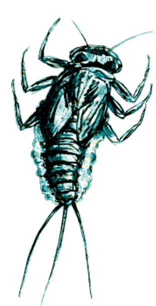
JULY 2013

BIOLOGICAL ASSESSMENT of SITES in the GALLATIN RIVER DRAINAGE, GALLATIN COUNTY, MONTANA:

MACROINVERTEBRATE ASSEMBLAGES

A REPORT TO
THE BLUE WATER TASK FORCE



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INTRODUCTION

With increased development in the watershed, the integrity of the Gallatin River and its tributaries may be threatened by impacts to channel structure and riparian zones as well as by degradation of water quality. Monitoring and assessment of biological assemblages can help to detect whether impacts and degradation are in fact occurring. For the past several years, the Blue Water Task Force (BWTF) has sampled benthic macroinvertebrates for monitoring and assessment of the waters of the Gallatin River drainage. The taxonomic and functional composition of benthic macroinvertebrate assemblages are known to respond to the effects of stressors that may be associated with the accelerating human influences on the River. Such stressors may include pollutants, sediment, thermal impacts and hydrologic alterations, and changes to the natural morphology of river channels and riparian zones.

In mid-September 2012, 4 sites in the Gallatin River watershed were sampled for benthic macroinvertebrates: single, unreplicated samples were collected.

This report begins by describing the methods for processing and identifying these 4 samples. Data resulting from that work were translated into a multimetric index, and scores were calculated. Scores were used to assign impairment classes to the sites. Narrative interpretations of the ecological condition of the macroinvertebrate assemblages are also reported. These narratives use the taxonomic and functional composition, tolerance and sensitivity characteristics, and habits of the benthic invertebrates to describe probable water quality and habitat influences on the assemblages. Interpretations maximize the information available in the data: they do not rely solely on a single cumulative index score which may mask the effects of stressors on the biota.

METHODS

Sample processing

Four macroinvertebrate samples, collected at sites in the Gallatin River drainage in September 2012, were delivered to Rhithron's laboratory facility in Missoula, Montana. All samples arrived in good condition. Table 1 gives site names, identifiers, and other metadata for the samples.

Subsamples of a minimum of 300 organisms were obtained using methods consistent with Montana Department of Environmental Quality (MDEQ) standard procedures (MDEQ 2006): Caton sub-sampling devices (Caton 1991), divided into 30 grids, each approximately 5 cm by 6 cm were used. Each individual sample was thoroughly mixed in its jar(s), poured out and evenly spread into the Caton tray, and individual grids were randomly selected. Grid contents were examined under stereoscopic microscopes using 10x – 30x magnification. All aquatic invertebrates from each selected grid were sorted from the substrate, and placed in 95% ethanol for subsequent identification. Grid selection, examination, and sorting continued until at least 300 organisms were sorted. The final grid was completely sorted of all organisms. If a sample contained fewer than 300 organisms, it was entirely sorted.

Organisms were individually examined using 10x – 80x dissecting scopes (Leica S8E and S6E) and identified to the lowest practical level consistent with MDEQ (MDEQ 2006) data requirements, using appropriate taxonomic references and keys.

Site identifier	Site name	Date sampled	Latitude (degrees North)	Longitude
Upper Middle: Middle Fork of West Fork of Gallatin River	**Upper Middle**	9/13/2012	45.266	-111.321
Ousel: South Fork of West Fork of Gallatin River	**Ousel**	9/13/2012	45.242	-111.335
Lake: South Fork	**Lake**	9/13/2012	45.290	-111.398
Community: Middle Fork of West Fork of Gallatin	**Community**	9/13/2012	45.271	-111.298

Table 1. Site and sample information.

Identification, counts, life stages, and information about the condition of specimens were recorded on bench sheets. To obtain accuracy in richness measures, organisms that could not be identified to the target level specified in MDEQ protocols were designated as “not unique” if other specimens from the same group could be taken to target levels. Organisms designated as “unique” were those that could be definitively distinguished from other organisms in the sample. Identified organisms were preserved in 95% ethanol in labeled vials, and archived at the Rhithron laboratory. Midges were morphotyped using 10x – 80x dissecting microscopes (Leica S8E and S6E) and representative specimens were slide mounted and examined at 200x – 1000x magnification using an Olympus BX 51 compound microscope. Slide mounted organisms were archived at the Rhithron laboratory along with the other identified invertebrates.

Quality control procedures

Quality control (QC) procedures for initial sample processing and subsampling involved checking sorting efficiency. These checks were conducted on 100% of the samples by independent observers who microscopically re-examined 25% of sorted substrate from each sample. All organisms that were missed were counted and this number was added to the total number obtained in the original sort. Sorting efficiency was evaluated by applying the following calculation:

$$SE = \frac{n_1}{n_{1+2}} \times 100$$

where: SE is the sorting efficiency, expressed as a percentage, n_1 is the total number of specimens in the first sort, and n_{1+2} is the total number of specimens in the first and second sorts combined.

Quality assurance procedures for taxonomic determinations of invertebrates involved checking accuracy, precision and enumeration. One sample (25% of samples) was randomly selected and all organisms re-identified and counted by an independent taxonomist. Taxa lists and enumerations were compared by calculating the Percent Taxonomic Difference (PTD), the Percent Disagreement in Enumeration (PDE) (Stribling et al. 2003), and a Bray-Curtis similarity statistic (Bray and Curtis 1957) for the selected sample. Rhithron's internal minimum data quality standards require less than 10% PTD, less than 5% PDE, and 95% similarity as measured by the Bray-Curtis statistic.

