

## MACROINVERTEBRATES

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### Analysis and Results

#### *Between sub-basins*

Finding differences in macroinvertebrate composition between sub-basins will give us an idea if aquatic communities vary across the watershed. This information can be further examined to find out exactly where problem areas exist and how aquatic communities respond to varying water quality and habitat parameters.

To assess the significance of differences in taxa richness and macroinvertebrate composition measures between sub-basins, we used one-way ANOVAs (Analysis of Variance). Significance was assessed at the  $\alpha = 0.05$  level. We found no significant differences between sub-basins for % Diptera (F-value= 1.89, p-value = 0.076), but we did find significant differences between sub-basins for percent EPT (F-value= 2.59, p-value = 0.017).

Significant differences between sub-basins were further assessed by comparing each sub-basin to the entire watershed. We did this to determine if any of the sub-basins stood out as potential problem areas compared to what was typical of the watershed. To test if sub-basin means were different from the overall mean, we compared 95% confidence intervals. First, we calculated the overall mean and 95% confidence interval (denoted by two numbers in parenthesis following the mean) for each parameter using all the data for the entire watershed. If the sub-basin mean did not fall within the overall 95% confidence interval, there is significant difference at the  $\alpha = 0.05$  level (Table 2). These analyses give us a good picture of which sub-basins are outliers compared to what was typically observed for the whole watershed.

**Table 2:** Mean percent EPT and percent Diptera values for each sub-basin. These values were compared to the mean and 95% confidence intervals for the entire French Creek watershed. Bolded values are significantly different from the overall mean at the  $\alpha = 0.05$  significance level.

Sub-basin	% EPT	% Diptera
Conneaut Outlet	<b>77</b>	<b>11</b>
Conneauttee Creek	<b>33</b>	21
Cussewago Creek	52	<b>28</b>
French Creek	67	<b>10</b>
Le Boeuf Creek	<b>28</b>	<b>50</b>
Little Sugar Creek	<b>37</b>	<b>26</b>
Muddy Creek	<b>65</b>	17
South Branch French Creek	<b>70</b>	17
Sugar Creek	<b>70</b>	17
West Branch French Creek	<b>25</b>	<b>15</b>
Woodcock Creek	54	<b>26</b>

French Creek Watershed mean	55	20
French Creek Watershed 95% CI	(48, 61)	(16,24)

The mean % EPT taxa across all sites was 55% (49, 61) and the mean % Diptera was 20% (16,24). West Branch French Creek, Le Boeuf Creek, Conneauttee Creek, and Little Sugar Creek sub-basins all fell significantly below the overall mean EPT percentage. Conneaut Outlet had the highest mean percent EPT (77%) of all the sub-basins followed by South Branch (70%), Sugar Creek (70%), and Muddy Creek (65%). Sub-basins with significantly higher percent Diptera than the watershed mean were Le Boeuf Creek, Cussewago, Woodcock, and Little Sugar Creek.

### *Microhabitat sampling*

Most of our sampling was done in riffles ( $n_{\text{riffle}}=104$ ) and runs ( $n_{\text{run}}=76$ ), and less in near bank vegetation ( $n_{\text{veg}}=28$ ), woody debris ( $n_{\text{wood}}=25$ ) and pools ( $n_{\text{pool}}=12$ ). We ran a one-way ANOVA to determine if there was a significant difference of percent EPT between microhabitat types. We found a significant difference in percent EPT for different sampled microhabitats (F-value = 4.71, p-value = 0.001). Mean % EPT for each microhabitat sampled were 43.7% (35.5, 51.9) in near bank vegetation, 35.0% (17.3, 52.6) in pools, 59.2% in riffles (54.4, 64.0), 50.3 % (44.5,56.1) in run and 45.7%(33.3, 58.1) in woody debris. We ran a similar one-way ANOVA to determine if there was a significant difference of percent Diptera between microhabitat types and found no significant differences (F-value =1.94, p-value = 0.104).

### *Sub-sampled sites*

Results from the 19 sub-sampled sites for genus level macroinvertebrate identification are shown in Table 3. The mean taxa richness at the family level is 17 (15.6, 18.3) and 21(19.3, 22.8) at the genus level. Since the number of macroinvertebrates identified at the 19 sites ranged from 82 to 240, we wanted to ensure there were no correlations between the numbers identified and the richness measures. Results of regression analysis show no significant relationships between the number of macroinvertebrates identified to the genus family richness (p-value = 0.268).

We used ANOVAs to assess the differences in taxa richness and macroinvertebrate composition measures between the 19 sub-sampled sites. Results are reported in Table 4. We found significant differences between sites for percent Plecoptera, percent Tricoptera on order level data. For genus level data, there were significant differences between sites for number of Plecoptera and number of EPT taxa.

We found significant differences between sites for percent Plecoptera, percent Tricoptera on order level data. Sites with particularly low percent Plecoptera are sites 33 and 40 in French Creek (confluences with West Branch French Creek and Le Boeuf Creek), mouth of Little Sugar Creek (site 41), Trout Run (site 23) on Le Boeuf Creek, mouth of Cussewago Creek (site 47), and site 49 on Conneauttee Creek. Sites with particularly low percent Tricoptera are Trout Run and East Branch Le Boeuf Creek (sites 23 and 24) in Le Boeuf Creek, and Gravel Run (site 18) in French Creek.

**Table 3:** Summary of macroinvertebrate data that was identified to genus level (19sites). Subsets of 82-212 individuals from each sample were identified. G=generic level.

