State of Ohio
Environmental Protection Agency

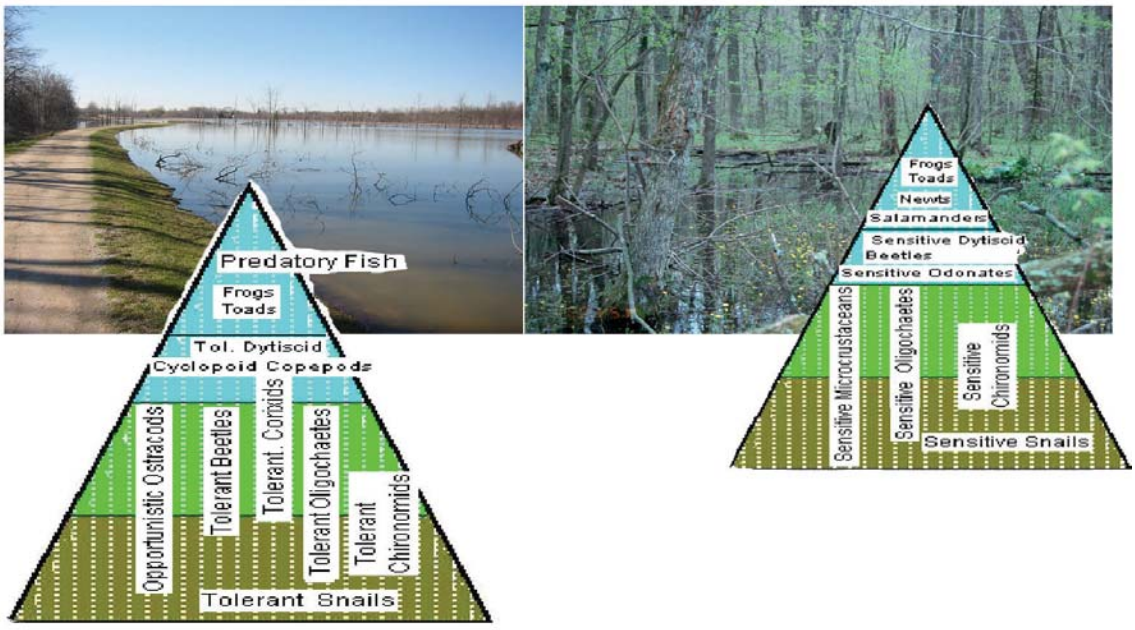
Wetland Ecology Group
Division of Surface Water

Investigations of Invertebrate Communities of Wetlands in the Huron/Erie Lake Plains Ecoregion and Ohio Mitigation Banks

An Addendum to:

INTEGRATED WETLAND ASSESSMENT PROGRAM. Part 8: Initial Development of Wetland Invertebrate Community Index for Ohio

Ohio EPA Technical Report WET/2006-3



Low Quality **High Quality**

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INTRODUCTION

This addendum to "Initial Development of Wetland Invertebrate Community Index for Ohio" (Knapp 2004) evaluates the invertebrate communities sampled from the Huron/Erie Lake Plain (HELP) ecoregion in 2003 and the Mitigation Bank sites in 2004. It was mentioned in the previous report that some adjustments to the Wetland Invertebrate Community Index (WICI) may need to be made. Identification of oligochaetes and ostracods down to the generic and specific taxonomic levels was necessary to show association with disturbance levels.

Invertebrates have long been recognized as sensitive indicator species of environmental conditions in rivers and streams (DeShon 1995, Yoder et al. 1995, Hynes 1970). The sensitivity and tolerance of invertebrate species make these organisms an excellent group to provide information on overall wetland condition. In this report, the relative abundance of different organism groups of herbivores, predators, and omnivores were sensitive to wetland perturbations compared to other groups that were tolerant to them. These sensitive and tolerant groups make up the metrics in the Wetland Invertebrate Community Index (WICI) developed from the Ohio EPA data, 1996-2002.

