

Study Our Streams
**Aquatic Benthic Macroinvertebrate Communities in Streams from the North
Shore of Lake Superior, 2008**

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Introduction

Benthic macroinvertebrates respond to ecosystem changes faster than other members of the aquatic community, and are therefore commonly used as an indication of the health of aquatic ecosystems. Trends and changes in aquatic macroinvertebrate populations and their community structure can serve as indicators of short-term stresses that may ultimately influence the aquatic community of Lake Superior.

The goals of this part of the *Study Our Streams* project were fourfold: to locate reference sites for minimally impacted streams along the north shore of Lake Superior, to sample benthic macroinvertebrates at two sites that had previously been sampled in an attempt to determine the effect of season/year on the composition of the benthic macroinvertebrate community, to assess the biological health of a remediated stream by comparing the community structure with that found in minimally impacted reference sites with similar physiographic features, and to examine two possibly impacted urban sites within the city limits of Thunder Bay.

Procedure

During 2005 we examined all watersheds draining into Lake Superior between Thunder Bay and Sault Ste. Marie to find rivers and streams that were minimally impacted and of variable size, stream order, substrate and other physiographic features (Deacon & Lavoie, 2008). The criteria used to determine whether or not a site was minimally impacted were outlined by the Ontario Benthos Biomonitoring Network (Jones *et al.*, 2005).

The candidates for minimally impacted reference sites were Deadhorse Creek, McKellar Creek, Whitesand River, McLean's Creek, and McInnes Creek (Fig. 1) from east to west, respectively. We sampled these five sites during mid- to late September 2008.

We sampled the Current River (Fig. 1) during late September 2008. This site had been sampled in October of 2004 and at the end of June 2005; therefore, we



Figure 1. Aquatic benthic macroinvertebrate sampling sites, north shore of Lake Superior, 2008.

hoped to determine if any widespread changes had occurred in community structure due to season and year. We also sampled the Jackpine River (Fig. 1) in September 2008. This site had been sampled in September of 2005 and 2007; therefore, we wanted to determine if any changes had occurred in community structure over time.

Blind Creek (Fig. 1), a small stream east of the City of Thunder Bay, experienced a washout caused by an extreme storm event in 1997. Rehabilitation of degraded habitat in the lower reaches of the creek was completed in 2006. The rehabilitated portion of the stream was sampled in mid-September 2008 to assess macroinvertebrate populations.

A rehabilitated portion of McVicar Creek (Test), a stream within the city limits of Thunder Bay, was sampled in June 2007 and was re-sampled in mid-September 2008 (Fig. 1). An additional sample for comparison, McVicar Creek (Urban) was taken approximately 200 metres further upstream from McVicar Creek (Test).

Benthic macroinvertebrates were sampled at each site according to OBBN protocols (Jones *et al.*, 2005), using a traveling kick-and-sweep technique with a

500-micron mesh D-net. Three sub-samples were collected at each of the sites and each sub-sample was preserved in 70% ethanol.

Approximately 100 benthic macroinvertebrates were randomly picked from each of the sub-samples using the 'bucket method' (Jones *et al.*, 2005) and examined with a Nikon SMZ1500 at 10X magnification. The specimens were identified at genus-level when possible (Appendix 1 - Appendix 10), using Merritt and Cummins (1996) and Wiggins (1996). The biotic indices for the sites were calculated based on identification of 27-taxa, as outlined by the OBBN (Jones *et al.*, 2005).

The OBBN Biotic Indices (Table 1) (Jones *et al.*, 2005) used to analyse the 27-taxa identified from the candidate sites provide an insight into present and past conditions experienced by the aquatic macroinvertebrate communities. Some of the biotic indices (high % Worms, high % Chironomids) are useful for characterising sites that are heavily impacted by nutrient enrichment. Nutrient enrichment will cause premature eutrophication resulting in low dissolved oxygen in the water, with consequent degradation of the habitat. Other biotic indices (high % EPT, low Hilsenhoff Biotic Index values) help to confirm high water quality at the site. Each biotic index provides a separate insight about the quality of the habitat. The combination of several indices makes it possible to evaluate the relative, long-term health of the site. However, not all biotic indices are necessary to determine whether a site is impaired, or whether it should be considered a suitable reference site.

The biotic indices used to evaluate all the sites were: Richness, Shannon's H' Diversity, Hilsenhoff Biotic Index, % Dominant, % EPT, % Chironomids, and % Worms (Table 2). These biotic indices were compared with reference data from other sites from the north shore of Lake Superior (Deacon & Lavoie, 2005; Deacon & Lavoie, 2008).

Observations

2008 Regional Reference Sites

The Deadhorse Creek site (DH-1) (Table 2) had a high Richness (10.7), very high Shannon's H' Diversity (1.93), moderately low Hilsenhoff Biotic Index (5.27), moderately low % Dominants (31.3), low % Chironomids (24.6), and moderately low % Worms (3.3) for northern Ontario. The % EPT (50.1) was moderate. These Indices are considered indicative of a healthy ecosystem. Site DH-1 should be included in the OBBN Reference Site database.

The McKellar Creek site (MK-1) (Table 2) had a moderate Richness (8.7), and Shannon's H' Diversity (1.58), a moderately low Hilsenhoff Biotic Index (4.89), % Dominants (36.8), % Chironomids (35.2), and % Worms (2.8). The % EPT (56.5) was high. These Indices are considered indicative of a healthy

Table 1. Biotic Indices: calculations and descriptions.

