Macroinvertabrate Community of Allen Creek, Jefferson County, WI.

Submitted to:

The Friends of Allen Creek Watershed

Submitted by:

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Introduction

Allen Creek is located in southeastern Wisconsin in an eco-region known as the Southeast Glacial Plains. The Southeast Glacial Plains region of Wisconsin consists of Calumet, Columbia, Dane, Dodge, Fond du Lac, Green, Green Lake, Jefferson, Ozaukee, Rock, Sheboygan, Walworth, Washington, Waukesha, Waupaca, and Winnebago counties (WDNR). The Southeast Glacial Plains has the highest aquatic productivity for plants, insects, invertebrates, and fish, of any Ecological Landscape in the state (WDNR). However, most streams and wetland areas of the region have been degraded or lost over the years due to ditching, bank erosion, organic pollution, and ground water. According to the WDNR, watershed pollution is about average, but groundwater pollution is worse than average when compared to the rest of the state.

Allen Creek is significant because it is a critical water source to the Lower Koshkonong creek watershed (WDNR 2001). Allen Creek has a length of over 7 miles and a watershed of 5785 acres. Agricultural fields and a small portion of urban and suburban development surround the basin. Streams surrounded by agriculture usually experience organic pollution in the form of runoff. In such cases, the taxa of macroinvertebrates in the stream will shift from intolerant organisms to tolerant organisms. Representatives of intolerant macroinvertebrates include species of Ephemeroptera (mayflies), many Trichoptera (caddisflies), and Plecoptera (stoneflies). Representatives of tolerant macroinvertebrates are species from Isopoda (sowbugs), some Amphipoda (scuds), Coleoptera (aquatic beetles), some Trichoptera, along with Diptera (flies) families, Simuliidae (blackflies) and Chironomidae (midges).

Allen Creek was first sampled in 1992 by the Wisconsin Department of Natural Resources (WDNR) to determine the water quality using the Hilsenhoff Biotic Index (HBI). The Hilsenhoff Biotic Index was first developed by Dr. William Hilsenhoff of the University of Wisconsin-Madison. The index assigns macroinvertebrates a number value between zero and ten based on their tolerance to organic pollution. Insects with a value of zero are the most sensitive to organic pollutants, and insects with a value of ten are the least sensitive to organic pollutants. The water quality of Allen Creek using the HBI index was found to be "fair," which suggests that there was "fairly significant amounts of organic pollution" entering the stream (Table 2 and Table 4). Allen Creek was reevaluated in 1997 and 2003 and the water quality was rated as "good," which suggests that "some organic pollution" was present. In 2006, the Friends of Allen Creek Watershed (FACW) sampled Allen Creek at two sites: Amacher's House, just downstream of State Highway 26, and Bleecker's House, just upstream of Poeppel Road.

The three objectives of this report are (1) what is the status of the macroinvertebrate community now in 2006, (2) how do the communities found in 2006 compare to historical communities of Allen Creek documented in 1992, 1997, and 2003 (3) how does Allen Creek's macroinvertebrate community compare to those of other streams in Jefferson County?

Methods

Samples were collected from Allen Creek on October 22, 2006 at the Amacher's House site, just downstream of the glacial river pedestrian path, and the Bleecker's House site, upstream of the Poeppel Rd crossing. Quantitative samples were taken in riffles using a 500 micron kick net. Three replicate kicks were performed at each site by disturbing an area of 1 m^2 upstream of the net to a depth of approximately 15 cm. Samples were collected and debris was removed by passing the sample through a no. 35 (500 micron) sieve before preserving the 3 composited samples in 70% ethanol. Table 1 shows the different sizes of substrate that were be found in a stream. The riffle substrate was documented with respect to its percent composition of boulders (> 256mm), rubble (8.0mm – 64.00mm), gravel (0.5mm – 8.0mm), sand (0.125mm- 0.0.5mm), silt (<0.063mm), detritus(leaf material), and debris/vegetation.

Table 1: Substrate Type and Size

Substrate	Particle size (mm)
Silt	< 0.063
Mud, very fine sand	0.063 - 0.125
Fine to medium fine sand	0.125 - 0.500
Coarse sand to medium gravel	0.500 - 8.000
Coarse gravel to large pebbles	8.000 - 64.000
Small to large cobble	128 - 256
Boulders	>256

Allen Creek was sampled by FACW in October, 2006 and by WDNR in 1992, 1997, and 2003.

Dr. Kurt Schmude processed the samples from FACW at the Lake Superior Research Institute (LSRI) lab at University of Wisconsin-Superior. All macroinvertebrates were sorted and identified to their lowest taxonomic level (family, genus, or species. Each taxon has been assigned an HBI tolerance value depending on its tolerance to organic pollution (Hilsenhoff 1987). The macroinvertebrates used in the index include those whose entire life cycle is within the aquatic environment. The stream

HBI represents the average index value for all the macroinvertebrates enumerated in the sample (see formula for metric # 5 below). The stream HBI values have been assigned a relative water quality rating expressing the degree of organic pollution as shown in Table 2.

Table 2- Biotic Index Values for Water Quality. Samples were collected in March, April, May, September, and early October.

Biotic Index	Water Quality	Degree of Organic Pollution
0.00 - 3.50	Excellent	No apparent organic pollution
3.51 - 4.50	Very Good	Possible slight organic pollution
4.51 - 5.50	Good	Some organic pollution
5.51 - 6.50	Fair	Fairly significant organic pollution
6.51 - 7.50	Fairly Poor	Significant organic pollution
7.51 - 8.50	Poor	Very significant organic pollution
8.51 - 10.00	Very Poor	Severe organic pollution

The WDNR currently uses the HBI to assess non-point source pollution throughout the state. The 2006 samples from Allen Creek were compared to historical data collected in 1992, 1997, and 2003 by WDNR. The following metrics were calculated:

1. Sum: total organisms collected.
2. Sum without taxa that have no tolerance values.
3. Taxa Richness: total number of taxa identified.
4. EPT Richness: total number of taxa identified from the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT).
5. Hilsenhoff Biotic Index (HBI) water quality value:

$$\frac{(\sum \text{HBI product})}{(\sum \text{taxa with HBI tolerance value})}$$

6. Use table 2 to identify the HBI water quality values in reference to the degree of organic pollution entering the stream system.

Results and Discussion

Since 1992, Allen Creek has been sampled at seven different sites with variable substrate composition and physical characteristics (Table 3). The WDNR and representatives of FACW documented the substrate composition (boulders, rubble, gravel, sand, silt, detritus, and debris/vegetation). The majority of sites consisted of a mixture of rubble, gravel, and sand; only one site contained all gravel substrate (Table 3). The WDNR documented average channel width, average depth, average water velocity, water temperature, and DO. The stream's average width was 8.2 ft with an average depth of 1.24 ft. The stream's velocity ranged between 0.5 to 1.5 ft/s. Measured dissolved oxygen concentrations were not limiting to aquatic life. The water temperature varied seasonally (Table 3).

