Macroinvertebrate Investigation of the West Branch Lackawaxen River
EV Attainment Study

Apr-05

Introduction:

Macroinvertebrates were collected at two sites on the West Branch Lackawaxen River, near Creamton, Wayne County, on April 16, 2005. This collection event was a follow up to collections performed in April and October of 2000. Data from those investigations indicated that the river supports a diverse community of macroinvertebrates at sites sampled between the source at Belmont Lake and the most downstream site at Baird's Pool. Water temperature, dissolved oxygen, pH, conductivity and alkalinity measurements further reflected the relatively unimpacted, natural condition of the river.

The purpose of this investigation was to compare the current data to previous collection events, and to use the data to determine if the river meets criteria, based on macroinvertebrate indicators, to attain Exceptional Value (EV) status, when compared to an EV reference stream. To attain an EV classification, the percent comparison of the West Branch Lackawaxen River to the reference must be equal to or greater than 92%. Procedures for determining EV attainability are set forth in the Pennsylvania Department of Environmental Protection's *Water Quality Antidegradation Implementation Guidance* (2003).

Methods:

Field collections, lab procedures and subsequent data analysis for this investigation, followed the above referenced publication. Macroinvertebrates were collected using a D-frame net in riffle and run habitats. A total of six kick samples were collected at each site, three from each habitat, and composited into one sample jar. Samples were preserved with 70% ethanol and returned to the lab for analysis. Physical characteristics, water temperature, dissolved oxygen (DO), pH, conductivity and alkalinity were measured in-stream at each site. A Habitat Assessment form, taken from the antidegradation publication, was also completed. Macroinvertebrate collections, physical and chemical measurements and the habitat assessment were performed in much the same way as those conducted during previous investigations, except that during previous macroinvertebrate collections, four kick samples were taken and composited at each site, instead of the six required by the antidegradation guidance.

The data used to determine EV status is based on a 200-count subsample of all the invertebrates collected from a site. All organisms were first picked from each sample, identified, and placed in a shallow pan. A 200-count subsample was then randomly picked, organisms were identified, and data necessary to determine EV attainment was generated.

Results:

Data generated from the identification of all macroinvertebrates collected from each site include the following items, presented in TABLE 1:

a. A complete list of all the macroinvertebrates collected at each site, identified primarily to genus and in some instances species.

b. An indication of each organisms relative abundance, where **R**are = 0-3 organisms found, **C**ommon = 4-10, **A**bundant = 11-50, and **D**ominant =>50.

c. Each organism's Hilsenhoff Score (HS), a pollution tolerance value, ranging from 0-10, with 0 indicating that an organism is extremely sensitive to pollution and 10 indicating a pollution tolerant organism. The Hilsenhoff scores have been modified to reflect the behavior of taxa found in Pennsylvania, and were provided by PA DEP.

d. Common names of individual organisms.

Data generated as a result of the 200-count subsample were used to calculate the following biotic metrics, which are present in TABLES 2A & 2B:

a. Taxa richness – the total number of different organisms

b. Modified EPT richness – the number of organisms found within the Orders **E**phemeroptera (mayflies), **P**lectoptera (stoneflies), and **T**richoptera (caddisflies), minus a few select EPT organisms considered pollution tolerant. EPT organisms are usually considered pollution sensitive and their abundance is generally a direct reflection of the water and habitat quality conditions found at a site.

c. Modified Hilsenhoff Index – an index that reflects macroinvertebrate tolerance to organic pollution. Based on the individual Hilsenhoff scores assigned to each organism from the 200-count subsample.

d. Percent Dominant Taxa – the percent of the total abundance made up by the single most abundant taxa. Higher percentages indicate that a macroinvertebrate community is dominated by one type of organism, generally reflecting that water or habitat quality has been impacted.

e. Percent Modified Mayflies – the percent of the total abundance made up by the total abundance of mayflies, minus pollution tolerant mayfly taxa.

The calculated values of these biotic metrics are then compared to metric values from a reference stream. This comparison analysis is shown in TABLE 3. See Appendix A in the *Antidegradation Guidance* document for more information on the analysis procedures for determining EV attainment.

Physical and chemical conditions measured in the field at the time of this investigation are summarized in TABLE 4. Values measured during the October 2000 macroinvertebrate sampling event, and a water quality monitoring event on June 9, 2001, are included for comparison purposes.