Data analysis

Taxa and counts for each sample were entered into Rhithron's database application (RAILIS v.2.1). Life stages, "unique" designations, and the condition of specimens were also entered. Bioassessment metrics were calculated by the database application and a multimetric index developed for montane ecoregions of Montana (Bollman 1998) was calculated and scored.

Narrative interpretations of the taxonomic and functional composition of the aquatic invertebrate assemblages are based on demonstrated associations between assemblage components and habitat and water quality variables gleaned from the published literature, the writer's own research (especially Bollman 1998) and professional judgment, and those of other expert sources (especially Wisseman 1996). These interpretations are not intended to replace canonical procedures for stressor identification, since such procedures require substantial surveys of habitat, and historical and current data related to water quality, land use, point and non-point source influences, soils, hydrology, geology, and other resources that were not readily available for this study. Instead, attributes of invertebrate taxa that are well-substantiated in diverse literature, published and unpublished research, and that are generally accepted by regional aquatic ecologists, are combined into descriptions of probable water quality and instream and reach-scale habitat conditions.

The approach to this analysis uses some assemblage attributes that are interpreted as evidence of water quality and other attributes that are interpreted as evidence of habitat integrity. Attributes are considered individually, so information is maximized by not relying on a single cumulative score, which may mask stress on the biota.

Water quality variables are estimated by examining mayfly taxa richness and the Hilsenhoff Biotic Index (HBI) value. Other indicators of water quality include the richness and abundance of hemoglobin-bearing taxa and the richness of sensitive taxa. Mayfly taxa richness has been demonstrated to be significantly correlated with chemical measures of dissolved oxygen, pH, and conductivity (e.g. Bollman 1998, Fore et al. 1996, Wisseman 1996). The Hilsenhoff Biotic Index (HBI) (Hilsenhoff 1987) has a long history of use and validation (Cairns and Pratt 1993). In Montana foothills, the HBI was demonstrated to be significantly associated with conductivity, pH, water temperature, sediment deposition, and the presence of filamentous algae (Bollman 1998). The presence of filamentous algae is also suspected when macroinvertebrates associated or dependent on it (e.g. LeSage and Harrison 1980, Anderson 1976) are abundant. Nutrient enrichment in Montana streams often results in large crops of filamentous algae (Watson 1988). Sensitive taxa exhibit intolerance to a wide range of stressors (e.g. Wisseman 1996, Hellawell 1986, Friedrich 1990, Barbour et al. 1999), including nutrient enrichment, acidification, thermal stress, sediment deposition, habitat disruption, and others. These taxa are expected to be present in predictable numbers in functioning montane and foothills streams (e.g. Bollman 1998).

Thermal characteristics of the sampled site are predicted by the richness and abundance of cold stenotherm taxa (Clark 1997), and by calculation of the temperature preference of the macroinvertebrate assemblage (Brandt 2001). Hemoglobin-bearing taxa are also indicators of warm water temperatures (Walshe 1947), since dissolved oxygen is directly associated with water temperature; oxygen concentrations can also vary with the degree of nutrient enrichment. Increased temperatures and high nutrient concentrations can, alone or in concert, create conditions favorable to hypoxic sediments, habitats preferred by hemoglobin-bearers.

The condition of instream and streamside habitats is estimated by 3 characteristics of the macroinvertebrate assemblages. Stress from sediment is evaluated by caddisfly richness and by "clinger" richness (Kleindl 1996, Bollman 1998, Karr and Chu 1999). A newer tool, the Fine Sediment Biotic Index (FSBI) (Relyea et al. 2000) shows promise when applied to the montane and foothills regions.

The functional characteristics of macroinvertebrate assemblages are based on the morphology and behaviors associated with feeding, and are interpreted in terms of the River Continuum Concept (Vannote et al. 1980) in the narratives. Alterations from predicted patterns in montane and foothills streams may be interpreted as evidence of water quality or habitat disruption. For example, shredders and the microbes they depend on are sensitive to modifications of the riparian zone (Plafkin et al. 1989).

RESULTS

Quality Control Procedures

Results of quality control procedures for subsampling and taxonomy are given in Table 2. Sorting efficiency averaged 99.39% for all samples, and all 3 quality control parameters for taxonomy and enumeration fell well within internal and accepted industry standards.

Table 2. Results of quality control procedures for subsampling and taxonomy.

Site name	Sample date	PDE	PTD	Bray-Curtis similarity for taxonomy and enumeration (%)
Upper Middle	9/13/2012			
Ousel	9/13/2012			
Lake	9/13/2012	1.32	3.26	98.02
Community	9/13/2012			

Bioassessment

Table 3 summarizes values and scores for metrics in the MVFP bioassessment index (Bollman 1998), which was used to evaluate the aquatic invertebrate assemblages. Results for each sample are reported, and impairment classifications are assigned. Bioassessment scores, as percent of maximum score, are graphed in Figure 1.

When this method is applied to the invertebrate assemblage data, the results suggest that 2 sites (Ousel and Community) were unimpaired. Two sites (Upper Middle and Lake) achieved scores suggesting moderate impairment of biotic integrity.

