collected that the Conneaut Creek community at Rm 1.3 was of higher quality than the community collected in Area 1 of the Ashtabula River (upstream from Fields Brook). This apparent lack of quality at the upstream Ashtabula "control" station was unexpected. Possible upstream sources of degradation can not be ruled out including effects from heavy recreational boating and active shoreline development and modification. Field observations of moderate to heavy siltation on the artificial substrates at this site may have been a result of these types of activities. Aquatic macrophytes in this area also had a heavy layering of clay silts. Only slight siltation was noted on the artificial substrates in Conneaut Creek at RM 1.3. It appears that habitat degradation due to excessive siltation has contributed to the lower quality macroinvertebrate fauna in the Ashtabula River. The ADV for area 1 is 13.0 (10.8/mile), the largest ICI-ADV for the study area. All of this degradation occurs in the lentic portion of the Area 1 segment. In the equivalent Conneaut Creek river segment the ICI values met the interim WWH criterion and the ADV is zero.

AREA 2

A comparison of the Ashtabula station downstream from Fields Brook (RM 1.3) with the upstream station (RM 1.9) revealed little difference in the composition or quality of the two macroinvertebrate communities. If anything, the downstream station reflected somewhat better conditions. The downstream ICI score of 16 was higher than the upstream score of 12. This would typically be regarded as a non-significant departure, however, mayfly and caddisfly taxa, generally considered pollution sensitive macroinvertebrate groups, were better represented at the downstream site, both in kinds and numbers. As at the upstream Fields Brook site, the ICI score of 16 at RM 1.3 was significantly different from the Conneaut Creek score of 22. Again this difference was more pronounced in the actual raw

data collected. This site was also less diverse than the Conneaut site with regard to total numbers of taxa collected and mayfly and midge taxa present. Conneaut Creek at RM 1.3 produced 58 different taxa while the Ashtabula at RM 1.3 produced 32 taxa. Siltation levels at the Ashtabula River site were again higher than those observed in Conneaut Creek. Data provided by Dr. White and N. Alldridge, though not quantified in the same manner as the OEPA data, indicated there was no impact from high conductivity levels in the Fields Brook area. White and Alldridge (1981) concluded that conductivity was not impacting biological communities. Since the White and Alldridge (1981) study, there has been extensive marina development in the Ashtabula River estuary. The data from this OEPA study indicate that the effects of boating activities and shoreline modifications on macroinvertebrate communities probably overshadow any effects that could be attributed to the contaminants associated with Fields Brook. The ADV for ICI in this area is 5.2 (5.2/mile). In the equivalent Conneaut Creek river segment the ADV is zero.

AREA 3

ICI values for the two shipping channel locations in the Ashtabula River (RM 0.6) and Conneaut Creek (RM 0.4) were essentially the same, 14 and 12, respectively. Over 80% of the organisms collected at the two sites were zebra mussels and oligochaetes (segmented worms). Communities predominated by these two lentic taxa were not unexpected given the near complete transition to lake habitat conditions at both sites. Given the severe limitations in habitat at both sites (the Conneaut in particular), there appeared to be little or no difference in quality of the macroinvertebrate communities. Thus, a direct effect attributable to Fields Brook contamination could not be differentiated in this segment of the Ashtabula River. Unfavorable habitat conditions appeared to be the overriding factor limiting macroinvertebrate composition and diversity. The ADV for the ICI in the ship channels of the Ashtabula River and Conneaut Creek is 5.0 (7.1/mile) and 5.4 (10.8/mile), respectively.

AREA 4

Macroinvertebrate samples from harbor sites consisted of three composited Petite Ponar grabs collected at three locations: Conneaut harbor off the West Breakwater (RM 0.1), Ashtabula harbor off the West Breakwater (RM 0.1), and Ashtabula harbor off the Inner Breakwater (RM 0.2). Macroinvertebrate species richness was highest in Conneaut harbor where 31 different taxa were collected. Species richness at the site was about 40% higher than the Ashtabula Inner Breakwater site where 23 taxa were collected and about 60% higher than the Ashtabula West Breakwater site where only 19 taxa were collected. Organism density was nearly identical at the two West Breakwater locations (27222/m^2 in the Conneaut; 24427/m^2 in the Ashtabula) while density at the Ashtabula Inner Breakwater location was much lower (9386/m^2).

Samples at all three locations were predominated by oligochaetes of the Family Tubificidae, many species of which are amongst the most tolerant to gross organic enrichment of all macroinvertebrates. Oligochaete populations and community compositions were very similar at all three sites. At none of the sites did oligochaetes make up less than 85% of the organisms collected. This would place both harbors in the polluted class using the percent oligochaete classification system of Goodnight and Whitley (1961). Another commonly used tool, the Trophic Condition Index (TCI) proposed by Howmiller and Scott (1977), is based on oligochaete species associations with differing pollution tolerance and has been used to make comparisons of relative quality between harbor and open water sampling stations (Krieger 1984, 1989). TCI values are scored on a scale from 0 to 2 with a 0 score an indication of a pollution sensitive oligochaete association and 2 a pollution tolerant association. Values derived for the Ashtabula and Conneaut harbor sites were all greater than 1.91, indicating that the oligochaetes collected were predominantly species tolerant to organic enrichment. These values were similar to those calculated for other Lake Erie harbors by Krieger (1984, 1989). It appeared that neither the Ashtabula nor Conneaut harbor macroinvertebrate communities differed substantially from those collected from other Lake Erie harbors. All are apparently affected by organically enriched conditions.

There was some evidence, however, that the degree of organic enrichment was less severe in Conneaut harbor than Ashtabula harbor. The much higher taxa diversity in Conneaut harbor was primarily due to increased kinds and numbers of midges collected. The midge assemblage in Conneaut harbor consisted of species with wider ranges of pollution tolerance than those species collected at either Ashtabula site, of which all were essentially pollution tolerant varieties. In addition, the Conneaut harbor site supported much more diverse populations of fingernail clams and a lentic caddisfly species. Larvae of this caddisfly were not present in Ashtabula harbor. During a recent study conducted in the vicinity of Cleveland harbor Krieger (1989) found it to exist only at the less polluted open water sites . Regardless of the enrichment in Conneaut and Ashtabula harbors, there was no evidence that residual contaminated sediments from Fields Brook pollutants were having a significant negative influence on the quality of the Ashtabula harbor communities.

Conclusions

The data from this study demonstrate that the detectable impact from the Fields Brook associated pollutants to the biological community of the Ashtabula River is confined to the area upstream from the ship channel and downstream from the turning basin (**AREA 2**). This area does not attain the interim WWH criteria for Lake Erie estuaries. IBI, MIwb, and ICI values for the area (RM 1.3) are 26, 5.8, and 16 respectively and fall in the "fair" category. ADVs for the area are IBI-19.0, MIwb-1.6, and ICI-5.2. When compared to the other AOCs the Ashtabula River has similar levels of community suppression but the extent

of degradation is not nearly as great (Ohio EPA 1988). The Ashtabula River impairment extends one mile while the Maumee, Black, and Cuyahoga River impairments extend over 5, 6, and 7 miles respectively.

Other impacts in the Ashtabula River estuary are primarily attributable to marina development and associated boat traffic and habitat modification for international shipping. Marina associated impairment was not found to be greater than the impact of the contaminated sediments, though invertebrate communities were slightly poorer than those in the Fields Brook effected area. For all indices the ship channel effect was found to have more of a negative influence than the contaminated sediments (invertebrate communities were least affected).

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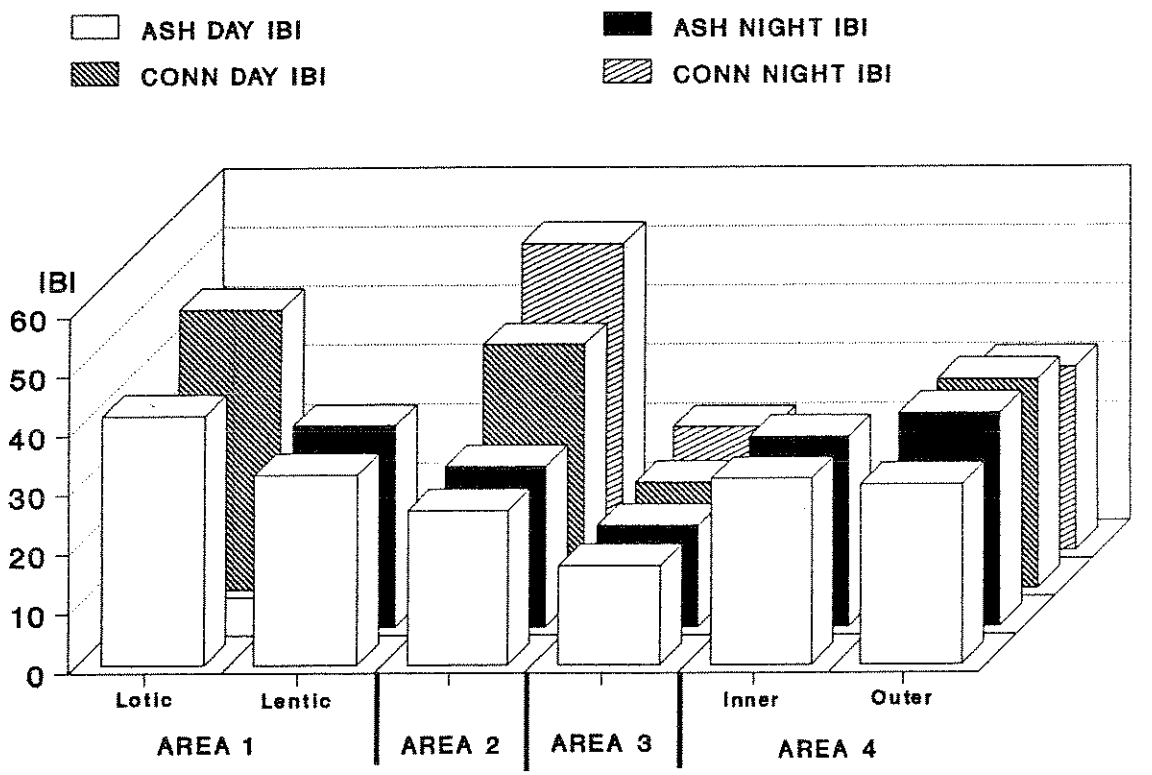

Figure 2. Bar graph of day and night IBI values for the Ashtabula River and Conneaut Creek study area.

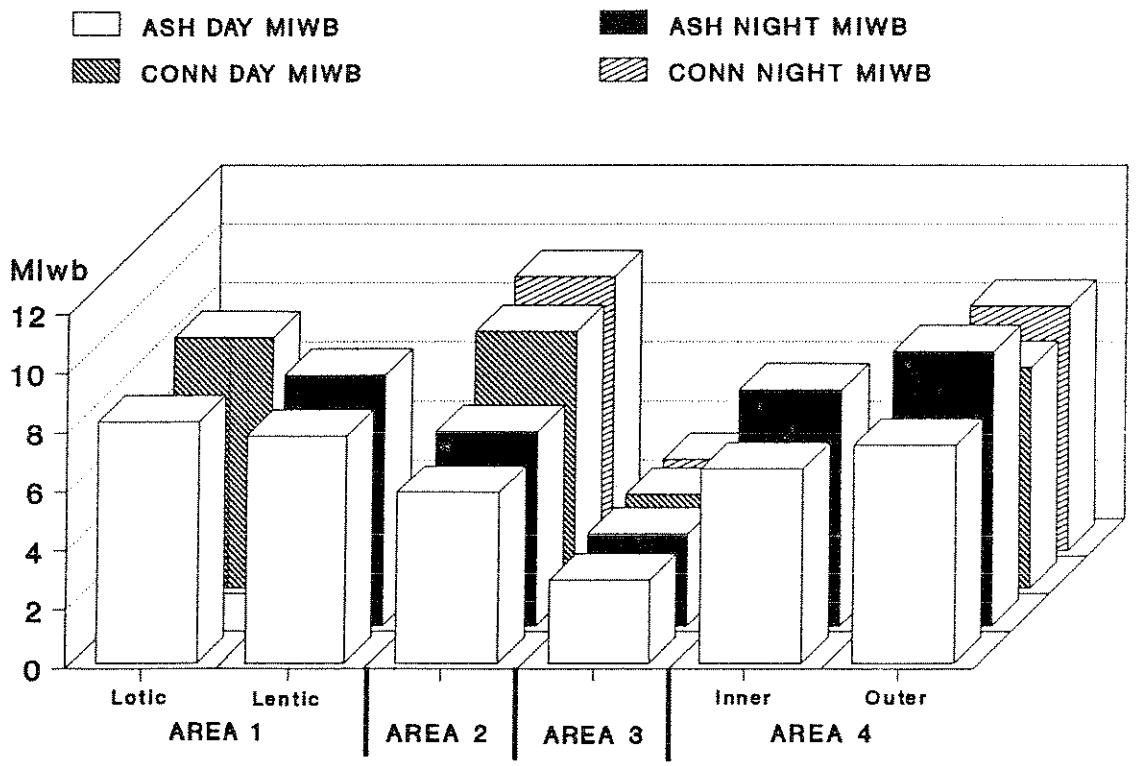

Figure 3. Bar graph of day and night MIwb values for the Ashtabula River and Conneaut Creek study area.

