

Final Report

A Survey of Aquatic Macroinvertebrates at Kings Mountain National Military Park (CESU)

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INTRODUCTION

The identification of land use impacts on stream habitats and biotic assemblages constitutes as an essential component of resource management (Richards et al. 1996). Stream hydrology, chemistry, geomorphology, and biotic assemblage structure are tightly linked with a suite of regional terrestrial factors including climate, vegetation, slope, elevation, geology, and land cover/land use (Johnson and Gage 1997). Because stream ecosystems are so tightly linked with their terrestrial watersheds, disturbances of land surfaces often lead to disturbances within their corresponding aquatic ecosystems (Wang et al. 2001, Wang 2003).

Background

Kings Mountain is a rocky spur of the Blue Ridge Mountain that rises 46 m above the surrounding area. In 1780, the British Major Patrick Ferguson and his loyalist militia were severely defeated by a small band of patriotic forces, turning the tide on England's attempt to conquer the South. Congress established this 1,597 ha site to become a National Military Park in 1931.

Topographically, Kings Mountain National Military Park (KMNMP) is characterized by a series of ridges that generally run from southwest to northeast. Elevations in the Park range from 197 m to 324 m above sea level and dendritic drainages create numerous ravines. Tulip poplar, sweet gum, black walnut, and American sycamore dominate floodplain forests in the Park. On mesic and dry-mesic slopes, overstories contain white oak, red maple, and tulip poplar, and understories contain large components of flowering dogwood. Typical dry-sites species include chestnut oak, scarlet oak, and shortleaf pine with post oak and blackjack oak also common. Fire suppression and other changes in land use have drastically increased the density of trees at KMNMP compared to that at the time of the battle. A management plan is underway to restore the battlefield to its historic vegetation structure.

Adjacent land use change and current upstream land uses in the Kings Creek watershed are topics of highest concern at KMNMP. Land use within the Kings Creek drainage includes light agriculture, forest, and a few homes. Cattle are known to lounge in Kings Creek near the confluence of Stonehouse Branch. With exception of Kings Creek and the downstream of Dillingham Branch, all streams drain Park lands. The Park is very active in fire management and allows horseback riding on its trails.

Objectives

The work proposed here characterizes the aquatic macroinvertebrate community and the biotic condition of watersheds on KMNMP and may be used to better manage the aquatic resources found within the Park. This work develops a structure and the initial dataset that may be used for measuring progress towards maintain biological integrity within the Park.

Objective 1: to determine the aquatic macroinvertebrate assemblage at representative sample sites from the waters within the Park, sample site being located by collaboration with Park staff.

Objective 2: the development of a sampling scheme which yields taxonomic composition and relative abundance, as well as establish a methodology for future monitoring of aquatic macroinvertebrates by Park staff or citizen scientists.

Objective 3: the utilization of standard sampling equipment and data descriptions which produce exchangeable results with South Carolina and North Carolina state agencies.

Objective 4: point sampling of water quality parameters (pH, temperature, conductivity, dissolved oxygen) at time of aquatic macroinvertebrate sampling.

METHODS

In 2009 we sampled 15 stream reaches for aquatic macroinvertebrate assemblages. Each stream-reach included aquatic macroinvertebrate samples, in-stream habitat evaluation, probe water quality measurements, and GPS site coordinates.

Sample Locations

KC1 – Kings Creek upstream of confluence of Dillinghouse Branch

KC2 – Kings Creek upstream of Hwy 216

KC3 – Kings Creek (trib)

KC4 – Kings Creek (trib)

S1 – Long Branch (trib) downstream of horse trail crossing

S2 – Long Branch (trib) .5 km downstream of Hwy 261

S3 – Long Branch (trib) south of Hwy 261

T1 – Long Branch upstream of Hwy 261 at Park boundary

T2 – Long Branch downstream of treatment plant discharge

T3 – Long Branch upstream of treatment plant discharge

T4 – Pole Branch above confluence with Long Branch

DH1 – Dillinghouse Branch upstream of confluence with Kings Creek

SH1 – Stonehouse Branch upstream of gated road

GB1 – Garner Branch upstream of Park boundary

GB2 – Garner Branch (trib) upstream of Park Boundary

All sampled sites were GPS located to assure the exact location of sites using a Garmin GPSmap 76Cx (sample site coordinates and elevations Table 6). Location of these sample sites is shown in figure 1.

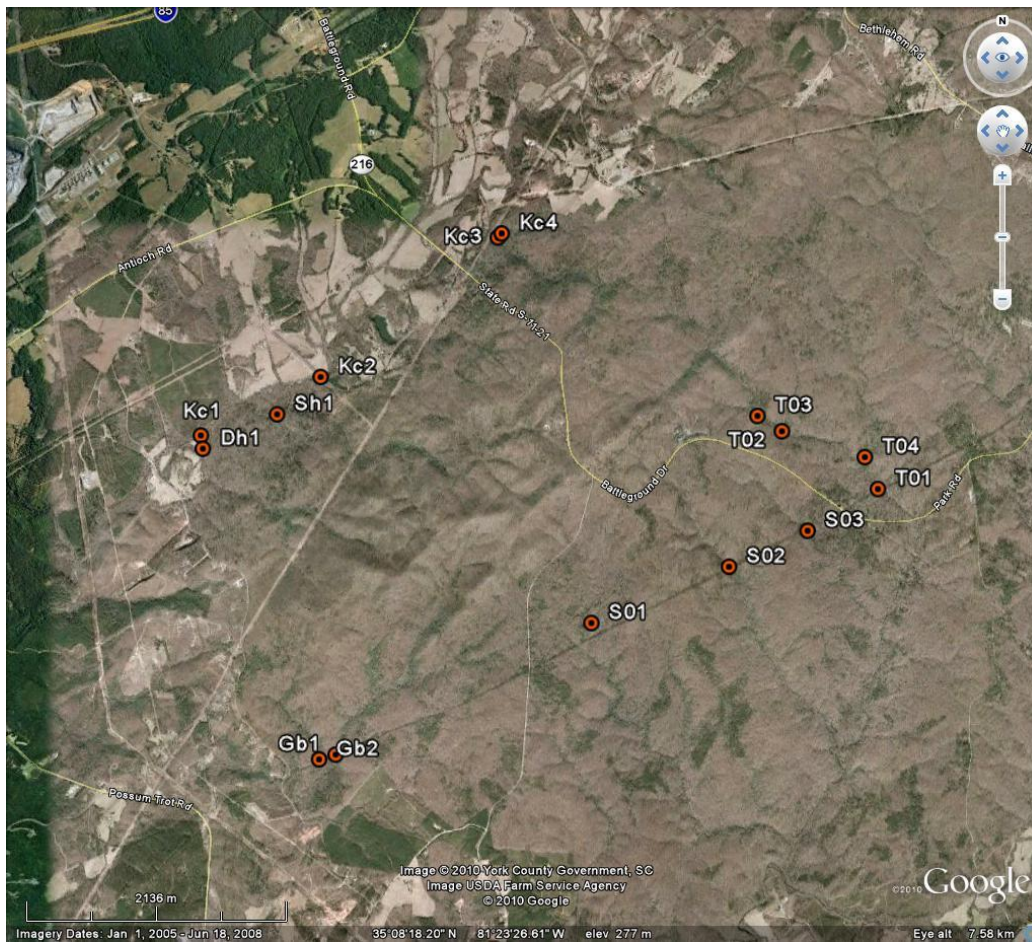


Figure 1. Aerial photograph (Google Earth) of Kings Mountain National Military Park showing sampling sites visited fall 2009.

Aquatic Macroinvertebrates

Aquatic macroinvertebrate sample sites were located throughout KMNMP. Aquatic macroinvertebrate sampling at each site consisted of 5 man minutes sampling in all available habitat types. In addition, we conducted a 5 man minute visual inspection and collection from rocks, woody debris, aquatic macrophytes, and other stable substrate where appropriate. Three replicate samples were collected at each site. Aquatic macroinvertebrates and associated detritus were collected in 500 micron mesh nets and sampled material from different habitat types was pooled as a single sample. All sampled material was preserved in 95% ethanol and returned to the laboratory where aquatic macroinvertebrates were picked from the detritus and identified to the lowest possible taxonomic level. All organisms were taken to species level where possible excluding aquatic worms (Oligochaeta), water mites (Hydracarina), and fingernail clams (Sphaeriidae). These identifications stopped at Order and Family level identifications.

A reference collection was developed for KMNMP. All reference material is stored in 80% ethanol and retained in the Clemson University Stream Laboratory for 5 years. At the conclusion of the five year period, the reference collection will then become a part of the KMNMP museum collection.

The aquatic macroinvertebrate sampling protocol and methodology discussed above meet the requirements of our South Carolina Department of Health and Environmental Control (SCDHEC) certified laboratory. Aquatic macroinvertebrate data has been organized and analyzed to provide total numbers,

taxa richness, EPT richness, functional feeding group percentages, the North Carolina Biotic Index (NCBI) tolerance scores, and SCDHEC Bioassessment Values (biological water quality scores). A multivariate analysis of community composition and estimates of β Diversity (species turnover between sites) were developed based upon abundance values.

Richness Measures

Total Number (TN) is a count of the total number of individuals at any one specific site.

Taxa Richness (TR) is a count of the total number of unique taxa, identified to the lowest possible taxonomic level. In most cases, increasing taxa richness is associated with increasing health of the aquatic system (Barbour et al. 1999).

EPT richness (EPT) is a count of the taxa in each the Ephemeroptera, Plecoptera and Trichoptera orders. These are the three orders of aquatic benthic macroinvertebrates that are most sensitive to pollution. In most cases, EPT richness increases with improved water quality (Barbour et al. 1999).

Feeding Measures – Many collected taxa did not have assigned functional feeding strategies, in this case the numbers associated with this taxa were still tallied for the final percentage score for all feeding measures categories. The following is modified from Merritt et al. 2008 and Barbour et al. 1999.

Percent Predator (%P) is the percentage of the benthic macroinvertebrates that primarily feed on other living animal tissue. This may include engulfing or piercing carnivores.

Percent Gatherer Collector (%GC) is the percentage of the benthic macroinvertebrates that gather or feed in the sediments on decomposing fine particulate organic matter.

Percent Filterer Collector (%FC) is the percentage of the benthic macroinvertebrates that feed by filtering fine particulate organic matter from either the water column or sediments.

Percent Scrapers (%SC) is the percentage of the benthic macroinvertebrates that forage on periphton-attached algae and associated material by scraping mineral and organic surfaces. Percent scrapers increase with improved water quality.

Percent Shredders (%SH) is the percentage of the benthic macroinvertebrates that feed on living vascular tissue, decomposing vascular coarse particulate organic matter and wood. Percent shredders increase with improved water quality.

Tolerance Measures

The North Carolina Biotic Index (NCBI) is a commonly used multimetric for water quality. This measurement of biotic integrity is derived from an individual taxa's tolerance to organic pollution (NCDENR 2006). Bias of overly abundant benthic macroinvertebrates is controlled for by changing total counts of unique taxa to 1 for 1-2 organisms, 3 for 3-9 organisms, and 10 for the presence of greater than 10 organisms. These new values are then applied to the standard NCBI equation:

$$\text{Biotic Index} = \sum(TV_i)(n_i)/N$$

Where: TV_i = i th taxon tolerance value
 n_i = i th taxon abundance value
 N = sum of all individuals with tolerance values

The output is expressed as a single value from 0 to 10 where 0 is the most favorable value and 10 being the worst (Hilsonhoff 1988, Lenat 1993). Hilsenhoff (1982) provided some reasonable criteria for organic pollution that can be tentatively applied to our biotic index values.