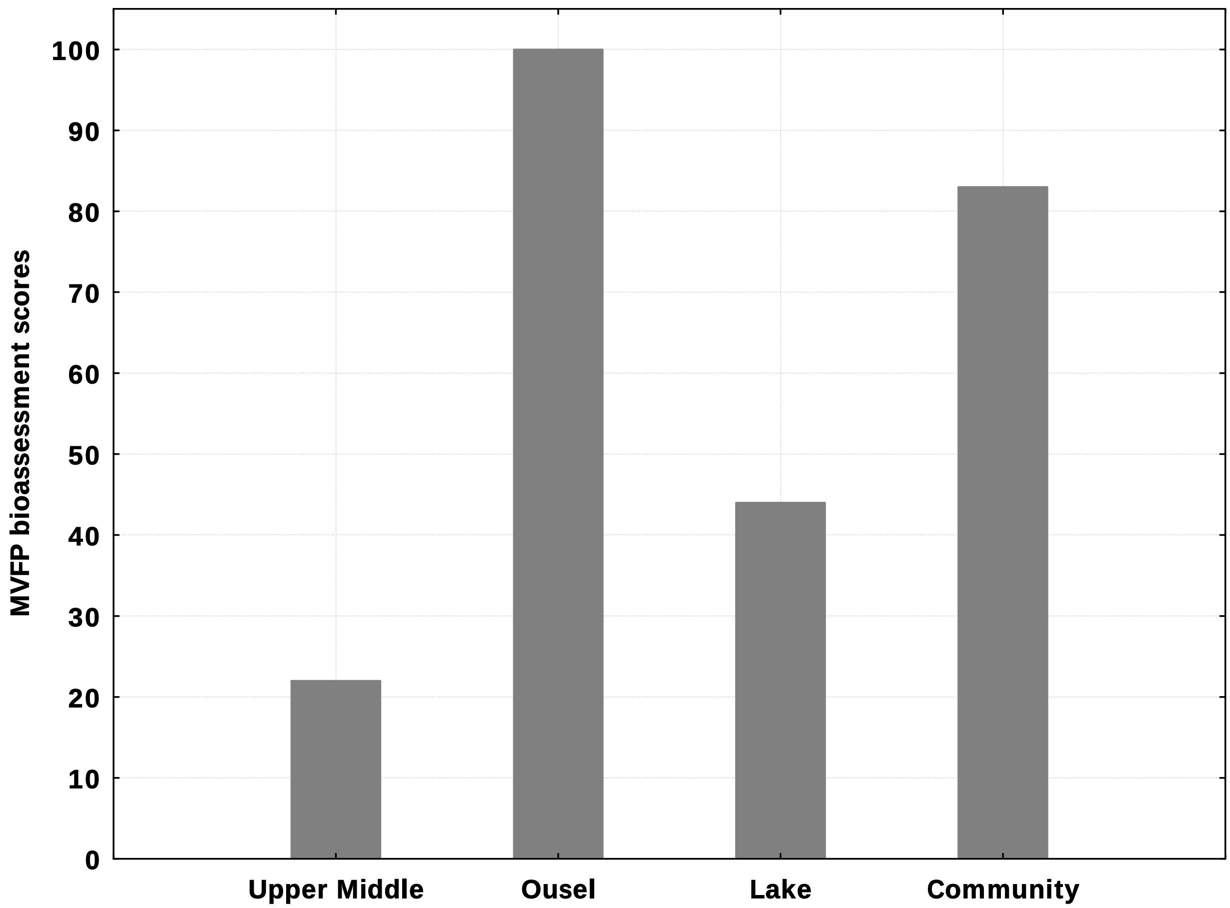

Figure 1. Bioassessment scores (MVFP: Bollman 1998) for sites in the Gallatin River drainage. Samples were collected in September 2012. Scores are given as percent of maximum score.

Table 3. Bioassessment index (MVFP: Bollman 1998) and individual metrics and scores for samples collected at sites in the Gallatin River watershed, September 2012.

	Upper Middle	Ousel	Lake	Community
METRICS				
Ephemeroptera richness	0	9	2	5
Plecoptera richness	0	7	0	1
Trichoptera richness	0	10	0	7
Number of sensitive taxa	0	12	1	4
Percent filterers	0	0.32	4.35	0.89
Percent tolerant taxa	11	0	4.01	0.59
Ephemeroptera richness	0	3	1	2
Plecoptera richness	0	3	0	1
Trichoptera richness	0	3	0	3
Number of sensitive taxa	0	3	1	3
Percent filterers	3	3	3	3
Percent tolerant taxa	1	3	3	3
TOTAL SCORE (max.=18)	**4**	**18**	**8**	**15**
PERCENT OF MAX.	**22**	**100**	**44**	**83**
Impairment classification*	**MOD**	**NON**	**MOD**	**NON**

* Impairment classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired.

Aquatic invertebrate assemblages

Upper Middle

The macroinvertebrate assemblage collected at this site suggests limited habitat availability. Additionally, impaired water quality cannot be ruled out. Diversity was very low: only 7 taxa were collected. The abundance of organisms was also very low: only 79 animals were counted in the entire sample. No mayflies were collected. The biotic index value (4.32) reflects the relative sensitivity of the dominant organism, the elmid beetle *Heterlimnius corpulentus*. The naidid oligochaete *Nais* sp. accounted for 20% of the animals in the sample: this worm may be associated with filamentous algae. Large crops of filamentous algae suggest nutrient enrichment. The thermal preference of the assemblage was calculated at 14.5ºC.

Two of the collected taxa were "clingers", and no caddisflies were encountered. These findings suggest that sediment deposition may have limited colonization of stony substrates. The FSBI could not be reliably calculated due to the low taxa richness. Two semivoltine organisms were present: *Heterlimnius corpulentus* and another elmid, *Optioservus* sp. Although stress from dewatering seems unlikely, thermal stress, or other catastrophic events may have influenced the biota here. The functional composition of the sample was dominated by gatherers. This pattern is sometimes interpreted as evidence of water quality impairment. Shredders were notably absent from the sampled assemblage.

Ousel

Metric indicators of water quality suggest excellent conditions at this site. Nine mayfly taxa were collected, and the biotic index value (2.07) was characteristic of unpolluted water. No fewer than 11 sensitive cold stenotherm taxa were present, including the mayfly *Drunella doddsii*, which was also the most abundant animal, and the stoneflies *Zapada columbiana* and *Doroneuria* sp. Cold, clean water is suggested by these findings. The calculated temperature preference of the assemblage was 11.3ºC.