In earlier reports (Mack 2001, Micacchion 2002), use of landscape attributes were used to develop initial metrics for amphibians and plants, and an overall index of wetland condition was discussed. The distributions of many of the amphibian and plant species have been described as landscape driven. The communities were affected to a large degree by anthropogenic change over the past two centuries. The relative abundance of the invertebrate communities appears to be driven more by the water and soil characteristics of the wetland community. The landscape features indirectly affect these characteristics. Reduced forest canopy and open water with no groundwater surcharge will have a higher water temperature which has a direct effect on invertebrate communities. In many mitigation projects, the top soil is scraped off leaving behind a nutrient poor soil incapable of supporting robust and diverse wetland communities (Fennessy et.al. 2004). An understanding of the relationships between rich and poor nutrients in wetland soils, plant community nutrient requirements, low and high decomposition rates, and invertebrate distributions is critical to making sound environmental decisions.

WETLAND INVERTEBRATE DATA ANALYSES

From the previous report (Knapp 2004), a Wetland Invertebrate Community Index (WICI) was formulated. WICI scores (Tables 2 and 3) were computed for the HELP ecoregion and Mitigation Bank study sites, from 2003 and 2004, respectively, using the scoring system from Table 1.

The individual metrics used were relative abundance of oligochaetes, microcrustaceans, dytiscid beetles, corixids, tolerant beetles, and tolerant snails. Microcrustaceans included cladocerans and ostracods. Corixid totals did not include the genus *Hesperocorixa*, considered at this time not to be as tolerant as the other genera. Tolerant beetles included the genera *Haliplus, Peltodytes, Berosus,* and *Tropisternus*. Tolerant snails included *Gyraulus parvus* and *Physella*.

Data analyses with refined taxonomy

Oligochaetes and ostracods were previously identified only to order for most of the Ohio EPA wetland invertebrate data from 1996 to 2002. These orders were identified to the generic and specific taxonomic levels in laboratory analyses including most of the 2003 and 2004 samples in this report. Additional samples with high densities, greater than 200 per site, of these two groups from the previous years

1996 to 2002 were revisited and also identified to generic and specific levels.

From this refined taxonomic level, tolerant species of oligochaetes and ostracods were associated with lesser quality sites. However, a large proportion of the sites for this analysis were mitigation bank data. Since ORAM scores are not applied to mitigation sites, the WICI scores were used as a disturbance scale in the analyses. The sites were grouped into four levels of density (0-10, 11-100, 101-300, and >300 organisms per site) and tested by general linear models for differences between groups (Tukey pairwise comparisons). Figure 1 shows that higher densities of tolerant species of oligochaetes and ostracods are associated with lower WICI scores ($p = 0.019$ and 0.000, respectively.)

The tolerant oligochaete species were identified as Tubificids, and the Naididae genera *Nais, Ophidonais*, and *Pristina*, plus other Naididae (not including the genera *Dero* and *Stylaria*.) The tolerant ostracod species associated with lower WICI scores were the species *Cypridopsis vidua* and *Cypria maculata*. At higher density levels, these species had adjusted median WICI values in the mid to low 20's (Figure 1). A WICI metric scale evaluating species and species groups considered average WICI values less than 20 as tolerant groups, and those greater than 40 sensitive. Based on these values, the tolerant oligochaete and ostracod species were subtracted from the WICI score and shown parenthetically as adjusted WICI values in Tables 2 and 3. The adjusted WICI values were also used for the boxplots in Figure 3.

Density Based Invertebrate Community Index

A density based invertebrate community index for wetlands is under development. The current WICI index, as used in this addendum, is based on relative abundance, or percentages of organisms present. Large densities of a specific organism/group will affect the percentage of the other organisms in the sample. A density based approach will give the same scoring value to an organism group from one sample with the same density as another sample with the approximate same density, regardless of the densities of the other organisms present in the sample.

