

2012 Monitoring Summary



Mulberry Fork at Cullman County Road 47 (34.08669/-86.69739)

BACKGROUND

The Mulberry Fork drainage encompasses 2,366 mi² in north central Alabama, spanning five counties—Blount, Cullman, Winston, Walker, and Jefferson. The variety of distinct habitats within this river system has produced very diverse biological communities. The upper Mulberry Fork, above the Broglen River, provides habitat for a diverse fish community. Twenty-seven fish species have been identified in the upper reaches of the river. However, diversity diminishes downstream in the lower Mulberry Fork.

During 2011 and 2012, the Alabama Department of Conservation and Natural Resources (ADCNR) conducted a survey of aquatic snails in the Black Warrior River basin. Surveys were conducted at twelve sites in the Mulberry Fork drainage, six of which were on the mainstem of the river. Four of those six sites yielded results with only pulmonates found at the site, no snails collected, or habitat too poor to sample. Five different species of snails were identified in Mulberry Fork.

A 38 mile stretch of the Mulberry Fork, from Marriott Creek near I-65 in Cullman County upstream to Blount County Road 6 near Brooksville, has been on Alabama's Clean Water Act (CWA) §303(d) list of impaired waters since 1998. It was listed for nutrients and siltation/habitat alteration from agricultural, industrial, and municipal sources.

The Alabama Department of Environmental Management (ADEM) conducted an intensive survey of the Mulberry Fork watershed in 2012. The objective of the survey was to collect data to develop nutrient and siltation Total Maximum Daily Loads (TMDLs) for the impaired segments. Ten stations on the mainstem of Mulberry Fork were sampled in 2012 (Figure 1). Macroinvertebrate assessments were conducted at three of these locations. Parameters included monthly in-situ measurements, flow, and water samples for lab analysis. Additionally, collection of composite samples from major point sources, time-of-travel (TOT) analyses, and 72-hour surveys of dissolved oxygen, temperature, pH, and conductivity were conducted at seven of the ten sites in June and September. The purpose of this report is to summarize the results of the macroinvertebrate assessment conducted at MBFB-7.