<u>Biotic Index</u>	<u>Water Quality</u>	<u>Degree of Organic Pollution</u>
00-3.50	Excellent	No organic pollution
3.51-4.50	Very good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-7.00	Fair	Significant organic pollution
7.01-8.50	Poor	Very significant organic pollution
8.51-100	Very poor	Severe organic pollution

The South Carolina Stream Bioclassification is a score based on the NCBI (provided above) and the EPT richness count to formulate a final Stream Bioclassification score. Values range from 1 to 5, with 1 indicating a poor bioclassification and a value of 5 being excellent (SCDHEC 2000).

1 = Poor 2 = Fair 3 = Good – Fair 4 = Good 5 = Excellent

Measures of Community Composition

While the identification of individual taxa and summary measures like species richness or bioassessment indices provide concise summary information about a location, additional insight may come from a consideration of the species composition of a site. Such measures incorporate the incidence, abundance, or relative abundance of all organisms found in a site. Perhaps the most powerful uses of these measures are 1) multivariate analyses of composition showing similarities between sites and (optionally) the environmental variables that predict composition; 2) change in species assemblage between sites and the factors related to this change. This change in composition between sites is frequently referred to as *turnover* or β -*diversity*. Information on species turnover can be a valuable tool to examine drivers of diversity on a landscape when β -diversity is strongly related to changes in environmental parameters.

We used two techniques to examine community composition and how it changed across sites in KMNMP. Non-metric multidimensional scaling (NMDS) is an ordination technique that translates the n -dimensional (n = # of taxa) community in relatively few dimensions (usually 2 or 3) so that differences between sites are readily interpreted visually or using simple statistical tests. In a robust NMDS plot, distances between points on the plot are directly representative of the differences in species composition of communities. We also calculated community similarity between all sets of sampling locations using a Bray-Curtis (BC) similarity index (Bray and Curtis 1957). The BC index represents % similarity between communities at each site, and represents a % change in composition (i.e., turnover or

Table 1. Benthic macroinvertebrate richness measures of total numbers of organisms (TN), taxa richness (TR) and Ephemeroptera, Plecoptera and Trichoptera (EPT) richness by site for fall 2009 at Kings Mountain National Military Park.

Site	TN	TR	EPT
KC1	2969	135	35
KC2	2093	119	32
KC3	832	93	38
KC4	902	68	22
S1	757	63	17
S2	648	72	30
S3	785	90	37
T1	1838	84	28
T2	1036	90	35
T3	1106	85	36
T4	767	64	24
DH1	1115	83	29
SH1	1915	91	37
GB1	575	73	27
GB2	888	64	23

β -diversity) between each pair of sites. We then examined relationships between β -diversity and the difference in environmental variables at each site. The goal of this analysis was to identify potential drivers of differences between sampling locations in KMNMP. The environmental variables we used as predictors of β -diversity were as follows: the 10 EPA Rapid Bioassessment categories, the EPA Rapid Bioassessment Total Score, temperature, dissolved oxygen, conductivity, pH, and site elevation.

Habitat Assessment

Habitat quality and biological diversity in rivers has been closely linked by Raven et al. (1998) and alteration of the habitat should be considered a source of stress on the aquatic ecosystem (Karr et al. 1986). Barbour et al. (1999) point out "The presence of a degraded habitat can sometimes obscure investigations on the effects of toxicity and/or pollution". Environmental Protection Agency (EPA) standard Habitat Assessments for Low Gradient Streams

(Barbour et al. 1999) were scored by visual observations made at each site before any measurements were taken to properly document ten habitat parameters of interest. Individual habitat parameter scores range from 20- Optimal score range is 20-16 and suboptimal score range is 15-11. Marginal score range is 10 to 6 and the poor score range is 5 to The highest possible total habitat score is 200 (10 habitat parameters multiplied by 20 points maximum). The habitat evaluation was performed on the same site (reach) from which the biological sampling was evaluated. The width of each site (reach) consisted of 100m x 40m.

Water Quality Measurements

Water quality measurements were taken prior to any sampling for baseline data. Measurements of temperature, dissolved oxygen, pH, and conductivity were taken at riffle areas. Temperature, dissolved oxygen, pH, and conductivity were taken with Yellow Spring Instrument Inc. (YSI) 556. Proper calibrations were performed prior to field use.

RESULTS

Aquatic Macroinvertebrates

Richness Measures (Table 1)

Total numbers of organisms (TN) and taxa richness (TR) were highest at KC1 and KC2. These sites located on Kings Creek were considerably larger than those sites located on the Park. In most cases, total numbers and richness values are found to be highest at streams of higher stream order. The highest Ephemeroptera, Plecoptera and Trichoptera (EPT) counts were found at KC3 (tributary of Kings Creek), S3 (tributary to Long Branch), and SH1 (Stonehouse Branch). These sites had little influence from discharges or road and trail crossings upstream of where the benthic macroinvertebrate survey was conducted. Site S1 (tributary to Long Branch below horse trail crossing) had the lowest taxa and EPT richness scores.

Feeding Measures (Table 2)

Numerous factors influence the presence, distribution and abundance of specific functional feeding taxa. In these results we will be reporting, where applicable, dominate or group of dominate taxa responsible for highest percentages of feeding measures.

Site KC3 (tributary of Kings Creek) showed the highest percentage of predators (%P), although there are no dominant taxa groups

driving this percentage. The highest percentage of gatherer collectors (%CG) was found at sites GB1 (Garner Branch) and GB2 (tributary of Garner Branch). The abundance of the Leptophlebid mayflies influenced GB1, and high counts of the amphipod *Crangonyx sp.* influenced GB2 gatherer collector percentages. Site KC1 (Kings Creek) showed the highest percentage of filterer collectors (%FC). This percentage was influenced by high counts of *Simulium sp.* (blackfly), *Isonychia sp.* (mayfly), the caddisflies *Chimarra sp.* and *Cheumatopsyche sp.*, and the clam *Cobacula fluminea* in comparison with all other sites. The abundance of Heptagniid mayflies influenced the high percentage of scrapers (%SC) at SH1 (Stonehouse Branch) and the abundance of the winter stonefly *Allocaonia sp.* greatly influenced the high percentage of

Table 2. Benthic macroinvertebrate feeding measures of percent predator (%P), percent gatherer collector (%CG), percent filterer collector (%FC), percent scraper (%SC) and percent shredder (%SH) by site for fall 2009 at Kings Mountain National Military Park.

Site	%P	%CG	%FC	%SC	%SH
KC1	8	15	42	8	10
KC2	7	13	17	8	42
KC3	14	13	18	20	24
KC4	5	36	14	3	30
S1	4	28	29	12	12
S2	7	10	14	30	15
S3	7	28	14	19	20
T1	10	10	36	23	16
T2	6	19	26	26	12
T3	7	8	31	27	19
T4	5	11	32	21	7
DH1	5	39	11	12	17
SH1	6	11	23	33	15
GB1	5	42	16	20	13
GB2	5	42	6	15	22

shredders at KC2 (Kings Creek). However, it is prudent to emphasize that different types of data—abundance, incidence, or biomass—can produce quite different estimates of functional feeding abundances.

Tolerance Measures (Table 3)

North Carolina Biotic Index showed highest values at sites KC1 and KC2 located outside of Kings Mountain National Military Park. Lower NCBI values indicate better water quality. Site S1 (tributary to Long Branch downstream of the horse trail crossing) had the highest value within the Park, and the lowest South Carolina Stream Bioclassification (Bioclassification) score. Higher bioclassification scores mean better water quality.

According to Hilsenhoff (1982), NCBI values classified fair water quality at sites KC1 and KC2 and good at site S1. All other sites were classified as very good using the NCBI approach. Although site S1 had the lowest South Carolina Stream Bioassessment score, the value indicated good water quality along with many other sites at the Park. Sites KC3 (tributary to Kings Creek), S3 (tributary to Long Branch), T2 (Long Branch), T3 (Long Branch), and SH1 (Stonehouse Branch) indicated the highest possible scores or excellent water quality.

Measures of Community Composition and Species Turnover

NMDS ordination showed that differences in community composition at sites were related to several environmental gradients (Figure 2). Invertebrate community composition at Kings Creek Site 1 & 2 (KC1 & 2) were the most distinct from other sites. These difference appeared to be related primarily to a gradient of in-stream substrate, temperature, and conductivity with KC1 & 2 being higher temperature, higher conductivity, and more sedimented with lower substrate heterogeneity. This same gradient (Axis 1 in Figure 2) also separated out the remaining sites, though less distinctly than with the 2 Kings Creek sites. Communities were also distinct along Axis 2 of the NMDS which identified a gradient that appeared to be related to substratum embeddedness and bank stability according to the EPA Rapid Bioassessment protocols. Finally, there was weak but significant separation along NMDS axis 3 that was highly correlated with dissolved oxygen and bank stability (Figure 2).

An analysis of turnover between sites (Figure 3) showed high turnover across the KMNMP sites with an average of ~65% dissimilarity between sites. These estimates of turnover are most likely the result of capturing a high level of environmental heterogeneity

Table 3. Benthic macroinvertebrate tolerance measures of North Carolina Biotic Index (NCBI) and the South Carolina Department Stream Bioclassification (Bioclassification) by site for fall 2009 at Kings Mountain National Military Park.

Site	NCBI	Bioclassification
KC1	5.99	4
KC2	5.78	4.1
KC3	3.61	5
KC4	4.07	4.2
S1	4.57	3.8
S2	4	4.4
S3	3.91	5
T1	4.2	4.5
T2	3.91	5
T3	4.09	5
T4	4.19	4.3
DH1	4.4	4.5
SH1	3.98	5
GB1	4.45	4.5
GB2	3.63	4

Figure 2: Non-metric multidimensional scaling of macroinvertebrate species by site. Points closer to one another in the ordination are more similar in species composition. Error bars are standard deviations based on the 3 sub-samples collected at each site. Species names in gray refer to species that correlate strongly on each axis, either positively or negatively. Environmental parameters in red are parameters that were strongly correlated with each axis. Species correlations are inherent weights (i.e., the ordination is based on the species) whereas environmental correlations are post-hoc.