Subcategory	Index	How to Calculate:	Indication
Richness/Diveristy	ABUNDANCE	Sum of Organisms	possibly impaired if extremely low or high value
	RICHNESS	Count of taxa found in a sample	the greater the number of taxa the higher the quality of the habitat
	INSECT RICHNESS	Count of Chironomidae+Culicidae +Ceratopogonidae +Tipulidae +Tabanidae +Simuliidae+Odonates(Zygoptera and Anisoptera) + Coleoptera + Ephemeroptera + Hemiptera + Lepidoptera + Megaloptera + Plecoptera + Trichoptera + misc Dipterans	the greater the number of taxa the higher the quality of the habitat
	DIPTERIAN RICHNESS	Count of Chironomidae+Culicidae +Ceratopogonidae+Tipulidae+Tabanidae+ Simuliidae	the greater the number of taxa the higher the quality of the habitat
	SIMPSON'S INDEX	Proportion of species i relative to the total number of species (p_i), squared Squared proportions for all the species summed, and the reciprocal is taken	probability that two individuals will belong to the same taxon
	SHANNON'S H' DIVERSITY	$H' = -\sum(p_i * \ln(p_i))$ where p_i =proportion of the count of each taxa	high values indicate increased evenness of the counts among the taxa and higher quality habitat
Composition	%AMPHIPODA	Sum of amphipoda /abundance *100	associated with eutrophic conditions
	%CHIRONOMIDAE	Sum of Chironomidae / Abundance*100	extremely abundant in highly eutrophic situations, but present in all habitats
	%CRUSTACEANS and MOLLUSCA	(Sum of Amphipoda+Decapoda+Isopoda +Gastropoda + Pelecypoda) /Abundance*100	associated with eutrophic conditions, but present in many habitats
	%CRUSTACEANS	(Sum of Amphipoda+Decapoda+Isopoda) /abundance*100	associated with eutrophic conditions, but present in many habitats
	%EPHEMEROPTERA	Sum of Ephemeroptera /abundance*100	the greater the value the higher the quality of the habitat
	%GASTROPODS	Sum of Gastropoda /abundance*100	associated with eutrophic conditions, but present in many habitats
	%HIRUDINEA	Sum of Hirudinea /abundance*100	associated with eutrophic conditions, but present in many habitats
	%ISOPODA	Sum of Isopoda /abundance*100	associated with eutrophic conditions
	%MOLLUSCA	(Sum of Gastropoda + Pelcypoda) /abundance*100	associated with eutrophic conditions, but present in many habitats
	%ODONATES	(Sum of Anisoptera and Zygoptera) /abundance*100	the greater the value the higher the quality of the habitat
	%OLIGOCHAETES	Sum of Oligochaetes /abundance*100	abundant in highly eutrophic situations, but present in many habitats
	%PELECYPODA	Sum of Pelecypoda /abundance*100	the greater the value the healthier the habitat
	%TIPULIDAE	Sum of Tipulidae /abundance*100	possibly impaired if extremely high value, but present in many habitats
	%TABANIDAE	Sum of Tabanidae /abundance*100	possibly impaired if extremely high value, but present in many habitats
	%SIMULIDAE	Sum of Simuliidae /abundance*100	possibly impaired if extremely high value, but present in many habitats
	%DIPTERA	(Sum of Chironomidae+Culicidae +Ceratopogonidae +Tipulidae+Tabanidae+Simuliidae +misc Dipterans) / Total Abundance* 100	possibly impaired if extremely low or high value
	%INSECTS	(Sum of abundance of Chironomidae+Culicidae +Ceratopogonidae +Tipulidae+Tabanidae+Simuliidae+Odonates (Zygoptera and Anisoptera) + Coleoptera + Ephemeroptera + Hemiptera + Lepidoptera + Megaloptera + Plecoptera + Trichoptera + misc Dipterans) / Total Abundance* 100%	possibly impaired if extremely low or high value
	%NON-DIPTERIAN INSECTS	(Sum of Zygoptera + Anisoptera + Coleoptera + Ephemeroptera + Hemiptera + Lepidoptera + Megaloptera + Plecoptera + Trichoptera)/Total Abundance* 100	a high value indicates higher water quality than a lower value
	%EPT	(Sum of Ephemeroptera + Plecoptera + Trichoptera) / Abundance * 100	a high value indicates higher water quality than a lower value
	%EOT	(Sum of Ephemeroptera + Anisoptera + Zygoptera + Trichoptera) / Total Abundance * 100	a high value indicates higher water quality than a lower value
Tolerance	%DOMINANT	Abundance of the Most Common Taxon / abundance * 100	the dominance of a pollution tolerant group indicates an impaired site
	HILSENHOFF'S BIOTIC INDEX	= $\sum(x_i/t_i)$ /Total abundance where x_i =abundance of each taxa and t_i = tolerance value for each taxa.	a low value implies low nutrient conditons. Values above 6.0 are of concern

ecosystem. Site MK-1 should be included in the OBBN Reference Site database.

The Whitesand River site (WS-7) (Table 2) had a high Richness (10.0), but a moderate Shannon's H' Diversity (1.59). The Hilsenhoff Biotic Index (5.40) was moderate and % Dominants (42.3) was moderately low. The % Chironomids (26.8) was low, and % Worms (3.8) was moderately low. The % EPT (57.1) was high. These Indices are considered indicative of a healthy ecosystem. Site WS-7 should be included in the OBBN Reference Site database.

Table 2. Mean biotic indices of the aquatic benthic macroinvertebrate communities at ten sites, 2008.

Site Name	Site Code	Sampling Date	Total Abundance	Richness	H' Diversity	Hilsenhoff's Biotic Index	% Dominants	% EPT	% Chironomids	% Worms
Deadhorse Creek	DH-1	20-Sep-08	103.7	10.7	1.93	5.27	31.3	50.1	24.6	3.3
McKellar Creek	MK-1	20-Sep-08	105.7	8.7	1.58	4.89	36.8	56.5	35.2	2.8
Whitesand River	WS-7	21-Sep-08	120.0	10.0	1.59	5.40	42.3	57.1	26.8	3.8
McLean's Creek	AC-1	21-Sep-08	107.3	9.0	1.77	4.96	28.2	60.4	23.8	7.1
MacInnes Creek	MC-1	19-Sep-08	112.7	7.3	1.47	6.10	40.2	28.1	33.7	34.2
Jackpine River	JP-1	21-Sep-08	121.3	9.7	1.57	6.00	44.1	35.7	44.1	10.3
Blind Creek	BC-1	17-Sep-08	114.7	10.0	1.62	5.49	40.1	53.9	25.2	7.3
Current River	CU-14	18-Sep-08	129.7	11.7	1.86	6.03	36.3	31.5	35.4	2.4
McVicar Urban	MVU-1	15-Sep-08	102.7	10.3	1.67	6.51	43.3	24.1	17.4	43.3
McVicar Test	MVT-1	15-Sep-08	114.3	11.3	1.81	6.57	40.3	15.8	17.0	30.2

The McLean's Creek site (AC-1) (Table 2) had a moderate Richness (9.0), a high Shannon's H' Diversity (1.77), a moderately low Hilsenhoff Biotic Index (4.96), a low % Dominants (28.2), a moderately low % Chironomids (23.8), and a moderate % Worms (7.1). The % EPT (60.4) was very high. These Indices are considered indicative of a healthy ecosystem. Site AC-1 should be included in the OBBN Reference Site database.