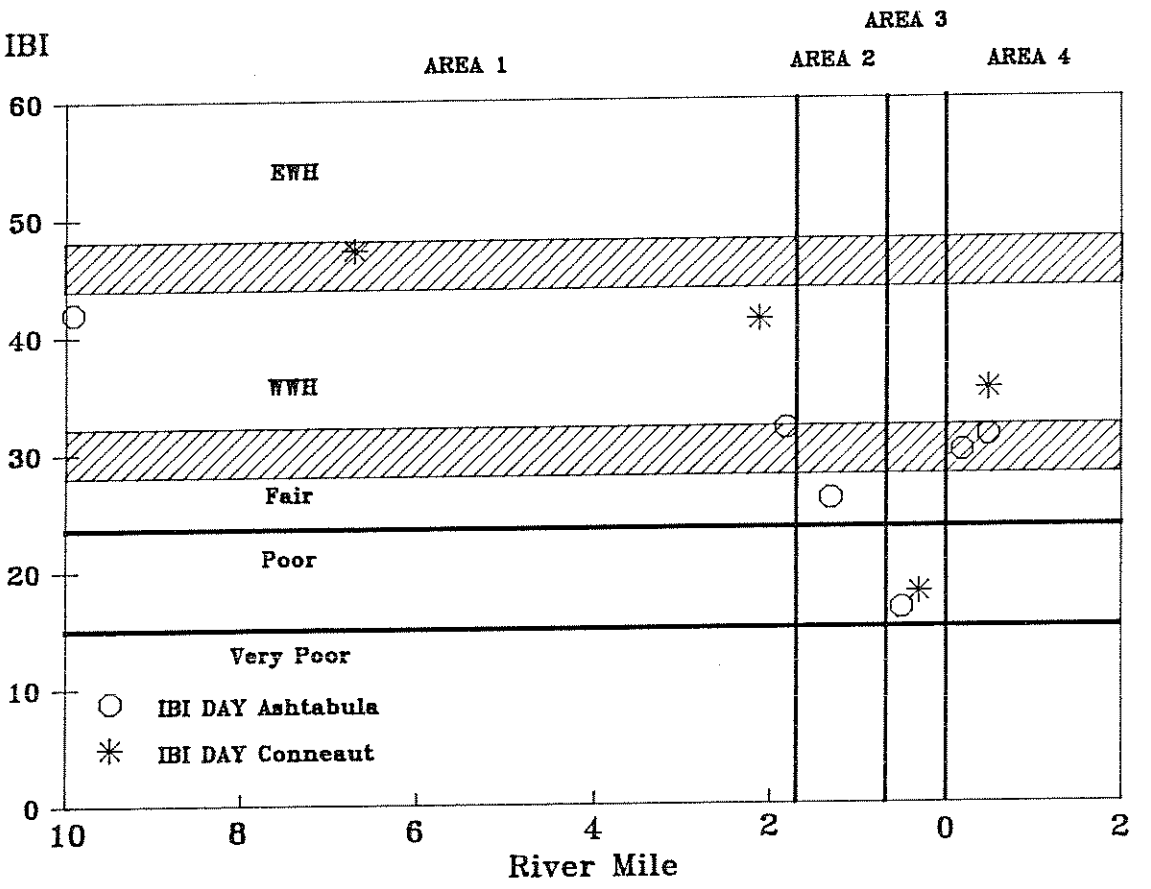

Figure 4. Day sample IBI values for the Ashtabula River and Conneaut Creek study area. IBI attainment values are EWH $\geq$ 48; WWH $\geq$ 32; fair < 28, $\geq$ 22; poor < 22, $\geq$ 16; and very poor < 16. Shaded areas represent the area of non-significant departure from EWH and WWH (4 points).

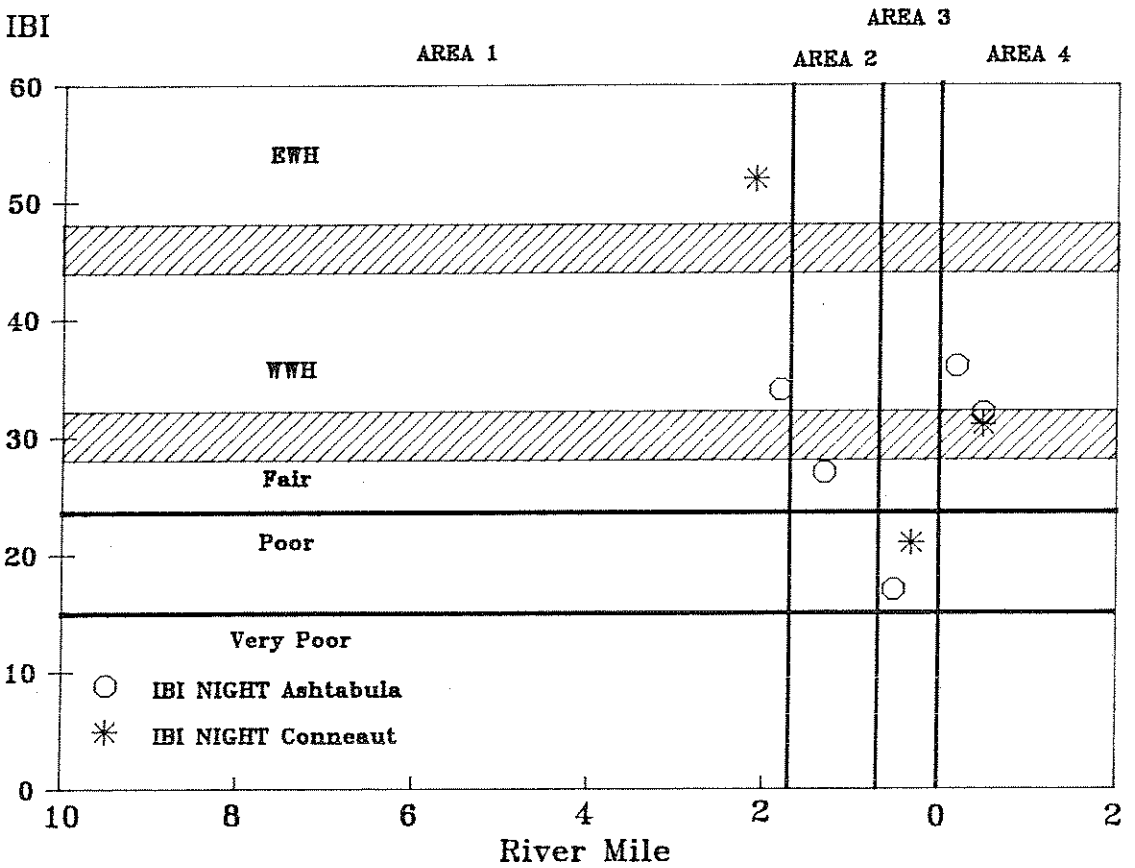

Figure 5. Night sample IBI values for the Ashtabula River and Conneaut Creek study area. IBI attainment values are EWH $\geq$ 48; WWH $\geq$ 32; fair < 28, $\geq$ 22; poor < 22, $\geq$ 16; and very poor < 16. Shaded areas represent the area of non-significant departure from EWH and WWH (4 points).

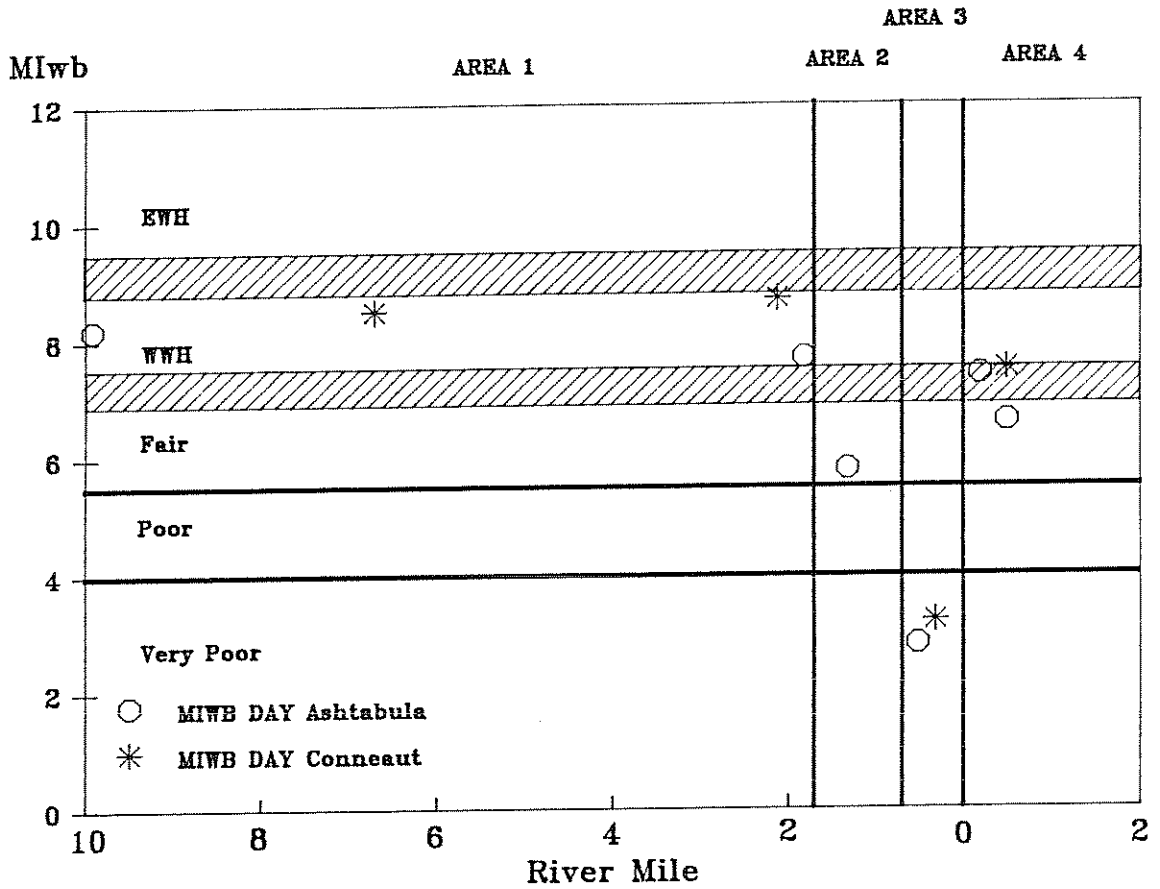

Figure 6. Day sample MIwb values for the Ashtabula River and Conneaut Creek study area. MIwb attainment values are EWH $\geq$ 9.6; WWH $\geq$ 7.5; fair < 7.0, $\geq$ 5.5; poor < 5.5, $\geq$ 4.0; and very poor < 4.0. Shaded areas represent the area of non-significant departure from EWH and WWH (0.5 points).

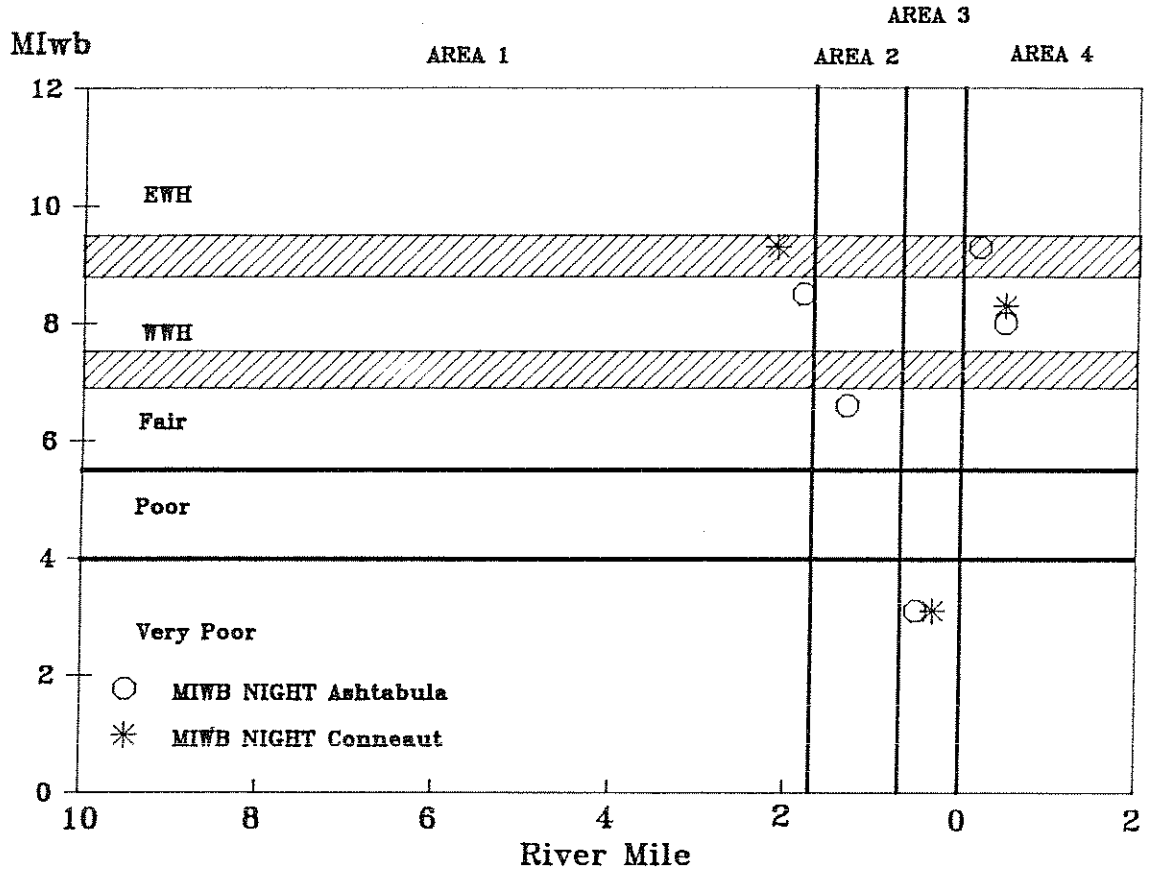

Figure 7. Night sample MIwb values for the Ashtabula River and Conneaut Creek study area. MIwb attainment values are EWH $\geq$ 9.6; WWH $\geq$ 7.5; fair < 7.0, $\geq$ 5.5; poor < 5.5, $\geq$ 4.0; and very poor < 4.0. Shaded areas represent the area of non-significant departure from EWH and WWH (0.5 points).

