Appendix G.2

Benthic Invertebrate Species in Freshwater Surber Samples
- Fifteen Mile Stream,
Envirosphere Consultants Limited

BENTHIC INVERTEBRATE SPECIES COMPOSITION IN FRESHWATER SURBER SAMPLES— FIFTEEN MILE STREAM

Lab Number: L2018-77

February 2019

Report to:

McCallum Environmental Ltd., Bedford, Nova Scotia

Prepared by:

Envirosphere Consultants Limited
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BENTHIC INVERTEBRATE SPECIES COMPOSITION IN
FRESHWATER SURBER SAMPLES—FIFTEEN MILE STREAM
for
McCallum Environmental Ltd., Bedford, Nova Scotia

FEBRUARY 2019

INTRODUCTION

McCallum Environmental Ltd. personnel collected freshwater benthic invertebrate samples from eighteen sample stations, from October 5 – 23, 2018. Samples were preserved in 70% Isopropyl alcohol; and subsequently shipped

to Envirosphere Consultants Limited, Windsor, Nova Scotia, for sorting, identification and enumeration of benthic invertebrates. Samples were received on October 30, 2018. The results of the analysis are presented in this report.

METHODS

SIEVING OF WHOLE SEDIMENTS

Aquatic benthic invertebrate samples from the streambed were collected using a Surber sampler (30.5 x 30.5 cm). The sediment samples were provided preserved (70% Isopropyl alcohol) in large Ziploc bags. Prior to sorting, samples were rinsed on an 0.5 mm sieve to remove preservative. All samples were processed at 100% with the exception of sites FIA 2.3, 3.2, 3.3 and 4.1, which were sub-sampled.

SUB-SAMPLING OF WHOLE SAMPLES

Sub-sampling ensures efficient processing time and selection of adequate numbers of organisms for analysis (i.e. 300+ organisms). Depending on the sample volume and the expected number of organisms present, samples designated for sub-sampling are manually divided to give equal portions, which are specific fractions of the original sample (e.g. 1/2). All fractions produced during sub-sampling are weighed and verified to be equivalent (i.e. within 0.5 to 1.0 g). Final counts and biomass for the sub-samples are extrapolated to 100%, based on the sub-sample percentage. Sub-sampling can affect measures of animal abundance and biomass by increasing variability, and may lead to slightly reduced estimates of taxon richness compared to whole samples.

SORTING AND IDENTIFICATION

Samples were examined at 6 - 6.4x magnification on a stereomicroscope, with a final brief check at 16x and all organisms were removed. Removal efficiency for lab personnel is checked by resorting 10% of samples to ensure a sorting efficiency of 90% or better (see Attachment 1). Organisms were subsequently stored in labeled vials in 70% Isopropyl alcohol. Wet weight biomass (grams per sample) was estimated by weighing animals to the nearest milligram at the time of sorting, after blotting to remove surface water.

Organisms were identified to an appropriate taxonomic level, typically to genus, using conventional literature for the groups involved (see Attachment 2). Organisms were identified by Heather Levy (B.Sc. Hons.) and verified by Valerie Kendall (M.Env.Sc.) of Envirosphere Consultants Ltd. Abundance of each

taxonomic group, number of taxanomic groups (taxa richness), and wet weight biomass were estimated from the data.

RESULTS AND DISCUSSION

Sample descriptions for samples, as received, are presented in Table 1. Identifications, abundance, taxon richness, and biomass measures are presented in Table 2. Abundance, taxon richness and biomass are expressed on a per sample basis.

Samples from FIA sites contained freshwater animals with major organism groups represented, primarily Diptera (midgefly larvae (Chironomidae and Ceratopogonidae)), Ephemeroptera (mayfly larvae), Trichoptera (caddisfly larvae), Coleoptera (aquatic beetles) and Oligochaetes (aquatic worms) were most numerous. Minor numbers of other groups such as Plecoptera (stonefly larvae), Collembola (springtails), Hemiptera (aphids), Lepidoptera (moth and butterfly larvae), Megaloptera (alderfly and dobsonfly larvae), Odonata (dragonfly and damselfly larvae), Hydrachnidia (water mites), other Diptera (Athericidae, Dolichopodidae, Empididae, Simuliidae and Tipulidae) and Mollusca (bivalves Pisidiidae; gastropods *Planorbula, Physa* and *Ferrissia*). Communities had a low to high diversity of organisms (8 –33 taxa per sample); low to high abundances (759 – 16,786 individuals per metre squared); and low to high biomasses (0.56 – 26.1 grams per metre squared) (Table 2).

