Benthic Macroinvertebrate Collections and Identifications within 8 Streams of the Bonne Femme Watershed.

A Final Report to the Boone County Watershed Coordinator

April 26, 2006

Prepared by Kathy E. Doisy

Introduction

The Bonne Femme Watershed Project is a 4-year, EPA-funded initiative sponsored by Boone County, Missouri. Partners in the project include the Boone County Commission, City of Columbia, City of Ashland, Missouri Department of Conservation, Missouri Department of Natural Resources, Boone County Soil and Water Conservation District, University of Missouri, USDA-Agricultural Research Service, Chouteau Grotto, and the Friends of Rock Bridge.

The main objective of this project is to maintain long-term water quality within the Bonne Femme watershed using watershed planning as a tool to manage growth and prevent further watershed degradation. This report addresses a small portion of the project goals in relation to the monitoring of streams within the watershed with the use of biological criteria.

The 1972 Amendments to the Federal Water Pollution Control Act and the Clean Water Act of 1987 changed the concept of water quality management in the United States. Management efforts shifted from simply determining what goes into a particular water body, to a more integrated approach that addresses the needs of the aquatic community. This new goal of "ecological integrity" refers to a system that has the capability of supporting and maintaining a balanced, integrated and adaptive community that has good diversity and resiliency. In other words, it is a system that can withstand an assault and recover. This requires more than just good water quality. Research by Judy et al. (1984) and others (Karr et al. 1985) has shown that halting the chemical degradation of water doesn't assure the restoration of its ecological or biological integrity. Changes in the energy source, habitat structure or flow regime can also profoundly affect the aquatic communities (Karr et al. 1986).

This change in focus has also resulted in a change in monitoring technology. Classical water quality monitoring was done using physical and/or chemical parameters. This was problematic because these data only provide information about the conditions that exist at the time of sampling. Most current monitoring programs have added a third component known as "biological monitoring" or "biomonitoring." This is the systematic use of biological responses (called "metrics") to evaluate changes in the environment. Biological impairment of the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa, dominance by any particular taxon combined with low overall taxon richness, or appreciable shifts in community composition

relative to the reference condition (Plafkin et al. 1989). These data can provide an indication of the cumulative effects of conditions changing over time.

For this study, the biological data presented herein will serve as a baseline data set to help researchers assess how stream health of the Bonne Femme watershed has changed over time, and help evaluate the effectiveness of the watershed planning and cost-share program.

Site locations

The GPS locations of the 8 sites that are the focus of this study are reported in Table 1. Macroinvertebrate samples were taken according to MDNR protocol starting at the lower end of the reach and moving upstream to prevent disturbance of the habitats to be sampled. Site 1 indicates the first or lower end of the reach (Table 1). It should be noted that Rock Bridge Creek, was included in these collections despite the expectation that its macroinvertebrate community would not be comparable to the other sites. The flow of this site comes up to the surface just a few feet upstream of the collection site from a cave. Localities with this type of "karst" topography are areas where the surface and groundwater are integrally connected. Unlike groundwater that is filtered through dense soil layers, groundwater in karst systems often moves rapidly to underground channels that fail to provide the effective natural filtration and absorption that characterizes other systems. As a result, these waters often contain contaminants and pollutants not found in groundwater. For these reasons this site was included in the collections due to its value as a sentinel site of possible perturbations in that area.

Table 1. X, Y coordinates for the upper and lower ends of the sample reaches. The X, Y numbers are in the following projection: feet with X= east, Y = north in reference to the fixed point NAD 1983 State Plane Missouri Central FIPS 2402 Feet.

Location	Site 1 X	Site 1 Y	Site 6 X	Site 6 Y
Bass Creek	1701103.43375	1092750.87158	1701853.96909	1092273.08773
Bonne Femme at 63 highway	1709216.18352	1107780.41314	1709668.54104	1108180.25056
Bonne Femme at Nashville Church	1689737.01449	1088629.47664	1690268.43553	1089049.75344
Clear Creek	1689772.42773	1108887.20800	1690132.94993	1109087.20387
Fox Hollow	1681833.83088	1077074.31629	1681832.91073	1076844.38539
Gans Creek	1690451.56558	1107722.12855	1691230.81796	1107527.09812
Rock Bridge Creek	1689788.13216	1106103.73720	--	--
Turkey Creek	1700157.08049	1092885.08328	1700149.22058	1093341.86078

Methods

The coarse flow habitats of 8 reaches of streams of interest within the Bonne Femme watershed were sampled according to MDNR protocol (Semi-Quantitative Macroinvertebrate Stream Bioassessment, June 20, 2003) from 28 March to 13 April, 2006. Modifications to the MDNR laboratory sorting protocol (MDNR-WQMS-209) were submitted to the MDNR project manager and approved prior to collections (see Appendix A). All identifications were made to the lowest possible level. Species identifications are reported for two genera, *Perlesta* and *Rhyacophila,* which are only reported to the genus level according to MDNR protocol. This information was included since it may prove of value in future investigations. However for this report, those sites with more than one species of these genera are restricted to a count of one to compare with the detection coefficients developed by the Missouri Department of Natural Resources Environmental Services Program.