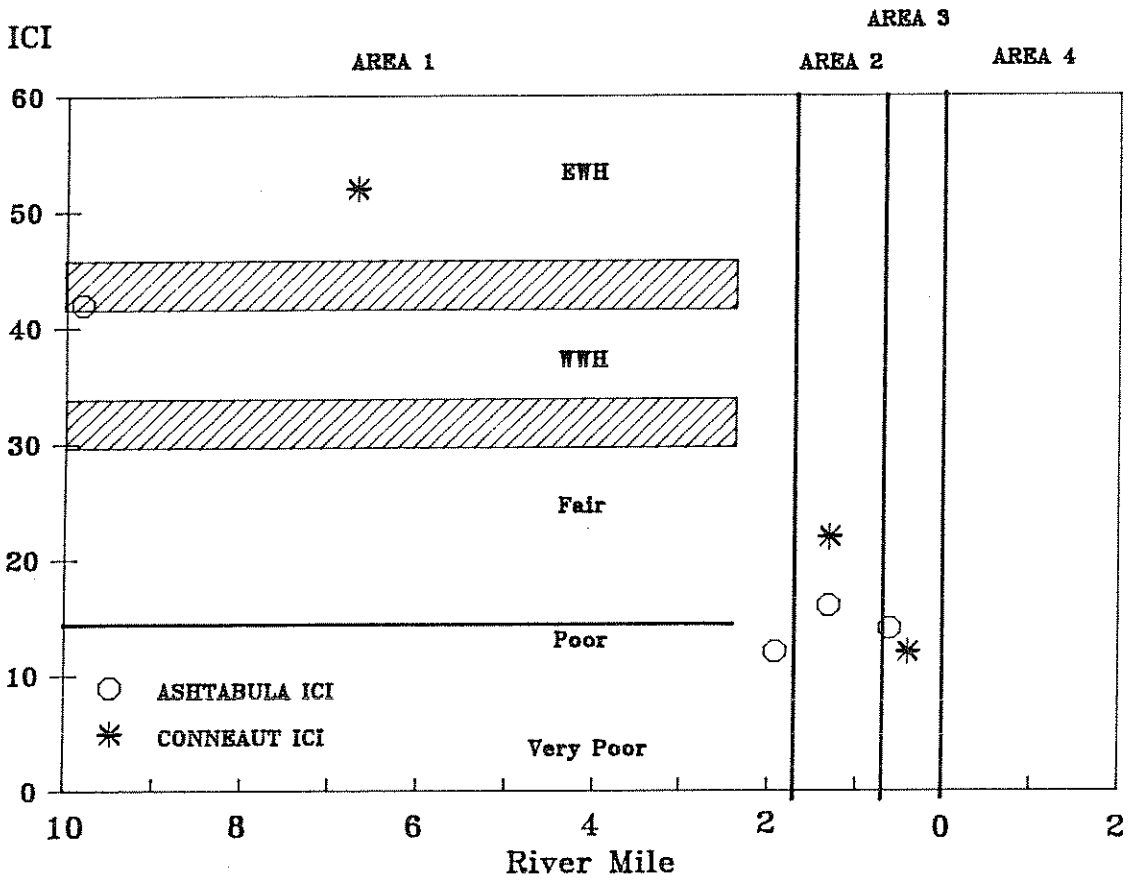

Figure 8. ICI values for the Ashtabula River and Conneaut Creek study area. ICI attainment values are EWH $\geq$ 46; WWH $\geq$ 34 (lotic criterion) $\geq$ 22 (interim estuary criterion); fair < 18, $\geq$ 14; poor < 14, > 0; and very poor = 0. Shaded areas represent the area of non-significant departure from EWH and WWH (4 points).

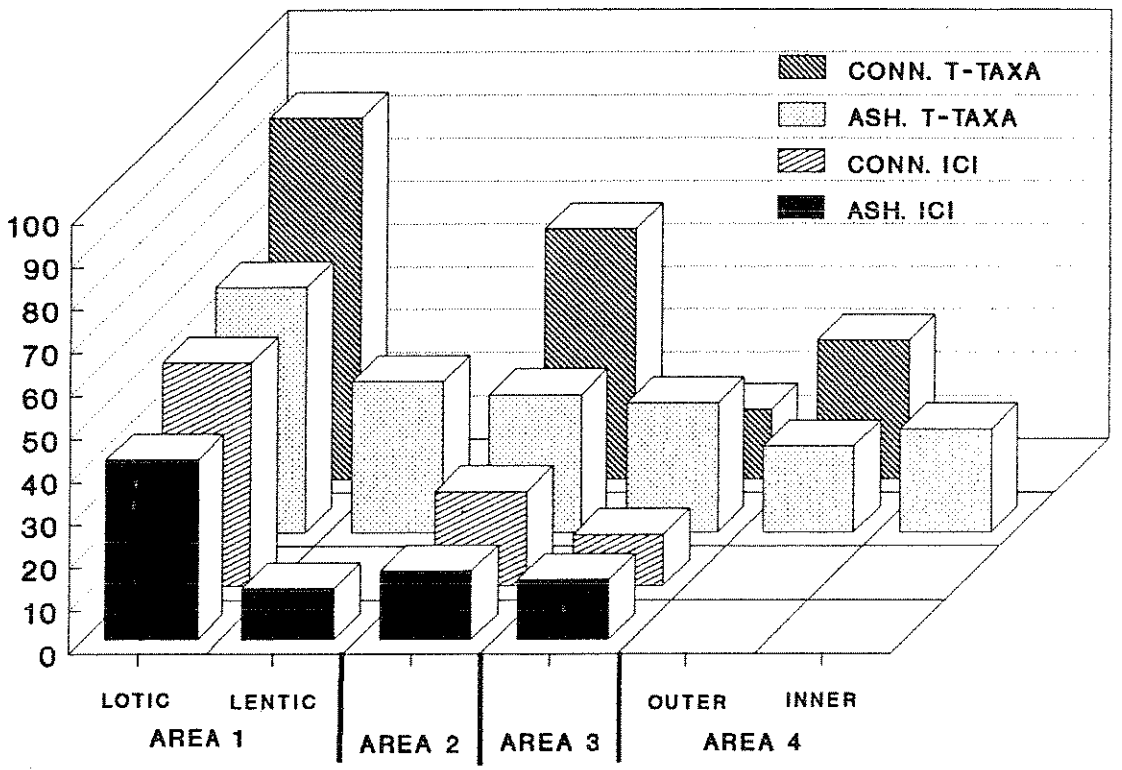

Figure 9. Bar graph of ICI values and number of total taxa collected at the individual sites for macroinvertebrate community samples in the Ashtabula River and Conneaut Creek study area. No ICI values have been calculated for the harbor areas of the study.

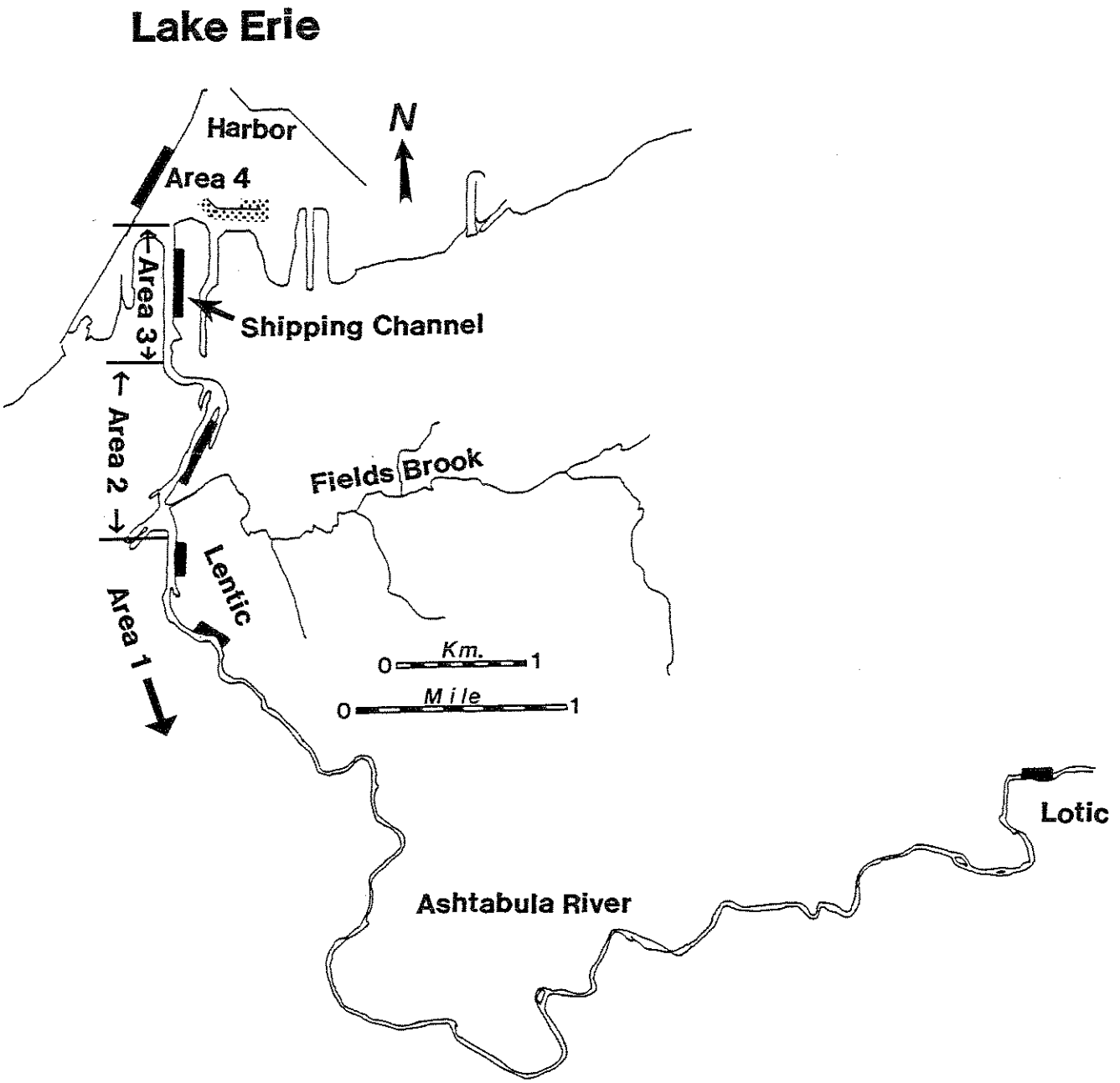

Figure 10. Ashtabula River study area and fish community sampling site locations (shaded areas). Benthic macroinvertebrate sampling sites are contained within the fish community sampling sites.