Samples from Antidam sites 1 to 6 contained few animals. Oligochaetes and midgefly larvae (Chironomidae) were most numerous and present at five and three of six sites, respectively. Mollusca (bivalves) and Ephemeroptera (mayfly larvae) were present at only one of the six sites. Communities had a low diversity of organisms (1 – 3 taxa per sample); low abundances (11 – 495 individuals per metre squared); and low biomasses (<0.01 – 0.21 grams per metre squared) (Table 2).

Limiting Conditions

The quality of the results presented in this report are dependent both on our analysis, and on the quality of samples as provided to Envirosphere Consultants Limited by the client. The analyses are based on practices normally accepted in the analysis of marine and freshwater benthic invertebrate samples, and with suitable controls for quality assurance. No other warranty is made.

Table 1. Characteristics of samples, McCallum Environmental Ltd., Fifteen Mile Stream, October 5 – 23, 2018.	
FIA 1.1	Fines with organic matter (moss and leaf debris).
FIA 1.2	Fine-grained sand with organic matter (detritus, leaf, woody and grass debris).
FIA 1.3	Coarse to medium-grained sand with silt and organic debris (roots, woody and plant).
FIA 2.1	Coarse to fine sand with silt and organic matter (grass and woody debris).
FIA 2.2	Fines and organic matter (woody, leaf and detritus).
FIA 2.3	Fines with organic matter (leaf and root debris).
FIA 3.1	Coarse to fine gravel with sand and woody debris. Bits of glass refuse were also in the sample.
FIA 3.2	Silt with organic matter (plant and woody debris).
FIA 3.3	Fines with organic matter (leaf and plant debris).
FIA 4.1	Organic matter (grasses, roots, algae, leaf and woody debris).
FIA 4.2	Fines with organic matter (plant, algae and woody debris).
FIA 4.3	Fines with organic matter (leaf, plant and woody debris).
Antidam 1	Fines with detritus, grass and woody debris.
Antidam 2	Organic matter (detritus and woody debris).
Antidam 3	Fines with organic matter (grass, needles and plant debris).
Antidam 4	Silt with organic matter (woody and plant debris).
Antidam 5	Fine with fine to medium-grained sand, as well as organic matter (grass and needle debris).
Antidam 6	Fines and coarse to medium-grained sand with organic matter (woody and plant debris).
Grain size classes: cobble = 6.4 cm and larger; pebble/ gravel = 4 mm to 6.4 cm; sand = 0.063 mm to 2 mm; silt = 0.004 mm to 0.063 mm; clay = <0.004 mm.	

Table 2. Abundance of benthic organisms in sediments from Fifteen Mile Stream, October 5 - 23, 2018.