Qualitative Dipnet Sampling Method

A qualitative dipnet method was used for sampling from 1996 to 2004. Evaluation of the organisms collected using this method showed little information gained in the number of taxa collected compared to the quantitative funnel trap method (Figure 2). The overall efficiency of the dipnet method to collect taxa was low (average of 14.0 taxa per site) compared to the funnel trap method (average of 34.9 taxa per site). There was only an average of 3.1 additional taxa per site when the dipnet taxa were added to the funnel trap taxa.

The qualitative dipnet method does not estimate densities or relative abundance of invertebrates. Densities of tolerant and sensitive invertebrate species were used to discriminate between low and high quality wetland sites with the funnel trap method. Based on the low numbers of taxa collected and the inability to estimate densities, the qualitative dipnet method is suggested at this time to be dropped from the program.

Other methods used by various wetland researchers use a dipnet method with a quantitative approach. The dipnet is sweeped for a specified distance and the combined substrates are either picked of organisms in the field or sorted later in a laboratory. These methods produce relative abundances that can be used for quantitative results. However, the use of funnel traps to collect a quantitative sample would appear to be a more consistent and standardized protocol.

Statistical Analyses

The statistical software Systat was used to perform all statistical tests and graphs in this addendum. General linear models parametric test (comparable to the analysis of variance and t-tests), and subsequent Tukey's multiple comparison test were used to explore and evaluate the

biological attributes. Adobe Photoshop software was used to edit text in graphs and for the images on the front cover.

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WETLANDS IN THE HURON/ERIE LAKE PLAINS (HELP) ECOREGION

In 2003, 30 sites were evaluated for macroinvertebrates in the Huron/Erie Lake Plains (HELP) Ecoregion. Wetlands spanning the range of disturbance levels throughout the ecoregion with an emphasis on sites in the Oak Openings subecoregion were selected for study.

The Oak Openings area is unique. It is situated on the old lake plain so there is a high content of clay in the soils underlying the area. Overlaying this highly impermeable soil are deep deposits of sand left from the old lake beach ridges that developed as lake waters retreated over time. In depressions wetlands develop where surface and ground water is retained. Wet prairies form in the depressions with upland prairies on the dunes and swales. The wetlands in this subecoregion have sandy soils with organic deposits. This is found nowhere else in the state and is rare globally.

Wetland Invertebrate Community Index (WICI) scores were calculated based on relative abundance (%), Table 2. Since the original report the index has been modified to exclude tolerant species from the positive metrics of percent oligochaetes and microcrustaceans (section 1.0). These modifications only affected one of the thirty sites in 2003, and are shown parenthetically in Table 2 as an adjusted WICI value.

Figure 3 compares WICI scores of mitigation data (2001), nonreference data and reference data from 1996 to 2002, the HELP ecoregion (2003), and the mitigation bank data (2004). The WICI scores from the HELP ecoregion were similar to the reference sites from other areas in the state. Many of the sites in the study area from 2003 were on protected lands such as the Irwin Prairie State Nature Preserve, Kitty Todd Preserve, Lou Campbell State Nature Preserve, Maumee State Forest, and Oak Openings Metropark

Most of the sites in 2003 scored high on the positive metrics for sensitive microcrustaceans (average of 7.2 of 10 possible) and sensitive snails (average of 7.6). Only one site, Blue Heron Marsh, had a high percentage of the tolerant ostracod, *Cypridopsis vidua* (section 1.0). *Aplexa elongata* was a very common snail in the HELP ecoregion and contributed to the relatively high scores for the sensitive snail metric.

In comparison, most of the 2003 sites had low percentages of corixids, tolerant beetles, and tolerant snails, and therefore scored high average metric values of 9.3, 6.8, and 6.3, respectively (Table 2). The tolerant snails *Physella* and *Gyraulus parvus* were generally present in low percentages (relative abundance), except at the NASA 100 and Steidtman Marsh sites, in which *Gyraulus parvus* accounted for 26.9 % and 9.3 % of the total density, respectively.