The MacInnes Creek site (MC-1) (Table 2) had a moderately low Richness (7.3) and Shannon's H' Diversity (1.47). The Hilsenhoff Biotic Index (6.10) was high; however, the % Dominants (40.2) and % Chironomids (33.7) were moderately low. The % Worms (34.2) was very high, and the % EPT (28.1) was moderately low. These indices possibly indicate a community from a nutrient-rich habitat high in organics that supports a high number of worms. This stream was the smallest sampled to date. The community may be normal for small streams; however, more small streams should be sampled before site MC-1 is included in the OBBN Reference Site database.

Resampled Sites

The Current River site (CU-14) was sampled in 2004, in 2005, and again in 2008. The 14 October 2004 sample had a high Richness (10.7) and Shannon's H' Diversity (1.85), and a moderate Hilsenhoff Biotic Index (5.43). The % Dominants (32.1) and % Chironomids (29.5) were moderately low. The % Worms (5.4) was moderate, as was the % EPT (48.6). Overall this site apparently supported a healthy ecosystem and was recommended for the OBBN Reference Site database in 2004 (Deacon & Lavoie, 2005).

The 29 June 2005 sample had a very high Richness (12.3), Shannon's H' Diversity (1.93), and high Hilsenhoff Biotic Index (6.22). The % Dominants (30.5) and % Chironomids (29.1) were moderately low. The % Worms (4.8) was moderate, whereas the % EPT (30.2) was moderately low (Deacon & Lavoie, 2008).

The 2008 Current River site (CU-14) (Table 2) sample had a very high Richness (11.7) and Shannon's H' Diversity (1.86). The Hilsenhoff Biotic Index (6.03) was high. The % Dominants (36.3), % Chironomids (35.4), % Worms (2.4), and % EPT (31.5) were moderately low.

The 2004 and 2008 samples were expected to be most similar because they were collected in the same season. The data from 2005 and 2008 are actually most similar even though the 2005 sample was collected during the summer, whereas the 2008 sample was collected during the autumn. The major difference was a lower Hilsenhoff Biotic Index and a slightly higher % EPT in 2004, possibly indicating a somewhat healthier community. The increase in the Hilsenhoff Biotic Index and decrease in the % EPT in 2008 could indicate a community responding to a more eutrophic habitat. Sampling should continue at site CU-14 to determine whether a change in the community is occurring.

The Jackpine River site (JP-1) that was first sampled on 20 September 2005 had moderate values for Richness (8.0), Shannon's H' Diversity (1.52), Hilsenhoff Biotic Index (5.76), % Dominants (40.9), and % Chironomids (34.1) (Deacon & Lavoie 2008). The % Worms (9.3) was higher than seen in any of the other sites sampled during 2005, possibly indicating nutrient enrichment causing eutrophication. However, the % EPT (49.7) was moderate and combined with the above values indicated that this community of organisms came from a healthy, although unusual ecosystem. Site JP-1 was included in the OBBN Reference Site database (Deacon & Lavoie, 2008).

The Jackpine River site (JP-1) was sampled again on 15 September 2007. The 2007 sample had a moderate Richness (8.7), Shannon's H' Diversity (1.38), Hilsenhoff Biotic Index (5.85), and % Dominants (53.4). The % Chironomids (34.2) was moderately low. The % Worms (11.6) was high, and the % EPT (47.6) was moderate, as noted during 2005 (Deacon & Lavoie 2008).

The Jackpine River site (JP-1) (Table 2) was sampled for a third time on 21 September 2008. The Richness (9.7) was moderately high, Shannon's H' Diversity (1.57) was moderate, and Hilsenhoff Biotic Index (6.00) was high. The % Dominants (44.1) was moderately low, the % Chironomids (44.1) was moderate, the % Worms (10.3) was high, and the % EPT (35.7) was moderate.

Although the biotic indices were similar between 2005 and 2007, the indices for 2008 differed considerably from the earlier samples. The high values for the Hilsenhoff Biotic Index, % Chironomids, and % Worms and the lower value for % EPT are of particular concern, possibly indicating organic enrichment. The Current River also showed a change in 2008 towards a community more characteristic of an organically enriched environment; however, both these streams are removed from sources of anthropogenic enrichment. Weather patterns may have influenced organic input in these streams or the changes noted are related to natural variability. Sampling should continue at sites JP-1 and CU-14 to try to determine which of these factors is affecting the communities.

Blind Creek

The Blind Creek site (BC-1) (Table 2) had a high Richness (10.0) and Shannon's H' Diversity (1.62). The Hilsenhoff Biotic Index (5.49) was moderate. The % Dominants (40.1) was moderately low and % Chironomids (25.2) was low. The % Worms (7.3) was moderate, and the % EPT (53.9) was high. These Indices indicate a healthy community in a high quality habitat. The composition of the benthic communities indicates that the rehabilitation of Blind Creek was successful.

McVicar Creek Test Sites

Test Site 2007

In 2007, the McVicar Creek Test site (MV-T1) had a very low Richness (6.3), Shannon's H' Diversity (1.22), and a very high Hilsenhoff Biotic Index (6.96). The % Dominants (52.8) was moderate; however, the % Chironomids (28.0) was low and the % Worms (36.2) was higher than found in any of the other 23 sites sampled to 2007. The % EPT (11.4) was very low (Deacon & Lavoie, 2008).

Amphipoda and Isopoda were found at this site in 2007. Amphipoda and Isopoda are characteristically found in habitats rich in organics. The biotic indices from site MV-T1 indicate a community composition possibly associated with nutrient enrichment causing eutrophication. Although site MV-T1 was rehabilitated, it still supports a community indicative of a moderately-impacted site.