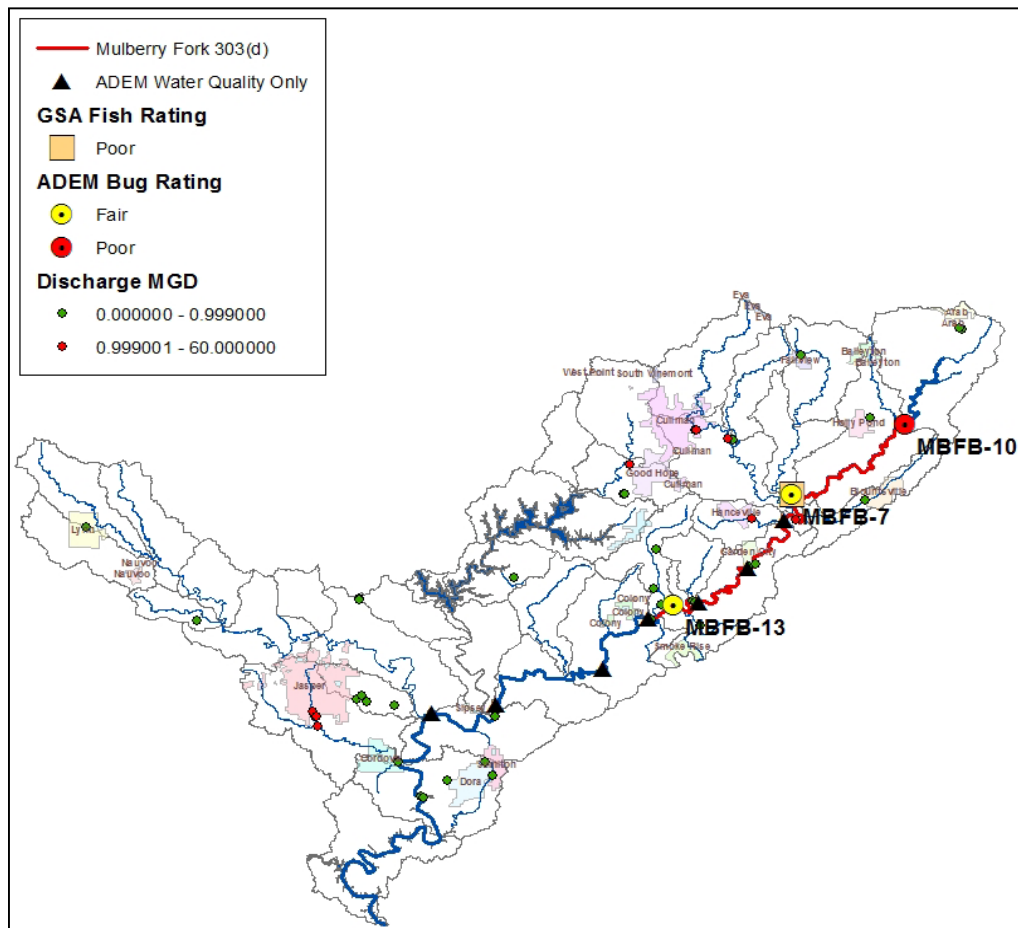


Figure 1. The locations of the sampling stations on the mainstem of Mulberry Fork. The 303(d) listed segments of Mulberry Fork are shown in red. Results of a fish IBI survey conducted by the Geological Survey of Alabama (GSA) and macroinvertebrate bioassessments conducted by ADEM are also shown (modified from ADEM Water Quality).

WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. Mulberry Fork at MBFB-7 is classified as a *Fish & Wildlife (F&W)* stream located in Cullman County. Based on the 2006 National Land Cover Dataset, landuse within the watershed is predominantly pasture land with some forest (27%) (Figure 2). About eight percent of the area is developed. As of June 6, 2013, a total of 15 NPDES permits have been issued in the watershed, most of which are construction storm-water permits.

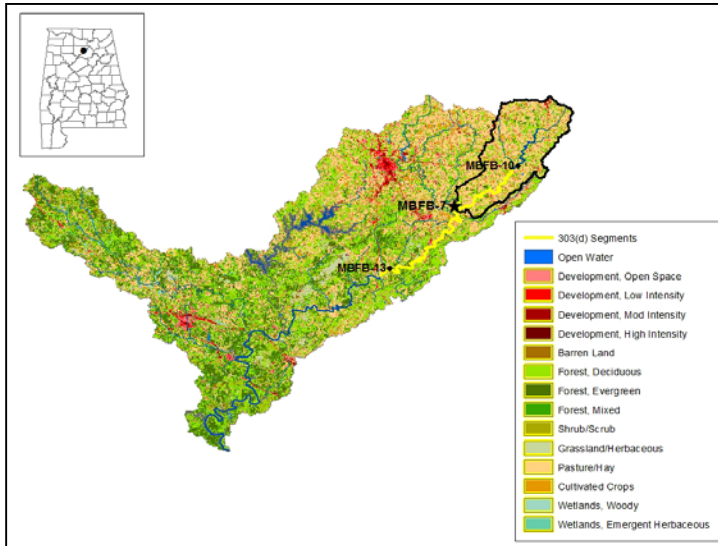


Figure 2. Sampling locations and landuse within the Mulberry Fork watershed. The 303(d) listed segments of the Mulberry Fork are shown in yellow.

REACH CHARACTERISTICS

General observations (Table 2) and a habitat assessment (Table 3) were completed during the macroinvertebrate assessment. In comparison with reference reaches in the same ecoregion, they give an indication of the physical condition of the site and the quality and availability of habitat. Mulberry Fork at MBFB-7 is a glide-pool stream located in the Southern Table Plateaus (68d) ecoregion (Figure 3). Benthic substrate consists primarily of sand. Overall habitat quality was rated as *marginal* for supporting biological communities due to poor instream habitat quality and poor channel sinuosity.