MITIGATION BANK STUDY

In 2004, invertebrates from 20 sites at seven banks were analyzed. The bank sites included were Cherry Valley, Chippewa, Grand River Lowlands, Panzner, Sandy Ridge, Three Eagles, and Trumbull Creek. Additionally, six sites from three banks samples in 2001 were analyzed from the Hebron, Little Scioto, and Slate Run banks.

The mitigation banks sampled in this study exhibited some of the most dramatic changes in invertebrate assemblages compared to high quality reference wetlands. The invertebrate assemblages were dominated by tolerant species of oligochaetes, ostracods, corixids, beetles, and physid snails. Relative abundance of more sensitive species was generally lower at the bank sites compared to reference wetlands. These differences were reflected in the WICI scores (Figure 3).

As discussed earlier in this report, taxonomic identification of oligochaetes and

ostracods to the generic and specific levels has shown associations of certain species with disturbance levels as reflected in low WICI values. The more tolerant species of oligochaetes and ostracods were collected at many of the bank sites. Table 3 shows the original WICI values with tolerant species included in the metric and the adjusted WICI values (parenthetically) with the tolerant species removed from the positive metrics.

Relative abundance (%) of tolerant beetles, corixids, and snails were high at the mitigation bank sites as reflected in the low average metric scores of 2.5, 3.6, and 1.8, respectively. The adult beetle genera *Berosus, Haliplus, Peltodytes*, and *Tropisternus* are mostly herbivores. They are commonly found in dense mats of aquatic vegetation or algae mats, as are some species of corixids. The tolerant snails *Physella* and *Gyraulu parvus* were abundant at the bank sites, as well.

Relative abundance (%) of more sensitive taxa of ostracods and dytiscid beetles were generally low at the bank sites, scoring average metric values of 2.0 and 1.8, respectively.

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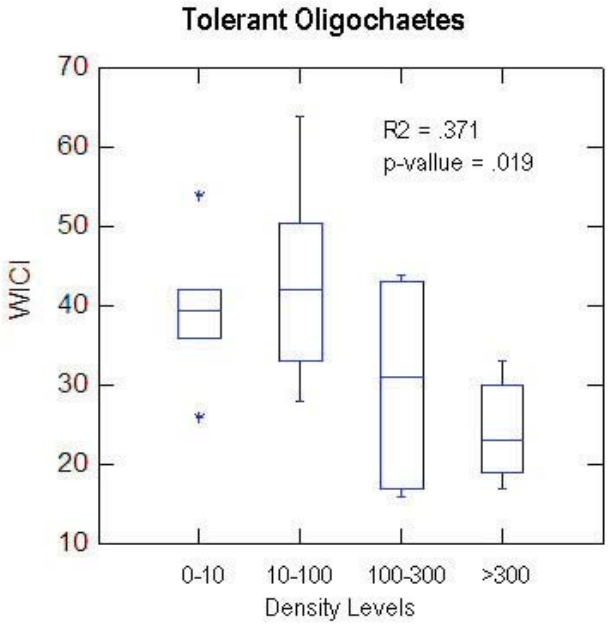