The McVicar Creek Test site (MV-T1) was resampled in 2008 and had a very high Richness (11.3) and a high Shannon's H' Diversity (1.81). The Hilsenhoff Biotic Index (6.57) was high whereas the % Dominants (40.3) was moderately low. The % Chironomids was extremely low (17.0) and the % Worms was very high (30.2). The % EPT (15.8) was low. Amphipoda and Isopoda were again found at this site which may be related to the proximity of MV-T1 to Lake Superior. These observations differ slightly from those of 2007, possibly because of the change in the date of sampling from June to September. Communities change composition during the year with the greatest diversity found during the autumn. The Richness and Shannon's H' Diversity both reflect a change to the expected greater diversity associated with season in 2008. Overall the data still indicate nutrient enrichment and an impacted site. Benthic macroinvertebrates indicate that recovery has not occurred.

The McVicar Creek Urban site (MV-U1) had a high Richness (10.3) and a moderately high Shannon's H' Diversity (1.67). The Hilsenhoff Biotic Index was high (6.51) whereas the % Dominants (43.3) was moderately low. The % Chironomids was extremely low (17.4); however, the % Worms was extremely high (43.3). This is the highest value for % Worms found to date. The % EPT (24.1) was moderately low. No Amphipoda or Isopoda were found; however, the extremely high % Worms is probably indicative of eutrophication. Elements of the taxa do indicate a potentially high quality habitat, eg. the Trichoptera genera *Cheumatopsyche*, *Rhyacophila*, *Lepidostoma*, and *Mystacides* (Appendix 9). If the source of the nutrient enrichment can be found and eliminated, then the aquatic benthic macroinvertebrate community should recover quickly.

Conclusion

The first goal of this project was to locate reference sites for minimally impacted streams along the north shore of Lake Superior. The Deadhorse Creek (DH-1), McKellar Creek (MK-1), Whitesand River (WS-7), and McLean's Creek (AC-1) sites warrant inclusion in the OBBN Reference Site database. MacInnes Creek (MC-1) may be typical of small streams from the north shore of Lake Superior; however, MC-1 should not be included in the OBBN Reference site data base until additional small streams can be sampled for comparison.

The second goal of this project was to sample benthic macroinvertebrates at two sites that had previously been sampled in an attempt to determine the effect of season/year on the composition of the benthic macroinvertebrate community. Both the Current River (CU-14) and Jackpine River (JP-1) had communities that had a similar structure (Table 2) among years; however, the Current River is possibly undergoing some sort of directional change and the Jackpine River is displaying variability.

The third goal was to assess the biological health of a remediated stream by comparing the community structure with that found in minimally impacted

reference sites with similar physiographic features. The OBBN Reference Site database is still not large enough to permit statistical analyses of Test Sites for the north shore of the Lake Superior basin; however, Blind Creek (BC-1) is remarkably similar in community structure to sites that have been included in the OBBN Reference Site database (Deacon & Lavoie, 2005; Deacon & Lavoie, 2008). Apparently the efforts to rehabilitate BC-1 were successful.

The fourth goal was to examine two urban sites that were possibly impacted. Evidently both McVicar Creek Test site (MV-T1) and McVicar Creek Urban site (MV-U1) are experiencing impairment, possibly because of eutrophication. Trichopteran elements of the taxa of both of these communities indicate a potentially high quality habitat. If the source of the impact can be found and corrected, then the benthic macroinvertebrate communities should recover quickly.

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Appendix 1. Benthic macroinvertebrates from Deadhorse Creek, Ontario, 2008.				
		Deadhorse Ck	Deadhorse Ck	Deadhorse Ck
		DH-1-1	DH-1-2	DH-1-3
		Riffle	Pool	Riffle
		20-Sep	20-Sep	20-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA		2	3	
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae				
Valvatidae				
Bivalvia				
Sphaeriidae		13	2	
ANNELIDA				
Oligochaeta		1	4	5
Hirudinea		1	1	
ARTHROPODA				
Hydracarina		5	3	4
Amphipoda				
Hyalellidae	<i>Hyalella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged	3		1
	<i>Acentrella</i>			
	<i>Baetis</i>	2	1	3
Heptageniidae	Juvenile/damaged	2		6
	<i>Leucrocuta</i>			
	<i>Rhithrogena</i>			
	<i>Steronema</i>		1	5
Ephemerellidae	Juvenile/damaged	4		7
	<i>Attenella</i>			
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s.str.)	4	5	
	<i>Serratella</i>	11	1	7
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged	1	5	1
	<i>Leptophlebia</i>	2	2	
Odonata				
Gomphidae	Juvenile/damaged			1
Aeshnidae	<i>Boyeria</i>		2	1
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged			
Nemouridae	Juvenile/damaged		1	
	<i>Nemoura</i>	5	7	6
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>	1		
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged		3	
	<i>Acroneuria</i>			
	<i>Claassenia</i>			3
Perlodidae	Juvenile/damaged			

Appendix 1 cont'd. Benthic macroinvertebrates from Deadhorse Creek, Ontario, 2008.				
		Deadhorse Ck	Deadhorse Ck	Deadhorse Ck
		DH-1-1	DH-1-2	DH-1-3
		Riffle	Pool	Riffle
		20-Sep	20-Sep	20-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera		2		
Halplidae	<i>Halplus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged		1	2
	<i>Dubiraphia</i>			
	<i>Optioservus</i>	3	1	6
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa	1	3	
Philopotamidae	Pupa			
	<i>Dolophilodes</i>	1		2
	<i>Chimarra</i>	2		4
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>	2		
Hydropsychidae	Juvenile	2		3
	<i>Cheumatopsyche</i>			
	<i>Hydropsyche</i>			7
Rhyacophilidae	<i>Rhyacophila</i>	4		3
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>			
Lepidostomatidae	<i>Lepidostoma</i>	3	12	7
Limnephilidae	Juvenile/damaged			
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>			
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyphelea</i>			
	<i>Probezzia</i>			
Chironomidae		26	38	12
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa	2	1	
	<i>Chelifera</i>	5	1	7
	<i>Hemerodromia</i>			
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		108	100	103
% Sorted		9.0	10.1	7.9