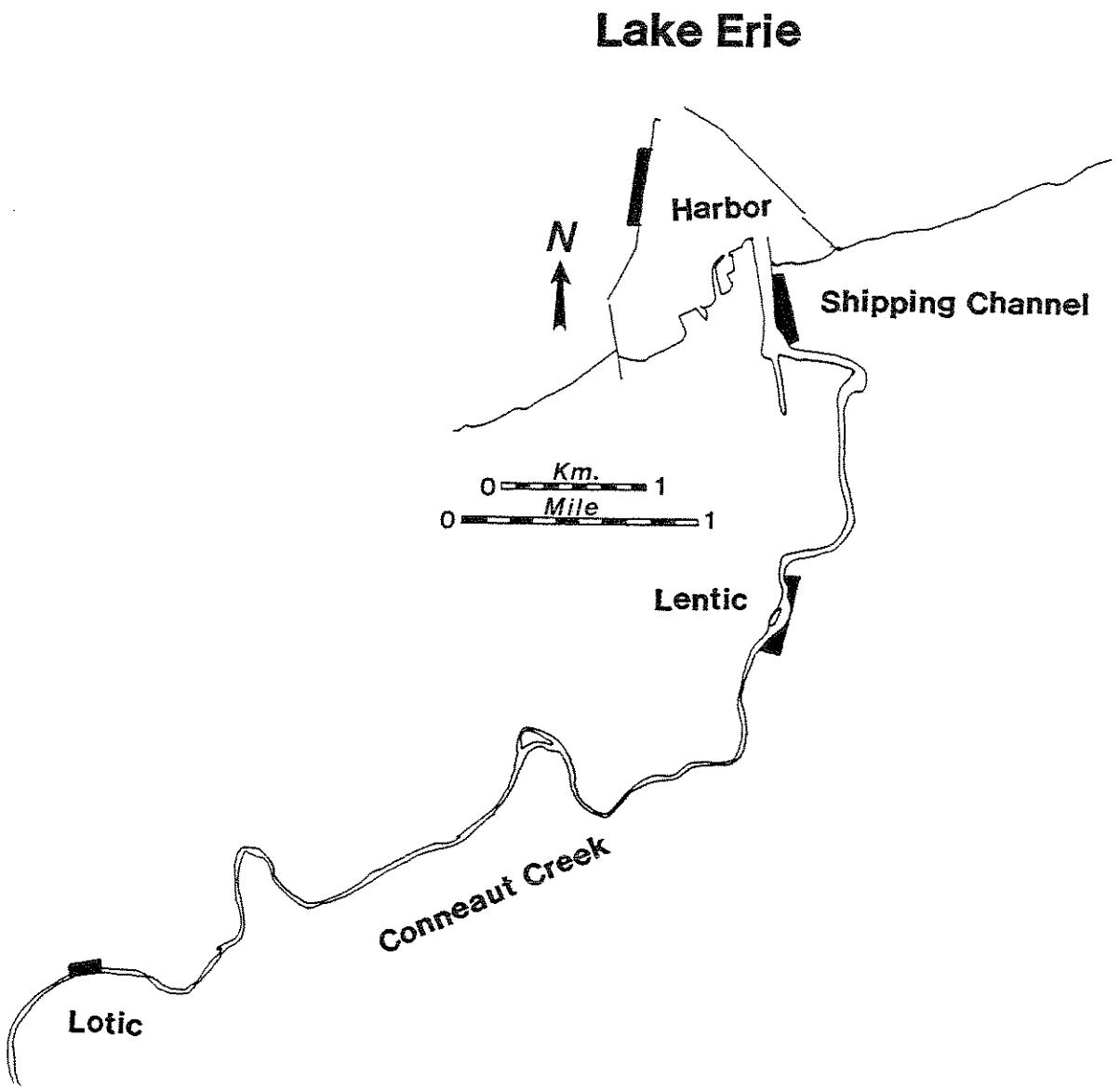

Figure 11. Conneaut Creek study area and fish community sampling site locations (shaded areas). Benthic macroinvertebrate sampling sites are contained within the fish community sampling sites.

the Ashtabula River Area of Concern (AOC) and other AOCs with similar estuary habitats. Attainment status follows guidance in Ohio EPA (1987[b]).

River Mile Fish/Invert.	IBI	Modified Iwb	ICI	QHEI	Attainment Status	Comments
Maumee River						
0.0/ -	21*	5.4*	-	63	(Non)	Harbor area (rip rap)
0.1/ -	19*	4.4*	-	49	(Non)	Bayshore intake channel
0.2/ -	23*	5.8*	-	58	(Non)	Rip rapped seawall, in bay
0.3/ -	21*	6.2*	-	59	(Non)	Bayshore discharge, in bay
0.4/ -	29ns	6.7*	-	56	(Non)	Maumee Bay shoreline
0.5/ -	25*	5.9*	-	64	(Non)	Rip rapped disposal area
0.6/ -	20*	5.5*	-	60	(Non)	Mouth of Otter Creek
0.7/0.8	22*	5.9*	14*	58	Non	Dst. Toledo WWTP
1.4/1.5	27*	6.1*	6*	67	Non	Ust. Toledo WWTP
1.5/ -	27*	5.6*	-	67	(Non)	Night sample
3.3/3.1	23*	6.3*	10*	59	Non	Dwst. CSOs
3.6/3.6	23*	6.3*	10*	61	Non	CSO area
4.7/4.5	32	7.2ns	10*	46	Full	Dst. Swan Creek
7.3/7.2	28*	7.0ns	8*	65	Non	Ust. Swan Creek
7.4/7.3	23*	6.4*	12*	64	Non	Dst. LOF
9.4/8.8	20*	6.9*	14*	63	Non	Ust. LOF
- /13.3	-	-	14*	-	(Non)	
13.7/13.6	25*	7.1ns	14*	62	Non	Natural shoreline
14.1/ -	32	8.0	-	61	(Full)	Dst. Perrysburg
14.2/ -	26*	7.1ns	-	61	(Partial)	Dst. Perrysburg
14.8/15.0	30ns	7.9	22	71	Full	Ust. Perrysburg
Vermilion River						
0.3/0.2	31ns	7.7	12*		Non	Mouth of river, rip rap
0.5/ -	25*	5.1*	-		(Non)	Marina area, dst. WWTP
- /0.9	-	-	6*		***	Vermilion WWTP mix zone
1.4/1.9	32	8.1	28		Full	Ust. Vermilion WWTP
2.4/ -	36	8.3	-		(Full)	Upper limit of estuary
Black River						
0.0/ -	25*	5.9*	-	-	(Non)	West breakwater (harbor)
0.9/ -	29*	6.7*	-	-	(Non)	Lorain WWTP area, mod.
2.7/ -	22*	5.9*	-	-	(Non)	Upper ship channel
3.3/ -	23*	5.7*	-	-	(Non)	Dst. US Steel, Coke plant
4.8/ -	27*	5.3*	-	61	(Non)	Dst. US Steel (heavy oil)
5.8/ -	20*	3.7*	-	68	(Non)	Upper reaches of estuary
Cuyahoga River (1988)						
0.8/ -	12*	3.4*	-	32	Non	Ship channel
1.5/ -	17*	3.6*	-	43	Non	Ship channel
3.4/ -	14*	4.7*	-	32	Non	Ship channel
- /4.0	-	-	10*	-	(Non)	Ship channel
5.1/ -	14*	4.1*	-	30	(Non)	Ship channel
- /5.3	-	-	12*	-	(Non)	Ship channel
5.6/5.6	15*	4.9*	12*	44	Non	Ust. ship channel
- /5.7	-	-	18ns	-	(Non)	LTV Steel area
- /5.8	-	-	18ns	-	(Non)	LTV Steel area
- /6.7	-	-	18ns	-	(Non)	Lentic-lotic transitional
6.8/6.7	14*	5.1*	24	-	Non	Lentic-lotic transitional

Table 1. Continued

River Mile Fish/Invert.	IBI	Modified Iwb	ICI	QHEI	Attainment Status	Comments
Grand River						
0.6/0.8	33	8.3	18ns	50	Full	Estuary mouth
2.0/2.1	41	8.3	18ns	60	Full	Dst. Painesville WWTP
3.0/3.0	27*	5.9*	22	52	Non	Adj. landfills
4.4/4.3	30ns	6.7*	34	64	Partial	Upper reach of estuary
Ashtabula River (day)						
0.5/0.6	13*	2.8*	14*	35	Non	Ship channel
1.3/1.3	26*	5.8*	16*	49	Non	Dst. Fields Brook AOC
1.8/1.9	32	7.6	12*	55	Non	Ust. Fields Brook
9.9/10.0	42	8.2	42	48	Full	Lotic area
Ashtabula River (night)						
0.5/ -	12*	3.1*	-	35	(Non)	Night sample-ship channel
1.3/ -	27*	6.6*	-	49	(Non)	Night sample-dst. Fields
1.8/ -	34	8.5	-	55	(Full)	Night sample-ust. Fields
Ashtabula Harbor (day)						
0.1/0.1	31ns	6.6*	-	51	(Partial)	West breakwater
0.2/0.2	30ns	7.4ns	-	56	(Full)	Inner breakwater
Ashtabula Harbor (night)						
0.1/ -	32	8.0	-	51	(Full)	Night sample-W. breakwater
0.2/ -	36	9.3	-	56	(Full)	Night sample-I. breakwater
Conneaut Creek (day)						
0.3/0.4	12*	3.3*	12*	37	Non	Ship channel
2.1/1.3	41	8.7	22	93	Full	Lentic reference site
6.7/6.7	47	8.5	52	59	Full	Lotic area
Conneaut Creek (night)						
0.3/ -	17*	3.2*	-	37	(Non)	Night sample-ship channel
2.1/ -	52	9.3	-	93	(Full)	Night sample-lentic site
Conneaut Harbor (day)						
0.1/0.1	35	7.5	-	55	(Full)	West breakwater
Conneaut Harbor (night)						
0.1/ -	31ns	8.3	-	55	(Full)	Night sample-W. breakwater

Interim Estuary Criteria: IBI - 32
MIwb - 7.5
ICI - 22

* Significant departure from ecoregional biocriteria; underlined values represent poor and very poor biological condition.

ns Non-significant departure from ecoregional biocriteria (4 IBI and ICI units; 0.5 Iwb units).

\- No sample taken.

*** Attainment criteria do not apply to mixing zone.

Table 2. Area of degradation values (ADV) for the Ashtabula River and Conneaut Creek study area with the percent negative departure from the interim estuary criteria (IBI-32, MIwb-7.5, ICI-22).

River Stream segment	ADV(ADV/mile) ICI	IBI	MIwb	Percent negative departure ICI	IBI	MIwb	Comments
Ashtabula River							
RM 0.0-0.7	5.0(7.1)	29.4(42.0)	2.1(3.0)	22.0	54.0	60.0	AREA 3
>0.7-1.7	5.2(5.2)	19.0(19.0)	1.6(1.6)	14.6	20.6	30.7	AREA 2
>1.7-2.9	13.0(10.8)	0	0	33.0	0	0	AREA 1 lentic
>2.9-10.0	0	0	0	0	0	0	AREA 1 lotic
Conneaut Creek							
RM 0.0-0.5	5.4(10.8)	22.4(44.8)	1.3(2.6)	53.0	57.0	53.0	ship channel
>0.5-2.4	0	0	0	0	0	0	lentic reference
>2.4-6.7	0	0	0	0	0	0	lotic reference

Table 3. IBI and MIwb scores and metrics for the Ashtabula and Conneaut study areas (B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modifie IBI	Iwb
ASHTABULA RIVER - (07-001)																	
Year:	89																
1.8	B	09-26-89	640017(3)	4(5)	3(3)	1(1)	1(1)	2(1)	11(5)	71(1)	5(1)	21(1)	0.9(3)	828(5)	30	8.0	
1.8	M	09-07-89	640022(5)	3(3)	4(3)	1(1)	13(1)	26(5)	30(1)	24(3)	3(1)	64(5)	3.7(1)	306(3)	32	9.1	
1.8	B	09-06-89	640014(3)	3(3)	3(3)	1(1)	5(1)	6(1)	8(5)	53(1)	6(3)	39(3)	2.7(3)	348(3)	30	8.2	
1.8	M	08-04-89	640021(5)	3(3)	5(3)	1(1)	11(1)	43(5)	28(1)	12(5)	9(3)	76(5)	2.6(3)	168(1)	36	7.9	
1.8	B	08-02-89	640015(3)	4(5)	2(1)	1(1)	6(1)	8(1)	7(5)	6(5)	9(3)	82(5)	3.0(3)	207(3)	36	6.8	
1.3	B	09-26-89	6400 8(1)	3(3)	2(1)	1(1)	7(1)	7(1)	11(5)	4(5)	46(5)	50(3)	0.0(5)	50(1) *	32	5.5	
1.3	M	09-07-89	6400 9(1)	3(3)	1(1)	1(1)	1(1)	2(1)	14(5)	8(5)	3(1)	89(5)	5.1(1)	178(1)	26	6.6	
1.3	B	09-06-89	6400 9(1)	3(3)	0(1)	0(1)	0(1)	0(1)	15(5)	18(3)	21(5)	62(5)	5.9(1)	58(1) *	28	6.0	
1.3	M	08-04-89	640013(3)	3(3)	0(1)	0(1)	0(1)	3(1)	29(1)	18(3)	18(5)	59(5)	2.9(3)	48(1) *	28	6.6	
1.3	B	08-02-89	6400 9(1)	2(3)	1(1)	1(1)	3(1)	3(1)	38(1)	41(1)	9(3)	50(3)	14.7(1)	42(1) *	18	6.0	
0.5	B	09-26-89	6400 1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	100(1)	0(1)	0.0(1)	8(1)**	12	1.5	
0.5	M	09-08-89	6400 3(1)	1(1)	0(1)	0(1)	0(1)	0(1)	17(1)	0(1)	0(1)	100(1)	0.0(1)	10(1)**	12	2.7	
0.5	B	09-06-89	6400 2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	93(1)	0(1)	7(1)	0.0(1)	28(1)**	12	2.6	
0.5	M	08-04-89	6400 3(1)	0(1)	0(1)	0(1)	0(1)	57(1)	0(1)	14(1)	0(1)	57(1)	14.3(1)	14(1)**	12	3.5	
0.5	B	08-02-89	6400 5(1)	2(3)	0(1)	0(1)	0(1)	0(1)	0(1)	29(1)	43(1)	29(1)	0.0(1)	14(1)**	14	4.3	
CONNEAUT CREEK - (07-100)																	
Year:	89																
2.1	B	09-27-89	640021(5)	3(3)	4(3)	4(5)	26(3)	37(5)	39(1)	42(1)	7(3)	47(3)	0.0(5)	348(3)	40	8.7	
2.1	M	09-08-89	640022(5)	4(5)	4(3)	3(3)	47(5)	55(5)	7(5)	8(5)	21(5)	67(5)	0.5(3)	360(3)	52	9.2	
2.1	B	09-07-89	640018(3)	3(3)	3(3)	1(1)	51(5)	55(5)	7(5)	8(5)	18(5)	69(5)	5.9(1)	314(3)	44	8.7	
2.1	M	08-09-89	640022(5)	4(5)	4(3)	3(3)	42(5)	49(5)	11(5)	11(5)	15(5)	68(5)	0.9(3)	406(3)	52	9.3	
2.1	B	08-08-89	640018(3)	3(3)	5(3)	3(3)	36(3)	43(5)	19(3)	19(3)	22(5)	58(5)	3.6(1)	332(3)	40	8.6	