Figure 3. Mulberry Fork at MBFB-7, June 19, 2012.

Table 1. Summary of watershed characteristics.

Watershed Characteristics		Black Warrior River
Basin		
Drainage Area (mi²)		129
Ecoregion^a		68d
Ichthyoregion^b		PLA
% Landuse		
Open water		<1
Wetland	Woody	<1
	Emergent herbaceous	<1
Forest	Deciduous	19
	Evergreen	3
	Mixed	5
Shrub/scrub		5
Grassland/herbaceous		2
Pasture/hay		51
Cultivated crops		7
Development	Open space	5
	Low intensity	2
	Moderate intensity	1
	High intensity	<1
Barren		<1
Population/km^{2c}		38
# NPDES Permits^d	TOTAL	15
	Construction Stormwater	8
	Industrial General	6
	Industrial Individual	1

a. Southern Table Plateaus

b. Plateau

c. 2000 US Census

d. #NPDES permits downloaded from ADEM's NPDES Management System database, June 6, 2013.

Table 2. Physical characteristics of Mulberry Fork at MBFB-7, October 24, 2012.

Physical Characteristics	
Width (ft)	60
Canopy Cover	Mostly Open
Depth (ft)	
	Run 1.5
	Pool 3.5
% of Reach	
	Run 15
	Pool 85
% Substrate	
	Bedrock 10
	Boulder 3
	Cobble 3
	Gravel 9
	Sand 60
	Silt 5
	Organic Matter 10

PERIPHYTON RESULTS

Excessive algal growth can indicate nutrient enrichment. Benthic substrate covered by filamentous algae causes habitat degradation and habitat smothering. Periphyton assessments were conducted in accordance with ADEM's 2005 Revised Periphyton Protocol. Results of periphyton sampling in relationship to stream flow are presented in Figure 4. Percent filamentous algae cover was 50%. However, the substrate may have been scoured. Mean daily discharge data from the nearest USGS gage station suggest stream flow peaked during the week preceding sampling.

MACROINVERTEBRATE RESULTS

Benthic macroinvertebrate communities were sampled using ADEM's Intensive Multi-habitat Bioassessment methodology (WMB-I). The WMB-I measures taxonomic richness, community composition, and community tolerance to assess the overall health of the macroinvertebrate community. Each score is based on a six point scale in comparison to least-impaired reference reaches characterized by similar drainage areas, gradient, and habitat. The final score is the sum of all metric scores, with a maximum score of 30. The metric results indicated the macroinvertebrate community to be in *fair* condition (Table 4).

Table 4. Results of the macroinvertebrate bioassessment conducted in Mulberry Fork at MBFB-7 on October 24, 2012.

Macroinvertebrate Assessment		
	Results	Scores
Taxa richness and diversity measures		
# EPT taxa	18	2
Taxonomic composition measures		
# Clinger taxa	12	0
Tolerance measures		
Beck's community tolerance index	9	0
% Nutrient tolerant organisms	16	6
% Tolerant taxa	33	6
WMB-I Assessment Score	---	14
WMB-I Assessment Rating		Fair (12-23)

FISH RESULTS

The Geological Survey of Alabama (GSA) conducted fish IBI assessments of the Mulberry Fork in 2010. These data provide information about the species richness and diversity, tolerance level, trophic system, and abundance of the fish community. Each score is a five-point scale in comparison to least-impaired reference reaches in the same ichthyoregion. The final score is the sum of all metric scores, with a maximum score of 60. Metric results indicated the fish community to be in *poor* condition (Table 5).

Table 3. Results of the habitat assessment conducted in Mulberry Fork at MBFB-7 on October 24, 2012.