Table 3: Substrate and Physical Characteristics

Date	Site	Run/Riffle	Boulders	Rubble	Gravel	Sand	Silt	Detritus	Debris/Veg	Width (ft)	Depth (ft)	Velocity	Temp ©	DO (mg/l)
7/1/1992	A	Riffle	*	*	100%	*	*	*	*	8.00	5.00	1.5->	23.90	10.80
7/1/1992	B	Run	*	20%	40%	*	40%	*	*	5.00	0.50	0.5-1.5	24.00	9.20
5/15/1997	A	Riffle	15%	30%	15%	30%	*	*	10%	10.00	0.50	0.5-1.5	8.50	13.30
5/15/1997	B	Riffle	10%	20%	20%	30%	10%	*	10%	10.00	1.00	0.5-1.5	8.60	13.00
11/7/2003		Riffle	*	40%	50%	10%	*	*	*	8.20	0.70	0.5 - 1.5	3.30	10.10
9/22/2006	Amacher's	Riffle	*	*	80%	20%	*	*	*	*	*	*	*	*
	Bleeker's	Riffle	*	70%	20%	10%	*	*	*	*	*	*	*	*

In 2006, an average of 236 organisms were collected at the two sites sampled by the FACW as compared to an average of 162 specimens included in the HBI counts of the five samples collected by WDNR (Table 4). The increased number of specimens recorded in the 2006 samples most likely represents an expanded search of the net samples in the laboratory beyond the minimum required and consequently does not represent a meaningful increase in abundance in total organisms in 2006 over previous years. Hilsenhoff (1987) recommended roughly a minimum of 100 specimens should be used to calculate the biotic index. The laboratory counting procedure used in HBI analysis calls for counting all organisms found in randomly-selected cells of a sorting tray until a minimum of 100 organisms with assigned tolerance values are reached. Consequently, the data included in HBI sample counts often represents only a small fraction or portion of the total number of organisms collected. The remainder of the sample is simply ignored and discarded. Counting more than the called-for minimum number of organisms probably improves the accuracy of the HBI data; however, such actions also increase total organism and total taxa counts. These total organism and total taxa counts cannot be directly compared with similar counts from older WDNR data that represent smaller subsets of the total community. Applying a standard procedure in the collection and processing of the macroinvertebrates samples would greatly resolve these problems. This would include using only the first 100 organisms for the Biotic Index and discarding the rest from the calculation but making note of any large rare organisms or new species that have not been collected (or are absent) from previous sampling events. Likewise, standardization of sampling efforts, including adopting a standard net mesh size, sampling time (limiting field sampling to say 5 minutes), and area to be searched, and restricting sampling to similar habitats (riffles & runs, versus pools and bank areas) would assist greatly in making future assessments of changes in water quality and watershed condition. Naturally, another important consideration would be to set up consistent sampling dates where macroinvertebrate speciation would be the greatest. The months that are recommended by Dr. Hilsenhoff are April, May, October, and early November.

Taxa and EPT richness did not differ appreciably among sampling dates despite some expected seasonal (see Table 4). Total taxa richness was lowest at the Amacher site in 2006. EPT richness was highest at the Bleecker House site, also in 2006. Higher EPT richness at the Bleecker house relative to earlier surveys may be partially an artifact of the laboratory effort (i.e., increased search of total sample), but the low total taxa count at the Amacher site appears more informative.

The low total taxa richness at the Amacher site relative to earlier sampling efforts could be due to differences in substrate, timing of hatches, loading from either inorganic or organic pollution, or life cycles. Substrate at the Amacher site consisted entirely of gravel and sand. The lack of diversity in available substrate (and microhabitats) at a given site could have contributed to the lower number of taxa observed. Substrate is very important because cobblestone/rubble can provide additional microhabitats and may also create greater aeration of the water to generate greater DO levels, both of which can promote greater diversity of organisms than that of a boulder and sand substrate or only a gravel and sand substrate such as found at the Amacher site. This might help explain the large discrepancy in taxa counts between the Amacher and Bleecker sites in 2006. Hatches could have occurred before the sampling event and those species would be absent. Organic pollution or groundwater pollution should be considered because these inputs are already present in the stream. Life cycles of invertebrates also needs to be considered because some macroinvertebrate life cycles can be from one year to seven years long before they emerge and are able to be identified properly in their larval stage.

Table 4: Summary of Taxa Richness, EPT richness, and HBI					
Date	**Site**	**Sum**	**Taxa Richness**	**EPT Richness**	**HBI**
7/1/1992	A	140	29	8	5.33
7/1/1992	B	143	20	5	5.56
5/15/1997	A	158	22	5	4.62
5/15/1997	B	169	24	7	4.42
11/7/2003		199	25	8	4.60
9/22/2006	Amacher's House	243	15	5	4.74
	Bleeker's House	229	22	10	4.60

The HBI values for Allen Creek have ranged from 4.42 (very good water quality) in May 1997 to 5.56 (fair water quality) in July 1992 (Table 4). HBI values in 2006 ranged between 4.74 at Amacher’s House and 4.60 at Bleecker’s House site, both of which indicate “good” water quality (Table 3). Bleecker’s House site had a slightly lower HBI value (indicative of slightly better water quality) than Amacher’s House site. This subtle difference agrees with the noted differences in total taxa and EPT taxa richness between the two sites, and most likely results from the observed differences in substrate.

The water quality of Allen Creek has remained fairly constant except for 1992, which was represented by HBIs of 5.33 and 5.56. Applying a seasonal adjustment factor of a minus 0.50 to these two summer values per recommendations by Hilsenhoff 1988, still would result in slightly higher HBI values for 1992 than exhibited in 1997, 2003, and

2006. Consequently, it appears that the HBI community of Allen Creek has shown a small shift from tolerant macroinvertebrates to more intolerant macroinvertebrates. This may be a sign that organic inputs or sediments entering the stream have decreased over the years.

Table 5 and Charts 1-7 show the composition of the organisms collected in 1992, 1997, 2003, and 2006. The orders and families delineated were Ephemeroptera, Trichoptera, Coleoptera, Diptera, family Chironomidae, Amphipoda, Isopoda, and Other (Plecoptera, Decapoda, Gastropoda, and Heteroptera). Chart 1-7 over time reveals that orders and families that represent tolerant macroinvertebrates such as isopoda, amphipoda, and chironomidae have decreased, while orders that represent intolerant macroinvertebrates such as Ephemeroptera, Trichoptera, and Coleoptera have increased since 1992. This is important because this shows that the water quality of Allen Creek is improving by the shift of tolerant macroinvertebrates to more intolerant macroinvertebrates (Appendix – 1).