TABLE 1

Order	Genus/species	Abundance Mead's Bridge	Abundance Corner Pool	HS	Common Name
EPT's					
Ephemeroptera	*Baetis tricaudatus*	D	A	6	Blue-winged Olive
	Ephemerella subvaria	D	D	1	Hendrickson
	Epeorus pleuralis	D	D	0	Quill Gordon
	Isonychia bicolor	C	A	3	Isonychia
	Paraleptophlebia adoptia	A	A	1	Blue Quill
	Stenonema vicarium	C	A	3	March Brown

Plecoptera	*Acroneuria abnormis*	R	A	0	Brown/yellow stonefly
	Agnetina capitata	R	A	2	Brown/yellow stonefly
	Isoperla	A	D	2	Little yellow stonefly
	Leuctra	R	R	0	Tiny Late Winter Black Stonefly
	Paragnetina media	-	R	1	Brown/yellow stonefly
	Pteronarcys	-	R	0	Large Black stonefly
	Strophopteryx	A	C	3	Early Brown Stonefly
	Sweltsa	R	R	0	Yellow Sally
	Tallaperla	-	R	0	Yellow Roachfly
Trichoptera	*Cheumatopsyche*	-	R	6	Little Sister Sedge
	Dolophilodes	R	R	0	Medium Evening Sedge
	Hydropsyche	A	D	5	Spotted Sedge
	Lepidostoma	R	R	1	Little Plain Brown Sedge
	Neophylax	R	C	3	Autumn Mottled Sedge
	Psilotreta	-	R	0	Dark Blue Sedge
	Pycnopsyche	R	-	4	Great Brown Autumn Sedge
	Rhyacophila	C	C	1	Green Sedge
Non-EPT's					
Megaloptera	*Nigronia*	-	C	2	Fishfly
Coleoptera	*Optioservus* larvae	R	C	4	Riffle Beetle
	Promoresia	-	R	2	Riffle Beetle
	Psephenus	-	C	4	Water Penny
Odonata	*Lanthus*	-	R	5	Clubtail Dragonfly
Diptera	*Antocha*	R	R	3	Crane fly
	Atherix	-	R	2	Snipe fly
	Chironomidae	A	A	6	Midge
	Dicranota	R	-	3	Crane fly
	Hexatoma	C	A	2	Crane fly
	Prosimulium	A	A	2	Black fly
	Tipula	C	-	4	Crane fly
Bivalvia	*Pisidium*	R	-	8	Fingernail clam
Oligochaeta		R	R	10	Aquatic worm

TABLE 2A

Results of 200-count subsample from Mead's Bridge

TAXA		Mead's Bridge (Rte. 247)	HS	# org. X HS
MAYFLIES				
Baetidae	***Baetis***	20	6	120
Ephemerellidae	***Ephemerella***	31	1	31
Heptageniidae	***Epeorus***	97	0	0
	Stenonema	2	3	6
Leptophlebiidae	***Paraleptophlebia***	9	1	9
Oligonuriidae	***Isonychia***	4	3	12
STONEFLIES				
Chloroperlidae	***Sweltsa***	1	0	0
Leuctridae	***Leuctra***	1	0	0
Perlidae	***Agnetina***	2	2	4
Perlodidae	***Isoperla***	5	2	10
Taeniopterygidae	***Strophopteryx***	4	3	12
CADDISFLIES				
Hydropsychidae	***Hydropsyche***	5	5	25
Limnephilidae	***Pycnopsyche***	1	4	4
TRUE FLIES				
Chironomidae	***sp.***	10	6	60
Simuliidae	***Prosimulium***	10	2	20
Tipulidae	***Dicranota***	1	3	3
	Hexatoma	1	2	2
	Tipula	1	4	4
NON-INSECT TAXA				
Oligochaeta	***sp.***	1	10	10
			SUM =	332
Subsample Size		206		
Taxa Richness		19		
Modified EPT		11		
Modified HBI = 332/206		1.61		
% Dominant Taxa		47.1		
Modified % Mayfly		69.4		