Habitat Assessment	%Maximum Score	Rating
GP		
Instream Habitat Quality	41	Poor (<41)
Sediment Deposition	59	Marginal (41-58)
Sinuosity	35	Poor (<45)
Bank and Vegetative Stability	63	Sub-optimal (60-74)
Riparian Buffer	83	Sub-optimal (70-89)
Habitat Assessment Score	127	
% Maximum Score	58	Marginal (41-58)

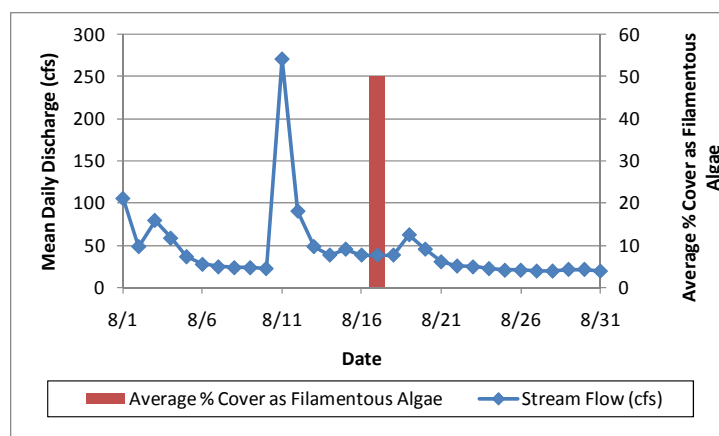


Figure 4. Results of periphyton sampling at MBFB-7 conducted August, 2012. The blue line indicates mean daily stream flow during the month of August 2012.

Table 5. Results of the fish IBI assessment conducted in Mulberry Fork at MBFB-7 on June 2, 2010 (GSA 2013).

Fish IBI Assessment	Results	Score
Species richness and diversity		
Total native species	18	3
Number cyprinid species	6	3
Number sucker species	2	3
Number <i>Lepomis</i> species	4	3
Number darter+madtom species	1	1
Tolerance and intolerance		
Percent dominant species	36	3
Percent of tolerant species	40	1
Percent <i>Lepomis</i>	13	3
Trophic Measures		
Percent omnivores	40	1
Percent carnivores	2	3
Abundance, condition, and reproduction		
Percent DELT+hybrids	1	1
Percent simple lithophils	26	3
Total IBI Score		28
IBI Assessment Rating		Poor (26-32)

WATER CHEMISTRY

Results of water chemistry analyses are presented in Table 6. When possible, in situ measurements and water samples were collected monthly or semi-monthly during April through November 2012 to help identify any stressors to the biological communities. Dissolved arsenic and dissolved thallium concentrations both exceeded human health criteria for fish consumption on July 2, 2012. Stream flow was very low on this date, measuring only 0.6 cfs. Median conductivity, hardness, and alkalinity were higher than expected for streams in the Southern Table Plateaus ecoregion. Ammonia-nitrogen was above the minimum detection limit in two of ten samples collected. However, the median ammonia-nitrogen concentration was below values expected for the ecoregion.

Dissolved oxygen (DO) was below *F&W* criterion during one sampling event on July 2, 2012. Stream pH exceeded *F&W* criterion in a sample collected June 19, 2012. In addition, pH concentrations violated these criteria during a 72-hour diurnal study conducted September 10-13, 2012. Dissolved oxygen, water temperature, pH, and conductivity were measured every fifteen minutes for 72 hours. Results of the study are shown in Figure 5. On average, DO in the water column changed approximately 8.1 mg/L in a diurnal cycle, ranging from 7.0 mg/L to 15.8 mg/L. Stream pH increased an order of magnitude in a diurnal cycle and ranged from 7.2 to 8.6 during the study. Stream pH was out of compliance for 1.5 hours during the 72-hour study.