Table 3. IBI and MIwb scores and metrics for the Ashtabula and Conneaut study areas (B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Modified Iwb
0.3	B	09-27-89	6400	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	50(1)	0(1)	0.0(1)	4(1)**	12	1.1
0.3	M	09-08-89	6400	5(1)	2(3)	0(1)	0(1)	0(1)	17(3)	0(1)	67(1)	4(1)	22(1)	0.0(5)	92(1) *	20	3.9
0.3	B	09-07-89	6400	3(1)	0(1)	0(1)	0(1)	0(1)	5(1)	0(1)	85(1)	5(1)	5(1)	0.0(1)	40(1)**	12	3.7
0.3	M	08-09-89	6400	2(1)	0(1)	0(1)	0(1)	0(1)	20(3)	0(1)	80(1)	0(1)	20(1)	0.0(1)	20(1)**	14	2.4
0.3	B	08-08-89	6400	5(1)	0(1)	1(1)	1(1)	1(1)	1(1)	0(1)	97(1)	1(1)	1(1)	0.0(1)	300(1)	12	5.0
CONNEAUT HARBOR - (07-998)																	
Year:	89																
0.1	B	09-27-89	640012	(3)	2(3)	2(1)	1(1)	1(1)	65(5)	6(5)	6(5)	10(3)	75(5)	0.0(5)	152(1) *	38	6.7
0.1	M	09-08-89	640013	(3)	3(3)	0(1)	0(1)	0(1)	1(1)	16(3)	11(5)	25(5)	39(3)	9.5(1)	268(3)	30	7.7
0.1	B	09-07-89	6400	9(1)	3(3)	0(1)	0(1)	0(1)	0(1)	8(5)	6(5)	32(5)	56(5)	11.2(1)	116(1) *	30	7.3
0.1	M	08-09-89	640012	(3)	3(3)	1(1)	1(1)	1(1)	2(1)	16(3)	4(5)	29(5)	64(5)	13.0(1)	418(3)	32	8.9
0.1	B	08-08-89	640011	(3)	3(3)	3(3)	1(1)	27(3)	29(5)	6(5)	6(5)	29(5)	47(3)	28.8(1)	124(1) *	38	8.4
ASHTABULA HARBOR - (07-999)																	
Year:	89																
0.2	B	09-26-89	640010	(1)	4(5)	0(1)	0(1)	0(1)	0(1)	22(3)	22(3)	38(5)	24(1)	4.2(1)	207(3)	26	7.3
0.2	M	09-25-89	640022	(5)	4(5)	2(1)	0(1)	1(1)	1(1)	16(3)	15(5)	23(5)	58(5)	5.5(1)	814(5)	38	9.9
0.2	B	09-06-89	640011	(3)	3(3)	0(1)	0(1)	0(1)	1(1)	16(3)	14(5)	44(5)	29(3)	2.8(3)	180(1)	30	7.0
0.2	M	09-05-89	640015	(3)	4(5)	1(1)	0(1)	0(1)	1(1)	15(3)	12(5)	28(5)	52(3)	2.0(3)	388(3)	34	8.7
0.2	B	08-01-89	640013	(3)	4(5)	1(1)	0(1)	1(1)	1(1)	13(5)	12(5)	19(5)	64(5)	45.7(1)	180(1)	34	7.9
0.1	B	09-26-89	6400	9(1)	3(3)	0(1)	1(1)	0(1)	0(1)	1(5)	1(5)	7(3)	82(5)	1.8(3)	220(3)	32	6.1
0.1	B	09-06-89	6400	7(1)	2(3)	0(1)	0(1)	0(1)	1(1)	1(5)	1(5)	5(3)	64(5)	1.8(3)	218(3)	32	5.7
0.1	M	09-05-89	640010	(1)	3(3)	0(1)	0(1)	0(1)	0(1)	2(5)	1(5)	10(5)	18(1)	0.8(3)	948(5)	32	7.2
0.1	M	08-03-89	640015	(3)	3(3)	1(1)	0(1)	0(1)	0(1)	7(5)	2(5)	20(5)	25(1)	11.5(1)	794(5)	32	8.8
0.1	B	08-02-89	640010	(1)	3(3)	1(1)	0(1)	1(1)	1(1)	2(5)	1(5)	25(5)	59(5)	4.7(1)	166(1) *	30	8.0

Table 4. IBI and MIwb scores and metrics for the Maumee R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
MAUMEE RIVER - (04-001)																	
Year:	86																
14.8	A	09-02-86	635916(3)	5(5)	4(3)	1(1)		3(1)	6(1)	11(5)	69(1)	4(1)	18(1)	1.6(3)	557(5)	30	8.3
14.8	A	07-23-86	635916(3)	3(3)	2(1)	0(1)		1(1)	3(1)	37(1)	14(5)	12(5)	60(5)	0.8(3)	149(1)	30	7.8
14.8	A	06-23-86	635916(3)	5(5)	3(3)	0(1)		1(1)	2(1)	8(5)	68(1)	5(1)	14(1)	1.2(3)	467(5)	30	7.6
14.2	B	08-13-86	6361 6(1)	0(1)	3(3)	0(1)		0(1)	3(1)	12(5)	44(1)	32(5)	24(1)	0.0(5)	60(1) *	26	7.1
14.1	A	09-02-86	636115(3)	6(5)	3(3)	0(1)		1(1)	7(1)	9(5)	75(1)	3(1)	15(1)	1.5(3)	372(3)	28	7.6
14.1	A	07-23-86	636115(3)	4(5)	5(3)	0(1)		5(1)	7(1)	54(1)	21(3)	7(3)	58(5)	0.0(5)	52(1) *	32	7.3
14.1	A	06-23-86	636122(5)	4(5)	6(5)	0(1)		10(1)	13(3)	18(3)	35(1)	17(5)	30(3)	1.4(3)	116(1) *	36	9.0
13.7	A	09-02-86	636211(3)	2(3)	2(1)	0(1)		1(1)	14(3)	8(5)	66(1)	1(1)	21(1)	1.3(3)	272(3)	26	7.5
13.7	A	07-23-86	636210(1)	2(3)	1(1)	0(1)		0(1)	0(1)	15(3)	26(3)	7(3)	30(3)	0.0(5)	78(1) *	26	6.7
13.7	A	06-23-86	636212(3)	3(3)	2(1)	0(1)		1(1)	1(1)	5(5)	66(1)	2(1)	12(1)	4.5(1)	250(3)	22	7.1
9.4	A	09-03-86	638517(3)	3(3)	3(3)	0(1)		1(1)	5(1)	7(5)	58(1)	5(1)	13(1)	0.0(5)	348(3)	28	8.1
9.4	A	07-28-86	6385 9(1)	2(3)	1(1)	0(1)		0(1)	0(1)	22(3)	40(1)	4(1)	9(1)	11.1(1)	70(1) *	16	6.5
9.4	A	06-24-86	638510(1)	1(1)	2(1)	0(1)		0(1)	0(1)	30(1)	66(1)	7(3)	9(1)	2.3(3)	62(1) *	16	6.2
9.4	A	06-03-86	638516(3)	2(3)	3(3)	0(1)		1(1)	1(1)	26(3)	40(1)	6(3)	38(3)	2.5(3)	118(1) *	26	7.2
7.4	A	09-03-86	639110(1)	1(1)	1(1)	0(1)		0(1)	54(5)	1(5)	40(1)	0(1)	57(5)	0.0(5)	572(5)	32	6.2
7.4	B	08-13-86	6391 7(1)	1(1)	1(1)	0(1)		1(1)	10(1)	4(5)	83(1)	3(1)	12(1)	0.0(5)	384(3)	22	5.2
7.4	A	07-28-86	639111(3)	1(1)	2(1)	0(1)		1(1)	5(1)	19(3)	45(1)	5(1)	31(3)	5.7(1)	142(1) *	18	6.7
7.4	A	06-24-86	639110(1)	3(3)	1(1)	0(1)		0(1)	0(1)	25(3)	44(1)	7(3)	31(3)	6.8(1)	88(1) *	20	7.4
7.4	A	06-03-86	639114(3)	2(3)	3(3)	0(1)		5(1)	5(1)	20(3)	57(1)	10(5)	23(1)	7.2(1)	140(1) *	24	8.0
7.3	A	09-03-86	639113(3)	4(5)	3(3)	0(1)		1(1)	15(3)	4(5)	77(1)	3(1)	17(1)	0.3(5)	666(5)	34	7.3
7.3	B	08-13-86	639112(3)	3(3)	2(1)	0(1)		0(1)	1(1)	12(5)	86(1)	5(1)	7(1)	2.5(3)	380(3)	24	7.3
7.3	A	07-28-86	639111(3)	3(3)	1(1)	0(1)		0(1)	2(1)	31(1)	33(1)	14(5)	24(1)	0.0(5)	58(1) *	24	6.5

Table 4. IBI and MIwb scores and metrics for the Maumee R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Modified Iwb
7.3	A	06-24-86	639111	(3) 4	(5) 2	(1) 0	(1) 0	(1) 0	(1) 6	(5) 78	(1) 3	(1) 6	(1) 0.4	(5) 468	(5)	30	7.1
7.3	A	06-03-86	639116	(3) 3	(3) 5	(3) 0	(1) 1	(1) 5	(1) 16	(3) 71	(1) 5	(1) 10	(1) 4.5	(1) 484	(5)	24	8.6
4.7	B	08-28-86	6601	9 (1)	2 (3)	2 (1)	0 (1)	0 (1)	12 (3)	1 (5)	83 (1)	2 (1)	14 (1)	0.0 (5)	1143 (5)	28	7.3
4.7	B	08-13-86	6601	9 (1)	4 (5)	1 (1)	0 (1)	0 (1)	66 (5)	2 (5)	31 (1)	1 (1)	68 (5)	0.0 (5)	990 (5)	36	6.6
4.7	A	07-28-86	660111	(3) 3	(3) 2	(1) 0	(1) 0	(1) 12	(1) 27	(3) 10	(5) 17	(5) 63	(5) 0.0	(5) 76	(1) *	34	7.5
4.7	A	06-24-86	660113	(3) 3	(3) 3	(3) 0	(1) 4	(1) 10	(1) 24	(3) 21	(3) 10	(5) 47	(3) 5.1	(1) 118	(1) *	28	7.6
3.6	A	09-03-86	660211	(3) 1	(1) 1	(1) 0	(1) 0	(1) 26	(5) 3	(5) 37	(1) 2	(1) 29	(3) 0.3	(5) 574	(5)	32	6.6
3.6	A	07-29-86	6602	7 (1)	3 (3)	1 (1)	0 (1)	2 (1)	2 (1)	5 (5)	63 (1)	0 (1)	28 (3)	5.3 (1)	108 (1) *	20	5.4
3.6	A	06-24-86	6602	8 (1)	1 (1)	1 (1)	0 (1)	0 (1)	0 (1)	19 (3)	43 (1)	10 (3)	21 (1)	2.4 (3)	68 (1) *	18	6.8
3.6	A	06-03-86	660210	(1) 2	(3) 2	(1) 1	(1) 1	(1) 8	(1) 14	(5) 26	(3) 0	(1) 21	(1) 10.3	(1) 126	(1) *	20	6.7
3.3	A	09-03-86	6603	9 (1)	1 (1)	1 (1)	0 (1)	0 (1)	3 (1)	2 (5)	72 (1)	1 (1)	4 (1)	0.0 (5)	604 (5)	24	6.4
3.3	A	07-29-86	6603	9 (1)	4 (5)	0 (1)	0 (1)	0 (1)	0 (1)	31 (1)	16 (5)	18 (5)	33 (3)	3.9 (1)	70 (1) *	26	6.1
3.3	A	06-24-86	6603	7 (1)	3 (3)	0 (1)	0 (1)	0 (1)	0 (1)	10 (5)	44 (1)	3 (1)	7 (1)	1.4 (3)	128 (1) *	20	6.3
3.3	A	06-03-86	660313	(3) 3	(3) 1	(1) 0	(1) 1	(1) 18	(3) 27	(3) 13	(5) 8	(3) 49	(3) 2.8	(3) 104	(1) *	30	7.1
1.5	B	08-14-86	660513	(3) 4	(5) 2	(1) 0	(1) 1	(1) 22	(3) 9	(5) 63	(1) 4	(1) 29	(3) 0.0	(5) 336	(3)	32	6.2
1.5	M	08-13-86	6605	7 (1)	0 (1)	1 (1)	0 (1)	4 (1)	18 (3)	14 (5)	75 (1)	1 (1)	21 (1)	0.0 (5)	124 (1) *	22	4.9
1.4	A	09-03-86	6605	6 (1)	1 (1)	0 (1)	0 (1)	0 (1)	11 (1)	1 (5)	79 (1)	0 (1)	14 (1)	0.0 (5)	360 (3)	22	5.5
1.4	A	07-29-86	660511	(3) 2	(3) 1	(1) 0	(1) 0	(1) 19	(3) 13	(5) 9	(5) 15	(5) 48	(3) 0.0	(5) 94	(1) *	36	6.6
1.4	A	06-24-86	6605	7 (1)	2 (3)	0 (1)	0 (1)	0 (1)	3 (1)	6 (5)	52 (1)	0 (1)	18 (1)	0.0 (5)	67 (1) *	22	6.2
0.7	B	08-27-86	6608	5 (1)	0 (1)	0 (1)	0 (1)	0 (1)	5 (1)	1 (5)	93 (1)	1 (1)	6 (1)	0.0 (5)	1156 (5)	24	6.3
0.7	A	07-29-86	660810	(1) 2	(3) 1	(1) 0	(1) 2	(1) 3	(1) 19	(3) 37	(1) 5	(3) 10	(1) 1.9	(3) 96	(1) *	20	6.0
0.7	A	06-25-86	6608	7 (1)	0 (1)	1 (1)	0 (1)	10 (1)	13 (3)	10 (5)	10 (5)	3 (1)	16 (1)	3.2 (1)	56 (1) *	22	5.5
0.6	A	09-04-86	660811	(3) 0	(1) 1	(1) 0	(1) 0	(1) 14	(3) 0	(5) 74	(1) 3	(1) 16	(1) 0.2	(5) 791	(5)	28	7.3