				Raw Numbers																
Date Sampled				October 5 - 23, 2018																
Phylum & Class	Order	Family	*Genus & Species*	FIA			FIA			FIA			FIA			Antidam					
				1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	1	2	3	4	5	6
Arthropoda Insecta																					
	Diptera																				
		Athericidae																			
			Atherix	0	11	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ceratopogonidae		0	77	77	1419	22	220	11	88	66	132	253	77	0	0	0	0	0	0
		Chironomidae*		2002	88	3322	561	2376	2728	1859	10098	8096	12540	1287	561	0	0	11	55	0	11
		Dolichopodidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
		Empididae																			
			Hemerodromia	22	902	33	11	11	132	0	0	22	0	0	0	0	0	0	0	0	0
		Simuliidae*		0	22	11	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0
		Tipulidae																			
			Antocha	55	165	0	0	44	0	0	0	0	0	0	0	0	0	0	0	0	0
			Limnophila?	0	0	11	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
			Tipula	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0
			Unidentified	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ephemeroptera																				
		Baetidae		0	22	44	0	0	0	0	22	176	0	0	0	0	0	0	0	0	0
		Caenidae																			
			Caenis	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ephemerellidae																			
			Eurylophella	33	231	44	0	33	0	176	528	506	0	0	0	0	0	0	0	0	0
		Heptegeniidae																			
			Maccaffertium	110	583	0	0	363	0	11	66	88	0	0	0	0	0	0	0	0	0
			Unidentified	0	286	0	0	44	176	22	308	0	0	0	0	0	0	0	0	0	0
		Leptophlebiidae																			
			Leptophlebia	22	66	33	0	0	0	33	22	0	0	0	0	0	0	0	0	0	0
			Unidentified	187	869	55	0	33	44	121	396	418	132	11	11	0	0	0	0	0	0
		Unidentified		0	0	22	11	583	0	0	0	0	0	0	0	0	0	0	0	11	0
	Plecoptera																				
	Unidentified (juveniles)			0	33	11	0	33	0	22	792	88	88	11	0	0	0	0	0	0	0
	Trichoptera																				
		Brachycentridae																			
			Brachycentrus	44	55	0	0	44	88	11	286	374	0	0	0	0	0	0	0	0	0
		Dipseudopsidae																			
			Phylocentropus	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Helicopsychidae																			
			Helicopsyche	0	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hydropsychidae																			

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				1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	1	2	3	4	5	6
			Cheumatopsyche	0	0	0	0	88	0	0	0	0	0	0	0	0	0	0	0	0	0
			Hydropsyche	33	528	33	0	1628	572	22	462	44	0	0	0	0	0	0	0	0	0
		Hydroptilidae																			
			Ochrotrichia?	66	220	99	55	11	44	11	286	44	0	0	0	0	0	0	0	0	0
			Oxyethira	33	0	99	0	77	396	88	88	110	308	22	11	0	0	0	0	0	0
		Leptoceridae																			
			Mystacides	11	0	11	11	0	0	0	0	22	0	0	0	0	0	0	0	0	0
			Oecetis	44	33	0	0	143	176	55	176	308	0	0	0	0	0	0	0	0	0
		Limnephilidae																			
			Sp A	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
		Philopotamidae																			
			Chimarra	0	11	0	11	561	132	0	0	0	0	0	0	0	0	0	0	0	0
		Phryganidae																			
			Ptilostomis	0	0	0	0	0	0	0	0	0	0	11	11	0	0	0	0	0	0
			Unidentified	0	0	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	0
		Polycentropodidae																			
			Cyrnellus?	110	187	11	0	88	704	0	44	44	0	0	11	0	0	0	0	0	0
			Neureclipsis	0	0	0	0	132	88	0	0	0	0	0	0	0	0	0	0	0	0
			Nyctiophylax	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Polycentropus	33	55	11	0	253	88	11	594	110	88	198	11	0	0	0	0	0	0
			unidentified	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
		Rhyacophilidae																			
			Rhyacophila	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pupae		0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
		Unidentified		0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
	Coleoptera																				
		Dytiscidae																			
			Potamonectes	0	0	0	0	0	0	0	0	0	0	44	11	0	0	0	0	0	0
		Elmidae																			
			Adult	242	0	0	22	407	440	22	242	132	0	0	0	0	0	0	0	0	0
			Promoresia	1144	858	0	0	693	3960	99	1672	2618	0	0	0	0	0	0	0	0	0
			Stenelmis	33	99	0	0	33	88	165	88	660	0	0	0	0	0	0	0	0	0
		Unidentified		11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Collembola																				
		Isotomoidea		0	11	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
	Hemiptera																				
		Aphididae		0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lepidoptera																				