Appendix 2 Benthic macroinvertebrates from McKellar Creek, Ontario, 2008.				
		McKellar Ck	McKellar Ck	McKellar Ck
		MK-1-1	MK-1-2	MK-1-3
		Riffle	Riffle	Pool
		20-Sep	20-Sep	20-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA		1		
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae		1		
Valvatidae				
Bivalvia				
Sphaeriidae				
ANNELIDA				
Oligochaeta		6	2	1
Hirudinea		2		
ARTHROPODA				
Hydracarina		4	1	3
Amphipoda				
Hyalellidae	<i>Hyaella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged	10	6	2
	<i>Acentrella</i>			
	<i>Baetis</i>	3		
Heptageniidae	Juvenile/damaged	1	4	2
	<i>Leucrocota</i>			1
	<i>Rhithrogena</i>			
	<i>Stenonema</i>	1	3	1
Ephemerellidae	Juvenile/damaged	2	1	
	<i>Attenella</i>			
	<i>Ephemerella</i>		2	1
	<i>Eurylophella</i> (s. str.)			1
	<i>Serratella</i>		2	
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged	1	3	4
	<i>Leptophlebia</i>	2	3	1
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>			
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged			
Nemouridae	Juvenile/damaged	1		
	<i>Nemoura</i>	9	12	8
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>		11	8
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>			
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged	4	5	

Appendix 2 cont'd. Benthic macroinvertebrates from McKellar Creek, Ontario, 2008.				
		McKellar Ck	McKellar Ck	McKellar Ck
		MK-1-1	MK-1-2	MK-1-3
		Riffle	Riffle	Pool
		20-Sep	20-Sep	20-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Halipidae	<i>Halipus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged			
	<i>Dubiraphia</i>			
	<i>Optioservus</i>			
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa			
Philopotamidae	Pupa			
	<i>Dolophilodes</i>	1		
	<i>Chimarra</i>			
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile		1	
	<i>Cheumatopsyche</i>		1	
	<i>Hydropsyche</i>	1		
Rhyacophilidae	<i>Rhyacophila</i>	5	3	
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>		1	
Lepidostomatidae	<i>Lepidostoma</i>	22	16	12
Limnephilidae	Juvenile/damaged			1
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>			
Diptera	Damaged/pupa		1	
Ceratopogonidae	<i>Dasyphelea</i>			
	<i>Probezzia</i>	2		
Chironomidae		32	23	56
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>	1	1	
Empididae	Juvenile/pupa			1
	<i>Chelifera</i>			
	<i>Hemerodromia</i>			
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		112	102	103
% Sorted		7.9	10.1	7.9

Appendix 3. Benthic macroinvertebrates from Whitesand River, Ontario, 2008.				
		Whitesand R	Whitesand R	Whitesand R
		WS-7-1	WS-7-2	WS-7-3
		Riffle	Riffle	Pool
		21-Sep	21-Sep	21-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA		1		1
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae				
Valvatidae				
Bivalvia				
Sphaeriidae		2	1	
ANNELIDA				
Oligochaeta		5	3	5
Hirudinea				
ARTHROPODA				
Hydracarina		1		2
Amphipoda				
Hyalellidae	<i>Hyalella</i>			15
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged		1	1
	<i>Acentrella</i>			
	<i>Baetis</i>	2		
Heptageniidae	Juvenile/damaged	20	19	6
	<i>Leucrocota</i>			
	<i>Rhithrogena</i>			
	<i>Stenonema</i>	1	1	1
Ephemerellidae	Juvenile/damaged	20	32	8
	<i>Attenella</i>			
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s. str.)		18	8
	<i>Serratella</i>			
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged			
	<i>Leptophlebia</i>		1	
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>			
Corduliidae	Juvenile			1
Plecoptera	Juvenile/damaged			
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>	1	5	4
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>		1	1
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged	1	1	
	<i>Acroneuria</i>	1		
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged			

Appendix 3 cont'd. Benthic macroinvertebrates from Whitesand River, Ontario, 2008.				
		Whitesand R	Whitesand R	Whitesand R
		WS-7-1	WS-7-2	WS-7-3
		Riffle	Riffle	Pool
		21-Sep	21-Sep	21-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliplus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged	1	2	
	<i>Dubiraphia</i>			1
	<i>Optioservus</i>	4	2	
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa			
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			
	<i>Chimarra</i>	5		
Polycentropodidae	<i>Neureclipsis</i>		3	1
	<i>Polycentropus</i>	6	1	
Hydropsychidae	Juvenile	11	8	
	<i>Cheumatopsyche</i>			
	<i>Hydropsyche</i>	6	1	
Rhyacophilidae	<i>Rhyacophila</i>	3	1	1
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>		1	
Lepidostomatidae	<i>Lepidostoma</i>	2	1	4
Limnephilidae	Juvenile/damaged			
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>			1
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>		1	
Chironomidae		15	41	40
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa	1		
	<i>Chelifera</i>	2		2
	<i>Hemerodromia</i>		1	
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		111	146	103
% Sorted		2.3	2.3	4.5

Appendix 4. Benthic macroinvertebrates from MacLean's Creek, Ontario, 2008.				
		MacLean's Ck	MacLean's Ck	MacLean's Ck
		AC-1-1	AC-1-2	AC-1-3
		Riffle	Riffle	Pool
		21-Sep	21-Sep	21-Sep
COELENTERATA		1		
PLATYHELMINTHES				
NEMATODA			1	2
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae				
Valvatidae				
Bivalvia				
Sphaeriidae				
ANNELIDA				
Oligochaeta		9	7	7
Hirudinea		1		
ARTHROPODA				
Hydracarina		4	7	4
Amphipoda				
Hyalellidae	<i>Hyaella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged	1	3	
	<i>Acentrella</i>			
	<i>Baetis</i>	1	2	
Heptageniidae	Juvenile/damaged	12	7	1
	<i>Leucrocuta</i>	1	1	
	<i>Rhithrogena</i>			
	<i>Stenonema</i>	3	6	4
Ephemerellidae	Juvenile/damaged	2	5	3
	<i>Attenella</i>			
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s str.)		1	3
	<i>Serratella</i>	1		
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged	5	2	8
	<i>Leptophlebia</i>	3	3	7
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>			
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged			
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>	20	9	15
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>			1
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>			
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged		2	3