Ten caddisfly taxa and 23 "clinger" taxa were counted, suggesting that colonization of stony substrate habitats was not limited by sediment deposition. The FSBI value (6.07) indicated a sediment-sensitive assemblage. Overall taxa richness (42) was within expectations for a montane river (Bollman and Bowman 2007). Instream habitats were probably diverse and intact. At least 7 stonefly taxa were supported at this site. Richness in this group may be related to the condition of reach-scale habitat features, such as streambank stability, riparian zone and channel integrity. It seems likely that the site was not subjected to catastrophic dewatering, since 3 long-lived semivoltine taxa were present in the collection. None of these were abundant, however: periodic thermal stress or scour cannot be ruled out. All expected functional groups were well-represented.

Lake

Only 2 mayfly taxa were counted in the sample collected at this site, and each taxon was represented by a single specimen. The biotic index value (7.30) was much higher than expected for a montane river. Water quality may have been impaired in this reach. Oligochaetes, midges, and blackflies (*Simulium* sp.) were the most abundant components of the benthic community. The sample was dominated by *Nais* sp., an oligochaete frequently associated with filamentous algae. This worm accounted for 67% of sampled animals. Large crops of filamentous algae may indicate nutrient enrichment. Copepods were present in small numbers, suggesting that lentic conditions were included in the sampling effort. The turbellarian flatworm *Polycelis coronata* was also represented by a few specimens, suggesting that groundwater may have influenced surface flow in the reach. The thermal preference of the assemblage was calculated at 15.2ºC.

No caddisflies were counted in the sample, and "clingers" were represented by only 5 taxa. Sediment deposition may have impeded colonization of stony substrate habitats. Overall taxa richness (17) was low: instream habitats may have been disrupted or monotonous. The absence of stoneflies may be related to streambank instability, riparian zone disturbance, or altered channel morphology. A single semivoltine taxon was collected; this was the elmid *Optioservus* sp., which was represented in both larval and adult forms. Although it was not abundant, its presence suggests that catastrophic dewatering was probably not influential here. However, periodic thermal stress or sediment scour cannot be ruled out. The functional composition of the assemblage was overwhelmed by gatherers, a pattern that is sometimes interpreted as evidence of water quality impairment. Other expected feeding groups were present, but only in small numbers.

Community

Midges and worms were the dominant taxa in the sample collected at this site. *Nais* sp. accounted for 51% of sampled animals: this worm may be associated with filamentous algae. The dominant midges (Diptera : Chironomidae), which were *Eukiefferiella gracei* and *Orthocladius* spp., are also often associated with filamentous algae. Large crops of filamentous algae suggest that water quality may be impaired by nutrient enrichment. Contrarily, the site also supported at least 3 sensitive cold stenotherm taxa, accounting for 2% of the assemblage. This group included the mayflies *Caudatella hystrix* and *Drunella doddsii*. The thermal preference for the sampled animals was calculated at 13.2ºC.

Caddisflies were represented by 7 taxa, and 15 "clinger" taxa were encountered. Sediment deposition apparently did not influence colonization of stony substrate habitats. Overall taxa richness (27), however, was not as high as expected for a montane river. Instream habitats may have been monotonous or disrupted. Stoneflies were poorly represented: only 2 specimens of *Doroneuria* sp. were present in the sample. Low richness among the stoneflies may be related to reach-scale habitat features such as loss of riparian zone function, unstable streambanks, or altered channel morphology. The presence of 5 semivoltine taxa suggests that stresses due to dewatering, thermal extremes, or scour were probably not influential. The functional composition of the assemblage was strongly dominated by gatherers. This pattern is sometimes interpreted as evidence of water quality impairment. All other expected feeding groups were present in small numbers.

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APPENDIX

Taxa lists and metric summaries

Blue Water Task Force
Gallatin River Watershed

September 2012

Taxa Listing

Project ID: BWTF12GR2
RAI No.: BWTF12GR2001

RAI No.: BWTF12GR2001
Client ID: Upper Middle
Date Coll.: 9/13/2012 No. Jars: 1
Sta. Name: Upper Middle: Middle Fork of West Fork of Gallatin
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Sperchontidae							
Sperchon sp.	1	1.27%	Yes	Adult		11	PR
Oligochaeta							
Enchytraeidae							
Enchytraeus sp.	1	1.27%	Yes	Unknown		4	CG
Naididae							
Nais sp.	16	20.25%	Yes	Unknown		8	CG
Coleoptera							
Elmidae							
Heterlimnius corpulentus	48	60.76%	Yes	Larva		3	CG
Optioservus sp.	2	2.53%	Yes	Adult		5	SC
Optioservus sp.	7	8.86%	No	Larva		5	SC
Diptera							
Ceratopogonidae							
Ceratopogoninae	2	2.53%	Yes	Larva		6	PR
Tipulidae							
Hexatoma sp.	2	2.53%	Yes	Larva		2	PR
Sample Count	79						