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				1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	1	2	3	4	5	6
			Sp A	0	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	0	0
	Megaloptera																				
		Corydalidae																			
			Nigronia	44	11	0	0	22	44	0	88	0	0	0	0	0	0	0	0	0	0
		Sialidae																			
			Sialis	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Odonata																				
		Aeshnidae																			
			Boyeria	0	0	0	11	0	0	0	0	0	0	11	11	0	0	0	0	0	0
		Calopterygidae																			
			Calopteryx	0	0	0	0	0	44	33	88	88	0	0	0	0	0	0	0	0	0
		Coengrionidae		0	0	0	0	44	0	0	22	0	0	11	0	0	0	0	0	0	0
		Corduliidea																			
			Tetragoneuria	0	0	0	0	0	0	0	0	22	0	0	22	0	0	0	0	0	0
		Gomphidae																			
			Hagenius	0	0	0	0	11	0	0	0	44	0	0	0	0	0	0	0	0	0
			Gomphus	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0
			Stylogomphus?	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0
			Nymph	0	0	0	0	0	0	44	22	0	0	0	0	0	0	0	0	0	0
		Unidentified		0	0	0	11	0	0	0	0	0	0	11	0	0	0	0	0	0	0
Athropoda Archnida																					
	Trombidiformes																				
		Hydrachnidae																			
			Sp A	33	22	33	33	22	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp B	22	99	0	0	0	0	0	44	22	0	0	0	0	0	0	0	0	0
			Sp C	0	33	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
			Sp D	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp E	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp F	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp G	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp H	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp I	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Sp J	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0
Mollusca Bivalvia																					
	Veneroida																				
		Pisidiidae		11	66	11	0	22	0	0	22	22	0	0	0	0	0	0	11	0	0
Mollusca Gastropoda																					
	Basommatophora																				

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				1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	1	2	3	4	5	6
		Ancylidae																			
			Ferrissia (limpet)	0	0	0	0	0	0	55	88	176	0	0	11	0	0	0	0	0	0
		Planorbidae																			
			Planorbula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Physidae																			
			Physa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida Clitellata																					
	Aquatic Worms (Oligochaeta)																				
				33	374	33	0	0	132	132	154	88	44	704	11	121	22	0	11	99	451
SUMMARY																					
Abundance #/m^2				4433	6171	4059	2233	7865	10307	3113	16786	14454	13376	2607	759	121	22	11	77	110	495
Taxa Richness				27	33	24	13	31	21	27	27	29	8	15	12	1	1	1	3	2	3
Biomass (grams/m^2)				3.70	5.35	0.66	0.56	26.1	11.2	2.38	10.3	13.7	4.46	1.8	8.07	0.05	0.01	<0.01	0.21	0.01	0.13
Excluded and Non-aquatic Taxa (not included in analyses).																					
Cladocera				0	0	0	0	0	0	66	0	286	0	TNTC	165	0	0	0	0	0	0
Copepoda				0	0	0	11	0	0	0	0	0	0	132	0	0	0	0	0	0	0
Diptera adult				0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homoptera (cast)				0	11	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0
Odonata (cast)				0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
Ostracod				0	0	0	0	0	176	0	0	0	0	0	0	0	0	0	0	0	0
*Larvae and pupae stages are combined.																					

ATTACHMENT 1 – SORTING EFFICIENCY

Envirosphere CONSULTANTS LIMITED

Sorting Efficiency Report

Client Name/Address:

Sample Information: Fifteen Mile Stream L2018-77

Sorted by: Jay Baker
Checked by: Heather Levy
Approved by: HL

Date: January - February 2019
Date Checked: February 9, 2019
Date: Feb. 11/19

SAMPLE NUMBER	STATED NUMBER OF ORGANISMS (A)	NUMBER OF ADDITIONAL ORGANISMS FOUND (B)	SORTING EFFICIENCY (%) (A/(A+B)) X 100	SORTED BY (Initials)
1. Antidon 6 100%	45	3	93.8%	
2. FIA 3 2 50%	763	33	95.9%	
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Comments:

M:\myfiles\ENVIROSPHERE Benthic Lab\QA_QC forms\Sorting Efficiency Report Form\Sorting Efficiency Report Form.docx

ATTACHMENT 2 – TAXONOMIC LITERATURE

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