Appendix 4 cont'd. Benthic macroinvertebrates from MacLean's Creek, Ontario, 2008.				
		MacLean's Ck	MacLean's Ck	MacLean's Ck
		AC-1-1	AC-1-2	AC-1-3
		Riffle	Riffle	Pool
		21-Sep	21-Sep	21-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliphus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged			
	<i>Dubiraphia</i>			
	<i>Optioservus</i>			
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa			
Philopotamidae	Juvenile/Pupa		1	
	<i>Dolophilodes</i>			
	<i>Chimarra</i>			
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			1
Hydropsychidae	Juvenile		1	
	<i>Cheumatopsyche</i>			
	<i>Hydropsyche</i>		3	
Rhyacophilidae	<i>Rhyacophila</i>	1	2	
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>			
Lepidostomatidae	<i>Lepidostoma</i>	20	13	15
Limnephilidae	Juvenile/damaged	1		1
Leptoceridae	Juvenile/damaged			1
	<i>Ceraclea</i>			
	<i>Mystacides</i>			
Diptera	Damaged/pupa	1		2
Ceratopogonidae	<i>Dasyhelea</i>			1
	<i>Probezzia</i>		1	
Chironomidae		20	25	32
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa		1	
	<i>Chelifera</i>		1	
	<i>Hemerodromia</i>	1		
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		108	104	111
% Sorted		11.3	15.8	10.1

Appendix 5. Benthic macroinvertebrates from MacInnes Creek, Ontario, 2008.				
		MacInnes Ck	MacInnes Ck	MacInnes Ck
		MC-1-1	MC-1-2	MC-1-3
		Riffle	Pool	Riffle
		19-Sep	19-Sep	19-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA			1	
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae				
Valvatidae				
Bivalvia				
Sphaeriidae				
ANNELIDA				
Oligochaeta		50	29	38
Hirudinea				
ARTHROPODA				
Hydracarina		2	1	2
Amphipoda				
Hyalellidae	<i>Hyaella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged	5		3
	<i>Acentrella</i>			
	<i>Baetis</i>	5		
Heptageniidae	Juvenile/damaged	1		
	<i>Leucrocuta</i>			
	<i>Rhithrogena</i>			
	<i>Stenonema</i>			1
Ephemerellidae	Juvenile/damaged			
	<i>Attenella</i>			
	<i>Ephemerella</i>	3		3
	<i>Eurylophella</i> (s. str.)			1
	<i>Serratella</i>			
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged			
	<i>Leptophlebia</i>			
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>			
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged	2		3
Nemouridae	Juvenile/damaged		3	1
	<i>Nemoura</i>	15		7
Leuctridae	Juvenile/damaged			6
	<i>Leuctra</i>	2	1	6
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>			
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged			

Appendix 5 cont'd. Benthic macroinvertebrates from MacInnes Creek, Ontario, 2008.				
		MacInnes Ck	MacInnes Ck	MacInnes Ck
		MC-1-1	MC-1-2	MC-1-3
		Riffle	Pool	Riffle
		19-Sep	19-Sep	19-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliphus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged			
	<i>Dubiraphia</i>			
	<i>Optioservus</i>			
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa			
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			
	<i>Chimarra</i>			
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile	4		
	<i>Cheumatopsyche</i>			
	<i>Hydropsyche</i>			
Rhyacophilidae	<i>Rhyacophila</i>			
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>			
Lepidostomatidae	<i>Lepidostoma</i>	5	14	6
Limnephilidae	Juvenile/damaged			
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>			
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>		4	1
Chironomidae		29	47	35
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>	1		
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa			
	<i>Chelifera</i>	1		
	<i>Hemerodromia</i>			
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		125	100	113
% Sorted		2.3	2.3	3.4

Appendix 6. Benthic macroinvertebrates from Jackpine River, Ontario, 2008.				
		Jackpine R	Jackpine R	Jackpine R
		JP-1-1	JP-1-2	JP-1-3
		Riffle	Pool	Riffle
		21-Sep	21-Sep	21-Sep
COELENTERATA				
PLATYHELMINTHES				1
NEMATODA		1	1	3
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae				
Valvatidae				
Bivalvia				
Sphaeriidae			2	
ANNELIDA				
Oligochaeta		6	18	13
Hirudinea				
ARTHROPODA				
Hydracarina				2
Amphipoda				
Hyalellidae	<i>Hyalella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged	1	1	
	<i>Acentrella</i>			
	<i>Baetis</i>	5		1
Heptageniidae	Juvenile/damaged	9		19
	<i>Leucrocuta</i>	1		2
	<i>Rhithrogena</i>	1		1
	<i>Stenonema</i>	1		
Ephemerellidae	Juvenile/damaged			1
	<i>Attenella</i>	3		
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s str.)		1	2
	<i>Serratella</i>		1	2
Caenidae	<i>Caenis</i>		1	
Leptophlebiidae	Juvenile/damaged	5	1	
	<i>Leptophlebia</i>	1	2	3
Odonata				
Gomphidae	Juvenile/damaged		2	
Aeshnidae	<i>Boyeria</i>			1
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged		1	
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>		1	2
Leuctridae	Juvenile/damaged		1	
	<i>Leuctra</i>			
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>	1		
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged			

Appendix 6 cont'd. Benthic macroinvertebrates from Jackpine River, Ontario, 2008.				
		Jackpine R	Jackpine R	Jackpine R
		JP-1-1	JP-1-2	JP-1-3
		Riffle	Pool	Riffle
		21-Sep	21-Sep	21-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliphus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged			
	<i>Dubiraphia</i>			
	<i>Optioservus</i>	1		
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa			1
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			1
	<i>Chimarra</i>			
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile	1	1	2
	<i>Cheumatopsyche</i>			
	<i>Hydropsyche</i>	11		1
Rhyacophilidae	<i>Rhyacophila</i>			1
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>		1	
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>			
Lepidostomatidae	<i>Lepidostoma</i>	10	9	16
Limnephilidae	Juvenile/damaged		2	
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>	1	1	
	<i>Mystacides</i>		1	
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>		10	
Chironomidae		63	57	40
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>			
	<i>Hexatoma</i>		1	3
	<i>Tipula</i>			
Empididae	Juvenile/pupa			
	<i>Chelifera</i>			
	<i>Hemerodromia</i>	2		6
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		124	116	124
% Sorted		3.4	5.6	11.3