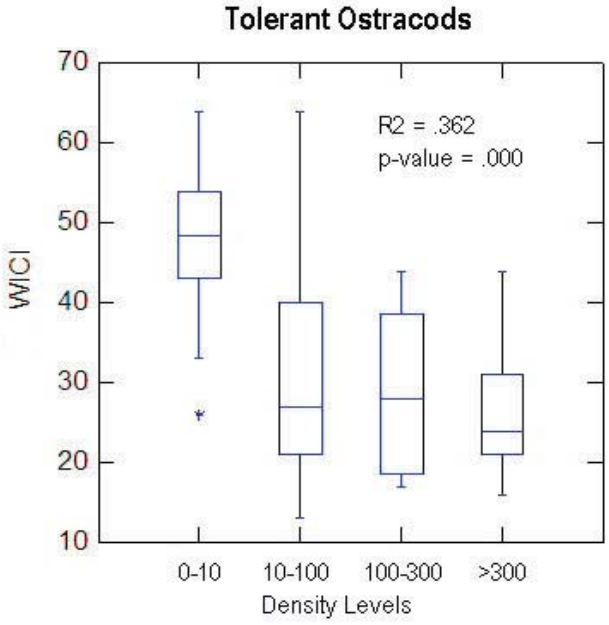

Figure 1. Histograms of WICI values at four density groups of tolerant oligochaetes and tolerant ostracods.

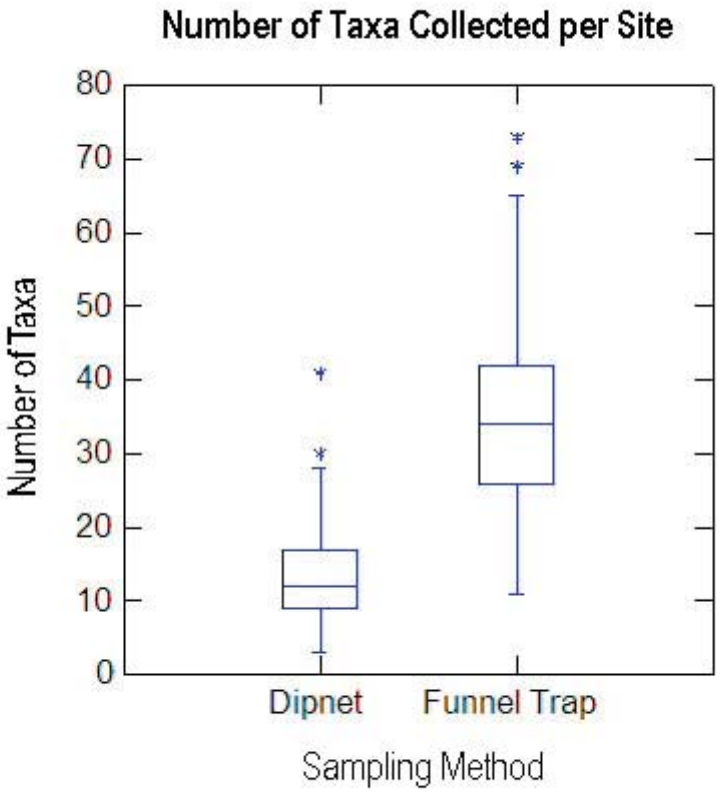

Figure 2. Number of invertebrate taxa collected per site from the dipnet qualitative sample and the quantitative funnel trap from 60 sites between 2001 and 2003.