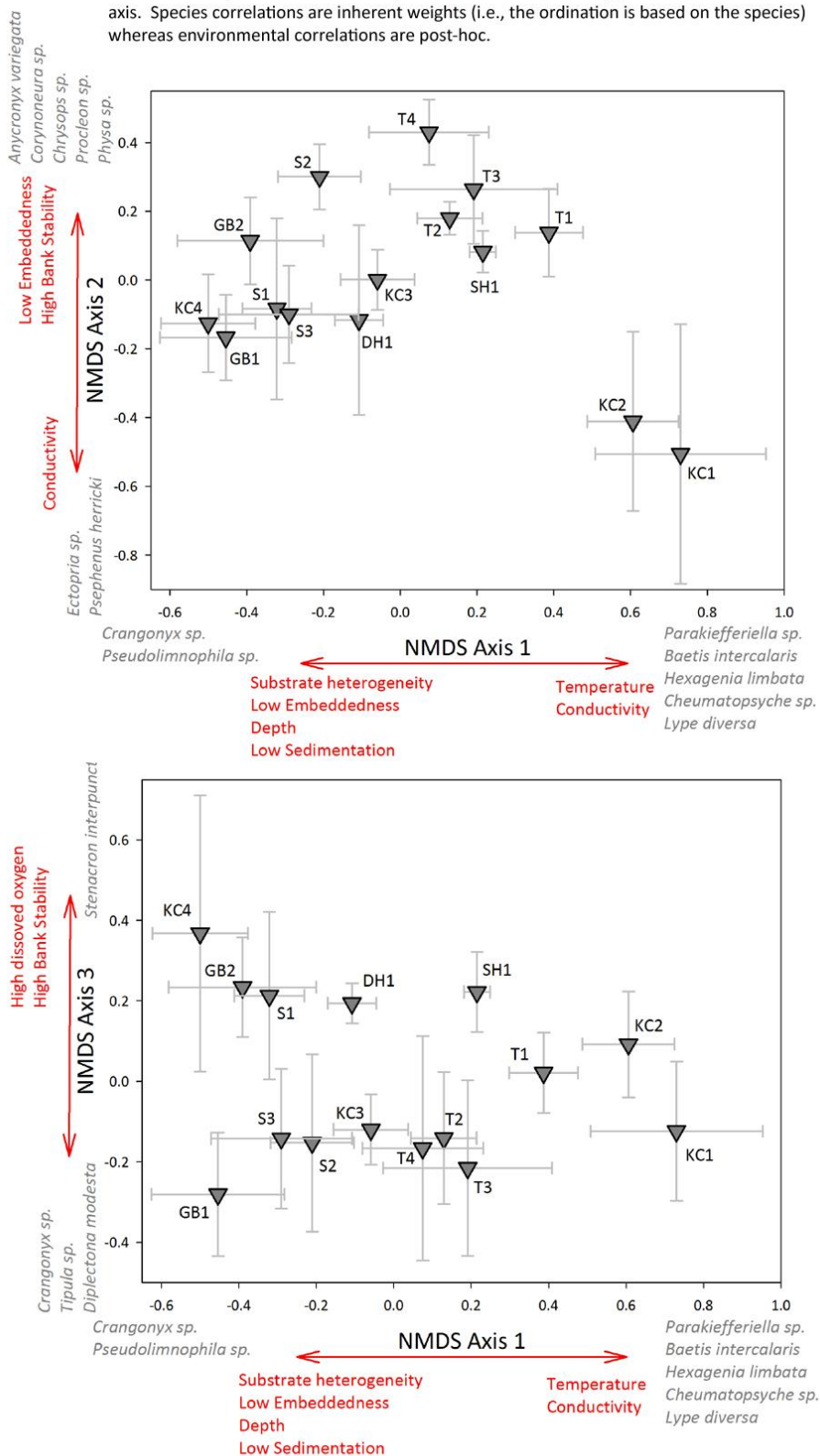
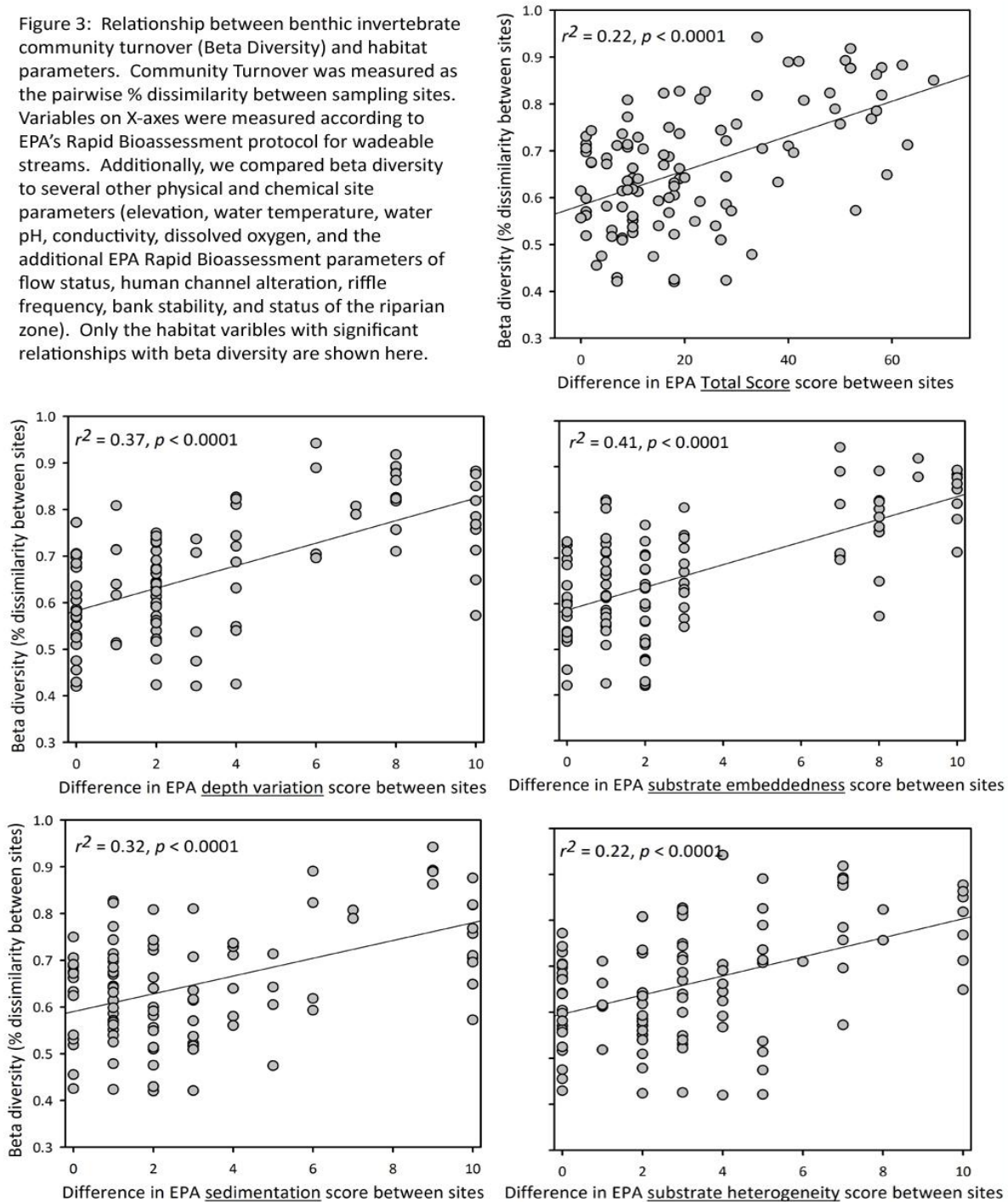


Figure 3: Relationship between benthic invertebrate community turnover (Beta Diversity) and habitat parameters. Community Turnover was measured as the pairwise % dissimilarity between sampling sites. Variables on X-axes were measured according to EPA's Rapid Bioassessment protocol for wadeable streams. Additionally, we compared beta diversity to several other physical and chemical site parameters (elevation, water temperature, water pH, conductivity, dissolved oxygen, and the additional EPA Rapid Bioassessment parameters of flow status, human channel alteration, riffle frequency, bank stability, and status of the riparian zone). Only the habitat variables with significant relationships with beta diversity are shown here.



in our sampling scheme (which was, in fact, one of our goals) and thus capturing the different aquatic macroinvertebrate communities that specialize on each environmental type. In particular, our analysis seemed to indicate that in-stream physical habitat was a strong driver of aquatic macroinvertebrate community type. We came to this conclusion because the 4 variables that were significantly related to β -diversity were all variables related to in-stream physical habitat. It is important to note that the x-axes in figure 3 represent the differences between sites in each variable as opposed to the actual values of that variable. In other words, the

correct interpretation of the bottom left panel of Figure 3 would be that as the difference in sedimentation between sites increases, differences in community composition also increase. β -diversity was also related to the Total EPA score, but that score was primarily driven by the 4 habitat variables (Figure 3). Neither water chemical variables, nor EPA variables related to channel form, nor EPA variables related to riparian habitat were related to β -diversity. That is not to imply that such variables are not important determinants of benthic invertebrate habitat. Our analysis only implies that *differences* in communities across sites were driven primarily by in-stream habitat variables. Actual scores by category for the EPA Rapid Bioassessment are found in Table 5.

Water Quality and Habitat

Water parameters for sites sampled in KMNMP had few readings to note (Table 4). High conductivity was noted at the Kings Creek sites (KC1 and KC2) not entirely encompassed by the Park. Lower dissolved oxygen at KC4 may have been a product of small watershed size and low flow, it is important to note

Table 4. Temperature (Temp), conductivity (Con), dissolved oxygen (DO), and pH by site for fall 2009 at Kings mountain National Military Park.				
Site	Temp	Con	DO	pH
KC1	12.78	184	9.79	6.95
KC2	13.43	186	14	7.47
KC3	12.43	22	9.6	7.23
KC4	12.5	20	6.15	6.59
S1	12.05	43	9.47	7.36
S2	163	40	9.72	7.12
S3	13	33	154	7.9
T1	12.65	35	121	7.4
T2	12.92	45	9.32	7.16
T3	12.87	29	9.52	7.15
T4	12.76	41	8.22	7.27
DH1	13.44	35	8.29	7.09
SH1	13.21	27	9.47	6.89
GB1	11.2	34	125	7.02
GB2	11.68	31	9.69	7.28

that this watershed has a small portion of this drainage outside of the Park boundaries. Although this measurement was low it is still fully capable of supporting a healthy benthic macroinvertebrate community assemblage. Habitat evaluation scores (Table 5) showed the lowest total scores being at sites KC1 and KC2, sites that are on the boundary of the Park but heavily influenced by upstream activities.

CONCLUSIONS AND RECOMMENDATIONS

Survys of aquatic macroinvertebrates yielded over 17,000 organisms representing 230 unique taxa. These surveys indicated that local habitat and water quality is good to excellent throughout KMNMP. The watershed of highest concern in KMNMP is that which drains into site S3 (tributary to Long Branch). Our study indicated the lowest richness and tolerance scores at this site. Futher surveys need to focus on this area to determine if impacts are correlated with current watershed activies or a product of legacy activities.

Watersheds draining into sites KC3 (tributary to Kings Creek, T3 (Long Branch), S3 (tributary to Long Branch), and SH1 (Stonehouse Branch) need continued monitoring and conservation as they represent areas with highest richness and tolerance scores (representing the best possible water quality scores). These sites may possibly represent the only grouping of excellent scored reference sites remaining in the EPA level IV Kings Mountain Piedmont Ecoregion.

Table 5. Individual and total EPA habitat parameter scores by site for fall 2009 at Kings mountain National Military Park.

	KC1	KC2	KC3	KC4	S1	S2	S3	T1
Available Cover	13	10	18	17	18	20	20	20
Embeddedness	8	8	16	15	16	18	18	16
Velocity / Depth Regime	10	10	18	16	18	18	20	20
Sediment Deposition	8	8	19	17	14	17	18	18
Channel Flow Status	18	20	18	14	17	19	18	20
Channel Alteration	20	15	20	20	20	20	20	20
Frequency of Riffles	20	13	16	20	18	18	17	18
Bank Stability	10	14	14	10	16	16	16	16
Vegetative Protection	18	17	10	20	20	20	20	20
Riparian Vegetative Zone	10	14	10	20	20	20	20	20
Total	135	129	159	169	177	186	187	188

Our analysis of β -diversity also suggested some potentially informative conclusions about maintenance of diversity in the park as a whole. While many studies focus on α -diversity (diversity at a particular site, for example, species richness or Shannon diversity index), the total diversity for a region (γ -diversity) is α -diversity $\times$ β -diversity. In other words, no single site contains all species within a region (in our case, KMNMP) and maintenance of regional diversity will require maintenance of factors that influence both site-specific diversity (α -diversity) and that drive the differences between sites (β -diversity). Our analysis of environmental factors related to β -diversity revealed that variation in in-stream habitat across sites was a major driver of β -diversity. So really, the take-home message is that maximizing diversity not only requires that good quality in-stream habitat be maintained, but also that a variety of good in-stream habitat be maintained.