Table 5: Allen Creek Macroinvertebrate Compositoin														
	Amachers		**Bleecker**		**2003**		**1997A**		**1997B**		**1992A**		**1992B**	
ORDERS	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
EPHEMEROPTERA	18	7.41	19	8.30	2	1.25	1	0.63	6	3.57	8	5.97	7	5.07
TRICHOPTERA	67	27.57	82	35.81	16	10.00	6	3.80	9	5.36	35	26.12	5	3.62
COLEOPTERA	140	57.61	108	47.16	73	45.63	70	44.30	106	63.10	30	22.39	14	10.14
DIPTERA	4	1.65	5	2.18	7	4.38	3	1.90	2	1.19	2	1.49	2	1.45
Chironomidae	11	4.53	10	4.37	5	3.13	39	24.68	21	12.50	29	21.64	3	2.17
AMPHIPODA	3	1.23	3	1.31	42	26.25	39	24.68	24	14.29	17	12.69	63	45.65
ISOPODA	0	0.00	1	0.44	13	8.13	0	0.00	0	0.00	12	8.96	43	31.16
OTHER (PLECOPTERA,	0	0.00	1	0.44	2	1.25	0	0.00	0	0.00	1	0.75	1	0.72
DECAPODA, GASTROPODA)														
Sum	243	100.00	229	100.00	160	100.00	158	100.00	168	100.00	134	100.00	138	100.00

<u>Ephemeroptera</u>

Ephemeroptera is one of five groups, others being Plecoptera, Trichoptera, Diptera, and adults and larvae of some Coleoptera (riffle beetles) are used in environmental studies dealing with water quality assessment (Hilsenhoff 1995). Mayflies are very diverse and inhabit many aquatic environments. Mayflies can be found in streams that are in pristine condition (HBI= 0 – 3.50) or streams that exhibit significant organic pollution (HBI= 6.51-7.50). Mayflies are not found in acidic environments and only a few species; such as *Caenis sp*. and *Paraleptophlebia sp.,* are found in water with oxygen levels less than 50% saturation (Mackie 2001). Since 1992, when it was first sampled, three families and four taxa of Ephemeroptera have been identified at Allen Creek to date. The HBI tolerance values for the Ephemeroptera species collected at Allen Creek ranged from two (Excellent) to seven (Fairly Poor). In 2006, *Baetis intercalaris* (HBI value = 6) and *Maccaffertium luteum/vicarm* (HBI value = 2) were collected for the first time. *Baetis flavistriga* (HBI value = 4) was found in greater numbers than previous years (Appendix 1). The genus *Caenis sp.* (HBI value = 7) was only collected in 1992 and has not been collected in successive years. The composition of Ephemeroptera in 2006 was greater (Amacher's House site: 7.41% and Bleecker's House site: 8.30%) than previous years (1992: 5.93% and 5.04%, 1997: 0.63% and 3.57%, 2003: 1.27%) (Table 5 and Chart 1-7). The increase in Ephemeroptera composition would suggest a possible decrease in organic input filtrating into Allen Creek.

Plecoptera

Stoneflies are the most sensitive group to organic pollution and they quickly decrease in numbers in response to low dissolved oxygen levels. The distribution of stoneflies throughout Wisconsin is that they are commonly collected in the northern part of the state and are rarely collected in the southeastern portion of the state due to land use, land development, and ground water pollution. Stoneflies are usually found in pristine streams or in streams that receives little or no organic pollution. Stoneflies preferentially inhabit cooler, flowing water with high DO saturation levels. *Taeniopteryx* sp. (HBI value = 2) of the family Taeniopterygidae was the only stonefly collected in Allen Creek since 2003. Future collections of stoneflies at Allen Creek are unlikely due to input of sediment from other streams, bank erosion, salt from roads, and organic input from surrounding pastures. These inputs need to be addressed and corrected in order to improve conditions so that stoneflies may one day inhabit Allen Creek.

Trichoptera

Nine taxa of Trichoptera have been identified since 1992. The HBI tolerance values for these taxa ranged from excellent to fair (Table 3). 2006 sampling produced a greater number of taxa than observed in 1992, 1997 and 2003. In 2006, *Certatopsyche morosa* (*bifida*) (HBI value = 6) was collected for the first time. *Cheumatopsyche* sp. (HBI value = 5) and *Hydropsyche betteni* (HBI value = 6) were found in high numbers at both sites in 2006. *Psychomyia flavida* (HBI value = 2) occurred at Bleecker's House site, but not at the Amacher's House site; *Psychomyia flavida* was also collected in 1997, but not in 1992 and 2003. *Helicopsyche borealis* (HBI value = 3) was found at both sites in 2006, and also in 1992. *Pycnopsyche* sp. (HBI value = 4) was found only in 1997 and 2003. The results show a fluctuation of taxa probably due to inconsistent collecting dates; sampling at different times of the year can lead to different taxa being collected. This is important because the composition of Trichoptera in 2006 was greater (Amacher's House site: 27.57% and Bleecker's House site: 35.81%) than previous years (1992: 3.60% and 25.93%), 1997: 3.80% and 5.36%, and 2003: 10.13%) (Table 5 and Chart 1-7).

Coleoptera

Four species of Coleoptera have been collected since 1992. The HBI tolerance values for the species ranged between four and five. *Optioservus fastiditus* (HBI = 4), larval *Stenelmis* sp (HBI = 5), and *Ectopria* sp. (HBI= 5) were identified in 2006. Both sites contained high numbers of *O. fastiditus* (Amacher's House site n = 90, Bleecker's House site n = 89) and *Stenelmis* larvae (Amacher's House site n = 49, Bleecker's House site n = 14). High numbers of these two these taxa also occurred in 1997 and 2003 as well. The percentages of Coleoptera in the 2006 macroinvertebrate samples were 57.61% and 47.16%. These percentages are slightly higher than the percentages observed in 1997 and 2003 (Charts 3-5). Aquatic beetles are important because most are found in streams that are rated as fair or better and can be found inhabiting in the crevices of driftwood or on rocks. *Ancyronyx varigata*, *Dubiraphia bivittata*, and *D.vittata*, and *Dubiraphia larvae* are riffle beetles that can be found in streams that contain significant to very significant amounts of organic pollution.

Diptera (other than Chironomidae, see below)

Diptera is one of the most diverse orders of all the macroinvertebrates. Species of the order Diptera have adapted to inhabiting streams that are in pristine condition to streams that are in poor condition. Diptera species that have adapted to well oxygenate streams utilize cutaneous respiration, and some, such as chironomids, have developed hemoglobin-like pigment that aids in oxygen storage, which allows them to live in oxygen-poor streams (Hilsenhoff 1987). Four families and eight genera of Diptera have been identified since 1992. The HBI tolerance values ranged from four (Very Good) to seven (Fairly Poor). In 2006, *Hemerodromia* sp. (HBI value = 6) was collected for the first time at both sites. The percentages of Diptera were 1.65% and 2.18%, and have not changed since 1992. The species that have been identified from Allen Creek are species that are common to Wisconsin. The order Diptera has not been a significant component of the macroinvertebrate fauna during various sampling years. Due to little or no change in the composition, it is suggested that the Allen Creek Diptera population other than Chironomids is stable. If the Diptera population would increase it could be due an increase in organic inputs, sediment dumping from near by streams, bank erosion, or increased runoff from nearby roads.

<u>Family Chironomidae</u>

Nineteen taxa of Chironomidae have been identified since 1992. The HBI tolerance values for these taxa ranged from five to nine. Only a total of six taxa of Chironomidae were identified in 2006. *Brilla* sp. (HBI value = 5), *Corynoneura* sp. (HBI value = 7), and *Tvetenia bavarica* group (HBI value = 5) were identified for the first time in 2006. The richness of Chironomidae was lower in comparison to the years 1992 and 1997. In 1992 and 1997, the richness of Chironomidae ranged from eight to nine, while in 2003 only three taxa were identified. The family Chironomidae contributed to roughly 4.50% of the total macroinvertebrate population collected in 2006. In previous years, the family Chironomidae comprised between 2.16% - 24.68% of the total macroinvertebrate population. It is not clear why a decrease in the composition and richness of Chironomidae occurred. The decrease in the composition of the family Chironomidae for 2006 could be due to a major hatch that occurred before the sampling date, which would cause a decrease in numbers.