RAI No.: BWTF12GR2002
Client ID: Ousel
Date Coll.: 9/13/2012
No. Jars: 2
Sta. Name: Ousel: South Fork of West Fork of Gallatin River
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Nemata	6	1.93%	Yes	Unknown		5	UN
Sperchontidae							
Sperchon sp.	1	0.32%	Yes	Adult		11	PR
Oligochaeta							
Enchytraeidae							
Mesenchytraeus sp.	8	2.57%	Yes	Unknown		4	CG
Ephemeroptera							
Ameletidae							
Ameletus sp.	2	0.64%	Yes	Larva		0	SC
Baetidae							
Baetis sp.	4	1.29%	No	Larva	Damaged	5	CG
Baetis bicaudatus	3	0.96%	Yes	Larva		2	CG
Baetis tricaudatus	1	0.32%	Yes	Larva		4	CG
Ephemerellidae							
Drunella doddsii	49	15.76%	Yes	Larva		1	SC
Drunella spinifera	2	0.64%	Yes	Larva		0	PR
Ephemerella sp.	2	0.64%	Yes	Larva	Early Instar	1.5	SC
Heptageniidae							
Cinygmula sp.	3	0.96%	Yes	Larva		0	SC
Epeorus deceptivus	3	0.96%	Yes	Larva		0	SC
Rhithrogena sp.	47	15.11%	Yes	Larva		0	SC
Plecoptera							
Chloroperlidae							
Sweltsa sp.	21	6.75%	Yes	Larva		0	PR
Nemouridae							
Zapada columbiana	1	0.32%	Yes	Larva		2	SH
Zapada Oregonensis Gr.	12	3.86%	Yes	Larva		2	SH
Perlidae							
Doroneuria sp.	1	0.32%	Yes	Larva		0	PR
Perlodidae							
Megarcys sp.	14	4.50%	Yes	Larva		1	PR
Perlodidae	2	0.64%	No	Larva	Early Instar	2	PR
Skwala sp.	2	0.64%	Yes	Larva		3	PR
Taeniopterygidae							
Taeniopterygidae	12	3.86%	Yes	Larva	Early Instar	2	SH

Taxa Listing

Project ID: BWTF12GR2
RAI No.: BWTF12GR2002

RAI No.: BWTF12GR2002 | Sta. Name: Ousel: South Fork of West Fork of Gallatin River
Client ID: Ousel
Date Coll.: 9/13/2012 | No. Jars: 2 | STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Trichoptera							
Apataniidae							
Apatania sp.	18	5.79%	Yes	Larva		3	SC
Brachycentridae							
Brachycentridae	1	0.32%	Yes	Larva	Early Instar	1	CF
Glossosomatidae							
Glossosoma sp.	1	0.32%	Yes	Larva		0	SC
Hydropsychidae							
Arctopsyche grandis	3	0.96%	Yes	Larva		2	PR
Rhyacophilidae							
Rhyacophila sp.	3	0.96%	No	Pupa		1	PR
Rhyacophila atrata complex	4	1.29%	Yes	Larva		0	PR
Rhyacophila Betteni Gr.	1	0.32%	Yes	Larva		0	PR
Rhyacophila blarina	1	0.32%	Yes	Larva		1	PR
Rhyacophila Hyalinata Gr.	3	0.96%	Yes	Larva		0	PR
Rhyacophila Vofixa Gr.	1	0.32%	Yes	Larva		0	PR
Uenoidae							
Oligophlebodes sp.	15	4.82%	Yes	Larva		3	SC
Coleoptera							
Elmidae							
Heterlimnius corpulentus	2	0.64%	Yes	Larva		3	CG
Diptera							
Ceratopogonidae							
Ceratopogoninae	12	3.86%	Yes	Larva		6	PR
Empididae							
Oreogeton sp.	1	0.32%	Yes	Larva		4	PR
Psychodidae							
Pericoma / Telmatoscopus	1	0.32%	Yes	Larva		4	CG
Tipulidae							
Dicranota sp.	2	0.64%	Yes	Larva		3	PR
Hexatoma sp.	13	4.18%	Yes	Larva		2	PR
Chironomidae							
Chironomidae							
Diamesa sp.	1	0.32%	Yes	Larva		5	CG
Eukiefferiella Devonica Gr.	1	0.32%	Yes	Larva		8	CG
Eukiefferiella Gracei Gr.	3	0.96%	Yes	Larva		8	CG
Nanocladius sp.	1	0.32%	Yes	Pupa		3	CG
Orthocladius sp.	25	8.04%	Yes	Larva		6	CG
Pagastia sp.	1	0.32%	Yes	Larva		1	CG
Thienemannimyia Gr.	1	0.32%	Yes	Larva		5	PR
Sample Count	311						

Taxa Listing

Project ID: BWTF12GR2
RAI No.: BWTF12GR2003

RAI No.: BWTF12GR2003 Sta. Name: Lake: South Fork
Client ID: Lake
Date Coll.: 9/13/2012 No. Jars: 1 STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Copepoda	2	0.67%	Yes	Unknown		8	CG
Ostracoda	2	0.67%	Yes	Unknown		8	CG
Gammaridae							
Gammarus sp.	3	1.00%	Yes	Unknown		4	SH
Planariidae							
Polycelis coronata	2	0.67%	Yes	Unknown		1	OM
Sperchontidae							
Sperchon sp.	1	0.33%	Yes	Adult		11	PR
Oligochaeta							
Naididae							
Nais sp.	197	65.89%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetidae	1	0.33%	Yes	Larva	Early Instar	4	CG
Ephemerellidae							
Ephemerella sp.	1	0.33%	Yes	Larva	Early Instar	1.5	SC
Coleoptera							
Elmidae							
Elmidae	6	2.01%	No	Larva	Early Instar	4	CG
Optioservus sp.	2	0.67%	Yes	Adult		5	SC
Optioservus sp.	1	0.33%	No	Larva		5	SC
Diptera							
Muscidae							
Muscidae	4	1.34%	Yes	Larva		10	PR
Simuliidae							
Simulium sp.	13	4.35%	Yes	Larva		6	CF
Chironomidae							
Chironomidae							
Cricotopus (Isocladius) sp.	1	0.33%	Yes	Larva		7	SH
Cricotopus trifascia	2	0.67%	Yes	Larva		7	SH
Orthocladiinae	9	3.01%	No	Larva	Early Instar	6	CG
Orthocladius sp.	48	16.05%	Yes	Larva		6	CG
Parachironomus sp.	2	0.67%	Yes	Larva		10	PR
Potthastia Longimana Gr.	1	0.33%	Yes	Larva		2	CG
Tvetenia Bavarica Gr.	1	0.33%	Yes	Larva		5	CG
Sample Count	299						