Table 5 (continued). Individual and total EPA habitat parameter scores by site for fall 2009 at Kings mountain National Military Park.

	T2	T3	T4	DH1	SH1	GB1	GB2
Available Cover	20	20	15	16	17	20	20
Embeddedness	18	16	16	15	15	18	17
Velocity / Depth Regime	20	20	17	18	16	20	18
Sediment Deposition	20	18	15	18	18	19	20
Channel Flow Status	20	13	17	18	20	20	18
Channel Alteration	20	20	20	20	15	20	20
Frequency of Riffles	16	20	18	16	13	20	16
Bank Stability	18	18	20	14	16	20	18
Vegetative Protection	20	20	20	18	20	20	20
Riparian Vegetative Zone	20	20	20	16	20	20	20
Total	192	185	178	169	170	197	187

Sample Site Coordinates (Table 6)

Table 6. Site sample coordinates in Universal Transverse Mercator (UTM) and elevation in meters by site for fall 2009 at Kings Mountain National Military Park.			
Site	Easting	Northing	Elevation
KC1	226674.124451	3892838.298884	195
KC2	226688.516995	3893315.386051	202
KC3	226722.797540	3894451.520203	199
KC4	226723.701540	3894481.476885	205
S1	226628.078671	3891311.621605	255
S2	226641.830517	3891767.627418	237
S3	22665664563	389206536380	196
T1	22666904752	389240044611	213
T2	226675.095062	389287474523	226
T3	226678.877167	3892995.848573	226
T4	226668.769479	389266778141	228
DH1	22667844505	3892729.567425	203
SH1	226679.312283	389301272137	208
GB1	226595.528214	3890232.075894	210
GB2	226594.357482	3890193.243338	230

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Appendix 1. Aquatic macroinvertebrate inventory, functional feeding designations (FF), and tolerance values (TV) for Kings Mountain National Military Park collected fall 2009, for sites located on Kings Creek (KC1, KC2), tributaries of Kings Creek (KC3, KC4) and tributaries of Long Branch (S1, S2, S3). Functional feeding designation of p = predator, cg = gatherer collector, fc = filterer collector, sc = scraper, and sh = shredder. Life stages are assumed to be larval or nymph unless indicated by L = Larvae, P = Pupae, or A = Adult. Benthic macroinvertebrates not achieving desired taxonomic level of identification are indicated by imm. = immature, dam. = damaged, or gender.

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Oligochaeta	Family	Genus species			45	42	11	0	0	0	1
Amphipoda	Crangonyctidae	Crangonyx sp.	cg	7.87	2	1	5	160	40	11	14
Amphipoda	Hyalellidae	Hyalella azteca cmplx	cg	7.75	2	0	0	0	0	0	0
Decapoda	Cambaridae	Cambaridae (imm.)		7.5	2	2	0	42	1	0	0
Decapoda	Cambaridae	Cambarus sp. (imm., gender)		7.62	4	6	7	5	24	12	9
Decapoda	Cambaridae	Cambarus howardi		7.62	0	0	5	1	2	3	0
Decapoda	Cambaridae	Cambarus robustus		4	0	1	0	0	0	0	2
Decapoda	Cambaridae	Procambarus sp. (imm., gender)		9.46	2	0	0	0	0	0	0
Isopoda	Asellidae	Caecidotea sp.	cg	9.1	0	7	0	0	0	0	0
Hydracarina	Family	Genus species		5.53	3	0	0	0	0	0	0
Coleoptera	Dryopdidae	Helichus fastigiatus (A)	sc	4.6	1	0	0	0	5	8	1
Coleoptera	Dytiscidae	Hydrocolus oblitus (A)	pr		0	0	0	0	0	0	0
Coleoptera	Dytiscidae	Ilybius sp. (L)	pr		0	1	0	0	0	0	0
Coleoptera	Dytiscidae	Neoporus sp. (L)		8.62	5	1	0	0	0	0	0
Coleoptera	Dytiscidae	Neoporus stratiopunctatus (A)		8.62	1	0	0	0	0	0	0
Coleoptera	Dytiscidae	Neoporus undulatus (A)		8.62	0	0	0	0	0	0	0
Coleoptera	Elmidae	Anycronyx variegata (L,A)	cg	6.49	4	5	0	0	0	0	0
Coleoptera	Elmidae	Dubiraphia sp. (L)		5.93	141	44	1	0	0	0	8
Coleoptera	Elmidae	Dubiraphia vittata (A)		4.1	51	5	0	0	0	0	1
Coleoptera	Elmidae	Macronychus glabratus (L,A)	cg	4.58	13	1	0	0	0	0	0
Coleoptera	Elmidae	Microcylloepus pusillus (L)		2.11	2	0	1	0	0	0	0
Coleoptera	Elmidae	Microcylloepus pusillus lodingi (A)		2.11	1	0	0	0	0	0	0
Coleoptera	Elmidae	Optioservus sp. (L)	sc	2.36	0	1	1	0	0	2	1
Coleoptera	Elmidae	Oulimnius sp. (L)		1.8	5	11	24	15	47	106	8
Coleoptera	Elmidae	Oulimnius latiusculus (A)		1.78	0	0	1	0	0	0	0
Coleoptera	Elmidae	Promoresia tardella (L,A)		0	0	0	0	0	0	1	0
Coleoptera	Elmidae	Stenelmis sp. (L)	sc	5.1	1	0	0	4	2	4	6
Coleoptera	Elmidae	Stenelmis convexula (A)	sc	5.1	0	0	0	0	1	4	0

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Coleoptera	Elmidae	Stenelmis lignicola (A)	sc	3	0	0	0	2	0	0	1
Coleoptera	Gyrinidae	Dineutus ciliatus (A)	pr	5.54	0	1	0	0	0	0	0
Coleoptera	Gyrinidae	Dineutus bicolor (A)	pr	5.54	3	7	0	0	0	0	0
Coleoptera	Gyrinidae	Gyrinus aeneolus (A)	pr	6.17	0	1	0	0	0	0	0
Coleoptera	Hydrophilidae	Tropisternus natator (A)	cg	9.68	0	1	0	0	0	0	0
Coleoptera	Psephenidae	Ectopria sp. (L)	sc	4.16	0	0	2	1	4	8	2
Coleoptera	Psephenidae	Psephenus herricki (L)	sc	2.35	0	0	13	0	3	19	14
Coleoptera	Ptilodactylidae	Anchytarsus bicolor (L)	sh	3.64	0	0	35	17	3	53	5
Diptera	Ceratopogonidae	Bezzia/Palpomia cmplx	pr	6.86	0	0	1	0	0	0	0
Diptera	Ceratopogonidae	Ceratopogon sp.	pr		0	0	1	0	2	0	0
Diptera	Ceratopogonidae	Culicoides sp.	pr	7.7	1	0	0	0	0	0	0
Diptera	Ceratopogonidae	Probezzia sp.	pr		19	19	0	0	1	2	0
Diptera	Ceratopogonidae	Sphaeromyia sp.	pr		3	2	2	2	0	0	0
Diptera	Chironomidae	Ablabesmyia janata	pr	7.4	6	10	0	0	0	0	0
Diptera	Chironomidae	Ablabesmyia mallochii	pr	7.19	6	7	1	0	0	0	0
Diptera	Chironomidae	Brillia flavifrons	sh	5.2	6	6	0	0	0	0	1
Diptera	Chironomidae	Chironomus sp.	cg	9.63	12	0	0	0	0	0	0
Diptera	Chironomidae	Cladotanytarsus sp. F	cg	3.2		2	0	0	0	0	0
Diptera	Chironomidae	Clinotanytarsus sp.	pr		2	3	0	0	0	0	0
Diptera	Chironomidae	Corynoneura sp.	cg		12	9	2	1	2	0	5
Diptera	Chironomidae	Corynoneura sp. C	cg		0	0	0	0	0	1	0
Diptera	Chironomidae	Cricotopus bicinctus	sh	8.5	5	1	0	0	0	0	0
Diptera	Chironomidae	Cricotopus politus	sh		39	15	0	0	0	0	0
Diptera	Chironomidae	Cricotopus triannulatus / infuscatus	sh	9	1	0	0	0	0	0	0
Diptera	Chironomidae	Cryptochironomus sp.	pr	6.4	7	15	0	1	4	0	0
Diptera	Chironomidae	Cryptotendipes sp.		6.19	1	9	0	0	0	0	0
Diptera	Chironomidae	Dicrotendipes neomodestus	cg	8.1	5	1	0	0	0	1	0
Diptera	Chironomidae	Dicrotendipes simpsoni	cg	9.95	0	0	0	0	0	0	0
Diptera	Chironomidae	Diplocladius cultriger	cg	7.41	8	10	30	14	83	5	35
Diptera	Chironomidae	Eukiefferiella sp. (indet.)	cg		0	0	1	0	0	0	1
Diptera	Chironomidae	Eukiefferiella brehmi grp.	cg	2.7	0	0	0	0	0	0	0
Diptera	Chironomidae	Eukiefferiella claripennis	cg	5.6	1	0	0	0	0	0	0
Diptera	Chironomidae	Eukiefferiella tirolensis	cg		0	0	4	1	0	0	0
Diptera	Chironomidae	Hydrobaenus sp. O	sc	9.54	11	3	0	0	0	0	1
Diptera	Chironomidae	Kiefferulus sp.	cg	8	0	0	0	0	0	0	0
Diptera	Chironomidae	Labrundinia pilosella	pr	5.91	1	1	0	0	0	0	0
Diptera	Chironomidae	Micropsectra dives / geminata	cg		0	0	0	4	10	2	0
Diptera	Chironomidae	Micropsectra sp. D	cg		1	0	0	0	0	0	2