<u>Amphipoda</u>

Amphipods are typically found in streams that contain fair to significant amounts of organic input. Amphipods ~~or~~ are also known as scuds. They are scavengers and detritivores. *Hyalella azteca (HBI =8*) would be found in streams with high levels of organic input, but there are some amphipods that can be found in streams that receive only a slight amount of organic pollution such as *Gammarus. pseudolimnaeus (HBI value=4).* One species of amphipod has been identified since 1992, *G. pseudolimnaeus* (HBI value = 4). Three *G. pseudolimnaeus* were collected at Amacher's House site and Bleecker's House site. The number of *G. pseudolimnaeus* collected in 2006 was much less than what was collected in 1992, 1997, and 2003 (Table 3 and Charts 1A and 1B). *G. pseudolimnaeus* comprised less than 1.50% of the total macroinvertebrates collected in 2006. This is less than what was collected in previous years: 1992 n = 45.32% and 12.59%, 1997 n = 24.68% and 14.29%, and 2003 n = 26.58% (Table 5 and Charts 1-7). The decrease in *G. pseudolimnaeus* could mean that there has been a further reduction in organic input from nearby agriculture pastures, streams, or from roads filtering into Allen Creek.

<u>Isopoda</u>

One species of isopod has been identified since 1992, *Caecidotea intermedia* (HBI = 8). Only one immature specimen was collected in 2006 at Bleecker's House site. When compared to previous years, isopods were found in greater numbers than were found in 2006. In 1992, *C. intermedia* comprised 45.32% and 12.59% of the total macroinvertebrates collected, and in 2003 it was 26.58% of the total macroinvertebrates collected. This species has a high tolerance to organic pollution (HBI value = 8). The decrease in *C. intermedia* suggests that there has been some reduction in the amount of organic input filtering into Allen Creek from upstream since it was last sampled.

Other

The “other” category includes Decapoda (crayfish), Gastropoda (snails), and Heteroptera (aquatic true bugs). The number of taxa in these orders was low and they have been collected only sporadically since 1992. The majority of the genera in the category “other” were primarily collected in 1992. “Others” comprised less than 2% of the total macroinvertebrates collected since 1992. These orders have not contributed significantly to the macroinvertebrate composition or to the determination of the water. We do not know conclusively whether or not the *Orconectes sp*. collected in 2006 is the invasive rusty crayfish *Orconectes rusticus*. Some Gastropods, or aquatic snails, can be used as another indicator of water quality because some aquatic snails are sensitive to temperature, dissolved oxygen, and sediment levels.

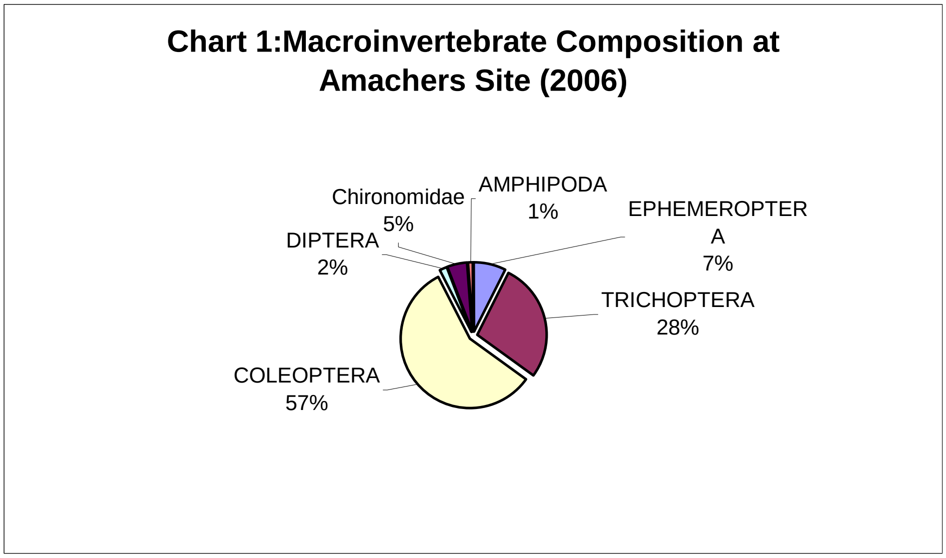


Chart 1:Macroinvertebrate Composition at Amachers Site (2006)
AMPHIPODA
1%
Chironomidae
5%
EPHEMEROPTER
A
7%
DIPTERA
2%
TRICHOPTERA
28%
COLEOPTERA
57%

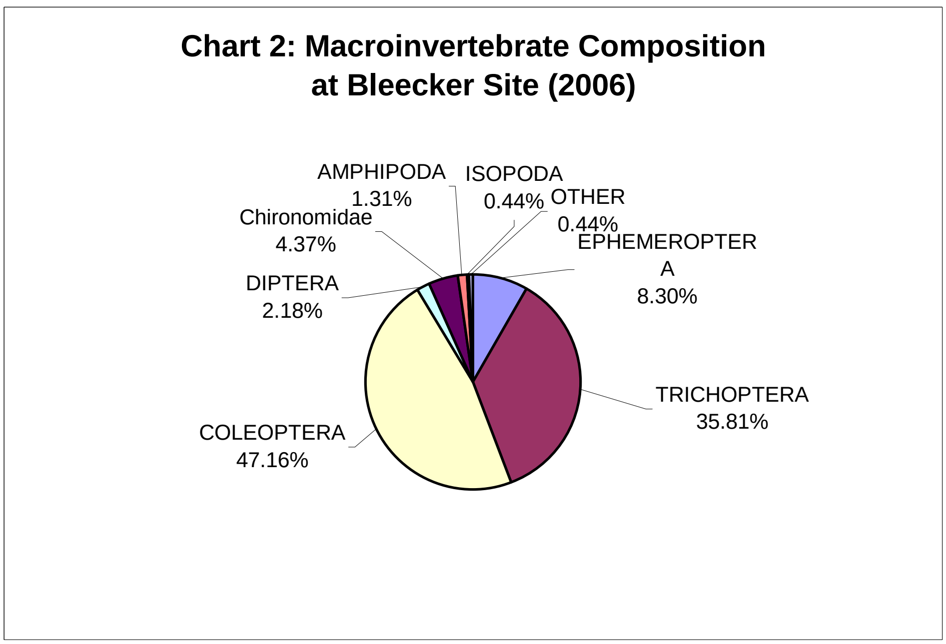


Chart 2: Macroinvertebrate Composition at Bleecker Site (2006)
AMPHIPODA
1.31%
ISOPODA
0.44%
OTHER
0.44%
Chironomidae
4.37%
EPHEMEROPTER
A
8.30%
DIPTERA
2.18%
TRICHOPTERA
35.81%
COLEOPTERA
47.16%