TABLE 2B

Results of 200-count subsample from Corner Pool

TAXA		Corner Pool	HS	# org. X HS
MAYFLIES				
Baetidae	***Baetis***	6	6	36
Ephemerellidae	***Ephemerella***	56	1	56
Heptageniidae	***Epeorus***	42	0	0
	Stenonema	5	3	15
Leptophlebiidae	***Paraleptophlebia***	10	1	10
Oligonuriidae	***Isonychia***	9	3	27
STONEFLIES				
Chloroperlidae	***Sweltsa***	3	0	0
Leuctridae	***Leuctra***	1	0	0
Perlidae	***Acroneura***	3	0	0
	Agnetina	2	2	4
	Paragnetina	1	1	1
Perlodidae	***Isoperla***	36	2	72
Taeniopterygidae	***Strophopteryx***	8	3	24
CADDISFLIES				
Hydropsychidae	***Hydropsyche***	12	5	60
Philopotamidae	***Dolophilodes***	1	0	0
Rhyacophilidae	***Rhyacophila***	1	1	1
Uenoidae	***Neophylax***	1	3	3
TRUE FLIES				
Chironomidae	***sp.***	6	6	36
Simuliidae	***Prosimulium***	6	2	12
Tipulidae	***Hexatoma***	6	3	18
BEETLES				
Psepheniade	***Psephenus***	2	4	8
MEGALOPTERA				
Coryduliidae	***Nigronia***	2	2	4
NON-INSECT TAXA				
Oligochaeta	***sp.***	1	10	10
			SUM =	397
Subsample Size		220		
Taxa Richness		23		
Modified EPT		15		
Modified HBI = 397/220		1.8		
% Dominant Taxa		25.4		
Modified % Mayfly		55.4		

TABLE 3

Biological Condition Scoring Comparisons
West Branch Lackawaxen River, Wayne County, April 16, 2005

METRIC	Candidate Site Mead's Bridge	Candidate Site Corner Pool	Reference Site
[1]TAXA RICHNESS	19	23	31
Cand/Ref (%)	61	74	
Biol. Cond. Score	1	5	8
[2]MOD. EPT INDEX	11	15	15
Cand/Ref (%)	73	100	
Biol. Cond. Score	6	8	8
[3]MOD. HBI	1.61	1.8	3.13
Cand-Ref	-1.52	-1.33	
Biol. Cond. Score	8	8	8
[4]% DOMINANT TAXA	47.1	25.4	19.4
Cand-Ref	27.7	6	
Biol. Cond. Score	0	8	8
[5]% MOD. MAYFLIES	69.4	55.4	22.7
Ref-Cand	-46.7	-32.7	
Biol. Cond. Score	8	8	8
TOTAL BIOLOGICAL CONDITION SCORE	23	37	40
% COMPARABILITY TO REFERENCE	**58**	**93**	**N/A**

NOTE: Reference EV stream is Wild Creek, Carbon County

TABLE 3B

%Comparison of Candidate Score to Reference Score	Stream Classification Category
>=92%	EV
83-92%	HQ
<83%	Existing use or designated use (Non-HQ or EV)

TABLE 4

Water Quality Data

16-Apr-05 9-Jun-01 7-Oct-00	Corner Pool	Mead's Bridge
Water Temperature (ºF)	**47.5** 57 50	**43.3** 57.6 50
Dissolved Oxygen (mg/L)	**10.5** 9.4 10.7	**11.2** 9.8 10.9
pH	**6.9** 7.6 7.6	**7** 7.8 7.9
Conductivity (µS/cs)	**48** 65 67	**57** 77 77
Alkalinity (mg/L as $CaCO_3$)	**9.2** 37 28	**11.8** 35 30
Total Hardness (mg/L as $CaCO_3$)	**20**	**20.8**

Note: Water quality criteria values (PA Code Title 25, Chapter 93.7)
For High Quality Cold Water Fisheries (HQ-CWF) Streams such as the West Branch Lackawaxen

Water Temperature – maximum of 52ºF between April 16-30
Dissolved Oxygen – minimum of 7.0 mg/L

Results Discussion:

Macroinvertebrate Community Comparisons

Same site on different sampling dates (Oct. 2000 vs. April 2005)

Mead's Bridge

A total of 27 taxa were collected at Mead's Bridge during both the 2000 and 2005 sampling events. During this year's collection event, 18 pollution tolerant EPT taxa were collected, compared to 16 in 2000. The biggest difference between the macroinvertebrate communities between the two sampling events was that a greater diversity and numbers of caddisflies were found during the 2000 event, in contrast to greater mayfly and stonefly diversity and numbers for this most recent sampling. A decreased caddisfly presence this spring could be attributed to the two major flood events that occurred in October 2004 and April 2005. Large caddisfly species appear to be especially vulnerable to displacement and elimination during flood events; such organisms were common during the 2000 collection. The caddisfly community will most likely experience a quick recovery, as remnant populations complete life cycles and new generations begin to appear. Non-EPT(generally pollution tolerant) taxa composition remained relatively unchanged between sampling events. A few different organisms were present during this sampling that were not collected in 2000, and visa versa. These differences can generally be attributed to individual life cycles; some organisms are more abundant during the spring, while some are more abundant during the fall.