Appendix 7. Benthic macroinvertebrates from Blind Creek, Ontario, 2008.				
		Blind Ck	Blind Ck	Blind Ck
		BC-1-1	BC-1-2	BC-1-3
		Riffle	Pool	Riffle
		17-Sep	17-Sep	17-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA			1	1
MOLLUSCA				
Gastropoda				
Ancylidae				
Hydrobiidae				
Lymnaeidae			1	
Physidae				
Planorbidae		2	3	
Valvatidae				
Bivalvia				
Sphaeriidae				
ANNELIDA				
Oligochaeta		12	2	9
Hirudinea			1	
ARTHROPODA				
Hydracarina		4	1	2
Amphipoda				
Hyalellidae	<i>Hyalella</i>	2	6	
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged	4	21	5
	<i>Acentrella</i>	3		4
	<i>Baetis</i>	2	2	1
Heptageniidae	Juvenile/damaged	11		4
	<i>Leucrocuta</i>	1		
	<i>Rhithrogena</i>			
	<i>Stenonema</i>	4		1
Ephemerellidae	Juvenile/damaged			1
	<i>Attenella</i>		6	3
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s. str.)			
	<i>Serratella</i>			
Caenidae	<i>Caenis</i>		2	
Leptophlebiidae	Juvenile/damaged	10	23	1
	<i>Leptophlebia</i>	2	25	2
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>	1		
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged			
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>	4		2
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>			
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>			
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged	1		6

Appendix 7 cont'd. Benthic macroinvertebrates from Blind Creek, Ontario, 2008.				
		Blind Ck	Blind Ck	Blind Ck
		BC-1-1	BC-1-2	BC-1-3
		Riffle	Pool	Riffle
		17-Sep	17-Sep	17-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliphus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged	4		3
	<i>Dubiraphia</i>			
	<i>Optioservus</i>	5		3
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa			
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			10
	<i>Chimarra</i>			1
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile			1
	<i>Cheumatopsyche</i>			2
	<i>Hydropsyche</i>			11
Rhyacophilidae	<i>Rhyacophila</i>			
Glossosomatidae	<i>Glossosoma</i>	3		3
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>	1		
Lepidostomatidae	<i>Lepidostoma</i>		1	
Limnephilidae	Juvenile/damaged			
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>	3		
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>		3	
Chironomidae		22	40	26
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>			
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa			1
	<i>Chelifera</i>			
	<i>Hemerodromia</i>			
Tabanidae	<i>Chrysops</i>			
Phoridae		1		1
Total number of individuals		102	138	104
% Sorted		13.5	3.4	16.9

Appendix 8. Benthic macroinvertebrates from Current River, Ontario, 2008.				
		Current River	Current River	Current River
		CU-14-1	CU-14-2	CU-14-3
		Riffle	Pool	Riffle
		18-Sep	18-Sep	18-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA		5		2
MOLLUSCA				
Gastropoda				
Ancylidae		1	1	
Hydrobiidae			4	
Lymnaeidae				
Physidae				
Planorbidae			10	1
Valvatidae				
Bivalvia				
Sphaeriidae		18	2	29
ANNELIDA				
Oligochaeta		6	2	2
Hirudinea				
ARTHROPODA				
Hydracarina		5		3
Amphipoda				
Hyalellidae	<i>Hyalella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged		1	1
	<i>Acentrella</i>			
	<i>Baetis</i>			
Heptageniidae	Juvenile/damaged	3		3
	<i>Leucrocuta</i>			
	<i>Rhithrogena</i>			
	<i>Stenonema</i>			
Ephemerellidae	Juvenile/damaged	7	2	1
	<i>Attenella</i>	5		4
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s. str.)	4	4	3
	<i>Serratella</i>	6		
Caenidae	<i>Caenis</i>		1	
Leptophlebiidae	Juvenile/damaged	5	5	4
	<i>Leptophlebia</i>	1	3	1
Odonata				
Gomphidae	Juvenile/damaged	2	2	
Aeshnidae	<i>Boyeria</i>			1
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged	1		
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>	5	1	4
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>	2		
Capniidae	<i>Paracapnia</i>		1	
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>	1		1
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged			

Appendix 8 cont'd. Benthic macroinvertebrates from Current River, Ontario, 2008.				
		Current River	Current River	Current River
		CU-14-1	CU-14-2	CU-14-3
		Riffle	Pool	Riffle
		18-Sep	18-Sep	18-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliplus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged	1	1	3
	<i>Dubiraphia</i>			
	<i>Optioservus</i>			5
	<i>Stenelmis</i>	1		
Trichoptera	Juvenile/damaged/ Pupa			
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			
	<i>Chimarra</i>	4		3
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile	3		6
	<i>Cheumatopsyche</i>			
	<i>Hydropsyche</i>	2		
Rhyacophilidae	<i>Rhyacophila</i>			
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			1
	<i>Ithytrichia</i>	2	2	
	<i>Oxyethira</i>	4	4	1
Lepidostomatidae	<i>Lepidostoma</i>	1		
Limnephilidae	Juvenile/damaged			
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>	6		
	<i>Mystacides</i>		5	1
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>	4		
Chironomidae		59	50	26
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>	1		
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa			
	<i>Chelifera</i>			
	<i>Hemerodromia</i>	12		5
Tabanidae	<i>Chrysops</i>			
Phoridae				
Total number of individuals		177	101	111
% Sorted		2.3	1.1	4.5

Appendix 9. Benthic macroinvertebrates from McVicar Creek (Urban), Ontario, 2008.				
		McVicar Urban	McVicar Urban	McVicar Urban
		MVU-1-1	MVU-1-2	MVU-1-3
		Pool	Riffle	Riffle
		15-Sep	15-Sep	15-Sep
COELENTERATA				
PLATYHELMINTHES			1	
NEMATODA		2	1	4
MOLLUSCA				
Gastropoda				
Ancylidae		4		
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae		1		2
Valvatidae				
Bivalvia				
Sphaeriidae		2		
ANNELIDA				
Oligochaeta		34	48	51
Hirudinea				
ARTHROPODA				
Hydracarina		10	3	6
Amphipoda				
Hyalellidae	<i>Hyalella</i>			
Gammaridae	<i>Gammarus</i>			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	<i>Caecidotea</i>			
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged			1
	<i>Acentrella</i>			
	<i>Baetis</i>	2	1	6
Heptageniidae	Juvenile/damaged	1		3
	<i>Leucrocuta</i>			1
	<i>Rhithrogena</i>			
	<i>Stenonema</i>	2	1	1
Ephemerellidae	Juvenile/damaged			
	<i>Attenella</i>			
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s str.)			
	<i>Serratella</i>			
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged	3		1
	<i>Leptophlebia</i>			
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>			
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged		9	
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>			4
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>			
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>			
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged			