Table 4. IBI and MIwb scores and metrics for the Maumee R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
0.6	A	07-30-86	6608	4(1)	0(1)	0(1)	0(1)	0(1)	0(1)	33(1)	67(1)	6(1)	11(1)	0.0(1)	22(1)**	12	3.7
0.5	A	09-04-86	660810	(1)	1(1)	1(1)	0(1)	0(1)	38(5)	3(5)	54(1)	1(1)	41(3)	0.0(5)	624(5)	30	6.5
0.5	A	07-30-86	6608	9(1)	1(1)	0(1)	0(1)	0(1)	6(1)	23(3)	35(1)	6(3)	16(1)	0.0(5)	48(1) *	20	5.2
0.4	A	09-25-86	660817	(3)	4(5)	1(1)	0(1)	0(1)	7(1)	14(5)	46(1)	26(5)	17(1)	0.5(5)	458(5)	34	6.9
0.4	A	07-24-86	660815	(3)	5(5)	0(1)	1(1)	0(1)	2(1)	20(3)	18(3)	7(3)	22(1)	1.1(3)	144(1) *	26	6.3
0.4	A	06-26-86	660811	(3)	2(3)	0(1)	0(1)	0(1)	13(3)	5(5)	31(1)	6(3)	22(1)	0.0(5)	158(1) *	28	7.0
0.3	A	09-25-86	660813	(3)	4(5)	2(1)	0(1)	0(1)	1(1)	22(3)	41(1)	16(5)	16(1)	2.4(3)	446(5)	30	8.6
0.3	A	07-24-86	6608	9(1)	2(3)	1(1)	0(1)	0(1)	2(1)	53(1)	43(1)	0(1)	28(3)	0.0(5)	44(1) *	20	6.1
0.3	A	06-26-86	6608	4(1)	0(1)	1(1)	0(1)	0(1)	0(1)	84(1)	88(1)	1(1)	1(1)	11.9(1)	42(1)	12	4.0
0.2	A	09-25-86	660818	(3)	6(5)	2(1)	0(1)	1(1)	21(3)	14(5)	34(1)	6(3)	52(3)	2.0(3)	256(3)	32	7.5
0.2	M	08-13-86	6608	9(1)	3(3)	0(1)	0(1)	0(1)	8(1)	42(1)	72(1)	2(1)	17(1)	2.4(3)	74(1) *	16	4.3
0.2	A	07-23-86	660810	(1)	5(5)	0(1)	0(1)	0(1)	0(1)	41(1)	32(1)	2(1)	41(3)	2.4(3)	47(1) *	20	5.1
0.2	A	06-26-86	660810	(1)	3(3)	0(1)	0(1)	0(1)	10(1)	7(5)	27(3)	20(5)	23(1)	6.7(1)	55(1) *	24	6.4
0.1	A	09-04-86	6608	6(1)	1(1)	0(1)	0(1)	0(1)	4(1)	10(5)	92(1)	0(1)	5(1)	1.0(3)	180(1)	18	5.0
0.1	A	07-24-86	6608	4(1)	1(1)	0(1)	0(1)	0(1)	0(1)	30(1)	30(1)	0(1)	40(1)	0.0(1)	14(1)**	12	3.6
0.1	A	06-26-86	6608	9(1)	1(1)	0(1)	0(1)	0(1)	7(1)	6(5)	7(5)	6(3)	26(1)	0.0(5)	166(1) *	26	4.7
0.0	B	08-28-86	6608	5(1)	0(1)	0(1)	0(1)	0(1)	43(5)	0(5)	43(1)	1(1)	55(5)	0.0(5)	1402(5)	32	7.1
0.0	A	07-24-86	6608	5(1)	1(1)	0(1)	0(1)	0(1)	0(1)	11(5)	7(5)	4(1)	19(1)	0.0(5)	47(1) *	24	5.0
0.0	A	06-25-86	6608	4(1)	0(1)	0(1)	0(1)	0(1)	7(1)	3(5)	0(5)	0(1)	41(3)	0.0(5)	56(1) *	26	4.0

Table 5. IBI and MIwb scores and metrics for the Vermilion R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
VERMILION RIVER - (21-001)																	
Year:	88																
2.4	A	09-26-88	26620(5)	6(5)	4(3)	1(1)	4(1)	10(1)	12(5)	27(3)	17(5)	51(3)	1.1(3)	478(5)	40	9.4	
2.4	A	08-23-88	26618(3)	5(5)	4(3)	2(3)	7(1)	7(1)	3(5)	60(1)	7(3)	25(1)	0.9(3)	448(5)	34	8.5	
2.4	A	07-12-88	26619(3)	6(5)	2(1)	2(3)	18(1)	20(1)	18(3)	16(5)	9(3)	72(5)	3.0(3)	166(1)	34	7.1	
1.4	A	09-26-88	26721(5)	7(5)	3(3)	1(1)	5(1)	6(1)	17(3)	24(3)	12(5)	63(5)	2.7(3)	508(5)	40	9.4	
1.4	A	08-22-88	26718(3)	6(5)	2(1)	1(1)	3(1)	4(1)	17(3)	42(1)	11(5)	42(3)	1.1(3)	598(5)	32	8.4	
1.4	A	07-12-88	26711(3)	4(5)	1(1)	1(1)	3(1)	6(1)	26(3)	32(1)	8(3)	46(3)	5.4(1)	182(1)	24	6.4	
0.5	A	09-26-88	268 5(1)	0(1)	1(1)	0(1)	0(1)	1(1)	1(5)	98(1)	0(1)	2(1)	0.0(5)	617(5)	24	5.1	
0.5	A	08-22-88	268 7(1)	2(3)	0(1)	0(1)	0(1)	0(1)	1(5)	98(1)	1(1)	1(1)	0.1(5)	1443(5)	26	5.6	
0.5	A	07-11-88	26810(1)	3(3)	1(1)	0(1)	0(1)	1(1)	5(5)	89(1)	1(1)	5(1)	0.0(5)	304(3)	24	4.7	
0.3	A	09-26-88	26810(1)	5(5)	2(1)	1(1)	1(1)	1(1)	12(5)	57(1)	5(3)	32(3)	0.6(3)	382(3)	28	7.2	
0.3	A	08-22-88	26814(3)	6(5)	1(1)	0(1)	0(1)	0(1)	4(5)	87(1)	1(1)	9(1)	1.1(3)	882(5)	28	7.0	
0.3	A	07-11-88	26817(3)	5(5)	1(1)	0(1)	0(1)	27(5)	3(5)	43(1)	13(5)	38(3)	0.7(3)	718(5)	38	8.8	

Table 6. IBI and MIwb scores and metrics for the Black R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
Black River - (20-001)																	
Year:	82																
5.8	A	10/28/82	425	3(1)	0(1)	0(1)	0(1)	0(1)	16(1)	0(5)	76(1)	8(3)	16(1)	0.0(5)	102(1) *	22	3.7
5.8	A	10/28/82	425	3(1)	0(1)	0(1)	0(1)	0(1)	16(1)	0(5)	76(1)	8(3)	16(1)	0.0(5)	102(1) *	22	3.7
5.8	A	10-28-82	425	3(1)	0(1)	0(1)	0(1)	0(1)	16(1)	0(5)	76(1)	8(3)	16(1)	0.0(5)	102(1) *	22	3.7
5.8	A	09/01/82	425	4(1)	0(1)	0(1)	0(1)	0(1)	1(1)	2(5)	94(1)	0(1)	2(1)	0.0(5)	192(1) *	20	3.9
5.8	A	08/05/82	425	3(1)	0(1)	0(1)	0(1)	0(1)	28(3)	0(5)	68(1)	0(1)	28(3)	0.0(5)	80(1) *	24	3.9
5.8	A	07/21/82	425	4(1)	0(1)	1(1)	0(1)	0(1)	21(1)	53(1)	79(1)	0(1)	21(1)	21.1(1)	18(1)**	12	3.2
4.8	A	10/28/82	464	11(3)	2(3)	2(1)	0(1)	1(1)	53(5)	9(5)	33(1)	11(5)	56(5)	2.1(3)	375(3)	36	6.8
4.8	A	10/28/82	464	11(3)	2(3)	2(1)	0(1)	1(1)	53(5)	9(5)	33(1)	11(5)	56(5)	1.6(3)	375(3)	36	6.8
4.8	A	10-28-82	464	11(3)	2(3)	2(1)	0(1)	1(1)	53(5)	9(5)	33(1)	11(5)	56(5)	0.0(5)	375(3)	38	6.8
4.8	A	09/01/82	464	6(1)	0(1)	1(1)	0(1)	0(1)	18(1)	18(3)	58(1)	22(5)	19(1)	6.1(1)	379(3)	20	6.0
4.8	A	08/05/82	464	7(1)	1(1)	1(1)	0(1)	0(1)	9(1)	10(5)	89(1)	1(1)	9(1)	3.7(1)	413(3)	18	4.4
4.8	A	07/21/82	464	3(1)	1(1)	0(1)	0(1)	0(1)	37(3)	49(1)	37(1)	0(1)	56(5)	14.0(1)	47(1) *	18	4.1
3.3	A	10/26/82	465	8(1)	1(1)	0(1)	0(1)	0(1)	10(1)	3(5)	89(1)	1(1)	10(1)	0.4(5)	1640(5)	24	6.9
3.3	A	10/26/82	465	8(1)	1(1)	0(1)	0(1)	0(1)	10(1)	3(5)	89(1)	1(1)	10(1)	0.4(5)	1640(5)	24	6.9
3.3	A	10-26-82	465	8(1)	1(1)	0(1)	0(1)	0(1)	10(1)	3(5)	89(1)	1(1)	10(1)	0.0(5)	1640(5)	24	6.9
3.3	A	09/01/82	465	11(3)	1(1)	1(1)	0(1)	0(1)	9(1)	23(3)	78(1)	10(5)	10(1)	1.9(3)	448(5)	26	6.1
3.3	A	08/05/82	465	10(1)	2(3)	0(1)	0(1)	0(1)	22(1)	28(1)	65(1)	6(3)	26(1)	6.0(1)	296(3)	18	5.8
3.3	A	07/21/82	465	10(1)	1(1)	0(1)	0(1)	0(1)	2(1)	76(1)	74(1)	2(1)	15(1)	21.9(1)	40(1) *	12	4.0
2.7	A	10/26/82	465	6(1)	1(1)	0(1)	0(1)	0(1)	0(1)	0(5)	99(1)	1(1)	1(1)	0.0(5)	4080(5)	24	6.9
2.7	A	10/26/82	465	6(1)	1(1)	0(1)	0(1)	0(1)	0(1)	0(5)	99(1)	1(1)	1(1)	0.0(5)	4080(5)	24	6.9
2.7	A	10-26-82	465	6(1)	1(1)	0(1)	0(1)	0(1)	0(1)	0(5)	99(1)	1(1)	1(1)	0.0(5)	4080(5)	24	6.9
2.7	A	09/02/82	465	9(1)	1(1)	0(1)	0(1)	0(1)	11(1)	2(5)	67(1)	9(3)	22(1)	0.0(5)	408(3)	24	6.6