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Diptera	Chironomidae	Microtendipes pedellus grp.	fc	5.5	49	51	51	17	82	41	54
Diptera	Chironomidae	Microtendipes rydalensis grp.	fc	6.2	1	2	0	0	0	0	0
Diptera	Chironomidae	Nanocladius brachicolus	cg	7.07	0	0	1	1	1	4	9
Diptera	Chironomidae	Nanocladius crassicornis / rectinervis	cg	7.07	4	1	0	0	0	0	0
Diptera	Chironomidae	Natarsia baltimorea	pr	9.95	0	0	1	0	0	2	1
Diptera	Chironomidae	Nilothauma sp.		5.03	0	0	0	0	0	0	0
Diptera	Chironomidae	Parachaetocladius abnobaesus	cg	0	0	0	4	0	18	25	5
Diptera	Chironomidae	Paracladopelma undine		4.93		1	0	0	0	0	0
Diptera	Chironomidae	Parakiefferiella sp. A	cg	5.4	7	5	0	0	0	0	0
Diptera	Chironomidae	Paralauterborniella nigrohalteralis	cg	4.77	2	3	5	1	0	0	0
Diptera	Chironomidae	Paramerina sp.		4.29	3	0	0	0	0	0	0
Diptera	Chironomidae	Parametriocnemus sp.	cg	3.65	3	0	4	6	0	0	4
Diptera	Chironomidae	Paraphaenocladius sp.	cg		1	11	10	97	8	1	20
Diptera	Chironomidae	Paratanytarsus dissimilis		8.45	4	0	0	0	0	0	0
Diptera	Chironomidae	Paratendipes albimanus	cg	5.11	0	0	0	2	4	0	0
Diptera	Chironomidae	Phaenopsectra obediens grp.	sc	6.5	10	8	1	1	43	0	0
Diptera	Chironomidae	Phaenopsectra punctipes grp.	sc	6.5	2	0	0	4	0	0	1
Diptera	Chironomidae	Polypedilum aviceps	sh	3.65	3	6	1	2	19	0	4
Diptera	Chironomidae	Polypedilum fallax grp.	sh	6.39	0	2	0	5	1	0	1
Diptera	Chironomidae	Polypedilum flavum	sh		1	6	0	0	0	0	0
Diptera	Chironomidae	Polypedilum halterale grp.	sh	7.3	19	1	0	0	0	0	0
Diptera	Chironomidae	Polypedilum illinoense grp.	sh	9	1	3	0	0	0	0	0
Diptera	Chironomidae	Polypedilum scalaenum grp.	sh	8.4	0	3	0	2	1	0	0
Diptera	Chironomidae	Potthastia longimana	cg	6.5	3	2	1	0	0	0	0
Diptera	Chironomidae	Procladius sp.	pr	9.1	21	2	1	0	0	0	0
Diptera	Chironomidae	Pseudochironomus sp.		5.36	72	12	0	0	0	0	1
Diptera	Chironomidae	Rheocricotopus robacki	cg	7.28	0	2	0	0	0	0	0
Diptera	Chironomidae	Rheotanytarsus exiguus grp.	fc	5.89	0	3	0	0	1	0	0
Diptera	Chironomidae	Rheotanytarsus pellucidus	fc	5.89	15	3	0	0	0	0	0
Diptera	Chironomidae	Saetheria tylus	cg	7.07	0	1	0	0	0	0	0
Diptera	Chironomidae	Stempellinella fimbriata		4.62	11	7	3	1	7	1	2
Diptera	Chironomidae	Stempellinella leptocelloides		4.62	2	4	1	0	0	0	0
Diptera	Chironomidae	Stenochironomus sp.	cg	6.45	2	1	0	2	0	1	0
Diptera	Chironomidae	Stilocladius clinopten		0.98	0	0	0	1	0	0	0
Diptera	Chironomidae	Stictochironomus devinctus	cg	6.52	1	4	1	0	0	0	0
Diptera	Chironomidae	Tanytarsus sp. A	fc	6.76	3	3	0	0	0	0	0
Diptera	Chironomidae	Tanytarsus sp. C	fc	6.76	3	1	2	0	0	2	1
Diptera	Chironomidae	Tanytarsus sp. L	fc	6.76	2	1	0	0	0	0	0

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Diptera	Chironomidae	Tanytarsus sp. M	fc	6.76	1	0	2	1	0	1	0
Diptera	Chironomidae	Tanytarsus sp. O	fc	6.76	0	2	0	1	1	0	0
Diptera	Chironomidae	Tanytarsus sp. U	fc	6.76	0	2	0	0	0	0	0
Diptera	Chironomidae	Thienemanniella lobapodema	cg	5.9	0	0	0	1	0	0	0
Diptera	Chironomidae	Thienemanniella xena	cg	5.9	1	0	1	0	2	0	7
Diptera	Chironomidae	Thienemannimyia grp. sp.	pr		76	89	8	5	24	2	5
Diptera	Chironomidae	Tribelos jucundum	cg	6.3	5	76	2	18	6	2	0
Diptera	Chironomidae	Trissopelopia ogemawi	pr		0	0	0	1	8	0	2
Diptera	Chironomidae	Tvetenia paucunca	cg		1	0	2	2	7	2	7
Diptera	Chironomidae	Unniella multivirga			0	0	2	0	0	2	0
Diptera	Chironomidae	Xylotopus par		5.99	3	4	0	1	0	0	0
Diptera	Chironomidae	Zavreliomyia thryptica cmplx	pr		0	0	3	2	3	1	3
Diptera	Culicidae	Anopheles sp.	fc	8.58	4	1	0	0	0	0	0
Diptera	Dixidae	Dixa sp.	fc	2.55	0	0	0	4	0	1	5
Diptera	Empididae	Clinocera sp.			0	0	2	0	0	0	1
Diptera	Empididae	Hemerodromia sp.	pr		3	1	1	0	0	0	0
Diptera	Ptychopteridae	Ptychoptera sp.	cg		0	0	0	0	0	0	1
Diptera	Sciaridae	Sciara sp.			0	0	2	0	0	0	0
Diptera	Simuliidae	Simulium sp. (imm.)	fc		108	10	5	0	2	6	1
Diptera	Simuliidae	Simulium tuberosum	fc	4.42	25	1	0	0	0	0	0
Diptera	Simuliidae	Simulium ubiquitum	fc		0	0	0	0	0	0	1
Diptera	Simuliidae	Simulium vandali	fc		0	0	0	0	0	0	0
Diptera	Tabanidae	Chrysops sp.	pr	6.73	10	15	0	0	0	0	0
Diptera	Tipulidae	Antocha sp.	cg	4.25	3	1	0	0	0	1	1
Diptera	Tipulidae	Dicranota sp.	pr	0	0	0	0	0	0	0	0
Diptera	Tipulidae	Erioptera sp.	cg	4.62	1	2	0	0	0	0	0
Diptera	Tipulidae	Hexatoma sp.	pr	4.31	3	0	2	7	2	1	1
Diptera	Tipulidae	Limnophila sp.	pr		0	0	0	0	0	0	0
Diptera	Tipulidae	Pilaria sp.	pr		3	1	0	2	0	0	3
Diptera	Tipulidae	Pseudolimnophila sp.		7.22	0	0	0	8	1	5	6
Diptera	Tipulidae	Tipula sp.	sh	7.33	5	37	48	70	47	7	57
Ephemeroptera	Ameletidae	Ameletus lineatus	sc	2.38	0	0	1	0	0	0	0
Ephemeroptera	Baetidae	Acerpenna pygmaea	cg	3.9	0	0	0	0	1	0	1
Ephemeroptera	Baetidae	Baetis intercalaris	cg	4.99	45	49	0	0	0	0	0
Ephemeroptera	Baetidae	Baetis pluto	cg	4.28	2	1	7	0	0	3	22
Ephemeroptera	Baetidae	Centroptilium sp.	cg	6.6	26	8	0	0	0	0	1
Ephemeroptera	Baetidae	Dipheteron hageni		1.6	0	0	0	10	0	1	9
Ephemeroptera	Baetidae	Procladius sp.	cg	5	8	5	0	0	0	0	0

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Ephemeroptera	Baetidae	Pseudocloeon propinquum		5.8	12	10	0	0	0	0	0
Ephemeroptera	Baetiscidae	Baetisca carolina	cg	3.47	5	2	1	0	0	0	0
Ephemeroptera	Caenidae	Caenis diminuta	cg	7.41	217	20	0	0	0	0	1
Ephemeroptera	Caenidae	Sparbarus maculatus	cg		4	2	0	0	0	0	0
Ephemeroptera	Ephemerellidae	Ephemerella sp. (imm.)	cg	2.04	5	2	0	0	0	0	0
Ephemeroptera	Ephemerellidae	Eurylophella doris	cg	4.3	2	1	10	1	4	8	5
Ephemeroptera	Ephemerellidae	Eurylophella funeralis	cg	2.05	0	1	0	0	0	0	1
Ephemeroptera	Ephemerellidae	Teloganopsis deficiens	cg	2.8	0	0	0	0	0	0	7
Ephemeroptera	Ephemeridae	Ephemerella sp. (imm.)	cg		0	0	0	0	0	0	1
Ephemeroptera	Ephemeridae	Ephemerella guttulata	cg	0	0	0	1	0	0	0	0
Ephemeroptera	Ephemeridae	Hexagenia limbata	cg	4.9	35	20	3	0	0	0	0
Ephemeroptera	Heptageniidae	Leucrocota sp. (imm.)	sc	2.4	9	2	0	0	0	24	0
Ephemeroptera	Heptageniidae	Maccaffertium sp. (imm.)	sc		27	31	19	0	2	36	16
Ephemeroptera	Heptageniidae	Maccaffertium carlsoni	sc	2.1	0	0	14	7	1	3	38
Ephemeroptera	Heptageniidae	Maccaffertium modestum	sc	5.5	79	101	30	1	24	15	19
Ephemeroptera	Heptageniidae	Maccaffertium pudicum	sc	2	0	0	20	0	0	2	1
Ephemeroptera	Heptageniidae	Stenacron interpunctatum	sc	6.87	2	2	0	0	0	13	0
Ephemeroptera	Heptageniidae	Stenacron pallidum	sc	2.72	2	2	5	0	4	0	12
Ephemeroptera	Isonychiidae	Isonychia sp.	fc	3.45	198	88	2	0	0	3	1
Ephemeroptera	Leptohyphidae	Tricorythodes sp.	cg	5.06	4	1	0	0	0	0	0
Ephemeroptera	Leptophlebiae	Habrophlebia vibrans		0	0	0	8	0	0	10	40
Ephemeroptera	Leptophlebiae	Leptophlebia bradleyi	cg	3	7	6	17	15	26	1	72
Hemiptera	Gerridae	Aquarius regimis	pr		0	0	0	0	0	0	0
Hemiptera	Hebridae	Genus species (imm.)	pr		0	0	0	0	0	1	0
Hemiptera	Veliidae	Microvelia sp. (imm.)	pr		0	0	0	0	0	0	0
Hemiptera	Veliidae	Microvelia americana	pr		0	0	0	0	0	0	0
Hemiptera	Veliidae	Microvelia paludicola	pr		0	0	0	1	0	0	0
Hemiptera	Veliidae	Rhagovelia obesa	pr		0	1	0	0	0	0	1
Megaloptera	Corydalidae	Corydalus cornutus	pr	5.16	22	0	0	0	0	0	0
Megaloptera	Corydalidae	Nigronia fasciatus	pr	5.55	0	0	0	5	5	6	4
Megaloptera	Corydalidae	Nigronia serricornis	pr	4.95	2	0	9	0	0	2	1
Megaloptera	Silidae	Sialis aequalis	pr	7.17	1	0	5	0	0	0	0
Odonata	Aeshnidae	Boyeria vinosa	pr	5.89	4	4	1	0	0	1	2
Odonata	Calopterygidae	Calopteryx maculata	pr	8.3	18	13	2	1	0	0	3
Odonata	Coenagrionidae	Argia sp. (imm.)	pr	8.17	38	8	0	0	0	0	0
Odonata	Coenagrionidae	Argia fumipennis	pr	8.17	5	2	0	0	0	0	0
Odonata	Coenagrionidae	Argia sedula	pr	8.46	2	0	0	0	0	0	0
Odonata	Coenagrionidae	Argia tibialis	pr		7	1	0	0	0	0	0