Taxa Listing

Project ID: BWTF12GR2
RAI No.: BWTF12GR2004

RAI No.: BWTF12GR2004
Sta. Name: Community: Middle Fork of West Fork of Gallatin
Client ID: Community
Date Coll.: 9/13/2012
No. Jars: 1
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Other Non-Insect							
Cladocera	1	0.30%	Yes	Unknown		8	CF
Lebertiidae							
Lebertia sp.	1	0.30%	Yes	Adult		8	PR
Sperchontidae							
Sperchon sp.	1	0.30%	Yes	Adult		11	PR
Oligochaeta							
Enchytraeidae							
Mesenchytraeus sp.	1	0.30%	Yes	Unknown		4	CG
Naididae							
Nais sp.	174	51.48%	Yes	Unknown		8	CG
Ephemeroptera							
Baetidae							
Baetis sp.	16	4.73%	No	Larva	Early Instar	5	CG
Baetis tricaudatus	4	1.18%	Yes	Larva		4	CG
Ephemerellidae							
Caudatella hystrix	2	0.59%	Yes	Larva		0	SC
Drunella doddsii	4	1.18%	Yes	Larva		1	SC
Drunella grandis	1	0.30%	Yes	Larva		2	PR
Ephemerella sp.	3	0.89%	Yes	Larva	Early Instar	1.5	SC
Plecoptera							
Perlidae							
Doroneuria sp.	2	0.59%	Yes	Larva		0	PR
Trichoptera							
Brachycentridae							
Amiocentrus aspilus	1	0.30%	Yes	Larva		3	CG
Brachycentrus americanus	2	0.59%	Yes	Larva		1	CF
Micrasema sp.	2	0.59%	Yes	Larva		1	SH
Glossosomatidae							
Glossosoma sp.	18	5.33%	Yes	Larva		0	SC
Hydropsychidae							
Arctopsyche grandis	5	1.48%	Yes	Larva		2	PR
Rhyacophilidae							
Rhyacophila atrata complex	1	0.30%	Yes	Larva		0	PR
Rhyacophila Hyalinata Gr.	2	0.59%	Yes	Larva		0	PR
Coleoptera							
Elmidae							
Heterlimnius corpulentus	2	0.59%	Yes	Larva		3	CG
Optioservus sp.	1	0.30%	No	Larva		5	SC
Optioservus sp.	1	0.30%	Yes	Adult		5	SC
Diptera							
Tipulidae							
Antocha monticola	1	0.30%	Yes	Larva		3	CG

Taxa Listing

Project ID: BWTF12GR2
RAI No.: BWTF12GR2004

RAI No.: BWTF12GR2004
Sta. Name: Community: Middle Fork of West Fork of Gallatin
Client ID: Community
Date Coll.: 9/13/2012
No. Jars: 1
STORET ID:

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Chironomidae							
Chironomidae							
Cricotopus trifascia	9	2.66%	Yes	Larva		7	SH
Eukiefferiella sp.	7	2.07%	No	Pupa		8	CG
Eukiefferiella Devonica Gr.	12	3.55%	Yes	Larva		8	CG
Eukiefferiella Gracei Gr.	33	9.76%	Yes	Larva		8	CG
Orthocladiinae	1	0.30%	No	Pupa	Damaged	6	CG
Orthocladius sp.	1	0.30%	No	Pupa		6	CG
Orthocladius sp.	25	7.40%	Yes	Larva		6	CG
Pagastia sp.	3	0.89%	Yes	Larva		1	CG
Tvetenia Bavarica Gr.	1	0.30%	Yes	Larva		5	CG
Sample Count	338						

Metrics Report

Project ID: BWTF12GR2
RAI No.: BWTF12GR2001
Sta. Name: Upper Middle: Middle Fork of West Fork of Gallatin
Client ID: Upper Middle
STORET ID
Coll. Date: 9/13/2012

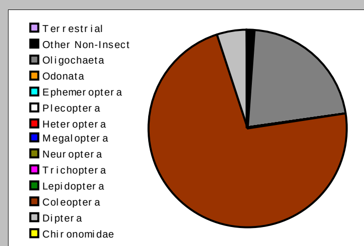
Abundance Measures

Sample Count: 79
Sample Abundance: 79.00 100.00% of sample used

Coll. Procedure: KICK
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	1	1	1.27%
Oligochaeta	2	17	21.52%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera	2	57	72.15%
Diptera	2	4	5.06%
Chironomidae			

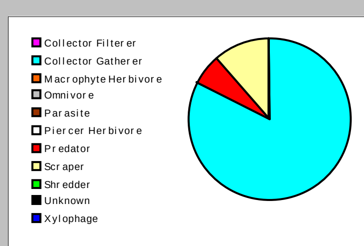


Dominant Taxa

Category	A	PRA
Heterlimnius corpulentus	48	60.76%
Nais	16	20.25%
Optioservus	9	11.39%
Hexatoma	2	2.53%
Ceratopogoninae	2	2.53%
Sperchon	1	1.27%
Enchytraeus	1	1.27%

Functional Composition

Category	R	A	PRA
Predator	3	5	6.33%
Parasite			
Collector Gatherer	3	65	82.28%
Collector Filterer			
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	1	9	11.39%
Shredder			
Omnivore			
Unknown			