Table 6. IBI and MIwb scores and metrics for the Black R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Modified Iwb
2.7	A	08/05/82	465	6(1)	1(1)	0(1)	0(1)	0(1)	7(1)	24(3)	82(1)	2(1)	16(1)	2.2(3)	68(1) *	16	4.2
2.7	A	07/21/82	465	10(1)	2(3)	0(1)	0(1)	0(1)	24(1)	20(3)	39(1)	1(1)	38(3)	15.5(1)	186(1)	18	5.7
0.9	A	10/26/82	466	6(1)	1(1)	0(1)	0(1)	0(1)	5(1)	0(5)	95(1)	0(1)	5(1)	0.0(5)	5857(5)	24	7.2
0.9	A	10/26/82	466	6(1)	1(1)	0(1)	0(1)	0(1)	5(1)	0(5)	95(1)	0(1)	5(1)	0.0(5)	5857(5)	24	7.2
0.9	A	10-26-82	466	6(1)	1(1)	0(1)	0(1)	0(1)	5(1)	0(5)	95(1)	0(1)	5(1)	0.0(5)	5856(5)	24	7.2
0.9	A	09/02/82	466	12(3)	1(1)	1(1)	0(1)	0(1)	10(1)	7(5)	33(1)	12(5)	54(5)	1.9(3)	430(5)	32	7.0
0.9	A	08/05/82	466	8(1)	2(3)	0(1)	0(1)	0(1)	32(3)	16(3)	31(1)	0(1)	67(5)	13.9(1)	417(3)	24	6.5
0.9	A	07/06/82	466	7(1)	2(3)	0(1)	0(1)	0(1)	43(3)	30(1)	23(3)	9(3)	67(5)	11.7(1)	261(3)	26	6.2
0.0	A	10/26/82	466	10(1)	2(3)	1(1)	0(1)	0(1)	79(5)	4(5)	5(5)	12(5)	83(5)	0.0(5)	682(5)	42	5.2
0.0	A	10/26/82	466	10(1)	2(3)	1(1)	0(1)	0(1)	79(5)	4(5)	5(5)	12(5)	83(5)	0.0(5)	682(5)	42	5.2
0.0	A	10-26-82	466	10(1)	2(3)	1(1)	0(1)	0(1)	79(5)	4(5)	5(5)	12(5)	83(5)	0.0(5)	682(5)	42	5.2
0.0	A	08/05/82	466	11(3)	2(3)	1(1)	0(1)	1(1)	3(1)	40(1)	55(1)	5(3)	31(3)	4.5(1)	96(1) *	20	6.4
0.0	A	07/21/82	466	13(3)	2(3)	1(1)	0(1)	3(1)	15(1)	37(1)	47(1)	7(3)	32(3)	2.5(3)	106(1) *	22	6.3
0.0	A	07/06/82	466	13(3)	1(1)	1(1)	0(1)	4(1)	15(1)	51(1)	54(1)	8(3)	28(3)	3.0(3)	70(1) *	20	5.8

Table 7. IBI and MIwb scores and metrics for the Cuyahoga R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
CUYAHOGA RIVER - (19-001)																	
Year:	88																
7.5	A	09-28-88	749	8(1)	3(3)	1(1)	0(1)	0(1)	13(1)	39(1)	85(1)	6(3)	9(1)	1.9(3)	66(1) *	18	4.6
7.5	A	08-31-88	749	7(1)	1(1)	1(1)	0(1)	0(1)	67(5)	73(1)	98(1)	0(1)	2(1)	0.0(5)	74(1)	20	4.8
7.5	A	07-27-88	749	8(1)	2(3)	1(1)	0(1)	0(1)	6(1)	35(1)	76(1)	6(3)	17(1)	5.0(1)	82(1) *	16	5.0
7.1	A	09-28-88	786	7(1)	0(1)	1(1)	0(1)	0(1)	18(1)	35(1)	91(1)	5(1)	3(1)	3.1(1)	84(1) *	12	5.7
7.1	A	08-31-88	786	11(3)	2(3)	1(1)	0(1)	0(1)	4(1)	19(3)	91(1)	0(1)	7(1)	2.5(3)	260(3)	22	5.3
7.1	A	07-27-88	786	8(1)	1(1)	1(1)	0(1)	0(1)	15(1)	24(1)	83(1)	4(1)	10(1)	1.3(3)	116(1) *	14	5.4
6.8	A	09-28-88	786	3(1)	1(1)	1(1)	0(1)	0(1)	2(1)	15(1)	98(1)	0(1)	2(1)	1.5(1)	110(1) *	12	4.4
6.8	A	08-31-88	786	10(1)	1(1)	1(1)	0(1)	0(1)	13(1)	51(1)	84(1)	2(1)	14(1)	4.8(1)	102(1)	12	4.9
6.8	A	07-27-88	786	10(1)	4(5)	1(1)	0(1)	0(1)	26(1)	35(1)	81(1)	4(1)	14(1)	1.1(3)	118(1) *	18	6.1
5.6	A	09-28-88	788	4(1)	1(1)	0(1)	0(1)	0(1)	3(1)	19(1)	78(1)	8(1)	14(1)	0.0(1)	60(1) *	12	5.0
5.6	A	08-31-88	788	5(1)	2(3)	0(1)	0(1)	0(1)	1(1)	5(5)	92(1)	2(1)	5(1)	1.6(3)	236(3)	22	4.6
5.6	A	07-27-88	788	5(1)	1(1)	0(1)	0(1)	0(1)	3(1)	12(1)	90(1)	2(1)	9(1)	0.0(1)	102(1) *	12	5.0
5.1	A	09-28-88	796	3(1)	0(1)	0(1)	0(1)	0(1)	6(1)	24(1)	91(1)	3(1)	6(1)	3.0(1)	50(1) *	12	4.4
5.1	A	08-31-88	796	4(1)	1(1)	1(1)	0(1)	0(1)	1(1)	7(5)	97(1)	0(1)	1(1)	3.5(1)	218(3)	18	4.8
5.1	A	07-27-88	796	3(1)	1(1)	0(1)	0(1)	0(1)	0(1)	3(1)	93(1)	0(1)	7(1)	33.3(1)	57(1) *	12	3.2
3.4	A	09-28-88	805	2(1)	0(1)	0(1)	0(1)	0(1)	0(1)	38(1)	98(1)	2(1)	0(1)	11.3(1)	66(1) *	12	3.7
3.4	A	08-31-88	805	4(1)	0(1)	0(1)	0(1)	0(1)	1(1)	9(5)	92(1)	2(1)	2(1)	3.0(1)	226(3)	18	5.2
3.4	A	07-27-88	805	4(1)	0(1)	2(1)	0(1)	0(1)	4(1)	37(1)	98(1)	0(1)	2(1)	6.5(1)	126(1)	12	5.2
1.5	A	09-28-88	807	3(1)	0(1)	1(1)	0(1)	0(1)	20(1)	90(1)	70(1)	0(1)	30(1)	10.0(1)	2(1)**	12	2.2
1.5	A	08-31-88	807	5(1)	0(1)	0(1)	1(1)	0(1)	1(1)	4(5)	94(1)	2(1)	2(1)	0.0(5)	340(3)	22	4.9
0.8	A	09-28-88	808	3(1)	0(1)	0(1)	0(1)	0(1)	0(1)	39(1)	82(1)	6(1)	6(1)	0.0(1)	40(1) *	12	3.4
Year:	87																

Table 7. IBI and MIwb scores and metrics for the Cuyahoga R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Modified Iwb
7.5	A	09-11-87	749	3(1)	0(1)	1(1)	0(1)	0(1)	2(1)	16(3)	96(1)	0(1)	4(1)	0.0(5)	82(1) *	18	3.1
7.5	A	07-30-87	749	4(1)	0(1)	1(1)	0(1)	0(1)	9(1)	95(1)	95(1)	0(1)	0(1)	54.6(1)	2(1)**	12	1.8
7.5	A	06-17-87	749	7(1)	0(1)	1(1)	0(1)	0(1)	72(5)	6(5)	25(3)	2(1)	73(5)	1.5(3)	246(3)	30	5.5
7.1	A	09-11-87	786	6(1)	1(1)	1(1)	0(1)	0(1)	11(1)	18(3)	95(1)	1(1)	1(1)	5.8(1)	142(1) *	14	5.1
7.1	A	07-30-87	786	6(1)	0(1)	1(1)	0(1)	0(1)	20(1)	75(1)	75(1)	10(1)	10(1)	30.0(1)	10(1)**	12	3.2
7.1	A	06-17-87	786	8(1)	2(3)	1(1)	0(1)	0(1)	63(5)	21(3)	35(1)	4(1)	60(5)	5.6(1)	234(3)	26	5.0
6.8	A	09-11-87	786	2(1)	0(1)	1(1)	0(1)	0(1)	3(1)	16(3)	97(1)	0(1)	0(1)	15.6(1)	54(1) *	14	3.1
6.8	A	07-30-87	786	3(1)	1(1)	1(1)	0(1)	0(1)	27(1)	91(1)	82(1)	0(1)	18(1)	27.3(1)	2(1)**	12	2.0
6.8	A	06-17-87	786	8(1)	2(3)	1(1)	0(1)	0(1)	51(5)	16(3)	43(1)	1(1)	55(5)	5.4(1)	124(1) *	24	4.5
5.5	A	09-11-87	788	4(1)	2(3)	0(1)	0(1)	0(1)	0(1)	6(5)	97(1)	1(1)	2(1)	1.8(3)	234(3)	22	5.0
5.5	A	07-30-87	788	4(1)	0(1)	1(1)	0(1)	0(1)	5(1)	61(1)	91(1)	2(1)	7(1)	4.5(1)	34(1) *	12	4.5
5.5	A	06-17-87	788	6(1)	0(1)	0(1)	0(1)	0(1)	9(1)	32(1)	52(1)	36(5)	11(1)	6.1(1)	140(1)	16	5.7
5.0	A	09-11-87	796	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	48(1)	76(1)	0(1)	5(1)	19.1(1)	28(1) *	12	3.4
5.0	A	07-30-87	796	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	84(1)	100(1)	0(1)	0(1)	0.0(1)	6(1)**	12	1.5
5.0	A	06-17-87	796	5(1)	1(1)	0(1)	0(1)	0(1)	21(1)	31(1)	56(1)	16(5)	24(1)	0.0(5)	86(1) *	20	5.4
3.4	A	09-11-87	805	4(1)	0(1)	0(1)	0(1)	0(1)	1(1)	24(3)	89(1)	8(3)	1(1)	3.0(3)	110(1) *	18	4.3
3.4	A	07-30-87	805	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	95(1)	95(1)	0(1)	0(1)	90.0(1)	2(1)**	12	0.6
3.4	A	06-17-87	805	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1)**	12	0.0
1.4	A	09-11-87	807	5(1)	1(1)	0(1)	0(1)	0(1)	8(1)	19(3)	82(1)	2(1)	9(1)	4.2(1)	154(1) *	14	4.4
1.4	A	07-30-87	807	2(1)	1(1)	1(1)	0(1)	0(1)	20(1)	100(1)	90(1)	0(1)	10(1)	40.0(1)	0(1)**	12	1.9
1.4	A	06-17-87	807	2(1)	0(1)	0(1)	0(1)	0(1)	93(5)	7(5)	6(5)	0(1)	94(5)	3.4(1)	166(1) *	28	3.8
0.8	A	09-11-87	808	6(1)	0(1)	0(1)	0(1)	0(1)	11(1)	14(5)	83(1)	2(1)	12(1)	2.1(3)	328(3)	20	5.7
0.8	A	07-30-87	808	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1)**	12	0.0