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Odonata	Coenagrionidae	Enallagma sp. (imm.)	pr	8.91	13	2	0	0	0	0	0
Odonata	Cordulegastridae	Cordulegaster sp. (imm.)	pr	5.73	0	0	1	0	1	0	0
Odonata	Cordulegastridae	Cordulegaster maculata	pr	5.7	0	0	0	0	0	0	0
Odonata	Corduliidae	Neurocordulia sp. (imm.)	pr	5.03	0	0	0	0	2	0	0
Odonata	Corduliidae	Somatochlora georgiana	pr	9.15	0	0	0	0	0	0	0
Odonata	Corduliidae	Somatochlora linearis	pr	9.15	0	0	0	1	1	0	0
Odonata	Gomphidae	Dromogomphus sp. (imm.)	pr	5.92	4	1	0	0	0	0	0
Odonata	Gomphidae	Gomphus sp. (imm.)	pr	5.8	8	6	8	0	2	2	5
Odonata	Gomphidae	Hagenius brevistylus	pr	3.99	1	0	0	0	0	0	0
Odonata	Gomphidae	Ophiogomphus sp. (imm.)	pr	5.54	7	9	0	0	0	0	0
Odonata	Gomphidae	Ophiogomphus mainensis	pr	5.54	5	0	0	0	0	0	0
Odonata	Gomphidae	Progomphus obscurus	pr	8.22	1	3	0	0	0	0	0
Odonata	Gomphidae	Stylogomphus albistylus	pr	4.72	4	1	11	0	0	7	9
Odonata	Gomphidae	Stylurus sp. (imm.)	pr	5.8	1	2	0	0	0	0	0
Odonata	Libellulidae	Genus species (imm.)	pr		0	0	0	0	0	0	0
Odonata	Macromiidae	Macromia sp. (imm.)	pr	6.16	9	3	0	0	0	0	0
Plecoptera	Capniidae	Allocapnia sp.	sh	2.52	169	789	54	18	2	20	4
Plecoptera	Chloroperlidae	Sweltsa lateralis		0	0	0	7	4	0	0	0
Plecoptera	Leuctridae	Leuctra sp.	sh	0.67	0	0	14	50	6	2	31
Plecoptera	Nemouridae	Amphinemoura nigrita	sh	3.33	0	0	0	0	0	0	0
Plecoptera	Nemouridae	Amphinemoura wui	sh	3.33	0	0	1	0	0	0	2
Plecoptera	Peltoperlidae	Tallaperla sp.	sh	1.2	0	0	18	91	0	5	21
Plecoptera	Perlidae	Acroneuria abnormis	pr	2.06	0	0	23	2	0	4	5
Plecoptera	Perlidae	Acroneuria filicis	pr		0	0	0	0	0	3	1
Plecoptera	Perlidae	Eccopectura xanthenes		3.74	1	1	11	23	0	16	4
Plecoptera	Perlidae	Paragnetina immarginata	pr	1.38	1	0	0	0	0	0	0
Plecoptera	Perlodidae	Genus species (imm.)	pr		0	0	0	0	1	0	0
Plecoptera	Perlodidae	Clioperla clio		4.72	6	18	0	0	0	0	0
Plecoptera	Perlodidae	Diploperla duplicata	pr	2.68	0	0	15	0	0	1	1
Plecoptera	Perlodidae	Isoperla holochlora	pr	0	1	0	0	0	0	0	0
Plecoptera	Perlodidae	Isoperla similis	pr		0	0	1	2	0	0	4
Plecoptera	Taeniopterygidae	Taeniopteryx sp.	sh	5.37	8	15	0	0	0	0	0
Trichoptera	Brachycentridae	Micrasema charonis	sh	0.75	0	0	1	0	0	0	0
Trichoptera	Brachycentridae	Micrasema scotti	sh		0	0	1	0	0	0	0
Trichoptera	Calamoceratidae	Anisocentropus pyraloides	sh	0.85	0	0	17	8	1	1	11
Trichoptera	Calamoceratidae	Heteroplectron americanum	sh	3.23	0	0	4	2	0	2	5
Trichoptera	Hydropsychidae	Ceratopsyche sparna	fc	2.7	1	0	0	0	0	0	0
Trichoptera	Hydropsychidae	Cheumatopsyche sp.	fc	6.22	526	109	36	0	16	7	27

Taxa			FF	TV	KC1	KC2	KC3	KC4	S1	S2	S3
Trichoptera	Hydropsychidae	Diplectrona modesta	fc	2.21	0	0	3	94	102	23	9
Trichoptera	Hydropsychidae	Hydropsyche sp. (imm.)	fc		0	7	1	0	4	0	0
Trichoptera	Hydropsychidae	Hydropsyche betteni/depravata	fc	7.78	63	6	1	0	1	2	0
Trichoptera	Hydroptilidae	Hydroptila sp.	ph	6.22	2	0	0	0	0	0	0
Trichoptera	Lepidostomatidae	Lepidostoma sp.	sh	0.9	0	0	0	5	0	0	0
Trichoptera	Leptoceridae	Oecetis persimilis	pr	4.7	0	1	0	0	0	0	0
Trichoptera	Leptoceridae	Triaenodes ignitus	sh	4.58	48	2	0	0	0	0	0
Trichoptera	Limnephilidae	Genus species (imm.)	sh		0	0	0	0	0	0	0
Trichoptera	Limnephilidae	Pycnopsyche sp. (imm.)	sh	2.52	2	2	6	0	10	6	16
Trichoptera	Limnephilidae	Pycnopsyche scabripennis	sh	2.5	0	0	0	0	0	0	0
Trichoptera	Molannidae	Molanna blenda	sc	6.09	0	0	2	1	0	1	0
Trichoptera	Odontoceridae	Psilotreta frontalis	sc	0	0	0	0	0	0	1	1
Trichoptera	Philopotamidae	Chimarra sp.	fc	2.76	198	55	7	1	1	2	3
Trichoptera	Philopotamidae	Dolophiloides sp.	fc	0.81	0	0	1	0	10	0	0
Trichoptera	Philopotamidae	Wormaldia sp.	fc	2.76	0	0	34	5	0	0	0
Trichoptera	Polycentropodidae	Nyctiophylax moestus	pr	3.3	4	1	0	0	0	0	0
Trichoptera	Polycentropodidae	Polycentropus sp.	pr	3.53	1	2	4	2	0	7	2
Trichoptera	Psychomyiidae	Lype diversa	sc	4.05	28	4	9	1	0	2	1
Trichoptera	Rhyacophilidae	Rhyacophila appalachian	pr		0	0	0	0	0	0	0
Trichoptera	Rhyacophilidae	Rhyacophila carolina	pr	0	1	0	20	15	2	3	5
Trichoptera	Rhyacophilidae	Rhyacophila fenestra/ledra	pr	3.86	0	0	0	0	0	0	0
Trichoptera	Rhyacophilidae	Rhyacophila nigrita	pr	0	0	0	0	0	0	0	1
Trichoptera	Rhyacophilidae	Rhyacophila torva	pr	1.59	0	0	1	0	0	0	1
Trichoptera	Rhyacophilidae	Rhyacophila sp. A (indet)	pr		0	0	0	0	0	0	0
Veneroida	Corbiculidae	Corbicula fluminea	fc	6.12	53	21	0	0	0	0	0
Veneroida	Sphaeridae	Genus species	fc		9	0	4	0	1	0	4
Neotaenioglossa	Pleuroceridae	Goniobasis proxima	sc		0	0	46	1	3	52	27
Pulmonata	Ancylidae	Ferrissia rivularis	sc	6.55	30	0	0	0	2	0	5
Pulmonata	Lymnaeidae	Lymnaea columella	sc	7.65	20	0	0	0	0	0	0
Pulmonata	Physidae	Physa sp.	sc	8.84	23	8	0	0	0	0	0
Pulmonata	Planorbidae	Menetus dilatatus	sc	8.23	1	0	0	0	0	0	0

Appendix 2. Benthic macroinvertebrate inventory, functional feeding designations (FF) and tolerance values (TV) for Kings Mountain National Military Park collected fall 2009, for sites located on Long Branch (T1, T2, T3), Pole Branch (T4), Dillinghouse Branch (DH1), Stonehouse Branch (SH1), and Garner Branch (GB1, GB2). Functional feeding designation of p = predator, cg = gatherer collector, fc = filterer collector, sc = scraper and sh = shredder. Life stages are assumed to be larval or nymph unless indicated by L = Larvae, P = Pupae, or A = Adult. Benthic macroinvertebrates not achieving desired taxonomic level of identification are indicated by imm. = immature, dam. = damaged, or gender.

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Oligochaeta	Family	Genus species			2	1	2	4	0	3	2	3
Amphipoda	Crangonyctidae	Crangonyx sp.	cg	7.87	1	4	7	10	244	115	58	305
Amphipoda	Hyalellidae	Hyalella azteca cmplx	cg	7.75	0	0	0	0	0	0	0	0
Decapoda	Cambaridae	Cambaridae (imm.)		7.5	0	0	6	0	0	0	0	0
Decapoda	Cambaridae	Cambarus sp. (imm., gender)		7.62	3	6	5	10	15	22	1	20
Decapoda	Cambaridae	Cambarus howardi		7.62	6	0	0	2	0	2	0	0
Decapoda	Cambaridae	Cambarus robustus		4	0	0	0	0	0	1	2	0
Decapoda	Cambaridae	Procambarus sp. (imm., gender)		9.46	11	0	0	0	0	0	2	0
Isopoda	Asellidae	Caecidotea sp.	cg	9.1	3	0	4	0	3	1	3	0
Hydracarina	Family	Genus species		5.53	0	0	0	0	0	0	0	0
Coleoptera	Dryopdidae	Helichus fastigiatus (A)	sc	4.6	0	0	2	0	2	3	4	1
Coleoptera	Dytiscidae	Hydrocolus oblitus (A)	pr		0	0	1	0	0	0	0	0
Coleoptera	Dytiscidae	Ilybius sp. (L)	pr		0	0	0	0	0	0	0	0
Coleoptera	Dytiscidae	Neoporus sp. (L)		8.62	0	0	0	0	0	0	0	0
Coleoptera	Dytiscidae	Neoporus stratiopunctatus (A)		8.62	0	0	0	0	1	0	0	0
Coleoptera	Dytiscidae	Neoporus undulatus (A)		8.62	1	0	2	0	0	0	0	0
Coleoptera	Elmidae	Anycronyx variegata (L,A)	cg	6.49	0	0	0	0	0	0	0	0
Coleoptera	Elmidae	Dubiraphia sp. (L)		5.93	1	0	1	0	1	1	0	0
Coleoptera	Elmidae	Dubiraphia vittata (A)		4.1	0	0	0	0	0	1	0	0
Coleoptera	Elmidae	Macronychus glabratus (L,A)	cg	4.58	1	0	0	0	0	1	0	0
Coleoptera	Elmidae	Microcylloepus pusillus (L)		2.11	0	0	0	0	0	0	0	0
Coleoptera	Elmidae	Microcylloepus pusillus lodingi (A)		2.11	0	0	0	0	0	0	0	0
Coleoptera	Elmidae	Optioservus sp. (L)	sc	2.36	23	17	4	12	4	8	0	0
Coleoptera	Elmidae	Oulimnius sp. (L)		1.8	35	61	38	128	128	160	1	42
Coleoptera	Elmidae	Oulimnius latiusculus (A)		1.78	1	0	2	2	0	0	0	0
Coleoptera	Elmidae	Promoresia tardella (L,A)		0	0	12	9	0	0	0	0	0
Coleoptera	Elmidae	Stenelmis sp. (L)	sc	5.1	2	0	0	5	3	1	2	1
Coleoptera	Elmidae	Stenelmis convexula (A)	sc	5.1	2	0	0	1	0	0	0	1