Appendix 9 cont'd. Benthic macroinvertebrates from McVicar Creek (Urban), Ontario, 2008.				
		McVicar Urban	McVicar Urban	McVicar Urban
		MVU-1-1	MVU-1-2	MVU-1-3
		Pool	Riffle	Riffle
		15-Sep	15-Sep	15-Sep
Hemiptera				
Corixidae	Juvenile/damaged			
Coleoptera				
Haliplidae	<i>Haliphus</i>			
Dytiscidae				
Elmidae	Juvenile/damaged	1		
	<i>Dubiraphia</i>			1
	<i>Optioservus</i>		1	2
	<i>Stenelmis</i>			1
Trichoptera	Juvenile/damaged/ Pupa		1	
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			
	<i>Chimarra</i>			
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile		6	3
	<i>Cheumatopsyche</i>	1	3	1
	<i>Hydropsyche</i>		9	2
Rhyacophilidae	<i>Rhyacophila</i>	3	2	
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>			
Lepidostomatidae	<i>Lepidostoma</i>	1	1	1
Limnephilidae	Juvenile/damaged		1	
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>	3		
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>			
Chironomidae		32	14	8
Tipulidae	Juvenile/damaged		1	1
	<i>Antocha</i>	1		
	<i>Dicronata</i>	1		
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa			
	<i>Chelifera</i>			
	<i>Hemerodromia</i>			
Tabanidae	<i>Chrysops</i>			
Phoridae		1		
Total number of individuals		105	103	100
% Sorted		18.0	11.3	20.3

Appendix 10. Benthic macroinvertebrates from McVicar Creek Test, Ontario, 2008.				
		McVicar Test	McVicar Test	McVicar Test
		MVT-1-1	MVT-1-2	MVT-1-3
		Pool	Riffle	Riffle
		15-Sep	15-Sep	15-Sep
COELENTERATA				
PLATYHELMINTHES				
NEMATODA			3	1
MOLLUSCA				
Gastropoda				
Ancylidae		1	1	1
Hydrobiidae				
Lymnaeidae				
Physidae		3		
Planorbidae				1
Valvatidae				1
Bivalvia				
Sphaeriidae		1		
ANNELIDA				
Oligochaeta		7	46	54
Hirudinea				
ARTHROPODA				
Hydracarina			3	7
Amphipoda				
Hyalellidae	<i>Hyalella</i>			
Gammaridae	<i>Gammarus</i>	38	21	
Decapoda				
Cambaridae			1	
Isopoda				
Asellidae	<i>Caecidotea</i>	7	14	2
Insecta				
Ephemeroptera	Juvenile			
Baetidae	Juvenile/damaged			5
	<i>Acentrella</i>			
	<i>Baetis</i>			3
Heptageniidae	Juvenile/damaged			4
	<i>Leucrocuta</i>		1	
	<i>Rhithrogena</i>			
	<i>Stenonema</i>		4	4
Ephemerellidae	Juvenile/damaged			
	<i>Attenella</i>			1
	<i>Ephemerella</i>			
	<i>Eurylophella</i> (s. str.)			
	<i>Serratella</i>			
Caenidae	<i>Caenis</i>			
Leptophlebiidae	Juvenile/damaged	2		1
	<i>Leptophlebia</i>	4		1
Odonata				
Gomphidae	Juvenile/damaged			
Aeshnidae	<i>Boyeria</i>			
Corduliidae	Juvenile			
Plecoptera	Juvenile/damaged			
Nemouridae	Juvenile/damaged			
	<i>Nemoura</i>		2	4
Leuctridae	Juvenile/damaged			
	<i>Leuctra</i>		1	
Capniidae	<i>Paracapnia</i>			
Perlidae	Juvenile/damaged			
	<i>Acroneuria</i>			
	<i>Claassenia</i>			
Perlodidae	Juvenile/damaged		1	1

Appendix 10 cont'd. Benthic macroinvertebrates from McVicar Creek Test, Ontario, 2008.				
		McVicar Test	McVicar Test	McVicar Test
		MVT-1-1	MVT-1-2	MVT-1-3
		Pool	Riffle	Riffle
		15-Sep	15-Sep	15-Sep
Hemiptera				
Corixidae	Juvenile/damaged	10		
Coleoptera				
Haliplidae	<i>Haliphus</i>	1		
Dytiscidae		1		
Elmidae	Juvenile/damaged			2
	<i>Dubiraphia</i>			
	<i>Optioservus</i>		1	1
	<i>Stenelmis</i>			
Trichoptera	Juvenile/damaged/ Pupa		2	
Philopotamidae	Pupa			
	<i>Dolophilodes</i>			
	<i>Chimarra</i>			
Polycentropodidae	<i>Neureclipsis</i>			
	<i>Polycentropus</i>			
Hydropsychidae	Juvenile			
	<i>Cheumatopsyche</i>			1
	<i>Hydropsyche</i>			1
Rhyacophilidae	<i>Rhyacophila</i>	1	4	4
Glossosomatidae	<i>Glossosoma</i>			
Hydroptilidae	<i>Hydroptila</i>			
	<i>Ithytrichia</i>			
	<i>Oxyethira</i>			
Lepidostomatidae	<i>Lepidostoma</i>			
Limnephilidae	Juvenile/damaged		1	
Leptoceridae	Juvenile/damaged			
	<i>Ceraclea</i>			
	<i>Mystacides</i>	1	1	
Diptera	Damaged/pupa			
Ceratopogonidae	<i>Dasyhelea</i>			
	<i>Probezzia</i>			
Chironomidae		25	19	13
Tipulidae	Juvenile/damaged			
	<i>Antocha</i>		1	
	<i>Dicronata</i>			
	<i>Hexatoma</i>			
	<i>Tipula</i>			
Empididae	Juvenile/pupa			
	<i>Chelifera</i>			
	<i>Hemerodromia</i>			
Tabanidae	<i>Chrysops</i>			1
Phoridae				
Total number of individuals		102	127	114
% Sorted		5.6	5.6	12.4