Macro Site Number	Site Name	Sub-Basin	Total Number ID'd	HBI	Taxa Richness-G	% Ephemeroptera	% Plecoptera	% Tricoptera	% EPT	% Diptera	% Chironomidae	No. Ephemeroptera Taxa-G	No. Plecoptera Taxa-G	No. Tricoptera Taxa-G	No. EPT Taxa-G
1	West Branch Sugar	Sugar	204	3.68	26	0.26	0.37	0.10	0.72	0.21	0.12	7	8	8	23
6	East Branch Muddy	Muddy	203	4.64	23	0.23	0.20	0.12	0.54	0.24	0.20	8	5	6	19
8	Beatty Run	Sugar	212	4.04	24	0.39	0.17	0.11	0.61	0.15	0.12	10	4	5	19
10	Patchell Run	French Creek	82	3.70	16	0.57	0.04	0.26	0.8	0.07	0.06	6	2	4	12
12	North Deer Creek	French Creek	184	4.26	28	0.42	0.19	0.07	0.66	0.25	0.14	9	2	10	21
15	Inlet Run	Conneaut French	207	3.01	16	0.20	0.56	0.13	0.76	0.06	0.04	9	3	3	15
18	Gravel Run	French Creek	203	6.29	21	0.26	0.03	0.03	0.32	0.31	0.21	7	3	3	13
20	Little Conneauttee	Conneauttee	202	5.41	21	0.39	0.11	0.05	0.41	0.19	0.19	12	4	3	19
23	Trout Run	Le Boeuf	204	8.55	12	0.02	0.02	0	0.06	0.72	0.71	3	1	1	5
24	East Branch Le Boeuf	Le Boeuf	199	7.64	20	0.11	0.08	0.03	0.17	0.55	0.54	4	3	4	11
25	West Branch FC	West Branch	199	5.92	18	0.17	0.02	0.09	0.16	0.19	0.19	5	1	4	10
29	Woodcock Creek	Woodcock South	203	6.50	21	0.17	0.07	0.09	0.22	0.34	0.32	6	4	3	13
30	Slaughter Run	Branch	228	4.98	21	0.46	0.03	0.06	0.50	0.13	0.12	11	1	4	16
33	French Creek at West Branch	French Creek	211	4.69	24	0.16	0.01	0.17	0.33	0.06	0.03	8	3	6	17
36	Mouth French Creek	French Creek	175	4.47	21	0.48	0.04	0.22	0.67	0.13	0.13	10	2	6	18
40	French Creek at Le Boeuf	French Creek	240	4.18	21	0.48	0	0.06	0.55	0.04	0.03	7	1	5	13
41	Mouth Little Sugar	Little Sugar	221	4.32	22	0.49	0	0.29	0.79	0.07	0.06	6	1	4	11
47	Mouth Cussewago	Cussewago	201	5.89	21	0.41	0.01	0.36	0.79	0.1	0.09	4	1	6	11
49	Conneauttee	Conneauttee	213	5.41	24	0.03	0.01	0.26	0.35	0.15	0.09	4	2	5	11

**Table 4:** Results of ANOVAs comparing site means of macroinvertebrate metrics. Significant (p-value <0.05) results are in bold type.

Parameter	F value	p-value
% EPT	.207	0.655
% Diptera	1.89	0.076
HBI	1.10	0.308
Genus Taxa Richness	0.04	0.850
% Ephemeroptera	0.00	0.965
<b>% Plecoptera</b>	<b>10.60</b>	<b>0.005</b>
<b>% Tricoptera</b>	<b>4.85</b>	<b>0.042</b>
% Chironomidae	0.21	0.602
<b>No. Plecoptera -Genus Level</b>	<b>12.70</b>	<b>0.002</b>
No. Ephemeroptera–Genus Level	1.99	0.175
No. Tricoptera –Genus Level	1.99	0.176
<b>No. EPT –Genus Level</b>	<b>6.06</b>	<b>0.025</b>

For genus level data, there were significant differences between sites for number of Plecoptera and number of EPT taxa. West Branch Sugar Creek (site 1) in Sugar Creek sub-basin had particularly high number of Plecoptera taxa compared to the other sites. The number of EPT taxa was particularly low at Trout Run (site 23) on Le Boeuf Creek and high at West Branch Sugar Creek. Trout Run (site 23) on Le Boeuf Creek has the lowest number of EPT taxa (5).

The mean HBI score for the 19 sites was 5.14 (4.46, 5.81). Inlet Run (site 15) in Conneaut Outlet sub-basin had the lowest HBI score (3.01) followed by the 2 sites in Sugar Creek sub-basin and Patchell Run (site 10) in French Creek sub-basin. The two sites on Le Boeuf Creek had the highest HBI values (8.6 and 7.6), followed by Woodcock Creek, Gravel Run (site 18) in French Creek and the mouth of Cussewago Creek.

The two sites in Le Boeuf sub-basin had particularly high percentages of Diptera (72% and 55%). Most of these Diptera are part of the family Chironomidae. The overall mean % Chironomidae was 18% (9, 26). The two sites in Le Boeuf sub-basin had particularly high percentages of Chironomidae (71% and 54%).

### Discussion of Results

Several studies have shown that certain macroinvertebrate metrics either increase or decrease (become impaired) with perturbation (e.g. Barbour et al. 1994, Barbour et al. 1996, DeShon 1995, Fore et al. 1996, Smith and Voshell 1997). By knowing how certain macroinvertebrates respond to water quality, we can begin to make statements about habitat and water quality at particular sites.

Later in this report, we analyze the relationships between macroinvertebrate metrics and water quality, land-use and habitat parameters. Macroinvertebrate responses to impairment of these parameters will be compared to established indices. We will then be able to better describe trends we see in the macroinvertebrate data. For instance, if we show that number of EPT taxa decrease with increased sedimentation; we can relate levels of sedimentation at a particular site with number of EPT taxa.