Chart 3: Macroinvertebrate Composition of 2003

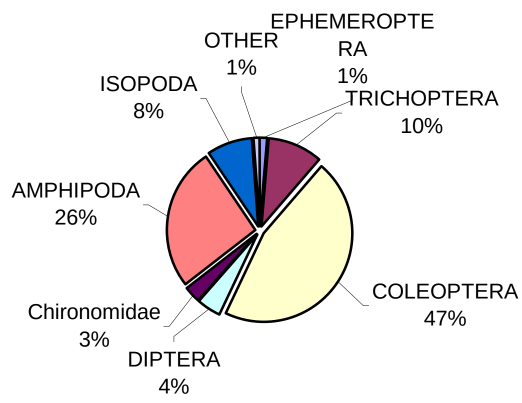
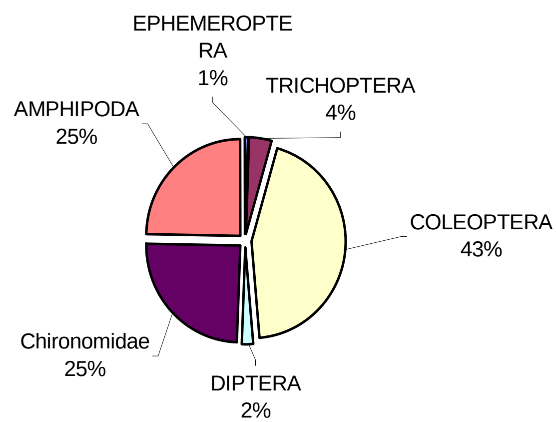


Chart 4: Macroinvertebrate Composition of1997A



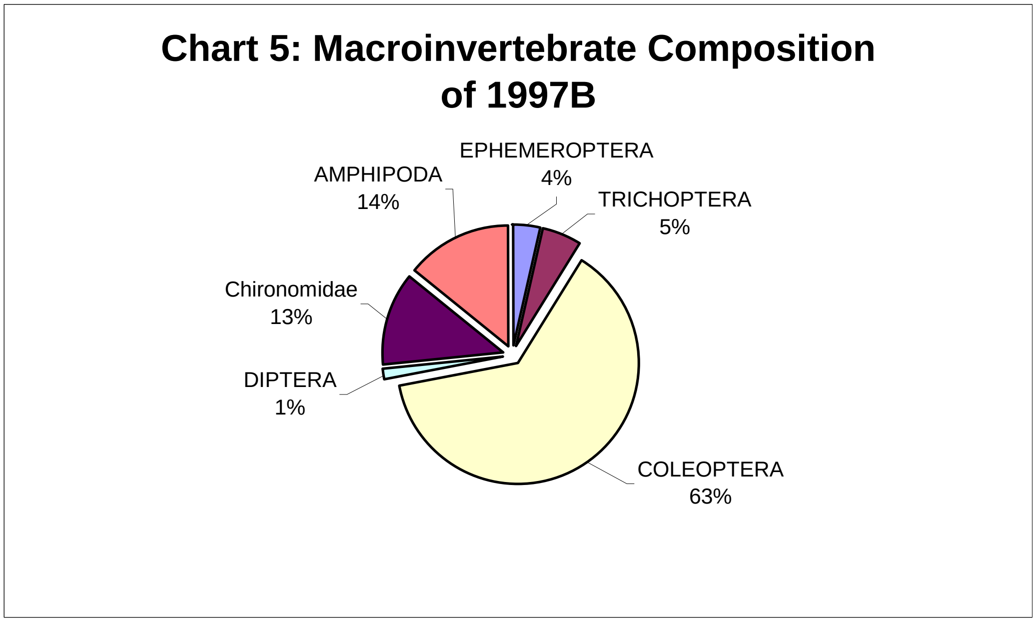


Chart 5: Macroinvertebrate Composition of 1997B
EPHEMEROPTERA 4%
AMPHIPODA 14%
TRICHOPTERA 5%
Chironomidae 13%
DIPTERA 1%
COLEOPTERA 63%

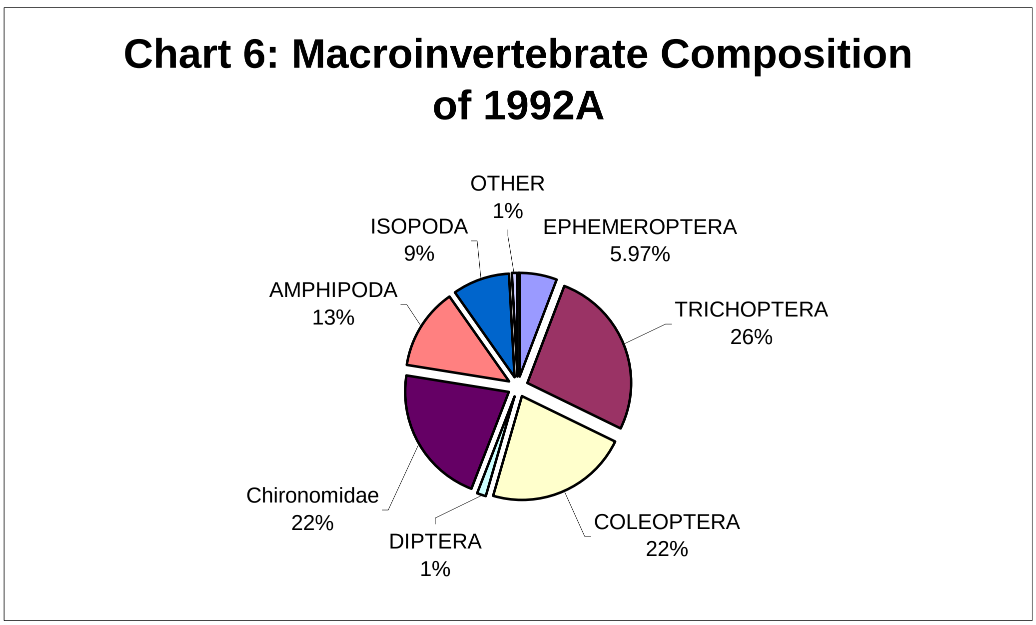
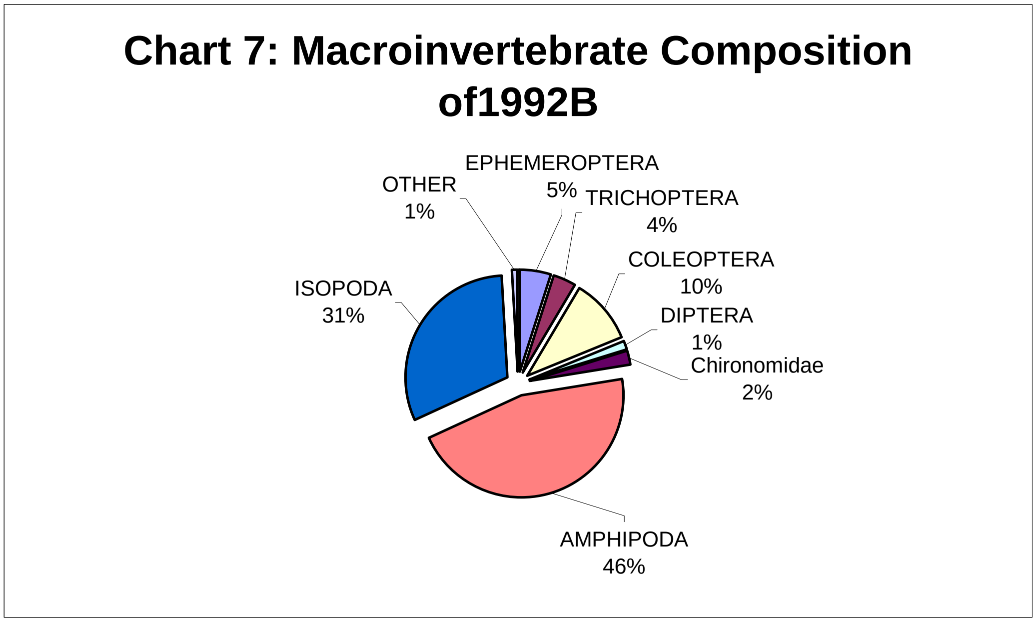


Chart 6: Macroinvertebrate Composition of 1992A
OTHER 1%
ISOPODA 9%
EPHEMEROPTERA 5.97%
AMPHIPODA 13%
TRICHOPTERA 26%
Chironomidae 22%
DIPTERA 1%
COLEOPTERA 22%



Discussion

There were three main questions asked: (1) what are the macroinvertebrate communities in 2006 with respect to species and tolerance, (2) how do the communities of 2006 compare to communities of Allen Creek collected in 1992, 1997, and 2003, and (3) how does Allen Creek's macroinvertebrate community compare to those of other streams in its ecoregion?