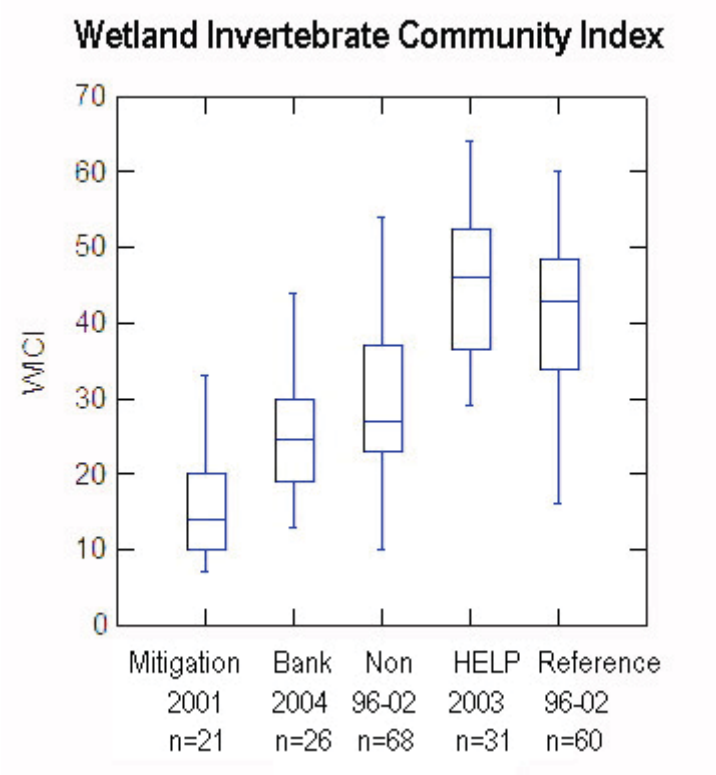

Figure 3. Wetland Invertebrate Community Index scores for Ohio EPA wetland datasets: mitigation data from 2001, mitigation bank data mostly from 2004, nonreference data from 1996 to 2002, the HELP ecoregion 2003, and reference data from 1996 to 2002. Adjusted WICI values from Tables 2 and 3 were used for the newer data from 2003 and 2004.

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Table 1. Metric score values (0, 3, 7, 10) assigned to relative abundance of organism groups using a 25th and 75th percentile scoring strategy.

	Metric score value assigned			
	0	3	7	10
Oligochaetes	< .006	< .026	< .085	≥ .085
Microcrustaceans	< .050	< .154	< .354	≥ .354
Dytiscids	< .019	< .047	< .120	≥ .120
Sensitive Snails	< .008	< .022	< .060	≥ .060
Corixids	> .0059	> .0005	> .00025	≤ .00025
Tolerant Beetles	> .036	> .014	> .001	≤ .001
Tolerant Snails	> .0522	> .0182	> .0031	≤ .0031
Odonates	> .023	> .009	> .001	≤ .001

Table 2. Wetland Invertebrate Community Index (WICI) metric scores of the Ohio EPA database sampled in 2003 in the Huron/Erie Lake Plains Ecoregion.

Wetland Name	Date	Oligo	Micro	Dytis	Corix	Tol Beetle	Odonat	Sens Snail	Tol Snail	Metric
Bike Trail	6/24/2003	0	3	3	3	10	0	10	0	29
BlueHeron Mrsh	7/1/2003	0	(0)10	3	7	0	3	0	7	(20)30
BlueHeron Wood	5/3/2003	0	10	7	10	10	7	7	10	61
Blue Oxbow	5/6/2003	0	7	0	10	7	10	10	10	54
D4	5/06/2003	0	10	7	10	10	7	10	10	64
Derby	6/25/2003	0	10	0	10	7	10	3	10	50
Green Oxbow	6/25/2003	10	10	0	7	10	7	10	10	64
Hiltner	5/14/2003	0	10	7	10	7	0	10	7	51
Irwin Pin Oak	5/6/2003	0	7	0	10	7	0	10	10	44
Irwin Prairie	5/6/2003	0	7	3	10	3	0	10	3	36
Irwin Vernal	5/6/2003	0	10	0	10	7	3	10	7	47
Kinglet	5/6/2003	0	7	0	10	10	10	10	7	54
Lodge	3/25/2003	0	10	0	10	10	10	3	3	46
Lou Campbell	6/25/2003	0	3	3	10	0	0	10	3	29
Lucas	6/25/2003	0	0	10	10	10	0	10	10	50
Mancy Tract	5/14/2003	0	0	7	10	0	10	10	10	47
Marie Delarme N	7/1/2003	3	10	0	10	10	10	10	10	63
Muck Farm	5/6/2003	0	10	0	10	7	3	10	3	43
Nasa 3	5/13/2003	0	3	3	10	7	0	3	7	33
Nasa 8	5/13/2003	0	10	3	10	7	0	0	7	34
Nasa 100	5/13/2003	0	7	0	10	0	10	7	0	34
Old State Line	5/14/2003	0	0	0	10	7	7	3	10	37
Patton Tract N	5/14/2003	0	7	0	10	3	0	7	3	30
Patton Tract SW	5/14/2003	0	7	3	10	3	7	10	3	43
Ranger	6/25/2003	0	10	7	10	10	0	7	7	51
Reed Road	3/25/2003	7	3	3	10	7	10	0	3	43
Rudolph Savan	7/1/2003	7	7	3	3	10	0	10	3	43
Skull 2	5/6/2003	0	10	3	10	10	3	7	3	50
Steidtman Button	7/1/2003	10	10	0	10	7	7	10	7	61
Steidtman Marsh	7/1/2003	10	7	0	10	7	3	0	0	37
Average Metric Value		1.6	(6.8)7.2	1.8	9.3	6.8	4.6	7.6	6.4	45.2 (44.9)