As indicated in Appendix A, biomonitoring for this project has been limited to surveillance of the EPT [Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies)] taxa, three orders of (generally) pollution-intolerant benthic insects. Although a multi-metric approach is used by the MDNR (Biological Criteria for Wadeable/Perennial Streams of Missouri, February 2002), the EPT richness metric has been reported in multiple studies to be a highly sensitive indicator of a variety of stream perturbations (Barbour et al. 1992, Wallace et. al. 1996, Rabeni et al. 1997). The EPT richness metric measures the species richness (number of taxa) of the aforementioned orders, providing a consistent, quantifiable biometric of stream health.

Results and Discussion

MDNR has published baseline or “reference” biocriteria for each of the ecological drainage units (EDU) within the state for either spring or fall collections (Missouri Biocriteria Wadeable/Perennial stream 25th Percentile and Bisection Values, 10 January 2006). The intended uses of these biological criteria as stated by MDNR include: the establishment of regional attainment goals within Missouri that are relevant to aquatic communities and protect the resource, establishing a scientific benchmark or baseline for monitoring the effectiveness of best management practices and restoration efforts, and to allow a baseline for evaluating the status of waterways and any changes over time. These baseline data, to which other streams may be compared, were developed by MDNR from multiple samplings of streams within each EDU. Reference conditions are represented by values that fall above the 25th percentile for the EPT richness metric. For details on the methodology see the Biological Criteria for Wadeable/Perennial Streams of Missouri, February 2002.

The current EPT richness metric reference data for warm water streams within the Ozark/Moreau/Loutre drainages sampled between 15 March and 15 April are 13 for the 25th percentile and 6 for the bisection (50th percentile) value. Since this study is based on a single metric out of the four metrics suggested by the MDNR, these results can not be considered the final statement regarding stream

conditions. However, examination of the single metric may allow for tentative conclusions about stream conditions. Streams with metric values higher than the 25th percentile may be considered fully biologically supporting, values equal to or less than the 25th percentile and greater than or equal to the bisection are partially biologically supporting, while values below the bisection indicate streams that should be considered non-biologically supporting.

Results of the sampling are reported in Table 2. For the 7 streams (excluding Rock Bridge Creek) the EPT richness metric ranged from 6 – 11 taxa. None of the sampled sites appear to be in reference (fully biologically supporting) condition, although all of them are equal to or above the bisection value for this area. The site with the highest EPT richness was Bass Creek, while the site with the lowest was the Bonne Femme at Highway 63. All the sites, excluding Rock Bridge, had at least one species of each order. Although the exact sampling locations are unknown, a previous study (early May 2001) of coarse flow habitat of some of these streams by the Community Storm Water Project found higher EPT richness values for Turkey (13) and Gans (11) creeks. There was no difference in EPT richness for Bass Creek, while the 2001 collections in Clear Creek found one less species.

Although abundance data were not part of this study, it should be noted that both Clear Creek and Gans Creek had exceptionally low numbers of specimens as compared to the other sites despite comparable collecting methods. Reductions in abundance may indicate chronic impact(s).

Another aspect of these data is the sensitivity of the collected taxa. Certain species from these collections are considered more sensitive to pollutants than others. These taxa include all the stoneflies, and the caddisflies *Chimarra, Polycentropus,* and *Rhyacophila*. In this regard, Turkey Creek scores the highest or best with 7 of these more sensitive taxa, followed by Bass Creek and Bonne Femme (at Nashville Church) with 6, and Fox Hollow with 5.

The collections from Rock Bridge Creek had only one relatively tolerant caddisfly, *Cheumatopsyche*. Since there are no previously reported collections from this location no assessment of conditions can be made at this time.

Literature Cited

Barbour, M.T., J.L. Plafkin, B.P. Bradley, C.G. Graves, and R.W. Wisseman. 1992. The evaluation of EPA's rapid bioassessment benthic metrics: metric redundancy and variability among reference stream sites. Environmental Toxicology and Chemistry. 11:437-449.

Judy, R.D., Jr., P.N. Seeley, T.M. Murray, S.C. Svirsky, M.R. Whitworth, and L.S. Ischinger. 1984. 1982 National Fisheries Survey. Vol. 1. Technical Resport: Initial Findings. U.S. Fish and Wildlife Service. FWS/OBS-84/06.