Table 7. IBI and MIwb scores and metrics for the Cuyahoga R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Modified Iwb
0.8	A	06-17-87	808	1(1)	0(1)	0(1)	0(1)	0(1)	55(2)	45(1)	45(1)	0(1)	55(1)	0.0(1)	17(1)**	12	2.4
Year:	85																
7.5	A	10-03-85	749	2(1)	0(1)	1(1)	0(1)	0(1)	48(5)	64(1)	84(1)	0(1)	0(1)	20.0(1)	18(1)**	16	3.6
7.1	A	10-03-85	786	5(1)	1(1)	1(1)	0(1)	0(1)	13(1)	23(3)	81(1)	0(1)	2(1)	3.9(1)	140(1) *	14	5.9
5.1	A	10-03-85	796	5(1)	0(1)	1(1)	0(1)	0(1)	0(1)	16(3)	85(1)	1(1)	0(1)	5.6(1)	404(3)	16	6.5
3.4	A	10-03-85	805	2(1)	0(1)	0(1)	0(1)	0(1)	0(1)	6(5)	78(1)	4(1)	0(1)	0.0(5)	398(3)	22	5.6
1.5	A	10-03-85	807	5(1)	0(1)	1(1)	0(1)	0(1)	5(1)	25(3)	57(1)	16(5)	2(1)	3.2(1)	94(1) *	18	4.1
0.8	A	10-03-85	808	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	38(1)	90(1)	2(1)	0(1)	4.0(1)	78(1) *	12	3.9
Year:	84																
7.5	B	10-16-84	749	2(1)	0(1)	1(1)	0(1)	0(1)	3(1)	3(5)	97(1)	0(1)	0(1)	18.8(1)	62(1) *	16	2.8
7.5	B	08-23-84	749	5(1)	1(1)	2(1)	0(1)	0(1)	2(1)	21(3)	95(1)	3(1)	2(1)	3.5(1)	92(1) *	14	5.0
7.5	B	07-25-84	749	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	16(3)	96(1)	0(1)	4(1)	20.0(1)	42(1)**	14	3.4
7.5	B	07-05-84	749	7(1)	2(3)	1(1)	0(1)	0(1)	22(1)	34(1)	87(1)	1(1)	8(1)	7.0(1)	102(1) *	14	5.6
7.1	B	10-16-84	786	3(1)	1(1)	1(1)	0(1)	0(1)	12(1)	15(5)	98(1)	0(1)	2(1)	56.4(1)	70(1) *	16	4.6
7.1	B	08-23-84	786	3(1)	0(1)	1(1)	0(1)	0(1)	7(1)	30(1)	100(1)	0(1)	0(1)	0.0(5)	60(1) *	16	4.5
7.1	B	07-25-84	786	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	22(3)	97(1)	0(1)	3(1)	11.1(1)	56(1) *	14	3.8
7.1	B	07-05-84	786	3(1)	1(1)	1(1)	0(1)	0(1)	36(3)	75(1)	98(1)	0(1)	2(1)	17.6(1)	22(1) *	14	3.0
5.1	B	10-16-84	796	4(1)	0(1)	0(1)	0(1)	0(1)	1(1)	50(1)	94(1)	0(1)	2(1)	29.5(1)	86(1) *	12	4.6
5.1	B	08-23-84	796	5(1)	1(1)	0(1)	0(1)	0(1)	0(1)	44(1)	94(1)	3(1)	3(1)	0.0(5)	40(1) *	16	3.2
5.1	B	07-25-84	796	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	38(1)	88(1)	0(1)	0(1)	22.1(1)	40(1) *	12	3.7
5.1	B	07-05-84	796	6(1)	3(3)	0(1)	0(1)	0(1)	4(1)	13(5)	77(1)	2(1)	19(1)	4.3(1)	82(1) *	18	5.4
3.4	B	10-16-84	805	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	25(3)	80(1)	0(1)	2(1)	52.7(1)	82(1) *	14	3.9
3.4	B	08-23-84	805	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	100(1)	80(1)	0(1)	20(1)	20.0(1)	0(1)**	12	0.6
3.4	B	07-25-84	805	2(1)	0(1)	0(1)	0(1)	0(1)	0(1)	87(1)	93(1)	0(1)	7(1)	33.3(1)	4(1)**	12	2.7

Table 7. IBI and MIwb scores and metrics for the Cuyahoga R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Modified Iwb
3.4	B	07-05-84	805	3(1)	1(1)	0(1)	0(1)	0(1)	13(1)	38(1)	81(1)	0(1)	19(1)	6.3(1)	20(1)**	12	3.6
1.5	B	10-16-84	807	2(1)	1(1)	0(1)	0(1)	0(1)	0(1)	18(3)	73(1)	0(1)	9(1)	0.0(1)	18(1)**	14	3.4
1.5	B	08-23-84	807	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(5)	0(1)	0(1)	0(1)	0.0(1)	0(1)**	12	0.0
1.5	B	07-25-84	807	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	100(1)	100(1)	0(1)	0(1)	50.0(1)	0(1)**	12	0.0
0.8	B	10-16-84	808	3(1)	0(1)	0(1)	0(1)	0(1)	3(1)	21(3)	72(1)	0(1)	17(1)	6.9(1)	46(1) *	14	3.2
0.8	B	08-23-84	808	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(5)	0(1)	0(1)	0(1)	0.0(1)	0(1)**	12	0.0
0.8	B	07-25-84	808	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(5)	0(1)	0(1)	0(1)	0.0(1)	0(1)**	12	0.0
0.8	B	07-05-84	808	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(5)	0(1)	0(1)	0(1)	0.0(1)	0(1)**	12	0.0
HARBOR - EAST SHORE - (19-998)																	
Year:	84																
1.0	B	10-16-84	6400	10(1)	2(3)	0(1)	0(1)	0(0)	38(5)	26(1)	26(3)	14(5)	50(3)	11.9(1)	62(1) *	26	5.4
1.0	B	08-29-84	6400	8(1)	2(3)	0(1)	0(1)	0(0)	33(3)	33(1)	36(1)	14(5)	42(3)	16.7(1)	48(1) *	22	4.4
1.0	B	07-25-84	6400	7(1)	1(1)	1(1)	0(1)	1(0)	25(3)	28(1)	28(3)	4(3)	27(3)	3.3(1)	204(3)	22	5.4
1.0	B	07-06-84	6400	9(1)	2(3)	1(1)	0(1)	5(0)	7(1)	16(1)	9(5)	12(5)	56(5)	7.0(1)	96(1) *	26	6.7
0.1	B	10-16-84	6400	4(1)	0(1)	0(1)	0(1)	0(0)	4(1)	8(3)	87(1)	2(3)	6(1)	3.9(1)	96(1) *	16	3.8
0.1	B	08-29-84	6400	8(1)	1(1)	0(1)	0(1)	0(0)	3(1)	7(3)	88(1)	0(1)	7(1)	0.0(5)	510(3)	20	5.1
0.1	B	07-25-84	6400	7(1)	1(1)	1(1)	0(1)	1(0)	5(1)	72(1)	78(1)	1(3)	6(1)	9.3(1)	44(1) *	14	3.4
0.1	B	07-17-84	6400	9(1)	1(1)	1(1)	0(1)	6(0)	20(3)	51(1)	51(1)	11(5)	20(1)	3.3(1)	34(1) *	18	5.3
HARBOR - WEST SHORE - (19-999)																	
Year:	84																
0.1	B	10-16-84	6400	7(1)	0(1)	0(1)	0(1)	0(0)	2(1)	17(1)	62(1)	2(3)	23(1)	19.3(1)	108(1) *	14	6.4
0.1	B	08-29-84	6400	7(1)	0(1)	0(1)	0(1)	0(0)	4(1)	6(3)	58(1)	2(3)	27(3)	1.6(1)	234(3)	20	5.3
0.1	B	07-25-84	6400	6(1)	1(1)	0(1)	0(1)	0(0)	2(1)	38(1)	83(1)	2(3)	7(1)	4.8(1)	52(1) *	14	3.8
0.1	B	07-17-84	6400	7(1)	1(1)	1(1)	0(1)	4(0)	7(1)	41(1)	56(1)	4(3)	19(1)	14.8(1)	35(1) *	14	5.1

Table 8. IBI and MIwb scores and metrics for the Grand R. and harbor (A&B=day; M=night).

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Percent of Individuals: Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	Iwb
GRAND RIVER - (03-001)																	
Year:	88																
2.0	A	09-29-88	70213(3)	3(3)	1(1)	1(1)	3(1)	7(1)	3(5)	7(5)	40(5)	45(3)	1.5(3)	100(1) *	32	7.2	
Year:	87																
4.4	B	09-16-87	69815(3)	2(3)	3(3)	2(3)	9(1)	54(5)	7(5)	15(5)	22(5)	61(5)	5.0(1)	188(1)	40	7.6	
4.4	A	08-19-87	69815(3)	2(3)	5(3)	1(1)	21(3)	27(3)	24(3)	39(1)	23(5)	31(3)	8.1(1)	94(1) *	30	6.7	
4.4	A	07-09-87	69813(3)	2(3)	2(1)	1(1)	4(1)	8(1)	42(1)	39(1)	30(5)	17(1)	8.7(1)	82(1) *	20	5.7	
3.0	B	09-16-87	70113(3)	4(5)	2(1)	1(1)	4(1)	65(5)	2(5)	18(3)	8(3)	71(5)	3.6(1)	162(1) *	34	6.4	
3.0	A	08-19-87	701 3(1)	1(1)	1(1)	0(1)	20(3)	20(1)	0(1)	40(1)	0(1)	60(1)	0.0(1)	10(1)**	14	3.0	
3.0	A	07-09-87	70117(3)	3(3)	3(3)	1(1)	12(1)	27(3)	5(5)	3(5)	25(5)	51(3)	5.1(1)	112(1) *	34	8.2	
2.9	B	03-24-87	701 8(1)	3(3)	2(1)	1(1)	10(1)	17(1)	14(5)	10(5)	10(5)	24(1)	3.5(1)	50(1) *	26	5.7	
2.0	B	09-16-87	70215(3)	4(5)	3(3)	1(1)	6(1)	66(5)	1(5)	6(5)	12(5)	78(5)	2.7(3)	218(3)	44	7.8	
2.0	A	08-19-87	70214(3)	6(5)	4(3)	2(3)	18(1)	30(3)	4(5)	1(5)	21(5)	76(5)	2.4(3)	158(1) *	42	8.4	
2.0	A	07-09-87	70218(3)	4(5)	4(3)	1(1)	9(1)	14(1)	3(5)	2(5)	37(5)	53(3)	2.2(3)	178(1) *	36	8.7	
1.9	B	03-24-87	702 7(1)	0(1)	3(3)	1(1)	21(3)	45(3)	17(3)	17(3)	10(5)	28(3)	3.5(1)	48(1) *	28	6.5	
0.6	B	09-15-87	70516(3)	4(5)	1(1)	0(1)	0(1)	3(1)	8(5)	42(1)	8(3)	34(3)	3.9(1)	422(5)	30	8.2	
0.6	A	08-19-87	70517(3)	3(3)	0(1)	0(1)	0(1)	14(1)	7(5)	13(5)	20(5)	50(3)	1.6(3)	476(5)	36	9.0	
0.6	A	07-09-87	70517(3)	5(5)	2(1)	0(1)	3(1)	8(1)	31(1)	3(5)	10(5)	58(5)	23.2(1)	254(3)	32	7.6	

Table 9. Summary of macroinvertebrate data collected from artificial substrate samplers (free-flowing/estuary sites) and Petite Ponar grabs (harbor sites) in the Ashtabula/Conneaut study area, July - September, 1989.

Station River Mile	Narrative Evaluation	Invertebrate Community Index	No. Quant. Taxa	No. Qual. Taxa	Density (/ft.^{2})
Free-Flowing					
Ashtabula					
10.0	Good	42	29	42	381
Conneaut					
6.7	Exceptional	52	43	65	665
Estuary					
Ashtabula					
1.9	Poor	12	17	27	1074
1.3	Fair	16	23	17	1322
0.6	Fair	14	23	20	2264
Conneaut					
1.3	Good	22	36	36	939
0.4	Poor	12	15	6	1086

Station River Mile	No. Taxa	Density (/m^2)	Percent Oligochaetes	Trophic Condition Index
Harbor				
Ashtabula				
0.1 (West Breakwall)	19	24,427	91	1.952
0.2 (Inner Breakwall)	23	9,386	91	1.910
Conneaut				
0.2 (West Breakwall)	31	27,222	86	1.925

Table 10. ICI index scores and metric values for the Ashtabula River and Conneaut Creek study area, 1989.

River/ River mile	Drainage area (sq.mi.)	Number of: Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa	Qual. EPT	Year	Eco-region	ICI
ASHTABULA RIVER														
10.0	109.0	29(4)	6(4)	1(2)	15(4)	28.4(4)	0.1(2)	41.3(6)	29.2(4)	2.4(6)	18(6)	89	3	42
1.9	132.0	18(2)	1(0)	1(0)	10(6)	0.1(2)	0.1(0)	1.0(2)	98.2(0)	43.8(0)	0(0)	89	3	12
1.3	136.0	23(4)	2(0)	2(2)	11(6)	0.5(2)	1.3(0)	0.6(2)	96.9(0)	30.9(0)	0(0)	89	3	16
0.6	137.0	23(4)	0(0)	2(2)	15(6)	0.0(0)	1.3(0)	0.4(2)	98.3(0)	11.4(0)	1(0)	89	3	14
CONNEAUT CREEK														
6.7	175.0	43(6)	9(6)	4(4)	18(6)	21.9(4)	3.2(2)	54.3(6)	19.2(6)	2.8(6)	26(6)	89	3	52
1.3	188.0	36(6)	4(2)	2(2)	20(6)	0.8(2)	0.7(0)	7.1(4)	88.0(0)	46.4(0)	3(0)	89	3	22
0.4	189.0	15(2)	1(0)	1(0)	8(6)	0.3(2)	0.1(0)	0.6(2)	99.0(0)	49.3(0)	0(0)	89	3	12