Corner Pool

A total of 33 taxa were collected at Corner Pool during this year's sampling event; 20 were collected in 2000. The difference in diversity can be attributed to a significant increase in the amount of pollution tolerant EPT taxa that were collected; 22 during this most recent event, compared to 12 during the fall 2000 event. The most significant increase occurred in the number of stonefly taxa that were collected; 9 in 2005 vs. 4 in 2000. Based on this data, there has been a significant increase in the amount of pollution sensitive taxa that comprise the macroinvertebrate community at this site. Even with the severe flood events that recently occurred, diversity at this site was much higher than was observed in 2000. One reason for this increase could be that the increased amount of kicks taken during this recent sampling event resulted in the collection of a more diverse community. Five of the nine stonefly taxa collected had a Rare occurrence, and may have been missed in the 2000 sampling event, when less kick samples were collected.

Between sites on same sampling date (Mead's vs Corner Pool)

A total of 6 more taxa were collected at Corner Pool than Mead's Bridge. This is not a very significant amount; the difference can be primarily attributed to greater pollution tolerant EPT diversity at Corner Pool (22 vs 18 taxa). The macroinvertebrate community composition at the two sites are comparable.

EV Attainment Determination

The 200-count subsample comparisons between the candidate sites (Mead's Bridge and Corner Pool) to the reference site (Wild Creek), indicates that the Corner Pool data attained a **93%** comparison to the reference site, and thus **attains the required > or =92% for EV designation** (see Table 3B).

Mead's Bridge attained only 58% compared to the reference data. The most significant shortfall for this site was the relatively low Taxa Richness value (19 vs 31) and the high dominance of one organism in the subsample (47.1% vs 19.4%). Nearly half (13 of 27) of the taxa collected from the Mead's Bridge site were Rare, increasing the chance that they would not be selected in the 200-count subsample, and thus reducing the likelihood of attaining a higher Taxa Richness value for the subsample. In addition, the mayfly taxa *Epeorus* accounted for nearly one-half of the subsample, reflecting its Dominant occurrence in the overall sample from that site and decreasing the likelihood of additional taxa being selected for the subsample. Finally only two of the six caddisfly taxa collected from the site were selected for the subsample; four of the six taxa had a Rare occurrence in the overall sample.

Water Quality Conditions

All of the measurements recorded in TABLE 4 for this sampling event fall within normal ranges and indicate that physical and chemical conditions of the stream are generally unimpacted by the surrounding watershed. The lower pH and alkalinity values that were recorded during this sampling event are normal for the time of year that this data was collected and temperature and DO values both fall within normal ranges for streams designated as High Quality Cold Water Fisheries

Summary Conclusions:

The macroinvertebrate communities at the Corner Pool and Mead's Bridge sites continue to support a diverse composition of organisms, consisting primarily of pollution sensitive EPT taxa. An increase in the number of kick samples collected at each site, performed in order to follow DEP protocols for stream redesignation, revealed additional EPT taxa that were not collected in the 2000 sampling event. Though caddisfly taxa appear to have been depressed due to recent flood events, an increase in the amount of stonefly taxa was recorded, and made up for decreased caddisfly abundance. The composition at both sites most likely reflects macroinvertebrate commmunities that develop unimpeded by the surrounding watershed and in-stream water and habitat quality.

Based on the data collected at the Corner Pool, the West Branch Lackawaxen River does attain EV designation within the Club's waters. The site attained a 93% comparison to reference site data, surpassing the 92% required for EV status. Generally waters **upstream** of the site where the sampling occurred could be reclassified. A future sampling at the more downstream Mead's Bridge site could very likely reveal EV status as well; this site's macroinvertebrate community seems to have been more depressed by the flood event, which would be reflected in the community composition that was collected.