Karr, J.R., R.C. Heidinger, and E.H. Helmer. 1985. Effects of chlorine and ammonia from wastewater treatment facilities on biotic integrity. Journal Water Pollution Control Federation 57:912-915.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: a Method and Its

Rationale. Illinois Natural History Survey Special Publication 5, Champaign, IL.
Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R. M. Hughes. 1989. Rapid Bioassessment Protocols for use in streams and rivers: benthic macroinvertebrates and fish. EPA/444/4-89-001, Office of water Regulations and Standards, U.S. Environmental Protection Agency, Washington, DC.
Rabeni, C. F., R. J. Sarver, N. Wang, G. S. Wallace, M. Weiland, and J. T. Peterson. 1997. Development of regionally based biological criteria for Missouri. Final Report to the Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, Missouri 65102.
Wallace, J. B., J. W. Grubaugh, and M. R. Whiles. 1996. Biotic Indices and Stream Ecosystem Processes - Results from an Experimental Study. Ecological Applications 6(1):140-151.

Table 2. Presence/absence of EPT taxa at the eight sites, spring 2006 collections. Presence is indicated by a "1". An asterisk also indicates presence but these were not included in the taxa count since MDNR does not identify to the species level for the indicated genera.

		Bass Creek	Bonne Femme at 63 Highway	Bonne Femme at Nashville Church	Clear Creek	Fox Hollow	Gans Creek	Rock Bridge Creek	Turkey Creek
	TAXA IDENTIFIED	3/29/2006	4/4/2005	4/5/2006	4/3/2006	4/5/2006	3/28/2006	4/13/2005	3/29/2006
CODES	Number of mayfly taxa	3	2	3	4	3	4	0	3
from MDNR	Number of plecoptera taxa	3	2	4	1	3	1	0	4
	Number of trichoptera taxa	5	2	3	4	3	3	1	3
	EPT richness	**11**	**6**	**10**	**9**	**9**	**8**	**1**	**10**
	Ephemeroptera								
	Baetidae								
1040	*Acerpenna*				1		1		
	Heptageniidae								
1240	*Stenacron interpunctatum*	1		1	1	1	1		1
1263	*Stenonema femoratum*	1	1	1	1	1	1		1
	Caenidae								
1444	*Caenis latipennis*	1	1	1	1	1	1		1
	Plecoptera								
	Nemouridae								
3200	*Amphinemura*			1		1			1
	Perlidae								
3590	*Perlesta cintipes*			*					
3590	*Perlesta fusca*	1	1	1	1	1	1		1
3621	*Perlinella drymo*								1
	Perlodidae								
3690	*Isoperla mohri*	1		1		1			1
3438	Chloroperlidae		1						
3460	*Haploperla brevis*	1		1					
	Trichoptera								
	Hydropsychidae								
5130	*Cheumatopsyche*	1	1	1	1	1	1	1	
5160	*Hydropsyche*	1							
	Polycentropidae								
5090	*Polycentropus*	1			1	1	1		1
	Philopotamidae								
5030	*Chimarra*	1		1	1				1
	Rhyacophilidae								
5240	*Rhyacophila fenestra*	1	1	1	1	1	1		1
5240	*Rhyacophila lobifera*	*	*				*		*

Modifications to the Missouri Department of Natural Resources Semi-Quantitative Macroinvertebrate Stream Bioassessment (SOP#8) of the QUALITY ASSURANCE PROJECT PLAN FOR WATER QUALITY MONITORING IN BONNE FEMME WATERSHED

Prepared by Kathy E. Doisy
for the Boone County Watershed Conservationist, Terry Frueh.

The following change will be made to the MDNR Semi-Quantitative Macroinvertebrate Stream Bioassessment (June 20, 2003) under section 3.0 Laboratory Processing of Samples:

The protocol for this project has been limited to riffle samples of 8 streams within the Bonne Femme watershed. In addition, metric calculations were limited to the EPT richness metric. Due to monetary constraints and the lack of interest in metrics related to abundance, field collected samples were not sub-sampled as indicated in the MDNR protocol. Instead, each field sample was transferred with two tap water rinses from its container to a large enamel pan to facilitate removal of aliquots. Aliquots (approximately 100 mL) were placed in a 500 um sieve to drain preservative then immersed in the sieve in a pan of tap water for approximately 15 minutes to rehydrate invertebrates. The aliquot was then drained and transferred to a white plastic examination pan where the macroinvertebrates were separated from debris and sediment using a sugar floatation procedure described by Anderson (1959). A second aliquot was then rinsed in the sieve and soaked in tap water while the first was being examined. Floating EPT invertebrates in the examination pan were removed and stored in a solution of 70% ethyl alcohol. Each aliquot was remixed and refloated repeatedly in the examination pan with the sugar solution until no additional EPT specimens were found in a complete scan of the pan surface under 1.75X magnification. Debris and non-EPT invertebrates were then discarded, the pan rinsed in tap water and the next aliquot, rinsed transferred to the examination pan, floated and examined. The procedure was continued until the entire original sample had been rehydrated, rinsed, floated and examined. In the transfer of the final aliquot, contents of the mixing bowl and sieve were rinsed and examined to insure no invertebrates missed being examined. This method ought to closely replicate the large and rare search method used by MDNR allowing the comparison of these EPT richness results with those all ready in place by MDNR.

Anderson, R. O., 1959. A modified floatation technique for sorting bottom fauna samples. Limnology and Oceanography 4: 223–225.