Table 3. Wetland Invertebrate Community Index (WICI) metric scores of the Ohio EPA database sampled at Mitigation Bank sites (mostly from 2004). Values in parenthesis ( ) are adjusted metric scores based on refined taxonomy of oligochaetes and ostracods with those species that are tolerant of disturbance removed from these two positive metrics.

Wetland Name	Date	Oligo	Micro	Dytis	Corix	Tol Beetle	Odonat	Sens Snail	Tol Snail	Metric
Cherry V 1N	6/29/2004	7	7	0	3	0	3	3	10	33
Cherry V 1S	6/29/2004	10	0	0	3	3	3	7	0	26
Cherry V Area 3	6/29/2004	0	3	3	3	0	0	10	0	19
Chippewa Mid	6/16/2004	7	(0)10	0	0	7	7	0	0	(21)31
ChippewaN pond	6/16/2004	7	(0) 7	3	3	7	7	3	0	(30)37
Chippewa S area	6/16/2004	(3)10	(0) 7	7	3	7	10	0	0	(30)44
Grand R A-D	6/29/2004	(0)10	(0) 7	0	3	7	7	0	0	(17)34
Grand R B-C	6/29/2004	10	(0) 7	0	3	3	3	3	0	(22)29
Grand R Forest	6/29/2004	10	(0) 3	0	10	3	7	7	3	(40)43
Hebron 1	5/13/2001	(0)10	10	3	3	7	10	3	7	(43)53
Hebron 2	5/13/2001	7	(0) 3	7	0	0	7	7	0	(28)31
L. Scioto 1	5/15/2001	0	(0) 7	0	10	0	3	0	0	(13)20
L. Scioto 2	5/15/2001	3	(0) 3	0	3	0	10	3	0	(19)22
L. Scioto 3	5/15/2001	(0)10	3	0	0	3	7	10	0	(23)33
Panzner A	6/16/2004	0	(0) 7	3	0	7	7	0	0	(17)24
Panzner B	6/16/2004	10	7	3	3	3	0	0	0	26
Panzner C	6/16/2004	10	7	3	0	3	7	0	0	30
Sandy Ridge 1	6/23/2004	(3) 7	(0)10	0	0	7	7	0	10	(28)41
Sandy Ridge 2	6/23/2004	(3) 7	(0)10	0	10	7	3	10	7	(40)54
Sandy Ridge 3	6/23/2004	(0) 7	(0)10	0	3	7	7	3	3	(23)40
Slate Run 4	5/3/2001	0	0	3	0	3	7	3	0	16
Trumbull cell5	6/30/2004	7	3	3	0	0	7	10	0	30
Trumbull cell7	6/30/2004	(0) 7	3	7	3	0	3	10	0	(26)33
Trumbull Forest	6/30/2004	0	7	0	0	3	3	10	0	23
3 Eagles NE Mdw	5/20/2004	0	0	3	0	0	3	10	0	16
3 Eagles Marsh	6/24/2004	(0)10	(0)10	0	3	7	0	0	7	(17)37
Average Metric Value		(3.7)6.4	(2.0)5.8	1.8	2.5	3.6	5.7	4.3	1.8	31.7 (25.2)