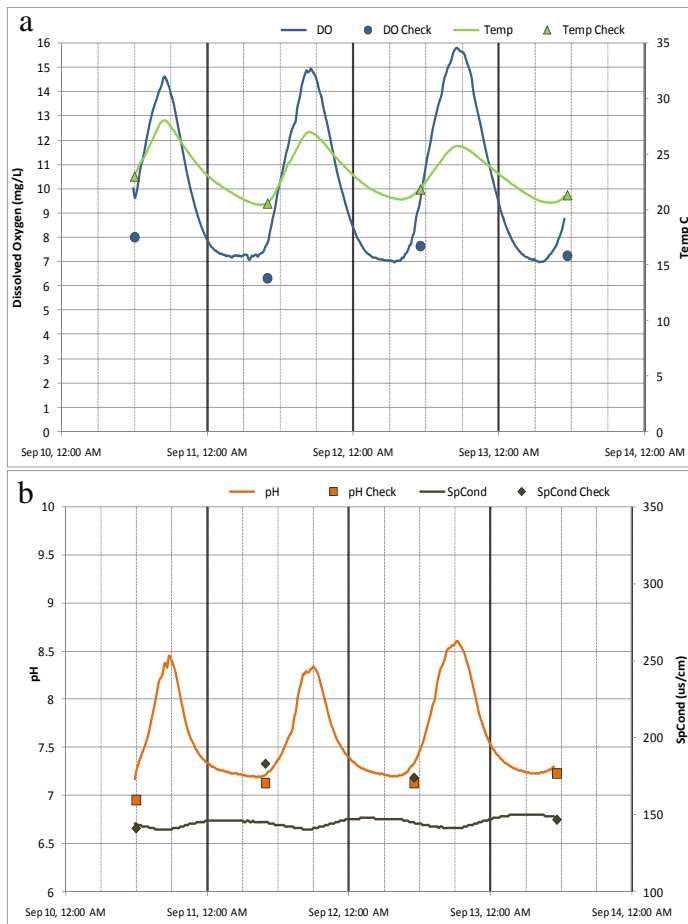


Figure 5. Results of 72-hour diurnal study conducted September 10-13, 2012. Lines indicate changes in DO and water temperature (a) and pH and conductivity (b) over time (courtesy of ADEM Water Quality).