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Coleoptera	Elmidae	Stenelmis lignicola (A)	sc	3	0	0	0	1	0	0	0	1
Coleoptera	Gyrinidae	Dineutus ciliatus (A)	pr	5.54	0	0	0	0	0	0	0	0
Coleoptera	Gyrinidae	Dineutus dicolor (A)	pr	5.54	0	0	0	0	0	0	0	0
Coleoptera	Gyrinidae	Gyrinus aeneolus (A)	pr	6.17	0	0	0	0	0	0	0	0
Coleoptera	Hydrophilidae	Tropisternus natator (A)	cg	9.68	0	0	0	0	0	0	0	0
Coleoptera	Psephenidae	Ectopria sp. (L)	sc	4.16	5	7	4	5	1	0	2	1
Coleoptera	Psephenidae	Psephenus herricki (L)	sc	2.35	35	32	9	10	4	23	0	31
Coleoptera	Ptilodactylidae	Anchytarsus bicolor (L)	sh	3.64	60	23	154	5	2	9	5	10
Diptera	Ceratopogonidae	Bezzia/Palpomia cmplx	pr	6.86	1	1	0	0	1	1	0	0
Diptera	Ceratopogonidae	Ceratopogon sp.	pr		0	0	0	0	0	0	0	0
Diptera	Ceratopogonidae	Culiciodes sp.	pr	7.7	0	0	0	0	0	0	0	0
Diptera	Ceratopogonidae	Probezzia sp.	pr		0	0	0	2	1	0	0	1
Diptera	Ceratopogonidae	Sphaeromias sp.	pr		0	1	0	0	0	1	0	0
Diptera	Chironomidae	Ablabesmyia janata	pr	7.4	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Ablabesmyia mallochi	pr	7.19	0	1	0	0	0	0	0	0
Diptera	Chironomidae	Brillia flavifrons	sh	5.2	2	0	0	2	6	5	0	0
Diptera	Chironomidae	Chironomus sp.	cg	9.63	3	0	0	0	0	0	0	0
Diptera	Chironomidae	Cladotanytarsus sp. F	cg	3.2	0	2	0	0	0	0	0	0
Diptera	Chironomidae	Clinotanytus sp.	pr		0	0	0	0	0	0	0	0
Diptera	Chironomidae	Corynoneura sp.	cg		1	1	1	0	1	0	0	0
Diptera	Chironomidae	Corynoneura sp. C	cg		0	1	2	0	1	0	3	1
Diptera	Chironomidae	Cricotopus bicinctus	sh	8.5	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Cricotopus politus	sh		2	6	3	1	0	3	1	0
Diptera	Chironomidae	Cricotopus triannulatus / infuscatus	sh	9	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Cryptochironomus sp.	pr	6.4	0	3	0	0	0	1	2	0
Diptera	Chironomidae	Cryptotendipes sp.		6.19	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Dicrotendipes neomodestus	cg	8.1	0	0	0	0	0	0	1	0
Diptera	Chironomidae	Dicrotendipes simpsoni	cg	9.95	2	0	0	0	0	0	0	0
Diptera	Chironomidae	Diplocladius cultriger	cg	7.41	50	78	7	12	24	3	8	6
Diptera	Chironomidae	Eukiefferiella sp. (indet.)	cg		11	26	13	3	0	0	0	1
Diptera	Chironomidae	Eukiefferiella brehmi grp.	cg	2.7	3	6	6	5	0	1	0	0
Diptera	Chironomidae	Eukiefferiella claripennis	cg	5.6	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Eukiefferiella tirolensis	cg		0	0	0	0	0	0	4	0
Diptera	Chironomidae	Hydrobaenus sp. O	sc	9.54	0	1	0	0	1	0	0	0
Diptera	Chironomidae	Kiefferulus sp.	cg	8	1	0	0	0	0	0	0	0
Diptera	Chironomidae	Labrundinia pilosella	pr	5.91	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Micropsectra dives / geminata	cg		0	1	0	0	3	4	0	0
Diptera	Chironomidae	Micropsectra sp. D	cg		1	0	0	0	0	0	0	0

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Diptera	Chironomidae	Microtendipes pedellus grp.	fc	5.5	53	108	41	25	62	38	29	22
Diptera	Chironomidae	Microtendipes rydalensis grp.	fc	6.2	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Nanocladius brachicolus	cg	7.07	6	0	2	2	0	3	0	1
Diptera	Chironomidae	Nanocladius crassicornis / rectinervis	cg	7.07	0	1	0	0	0	0	1	0
Diptera	Chironomidae	Natarsia baltimorea	pr	9.95	0	0	0	0	1	0	0	0
Diptera	Chironomidae	Nilothauma sp.		5.03		1	1	0	0	0	1	0
Diptera	Chironomidae	Parachaetocladius abnobaesus	cg	0	31	3	8	26	0	0	6	35
Diptera	Chironomidae	Paracladopelma undine		4.93	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Parakiefferiella sp. A	cg	5.4	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Paralauterborniella nigrohalteralis	cg	4.77	0	0	1	0	0	0	0	0
Diptera	Chironomidae	Paramerina sp.		4.29	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Parametriocnemus sp.	cg	3.65	1	3	1	0	0	5	1	2
Diptera	Chironomidae	Paraphaenocladius sp.	cg		2	3	2	3	4	6	1	2
Diptera	Chironomidae	Paratanytarsus dissimilis		8.45	0	0	0	0	0	0	2	0
Diptera	Chironomidae	Paratendipes albimanus	cg	5.11	1	1	0	0	4	1	1	1
Diptera	Chironomidae	Phaenopsectra obediens grp.	sc	6.5	4	0	8	1	10	0	9	0
Diptera	Chironomidae	Phaenopsectra punctipes grp.	sc	6.5	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Polypedilum aviceps	sh	3.65	15	7	1	3	3	6	1	0
Diptera	Chironomidae	Polypedilum fallax grp.	sh	6.39	0	0	0	1	0	1	0	0
Diptera	Chironomidae	Polypedilum flavum	sh		1	0	0	0	0	0	0	0
Diptera	Chironomidae	Polypedilum halterale grp.	sh	7.3	0	1	0	0	0	0	0	0
Diptera	Chironomidae	Polypedilum illinoense grp.	sh	9	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Polypedilum scalaenum grp.	sh	8.4	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Potthastia longimana	cg	6.5	4	1	0	2	0	7	0	1
Diptera	Chironomidae	Procladius sp.	pr	9.1	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Pseudochironomus sp.		5.36	0	4	0	0	3	0	0	0
Diptera	Chironomidae	Rheocricotopus robacki	cg	7.28	1	1	0	0	0	1	0	0
Diptera	Chironomidae	Rheotanytarsus exiguus grp.	fc	5.89	0	0	0	1	0	0	0	0
Diptera	Chironomidae	Rheotanytarsus pellucidus	fc	5.89	0	1	0	0	0	0	0	0
Diptera	Chironomidae	Saetheria tylus	cg	7.07	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Stempellinella fimbriata		4.62	0	2	2	3	2	6	0	0
Diptera	Chironomidae	Stempellinella leptocelloides		4.62	0	1	0	0	1	0	0	0
Diptera	Chironomidae	Stenochironomus sp.	cg	6.45	1	1	1	0	0	0	1	0
Diptera	Chironomidae	Stilocladius clinopten		0.98	6	0	0	1	1	0	0	0
Diptera	Chironomidae	Stictochironomus devinctus	cg	6.52	1	0	0	0	0	0	0	0
Diptera	Chironomidae	Tanytarsus sp. A	fc	6.76	0	0	1	0	0	5	0	0
Diptera	Chironomidae	Tanytarsus sp. C	fc	6.76	2	0	0	0	0	0	1	0
Diptera	Chironomidae	Tanytarsus sp. L	fc	6.76	0	1	0	0	0	0	0	0

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Diptera	Chironomidae	Tanytarsus sp. M	fc	6.76	0	3	3	1	1	5	0	0
Diptera	Chironomidae	Tanytarsus sp. O	fc	6.76	0	0	1	0	0	0	0	0
Diptera	Chironomidae	Tanytarsus sp. U	fc	6.76	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Thienemanniella lobapodema	cg	5.9	0	0	0	0	0	0	0	0
Diptera	Chironomidae	Thienemanniella xena	cg	5.9	0	4	0	0	1	1	0	0
Diptera	Chironomidae	Thienemannimyia grp. sp.	pr		0	1	3	2	8	18	5	1
Diptera	Chironomidae	Tribelos jucundum	cg	6.3	10	4	0	0	104	2	8	0
Diptera	Chironomidae	Trissopelopia ogemawi	pr		0	0	0	0	0	1	0	3
Diptera	Chironomidae	Tvetenia paucunca	cg		5	3	0	0	0	2	27	2
Diptera	Chironomidae	Unniella multivirga			0	8	3	1	3	0	2	0
Diptera	Chironomidae	Xylotopus par		5.99	0	1	0	0	2	0	1	0
Diptera	Chironomidae	Zavreliomyia thryptica cmplx	pr		1	0	0	0	3	0	1	1
Diptera	Culicidae	Anopheles sp.	fc	8.58	0	0	0	0	0	0	0	0
Diptera	Dixidae	Dixa sp.	fc	2.55	0	0	1	0	2	4	0	1
Diptera	Empididae	Clinocera sp.			0	0	0	0	2	0	0	0
Diptera	Empididae	Hemerodromia sp.	pr		0	0	0	0	0	0	0	0
Diptera	Ptychopteridae	Ptychoptera sp.	cg		0	0	0	0	0	0	0	0
Diptera	Sciaridae	Sciara sp.			0	0	1	0	0	0	0	0
Diptera	Simuliidae	Simulium sp. (imm.)	fc		2	2	3	0	4	0	0	0
Diptera	Simuliidae	Simulium tuberosum	fc	4.42	0	0	0	0	0	0	0	0
Diptera	Simuliidae	Simulium ubiquitum	fc		0	0	0	0	0	4	2	0
Diptera	Simuliidae	Simulium vandali	fc		0	0	0	0	0	0	1	0
Diptera	Tabanidae	Chrysops sp.	pr	6.73	0	0	0	0	3	0	3	1
Diptera	Tipulidae	Antocha sp.	cg	4.25	0	0	0	1	0	2	0	1
Diptera	Tipulidae	Dicranota sp.	pr	0	0	0	0	0	4	0	0	0
Diptera	Tipulidae	Erioptera sp.	cg	4.62	0	0	0	0	0	0	0	0
Diptera	Tipulidae	Hexatoma sp.	pr	4.31	14	1	3	4	5	14	1	1
Diptera	Tipulidae	Limnophila sp.	pr		0	0	0	0	0	0	0	2
Diptera	Tipulidae	Pilaria sp.	pr		0	0	0	0	0	0	0	0
Diptera	Tipulidae	Pseudolimnophila sp.		7.22	0	0	0	0	1	1	0	1
Diptera	Tipulidae	Tipula sp.	sh	7.33	48	26	15	15	28	74	14	78
Ephemeroptera	Ameletidae	Ameletus lineatus	sc	2.38	0	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	Acerpenna pygmaea	cg	3.9	0	1	0	0	0	0	0	0
Ephemeroptera	Baetidae	Baetis intercalaris	cg	4.99	0	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	Baetis pluto	cg	4.28	6	22	9	0	0	11	3	0
Ephemeroptera	Baetidae	Centropetia sp.	cg	6.6	0	0	0	0	0	0	1	0
Ephemeroptera	Baetidae	Diphetera hageni		1.6	0	0	1	0	0	0	0	0
Ephemeroptera	Baetidae	Procladius sp.	cg	5	0	0	0	0	0	0	0	0