The taxa richness values for Amacher's House site in 2006 was the lowest value compared to all other samples, while the value for Bleecker's House site was similar to other values. However, in 2006, the highest (Bleecker's House) and lowest (Amacher's House) EPT richness values were observed. The low taxa richness may be attributed to any number of factors, including substrate differences between sites, water temperature, or water velocity. These factors are important factors because they can dictate where certain macroinvertebrates inhabit a stream. Water temperature is especially important because as temperature rises certain macroinvertebrates are susceptible to heat exhaustion such as stoneflies, mayflies, certain caddisflies, and as well some fishes such as trout**.**

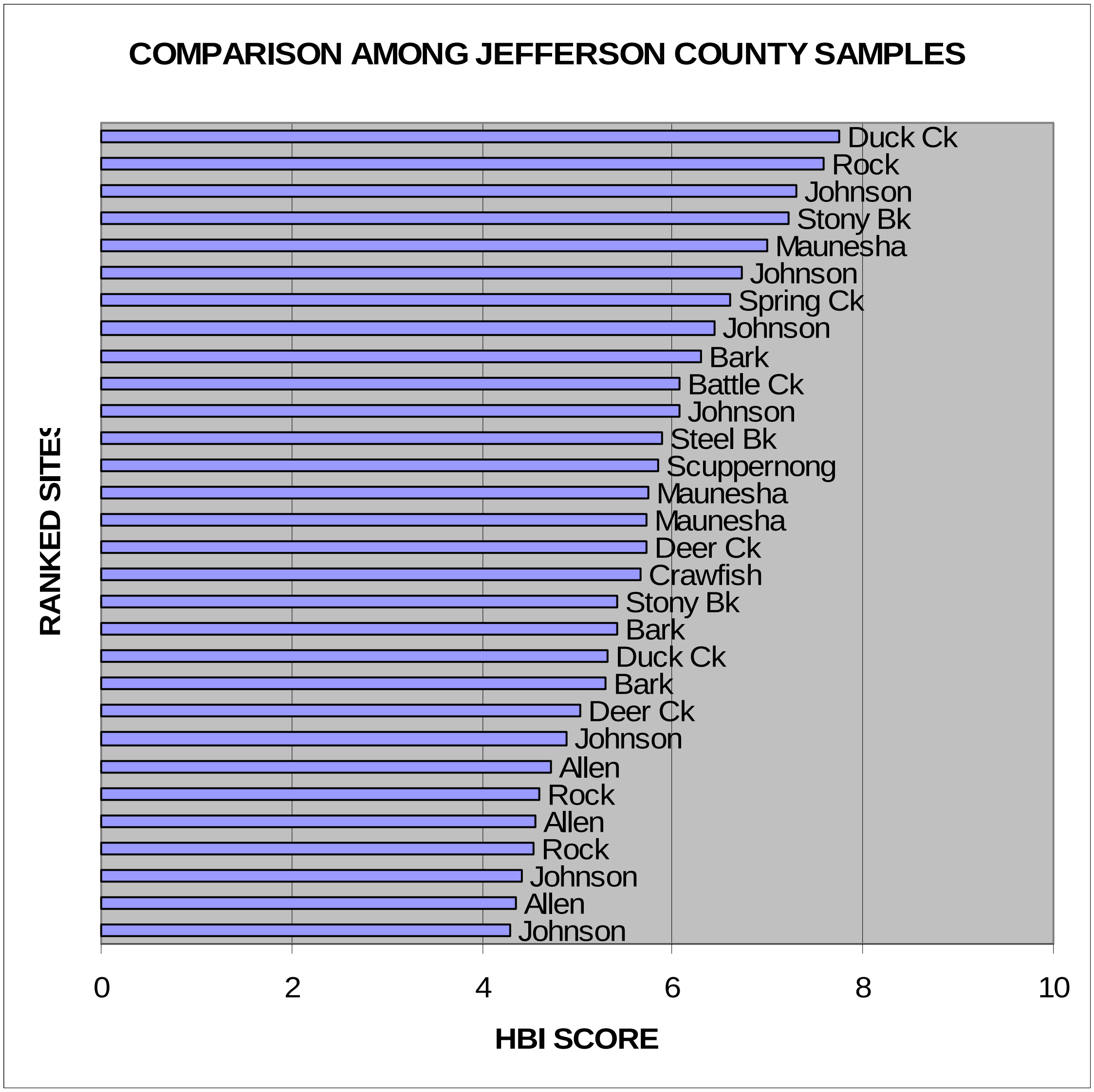
Water velocity is also important because it can increase DO levels in a stream and bring in or flush out nutrients. Substrate is important because it determines which type of organism will inhabit a given area of stream.

The water quality of Allen Creek in 2006, as determined by using the HBI, was deemed "good," which the same designation was obtained in 2003 and 1997. A status of "good" suggests some organic pollution is filtrating into Allen Creek (Table 2). The most likely source of organic pollution (based on aerial photographs that were provided) is from runoff from surrounding urban development, feeder streams, and/or agricultural fields. In 1992, summer HBI values were 5.33 and 5.56, indicating "good" to "fair" water quality, respectively. The majority of the organisms collected in 2006 had an assigned individual tolerance value ranging from four to six, but primarily with a value of five. The taxa that occurred in high numbers were *Cheumatopsyche* sp., *Hydropsyche betteni*, *Optioservus fastiditus*, and *Stenelmis* sp., all of which are common taxa in southern Wisconsin (Dr. Kurt Schmude, personal communication). These organisms have a medium tolerance to organic pollution and can be expected to be collected in streams with mild to medium amounts of organic pollution. Several new species were collected in 2006, such as *Baetis intercalaris, Maccaffertium luteum/vicariu, Ceratopsyche morosa* (*bifida*), *Hemerodromia* sp., *Brilla* sp., *Corynoneura* sp., and *Tvetenia bavarica* group. The majority of the new species obtained had HBI values between five and seven. These new species are common to the state and can be found in most streams that contain medium amounts of organic inputs. These new species would suggest that Allen Creek is becoming more diverse as water quality remains "good" and as long as organic pollution remains low.