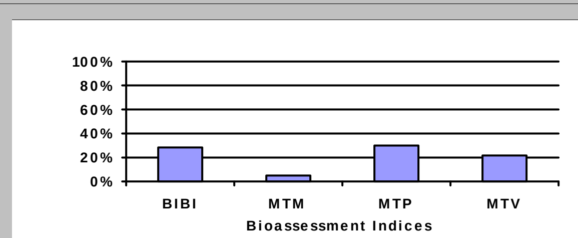


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	7
E Richness	0
P Richness	0
T Richness	0
EPT Richness	0
EPT Percent	0.00%
All Non-Insect Abundance	18
All Non-Insect Richness	3
All Non-Insect Percent	22.78%
Oligochaeta+Hirudinea Percent	21.52%
Baetidae/Ephemeroptera	0.000
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	60.76%
Dominant Taxa (2) Percent	81.01%
Dominant Taxa (3) Percent	92.41%
Dominant Taxa (10) Percent	100.00%
Diversity	
Shannon H (loge)	1.022
Shannon H (log2)	1.474
Margalef D	1.403
Simpson D	0.489
Evenness	0.136
Function	
Predator Richness	3
Predator Percent	6.33%
Filterer Richness	0
Filterer Percent	0.00%
Collector Percent	82.28%
Scraper+Shredder Percent	11.39%
Scraper/Filterer	0.000
Scraper/Scraper+Filterer	0.000
Habit	
Burrower Richness	1
Burrower Percent	2.53%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	2
Clinger Percent	72.15%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	
Hemoglobin Bearer Percent	
Air Breather Richness	1
Air Breather Percent	2.53%
Voltinism	
Univoltine Richness	4
Semivoltine Richness	2
Multivoltine Percent	1.27%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	2.53%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	3.295
Pollution Sensitive Richness	0
Pollution Tolerant Percent	11.39%
Hilsenhoff Biotic Index	4.321
Intolerant Percent	2.53%
Supertolerant Percent	20.25%
CTQa	95.333

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	9	30.00%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	4	22.22%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	1	4.76%	Severe



Monday, January 28, 2013

Metrics Report

Project ID: BWTF12GR2
RAI No.: BWTF12GR2002
Sta. Name: Ousel: South Fork of West Fork of Gallatin River
Client ID: Ousel
STORET ID
Coll. Date: 9/13/2012

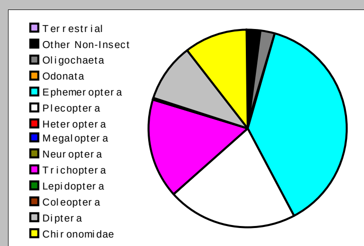
Abundance Measures

Sample Count: 311
Sample Abundance: 333.21 93.33% of sample used

Coll. Procedure: KICK
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	2	7	2.25%
Oligochaeta	1	8	2.57%
Odonata			
Ephemeroptera	9	116	37.30%
Plecoptera	7	65	20.90%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	10	51	16.40%
Lepidoptera			
Coleoptera	1	2	0.64%
Diptera	5	29	9.32%
Chironomidae	7	33	10.61%

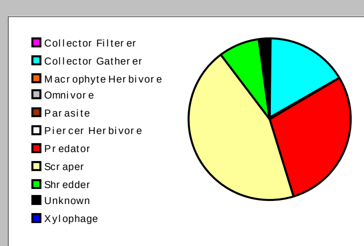


Dominant Taxa

Category	A	PRA
Drunella doddsii	49	15.76%
Rhithrogena	47	15.11%
Orthocladius	25	8.04%
Sweltsa	21	6.75%
Apatania	18	5.79%
Oligophlebodes	15	4.82%
Megarcys	14	4.50%
Hexatoma	13	4.18%
Zapada Oregonensis Gr.	12	3.86%
Taeniopterygidae	12	3.86%
Ceratopogoninae	12	3.86%
Mesenchytraeus	8	2.57%
Nemata	6	1.93%
Rhyacophila atrata complex	4	1.29%
Baetis	4	1.29%

Functional Composition

Category	R	A	PRA
Predator	17	88	28.30%
Parasite			
Collector Gatherer	11	51	16.40%
Collector Filterer	1	1	0.32%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	9	140	45.02%
Shredder	3	25	8.04%
Omnivore			
Unknown	1	6	1.93%