Table 6. Summary of water quality data collected April-November, 2012. Minimum (Min) and maximum (Max) values calculated using minimum detection limits (MDL) when results were less than this value. Median, average (Avg), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Parameter	N	Min	Max	Med	Avg	SD	E
Physical							
Temperature (°C)	11	7.9	30.8	24.5	22.3	8.0	
Turbidity (NTU)	13	1.2	9.6	2.4	3.2	2.3	
^J Total Dissolved Solids (mg/L)	10	32.0	104.0	76.0	74.0	21.2	
Total Suspended Solids (mg/L)	10	< 1.0	5.0	0.5	1.4	1.5	
Specific Conductance (µmhos)	11	89.8	156.8	135.6 ^G	131.8	18.0	
Hardness (mg/L)	6	18.9	34.2	28.0 ^G	27.4	5.2	
Alkalinity (mg/L)	10	23.8	57.1	40.0 ^M	40.2	10.5	
Stream Flow (cfs)	10	0.6	53.5	5.5	14.8	16.7	
Chemical							
Dissolved Oxygen (mg/L)	11	2.8 ^C	11.9	9.8	9.1	2.8	1
pH (su)	11	7.0	8.6 ^C	7.4	7.5	0.6	1
Ammonia Nitrogen (mg/L)	10	< 0.007	0.059	0.004	0.012	0.018	
^J Nitrate+Nitrite Nitrogen (mg/L)	10	0.009	1.516	0.075	0.269	0.462	
^J Total Kjeldahl Nitrogen (mg/L)	10	0.071	0.556	0.345	0.352	0.144	
^J Total Nitrogen (mg/L)	10	0.119	1.847	0.550	0.621	0.474	
^J Dissolved Reactive Phosphorus (mg/L)	10	< 0.004	0.027	0.008	0.010	0.007	
Total Phosphorus (mg/L)	10	0.014	0.081	0.044	0.040	0.020	
^J CBOD-5 (mg/L)	10	< 2.0	< 2.0	1.0	1.0	0.0	
Chlorides (mg/L)	10	5.0	11.6	8.9	8.8	2.2	
Total Metals							
^J Aluminum (mg/L)	4	< 0.043	0.163	0.060	0.076	0.061	
^J Iron (mg/L)	4	0.165	0.455	0.286	0.298	0.146	
^J Manganese (mg/L)	4	0.019	0.452	0.120	0.178	0.206	
Dissolved Metals							
Aluminum (mg/L)	4	< 0.043	< 0.043	0.022	0.022	0.000	
Antimony (µg/L)	4	< 3.6	< 3.6	1.8	1.8	0.0	
^J Arsenic (µg/L)	4	< 1.8	2.5 ^H	0.9	1.3	0.8	1
Cadmium (µg/L)	4	0.041	0.046	0.023	0.028	0.009	
Chromium (mg/L)	4	< 0.009	< 0.009	0.004	0.004	0.000	
Copper (mg/L)	4	< 0.020	< 0.020	0.010	0.010	0.000	
^J Iron (mg/L)	4	0.095	0.162	0.118	0.123	0.028	
Lead (µg/L)	4	< 0.9	< 0.9	0.4	0.4	0.0	
^J Manganese (mg/L)	4	0.018	0.399	0.110	0.159	0.182	
Mercury (µg/L)	4	< 0.035	< 0.035	0.018	0.018	0.000	
Nickel (mg/L)	4	< 0.042	< 0.042	0.021	0.021	0.000	
Selenium (µg/L)	4	< 2.5	< 2.5	1.2	1.2	0.0	
Silver (µg/L)	4	< 0.015	0.215	0.108	0.082	0.050	
^J Thallium (µg/L)	4	< 1.4	1.6 ^H	0.7	0.9	0.4	1
Zinc (mg/L)	4	< 0.012	< 0.012	0.006	0.006	0.000	
Biological							
Chlorophyll a (ug/L)	10	< 0.10	4.01	0.53	1.00	1.21	
E. coli (col/100mL)	4	11	57	44	39	22	

C=*F&W* criteria violated; E=# samples that exceeded criteria; G=value higher than median concentration of all verified ecoregional reference reach data collected in the ecoregion 68d; H=*F&W* human health criteria exceeded; J=estimate; M=value >90% of all verified ecoregional reference reach data collected in the ecoregion 68d; N= # samples.

DISCUSSION

Three segments of the Mulberry Fork are currently classified as impaired according to §303(d) of the Clean Water Act. The segments are impaired by nutrients and siltation/habitat alteration from agricultural, industrial, and municipal sources.

Overall habitat quality was categorized as *marginal* for supporting macroinvertebrate communities due to poor instream habitat quality and poor channel sinuosity. Results of the macroinvertebrate bioassessment conducted at MBFB-7 indicated the aquatic insect community to be in *fair* condition.

These results support the findings of a 2010 fish IBI survey conducted by the Geological Survey of Alabama (GSA). The metric results indicated the fish community at MBFB-7 to be in *poor* condition.

Water chemistry analyses showed dissolved arsenic and dissolved thallium both exceeded *F&W* human health criteria for fish consumption on one sampling date. Median conductivity, hardness, and alkalinity were elevated as compared to data from ADEM's least-impaired reference reaches in ecoregion 68d. DO and pH concentrations each violated *F&W* criteria during one sampling event. These results were corroborated by a 72-hour study that pH increased an order of magnitude in a diurnal cycle, ranging from 7.2 to 8.6 during the study. Stream pH was out of compliance for 1.5 hours during the 72-hour study. This swing in pH suggests that nutrient enrichment may be a problem in the reach. Continued monitoring of this reach is recommended.

FOR MORE INFORMATION, CONTACT:

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