When the macroinvertebrate community data from 2006 was compared to 1992, 1997, and 2003 data, I was unable to establish reasons that explained the changes observed in the communities. The main problem was the fact that all sampling events since 1992 were completed at different locations and at different times of the year. This situation adds uncontrolled variability to the data. The data shows that each site contained different substrate compositions and different environmental characteristics (Tables 1A and 1B). The homogeneity/heterogeneity of the substrate can dictate which groups or species of macroinvertebrates would inhabit a stream. This may account for the variability of relative densities of certain macroinvertebrate groups like Amphipoda, Isopoda, Chironomidae, Trichoptera, and Coleoptera. However, the values of taxa richness and EPT richness among years were fairly similar, except for Amacher's House site, which had the lowest value. Also, the time of the year is important with regards to macroinvertebrate sampling. A stream's macroinvertebrate population is usually greatest in early spring and fall. . Even though sampling sites were at different locations, the calculated water quality has improved from fair (2001 Allen creek was rated as 'fair') to good (WDNR 2001). The collections of macroinvertebrates from Allen Creek were completed in May, July, October, and November. July and November are not within the months that Hilsenhoff suggested as best months to sample (Hilsenhoff 1988) when the diversity is at its greatest. Sampling within these months is important because organisms of importance are either too small to identify or absent because they have not hatched yet. Different communities emerge at different times, and eggs can diapause at certain times of the year, making some taxa absent from the collection. However, an examination of the tolerance values of individual taxa shows a decrease in taxa that have a high HBI tolerance value and an increase of individuals with a low to medium HBI tolerance value. There is not enough comparable data to establish a trend of the current macroinvertebrate communities with regards to previous communities because of inconsistent sampling dates and sites.

The macroinvertebrate communities of Allen Creek are typical of a lotic community that occurs in Southern Wisconsin and is impacted by agricultural and urban pollution (Dr. Kurt Schmude, personal communication). A comparison among 30 HBI samples collected from various streams and rivers in Jefferson County during the past 20 years (WDNR BUGDATA base available on-line from UW Stevens Point) reveals that Allen Creek has some of the best water quality in the region (Chart 7). Three of the seven lowest (best quality) HBI scores were collected from Allen Creek.

Chart 7. A comparison of HBI scores among 30 macroinvertebrate samples collected from Jefferson County during the period 1988 to 2003, including 3 samples from Allen Creek. Data were obtained from the DNRBUG program, UW Stevens Point, and available on-line at http://www.uwsp.edu/water/biomonitoring/BUGPRO.HTM .



Conclusion

The water quality of Allen Creek appears to have improved slightly from 1992 to 1997 and has since remained fairly constant. Allen Creek may be rated as 'good' using the HBI water quality assessment system, and it appears to provide some of the best habitat for macroinvertebrates in Jefferson County. This assessment is supported by a small but subtle trend toward decreasing numbers of tolerant species and increasing numbers of intolerant species. If Allen Creek continues to be rated 'good,' we should continue to see a shift from tolerant organisms to a shift to intolerant organisms.

References

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Appendices

1. **Appendix-1:** Allen Creek Raw Data Sheet, HBI Calculation, Taxa Richness, EPT Richness

2. **Appendix-2:** Allen Creek Macroinvertebrate Composition

3. **Appendix-3:** Evaluation of water quality using biotic index values of samples collected in March, April, May, September, and early October (Hilsenhoff 1987)

Appendix-2

Allen Creek Macroinvertebrate Composition

	Amacher's House	Bleeker's House					
	9/22/2006	9/22/2006	11/7/2003	5/15/1997 A	5/15/1997 B	7/1/1992 A	7/1/1992 B
Taxa	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**
EPHEMEROPTERA							
Baetidae							
Baetis sp.						2	
Baetis flavistriga	18	17		1	5	6	
Baetis intercalaris		1					
Caenidae							
Caenis sp.							7
Heptageniidae			1				
Maccaffertium luteum/vicarium		1	1		1		
PLECOPTERA							
Taeniopterygidae							
Taeniopteryx sp.			2				
TRICHOPTERA							
Helicopsychidae							
Helicopsyche borealis	2	1					1
Hydropsychidae						3	
Ceratopsyche bronta		1	1			6	1
Ceratopsyche morosa	6	2					
Ceratopsyche slossonae		1	1	1	1	1	1
Cheumatopsyche sp.	21	54	5	1	2	20	2
Hydropsyche betteni	38	21	7	2	3	3	
Hydroptilidae							
Hydroptila sp.						2	
Limnephilidae							
Pycnopsyche sp.			2		2		
Psychomyiidae							
Psychomyia flavida		2		2	1		
COLEOPTERA							
Elmidae					1	1	
Dubiraphia sp. (larvae)						1	4
Dubiraphia quadrinotata			2				
Optioservus fastiditus	90	89	33	61	79	9	7
Stenelmis sp. (larvae)	49	14	26	6	21	19	1
Stenelmis crenata		5	11	3	4		2
Psephenidae							
Ectopria sp.	1		1		1		
DIPTERA							
Chironomidae							
Brillia sp.		1					
Corynoneura sp.		1					
Cryptochironomus sp.						2	
Cricotopus festivellus group				4	3		
Cricotopus trifascia group				1		5	
Microtendipes sp.						8	1
Microtendipes pedellus group	1				5		
Orthocladius sp.				26	6		
Parakiefferiella sp.	1						
Parametriocnemus sp.	2	1	1				
Paratendipes sp.				1		1	
Polypedilum illinoense group						1	
Polypedilum sp.				1		9	1
Polypedilum fallax group				2	1		
Rheotanytarsus sp.						1	
Stictochironomus sp.				1			
Tvetenia sp. A			2		1		
Tvetenia bavarica group	7	7					
Cladotanytarsus sp.			2		3		
Pupae				1	1	1	
Orthocladiinae (unidentified)				2	1		
Tanypodinae (unidentified)						1	1
Empididae							
Hemerodromia sp.	1	1					
Simuliidae							
Simulium vercundum complex				1			
Simulium vittatum complex	3	1	2	1		1	
Tabanidae							
Chrysops sp.						1	2
Tipulidae							
Antocha sp.				1	1		
Dicranota sp.			3				
Hexatoma sp.					1		
Pilaria sp.			1				
Tipula sp.		3	1				

Appendix-2 (continued)

Allen Creek Macroinvertebrate Composition

Taxa	Amacher's House 9/22/2006	Bleeker's House 9/22/2006	11/7/2003	5/15/1997 A	5/15/1997 B	7/1/1992 A	7/1/1992 B
	Total	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**
AMPHIPODA							
Gammarus pseudolimnaeus	3	3	42	39	24	17	63
ISOPODA							
Caecidotea sp.		1					
Caecidotea intermedia			13			12	43
DECAPODA							
Orconectes sp.		1					
GASTROPODA							
Physidae						1	1
HETEROPTERA							
Veliidae							
Rhagovelia sp.						1	
Corixidae							
Palmacorixa sp.							1
sum	243	229	160	158	168	135	139