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Ephemeroptera	Baetidae	Pseudocloeon propinquum		5.8	0	0	0	0	0	0	0	0
Ephemeroptera	Baetiscidae	Baetisca carolina	cg	3.47	1	1	0	0	0	5	0	0
Ephemeroptera	Caenidae	Caenis diminuta	cg	7.41	0	0	0	0	1	0	0	0
Ephemeroptera	Caenidae	Sparbarus maculatus	cg		0	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	Ephemerella sp. (imm.)	cg	2.04	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	Eurylophella doris	cg	4.3	15	15	4	13	21	17	6	5
Ephemeroptera	Ephemerellidae	Eurylophella funeralis	cg	2.05	0	0	0	0	4	1	0	1
Ephemeroptera	Ephemerellidae	Teloganopsis deficiens	cg	2.8	0	3	0	0	0	0	0	0
Ephemeroptera	Ephemeridae	Ephemera sp. (imm.)	cg		0	0	0	0	0	0	0	0
Ephemeroptera	Ephemeridae	Ephemera guttulata	cg	0	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemeridae	Hexagenia limbata	cg	4.9	0	0	1	3	0	4	0	1
Ephemeroptera	Heptageniidae	Leucrocuta sp. (imm.)	sc	2.4	6	11	3	1	0	6	0	0
Ephemeroptera	Heptageniidae	Maccaffertium sp. (imm.)	sc		192	79	96	98	37	276	15	25
Ephemeroptera	Heptageniidae	Maccaffertium carlsoni	sc	2.1	1	2	0	0	12	8	7	30
Ephemeroptera	Heptageniidae	Maccaffertium modestum	sc	5.5	99	56	47	0	41	261	17	18
Ephemeroptera	Heptageniidae	Maccaffertium pudicum	sc	2	18	6	59	12	10	26	0	1
Ephemeroptera	Heptageniidae	Stenacron interpunctatum	sc	6.87	2	9	19	4	1	6	33	0
Ephemeroptera	Heptageniidae	Stenacron pallidum	sc	2.72	2	3	13	2	3	9	1	1
Ephemeroptera	Isonychiidae	Isonychia sp.	fc	3.45	60	10	15	2	2	19	0	0
Ephemeroptera	Leptohyphidae	Tricorythodes sp.	cg	5.06	0	0	0	0	0	0	0	0
Ephemeroptera	Leptophlebiidae	Habrophlebia vibrans		0	3	3	2	0	9	5	5	10
Ephemeroptera	Leptophlebiidae	Leptophlebia bradleyi	cg	3	16	9	15	7	17	11	108	9
Hemiptera	Gerridae	Aquarius regimis	pr		0	0	0	0	0	0	1	0
Hemiptera	Hebridae	Genus species (imm.)	pr		0	0	0	0	0	0	0	0
Hemiptera	Veliidae	Microvelia sp. (imm.)	pr		0	0	1	1	0	0	0	0
Hemiptera	Veliidae	Microvelia americana	pr		1	0	0	0	0	0	1	0
Hemiptera	Veliidae	Microvelia paludicola	pr		0	0	0	0	1	0	0	0
Hemiptera	Veliidae	Rhagovelia obesa	pr		1	0	0	0	0	0	0	2
Megaloptera	Corydalidae	Corydalus cornutus	pr	5.16	0	0	0	0	0	0	0	0
Megaloptera	Corydalidae	Nigronia fasciatus	pr	5.55	0	0	1	4	0	2	0	5
Megaloptera	Corydalidae	Nigronia serricornis	pr	4.95	8	6	3	2	6	10	0	2
Megaloptera	Silidae	Sialis aequalis	pr	7.17	1	0	0	0	0	0	0	3
Odonata	Aeshnidae	Boyeria vinosa	pr	5.89	0	2	0	0	0	3	0	0
Odonata	Calopterygidae	Calopteryx maculata	pr	8.3	0	1	1	0	6	2	1	0
Odonata	Coenagrionidae	Argia sp. (imm.)	pr	8.17	0	0	0	0	0	0	0	0
Odonata	Coenagrionidae	Argia fumipennis	pr	8.17	0	0	0	0	0	0	0	0
Odonata	Coenagrionidae	Argia sedula	pr	8.46	0	0	0	0	0	0	0	0
Odonata	Coenagrionidae	Argia tibialis	pr		0	0	0	0	0	0	0	0

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Odonata	Coenagrionidae	Enallagma sp. (imm.)	pr	8.91	0	0	0	0	0	0	0	0
Odonata	Cordulegastridae	Cordulegaster sp. (imm.)	pr	5.73	0	0	2	0	1	1	0	1
Odonata	Cordulegastridae	Cordulegaster maculata	pr	5.7	0	0	1	0	0	1	0	0
Odonata	Corduliidae	Neurocordulia sp. (imm.)	pr	5.03	0	0	0	0	0	0	0	0
Odonata	Corduliidae	Somatochlora georgiana	pr	9.15	0	0	0	0	1	0	1	0
Odonata	Corduliidae	Somatochlora linearis	pr	9.15	0	0	0	0	0	0	0	0
Odonata	Gomphidae	Dromogomphus sp. (imm.)	pr	5.92	0	0	0	0	0	0	0	0
Odonata	Gomphidae	Gomphus sp. (imm.)	pr	5.8	2	0	3	0	1	0	0	2
Odonata	Gomphidae	Hagenius brevistylus	pr	3.99	0	0	0	0	0	0	0	0
Odonata	Gomphidae	Ophiogomphus sp. (imm.)	pr	5.54	0	1	0	0	1	6	0	0
Odonata	Gomphidae	Ophiogomphus mainensis	pr	5.54	0	0	0	0	0	0	0	0
Odonata	Gomphidae	Progomphus obscurus	pr	8.22	1	0	0	0	0	0	0	0
Odonata	Gomphidae	Stylogomphus albistylus	pr	4.72	20	16	19	3	9	8	0	11
Odonata	Gomphidae	Stylurus sp. (imm.)	pr	5.8	0	0	0	0	0	0	0	0
Odonata	Libellulidae	Genus species (imm.)	pr		0	0	1	0	0	0	0	0
Odonata	Macromiidae	Macromia sp. (imm.)	pr	6.16	0	0	0	0	0	0	0	0
Plecoptera	Capniidae	Allocapnia sp.	sh	2.52	147	28	8	6	99	83	12	28
Plecoptera	Chloroperlidae	Sweltsa lateralis		0	0	0	2	0	1	2	1	0
Plecoptera	Leuctridae	Leuctra sp.	sh	0.67	0	0	1	0	10	21	7	21
Plecoptera	Nemouridae	Amphinemoura nigrita	sh	3.33	0	0	0	0	0	1	0	0
Plecoptera	Nemouridae	Amphinemoura wui	sh	3.33	0	11	0	0	0	0	0	0
Plecoptera	Peltoperlidae	Tallaperla sp.	sh	1.2	8	10	3	3	1	26	4	17
Plecoptera	Perlidae	Acroneuria abnormis	pr	2.06	65	6	13	10	0	8	1	2
Plecoptera	Perlidae	Acroneuria filicis	pr		0	0	0	0	0	0	0	0
Plecoptera	Perlidae	Eccoptura xanthenes		3.74	26	7	10	24	4	8	0	6
Plecoptera	Perlidae	Paragnetina immarginata	pr	1.38	0	0	0	0	0	0	0	0
Plecoptera	Perlodidae	Genus species (imm.)	pr		2	0	0	0	2	5	0	0
Plecoptera	Perlodidae	Clioperla clio		4.72	0	0	0	0	0	1	0	0
Plecoptera	Perlodidae	Diploperla duplicata	pr	2.68	8	0	4	6	0	8	0	0
Plecoptera	Perlodidae	Isoperla holochlora	pr	0	0	1	0	0	0	0	0	0
Plecoptera	Perlodidae	Isoperla similis	pr		0	0	0	0	0	0	0	0
Plecoptera	Taeniopterygidae	Taeniopteryx sp.	sh	5.37	1	0	0	1	2	1	0	0
Trichoptera	Brachycentridae	Micrasema charonis	sh	0.75	0	3	4	0	0	0	0	0
Trichoptera	Brachycentridae	Micrasema scotti	sh		0	2	4	0	0	0	0	0
Trichoptera	Calamoceritidae	Anisocentropus pyraloides	sh	0.85	2	0	1	1	1	2	5	5
Trichoptera	Calamoceritidae	Heteroplectron americanum	sh	3.23	3	2	0	0	3	1	8	3
Trichoptera	Hydropsychidae	Ceratopsyche sparna	fc	2.7	0	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	Cheumatopsyche sp.	fc	6.22	457	110	250	184	16	218	6	0

Taxa			FF	TV	T1	T2	T3	T4	DH1	SH1	GB1	GB2
Trichoptera	Hydropsychidae	Dipletrona modesta	fc	2.21	0	0	3	0	21	21	6	26
Trichoptera	Hydropsychidae	Hydropsyche sp. (imm.)	fc		0	0	12	2	1	0	0	0
Trichoptera	Hydropsychidae	Hydropsyche betteni/depravata	fc	7.78	2	3	3	3	0	26	5	0
Trichoptera	Hydroptilidae	Hydroptila sp.	ph	6.22	0	0	3	1	0	0	0	0
Trichoptera	Lepidostomatidae	Lepidostoma sp.	sh	0.9	0	0	5	0	0	0	1	0
Trichoptera	Leptoceridae	Oecetis persimilis	pr	4.7	0	0	0	0	0	0	0	0
Trichoptera	Leptoceridae	Trienodes ignitus	sh	4.58	0	0	0	0	0	0	0	0
Trichoptera	Limnephilidae	Genus species (imm.)	sh		0	1	7	17	0	0	0	0
Trichoptera	Limnephilidae	Pycnopsyche sp. (imm.)	sh	2.52	13	8	0	0	32	50	14	37
Trichoptera	Limnephilidae	Pycnopsyche scabripennis	sh	2.5	0	0	0	0	1	0	0	0
Trichoptera	Molannidae	Molanna blenda	sc	6.09	0	0	0	0	1	0	0	12
Trichoptera	Odontoceridae	Psilotreta frontalis	sc	0	0	0	0	1	0	0	0	0
Trichoptera	Philopotamidae	Chimarra sp.	fc	2.76	90	31	8	30	10	85	35	1
Trichoptera	Philopotamidae	Dolophiloides sp.	fc	0.81	0	1	2	0	0	16	2	0
Trichoptera	Philopotamidae	Wormaldia sp.	fc	2.76	0	1	0	0	0	0	0	0
Trichoptera	Polycentropodidae	Nyctiophylax moestus	pr	3.3	0	0	0	0	0	0	0	0
Trichoptera	Polycentropodidae	Polycentropus sp.	pr	3.53	35	16	9	2	3	9	0	0
Trichoptera	Psychomyiidae	Lype diversa	sc	4.05	10	5	3	3	2	6	1	1
Trichoptera	Rhyacophilidae	Rhyacophila appalachian	pr		0	0	1	0	0	0	0	0
Trichoptera	Rhyacophilidae	Rhyacophila carolina	pr	0	9	1	9	5	4	29	6	4
Trichoptera	Rhyacophilidae	Rhyacophila fenestra/ledra	pr	3.86	0	1	0	0	0	6	0	0
Trichoptera	Rhyacophilidae	Rhyacophila nigrata	pr	0	8	3	3	0	0	3	4	3
Trichoptera	Rhyacophilidae	Rhyacophila torva	pr	1.59	0	0	0	0	0	0	5	0
Trichoptera	Rhyacophilidae	Rhyacophila sp. A (indet)	pr		0	0	1	0	0	0	0	0
Veneroida	Corbiculidae	Corbicula fluminea	fc	6.12	0	0	0	0	0	0	0	0
Veneroida	Sphaeridae	Genus species	fc		1	1	0	0	8	1	7	2
Neotaenioglossa	Pleuroceridae	Goniobasis proxima	sc		17	44	37	2	1	1	23	12
Pulmonata	Ancylidae	Ferrissia rivularis	sc	6.55	1	0	0	2	0	2	2	0
Pulmonata	Lymnaeidae	Lymnaea columella	sc	7.65	0	0	0	0	0	0	0	0
Pulmonata	Physidae	Physa sp.	sc	8.84	0	0	0	0	0	0	0	0
Pulmonata	Planorbidae	Menetus dilatatus	sc	8.23	0	0	0	0	0	0	0	0