Orders	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%
EPHEMEROPTERA	18	7.41	19	8.30	2	1.27	1	0.63	6	3.57	8	5.97	7	5.07
TRICHOPTERA	67	27.57	82	35.81	16	10.13	6	3.80	9	5.36	35	26.12	5	3.62
COLEOPTERA	140	57.61	108	47.16	73	46.20	70	44.30	106	63.10	30	22.39	14	10.14
DIPTERA	4	1.65	5	2.18	7	4.43	3	1.90	2	1.19	2	1.49	2	1.45
Chironomidae	11	4.53	10	4.37	5	3.16	39	24.68	21	12.50	28	20.90	2	1.45
AMPHIPODA	3	1.23	3	1.31	42	26.58	39	24.68	24	14.29	17	12.69	63	45.65
ISOPODA	0	0.00	1	0.44	13	8.23	0	0.00	0	0.00	12	8.96	43	31.16
OTHER (PLECOPTERA, DECAPODA, GASTROPODA,	0	0.00	1	0.44	0	0.00	0	0.00	0	0.00	2	1.49	2	1.45
Total	243	100.00	229	100.00	158	100.00	158	100.00	168	100.00	134	100.00	138	100.00

** 11/2003 does not include Tricladida and oligochaeta in the count.

** 5/15/1997 (N42deg 53min 54.0sec W 88deg 51min 36.0sec) does not include Oligochaeta in the count.

** 7/1/1992 (N42deg 53min 53.5sec W 88deg 51 min 37.4sec) does not include Perciformes and Hirudinea in the count.

**7/1/1992 (N42deg 52min 48.9sec W 88deg 49min 55.8sec) does not include Cypriniforms, Hirudinea, and Oligochaeta in the count.

Appendix-1

Allen Creek Raw Data Sheet, HBI Calculation, Taxa Richness, EPT Taxa Richness

	HBI	Amacher's House		Bleeker's House											
	Tolerance	9/22/2006		9/22/2006		11/7/2003		5/15/1997 A		5/15/1997 B		7/1/1992 A		7/1/1992 B	
Taxa	**Value**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**
EPHEMEROPTERA															
Baetidae															
Baetis sp.**	4											2	8		
Baetis flavistriga	4	18	72	17	68			1	4	5	20	6	24		
Baetis intercalaris	6			1	6										
Caenidae															
Caenis sp.	7													7	49
Heptageniidae	4					1	4								
Maccafertium luteum/vicarium	2			1	2	1	2			1	2				
PLECOPTERA															
Taeniopterygidae															
Taeniopteryx sp.	2					2	4								
TRICHOPTERA															
Helicopsychidae															
Helicopsyche borealis	3	2	6	1	3									1	3
Hydropsychidae**	4											3	12		
Ceratopsyche bronta	5			1	5	1	5					6	30	1	5
Ceratopsyche morosa (bifida)	6	6	36	2	12										
Ceratopsyche slossonae	4			1	4	1	4	1	4	1	4	1	4	1	4
Cheumatopsyche sp.	5	21	105	54	270	5	25	1	5	2	10	20	100	2	10
Hydropsyche betteni	6	38	228	21	126	7	42	2	12	3	18	3	18		
Hydroptilidae															
Hydroptila sp.	6											2	12		
Limnephilidae															
Pycnopsyche sp.	4					2	8			2	8				
Psychomyiidae															
Psychomyia flavida	2			2	4			2	4	1	2				
COLEOPTERA															
Elmidae**	4									1	4	1	4		
Dubiraphia sp. (larvae)	xx											1	xx	4	xx
Dubiraphia quadrinotata	5					2	10								
Optioservus fastiditus	4	90	360	89	356	33	132	61	244	79	316	9	36	7	28
Stenelmis sp. (larvae)	5	49	245	14	70	26	130	6	30	21	105	19	95	1	5
Stenelmis crenata	5			5	25	11	55	3	15	4	20			2	10
Psephenidae															
Ectopria sp.	5	1	5			1	5			1	5				
DIPTERA															
Chironomidae															
Brillia sp.	5			1	5										
Cladotanytarsus sp.	7					2	14			3	21				
Corynoneura sp.	7			1	7										
Cryptochironomus sp.	8											2	16		
Cricotopus festivellus group	7							4	28	3	21				
Cricotopus trifascia group	7							1	7			5	35		
Microtendipes sp.	6											8	48	1	6
Microtendipes pedellus group	6	1	6							5	30				
Orthocladius sp.	6							26	156	6	36				
Parakiefferiella sp.	xx	1	xx												
Parametriocnemus sp.	5	2	10	1	5	1	5								
Paratendipes sp.	8							1	8			1	8		
Polypedilum illinoense group	6											1	6		
Polypedilum sp.	6							1	6			9	54	1	6
Polypedilum fallax group	6							2	12	1	6				
Rheotanytarsus sp.	6											1	6		
Stictochironomus sp.	9							1	9						
Tvetenia sp. A	5					2	10			1	5				
Tvetenia bavarica group	5	7	35	7	35										
Pupae**	xx							1	xx	1	xx	1	xx		
Orthocladiinae (unidentified)	xx							2	xx	1	xx				
Tanypodinae (unidentified)	xx											1	xx	1	xx
Empididae															
Hemerodromia sp.	6	1	6	1	6										
Simuliidae															
Simulium vercundum complex	6							1	6						
Simulium vittatum complex	7	3	21	1	7	2	14	1	7			1	7		
Tabanidae															
Chrysops sp.	6											1	6	2	12
Tipulidae															
Antocha sp.	3							1	3	1	3				
Dicranota sp.	3					3	9								
Hexatoma sp.	2									1	2				
Pilaria sp.	7					1	7								
Tipula sp.	4			3	12	1	4								

Appendix-1 (continued)

Allen Creek Raw Data Sheet, HBI Calculation, Taxa Richness, EPT Taxa Richness

	HBI	Amacher's House		Bleeker's House											
	Tolerance	9/22/2006		9/22/2006		11/7/2003		5/15/1997 A		5/15/1997 B		7/1/1992 A		7/1/1992 B	
Taxa	**Value**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**	**Number**	**Product**
AMPHIPODA															
Gammarus pseudolimnaeus	4	3	12	3	12	42	168	39	156	24	96	17	68	63	252
ISOPODA															
Caecidotea sp.	8			1	8										
Caecidotea intermedia	8					13	104					12	96	43	344
DECAPODA															
Orconectes	xx			1	xx										
GASTROPODA															
Physidae	xx											1	xx	1	xx
HIRUDINEA															
Erpobdellidae	xx											1	xx	1	xx
HETEROPTERA															
Veliidae															
Rhagovelia sp.	xx											1	xx		
Corixidae															
Palmacorixa sp.	xx													1	xx
TRICLADIDA	xx					34	xx								
OLIGOCHAETA														2	xx
Naidinae	xx									1	xx				
Tubifinae	xx					5	xx								
CYPRINIFORMES															
Cyprinodontidae	xx													1	xx
PERCIFORMES															
Percidae	xx											4	xx		
sum		243	1147	229	1048	199	761	158	716	169	734	140	693	143	734
sum w/o taxa that have no tol.val		242	1147	228	1048	160	761	155	716	166	734	130	693	132	734
Taxa Richness		16		22		25		20		22		25		20	
EPT Taxa Richness		5		10		8		5		7		6		5	
Hilsenhoff Biotic Index			4.74		4.60		4.76		4.62		4.42		5.33		5.56

**** = not included in taxa richness**
xx = no tolerance value assigned
by Hilsenhoff

Apendix- 3 : Evaluation of water quality using biotic index values of samples colected in March, April, May, September, and early October (Hilsenhof 1987)

Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic polution
6.51-7.50	Fairly poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10	Very Poor	Severe organic pollution