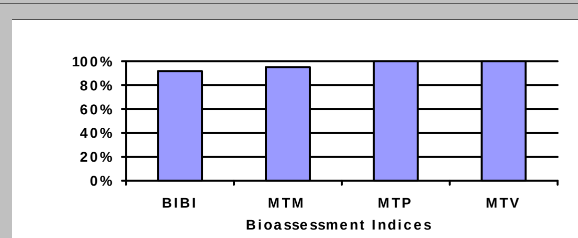


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	42
E Richness	9
P Richness	7
T Richness	10
EPT Richness	26
EPT Percent	74.60%
All Non-Insect Abundance	15
All Non-Insect Richness	3
All Non-Insect Percent	4.82%
Oligochaeta+Hirudinea Percent	2.57%
Baetidae/Ephemeroptera	0.069
Hydropsychidae/Trichoptera	0.059
Dominance	
Dominant Taxon Percent	15.76%
Dominant Taxa (2) Percent	30.87%
Dominant Taxa (3) Percent	38.91%
Dominant Taxa (10) Percent	72.67%
Diversity	
Shannon H (loge)	2.964
Shannon H (log2)	4.276
Margalef D	7.180
Simpson D	0.076
Evenness	0.048
Function	
Predator Richness	17
Predator Percent	28.30%
Filterer Richness	1
Filterer Percent	0.32%
Collector Percent	16.72%
Scraper+Shredder Percent	53.05%
Scraper/Filterer	140.000
Scraper/Scraper+Filterer	0.993
Habit	
Burrower Richness	3
Burrower Percent	4.82%
Swimmer Richness	3
Swimmer Percent	3.22%
Clinger Richness	23
Clinger Percent	71.70%
Characteristics	
Cold Stenotherm Richness	11
Cold Stenotherm Percent	34.73%
Hemoglobin Bearer Richness	
Hemoglobin Bearer Percent	
Air Breather Richness	2
Air Breather Percent	4.82%
Voltinism	
Univoltine Richness	26
Semivoltine Richness	3
Multivoltine Percent	15.43%
Tolerance	
Sediment Tolerant Richness	2
Sediment Tolerant Percent	4.82%
Sediment Sensitive Richness	2
Sediment Sensitive Percent	1.29%
Metals Tolerance Index	1.977
Pollution Sensitive Richness	12
Pollution Tolerant Percent	0.00%
Hilsenhoff Biotic Index	2.071
Intolerant Percent	66.24%
Supertolerant Percent	1.29%
CTQa	51.147

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	46	92.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	30	100.00%	None
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	18	100.00%	None
MTM	Montana DEQ Mountains (Bukantis 1998)	20	95.24%	None



Metrics Report

Project ID: BWTF12GR2
RAI No.: BWTF12GR2003
Sta. Name: Lake: South Fork
Client ID: Lake
STORET ID
Coll. Date: 9/13/2012

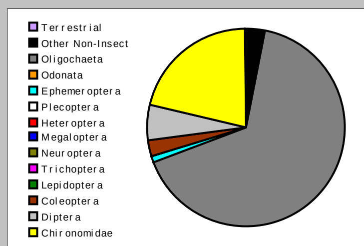
Abundance Measures

Sample Count: 299
Sample Abundance: 8,970.00 3.33% of sample used

Coll. Procedure: KICK
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	5	10	3.34%
Oligochaeta	1	197	65.89%
Odonata			
Ephemeroptera	2	2	0.67%
Plecoptera			
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera			
Lepidoptera			
Coleoptera	1	9	3.01%
Diptera	2	17	5.69%
Chironomidae	6	64	21.40%

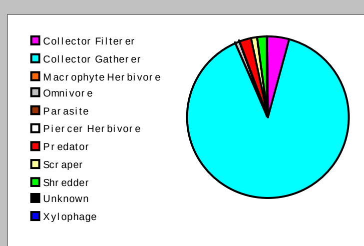


Dominant Taxa

Category	A	PRA
Nais	197	65.89%
Orthocladius	48	16.05%
Simulium	13	4.35%
Orthocladiinae	9	3.01%
Elmidae	6	2.01%
Muscidae	4	1.34%
Optioservus	3	1.00%
Gammarus	3	1.00%
Polycelis coronata	2	0.67%
Parachironomus	2	0.67%
Ostracoda	2	0.67%
Cricotopus trifascia	2	0.67%
Copepoda	2	0.67%
Tvetenia Bavarica Gr.	1	0.33%
Ephemerella	1	0.33%

Functional Composition

Category	R	A	PRA
Predator	3	7	2.34%
Parasite			
Collector Gatherer	7	267	89.30%
Collector Filterer	1	13	4.35%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	2	4	1.34%
Shredder	3	6	2.01%
Omnivore	1	2	0.67%
Unknown			

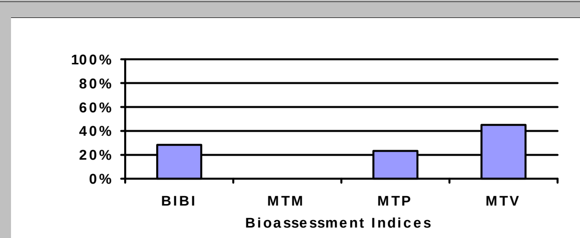


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	17
E Richness	2
P Richness	0
T Richness	0
EPT Richness	2
EPT Percent	0.67%
All Non-Insect Abundance	207
All Non-Insect Richness	6
All Non-Insect Percent	69.23%
Oligochaeta+Hirudinea Percent	65.89%
Baetidae/Ephemeroptera	0.500
Hydropsychidae/Trichoptera	0.000
Dominance	
Dominant Taxon Percent	65.89%
Dominant Taxa (2) Percent	81.94%
Dominant Taxa (3) Percent	86.29%
Dominant Taxa (10) Percent	95.99%
Diversity	
Shannon H (loge)	1.133
Shannon H (log2)	1.634
Margalef D	2.834
Simpson D	0.514
Evenness	0.083
Function	
Predator Richness	3
Predator Percent	2.34%
Filterer Richness	1
Filterer Percent	4.35%
Collector Percent	93.65%
Scraper+Shredder Percent	3.34%
Scraper/Filterer	0.308
Scraper/Scraper+Filterer	0.235
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	0
Swimmer Percent	0.00%
Clinger Richness	5
Clinger Percent	8.70%
Characteristics	
Cold Stenotherm Richness	0
Cold Stenotherm Percent	0.00%
Hemoglobin Bearer Richness	1
Hemoglobin Bearer Percent	0.67%
Air Breather Richness	0
Air Breather Percent	0.00%
Voltinism	
Univoltine Richness	5
Semivoltine Richness	1
Multivoltine Percent	24.08%
Tolerance	
Sediment Tolerant Richness	0
Sediment Tolerant Percent	0.00%
Sediment Sensitive Richness	0
Sediment Sensitive Percent	0.00%
Metals Tolerance Index	4.800
Pollution Sensitive Richness	1
Pollution Tolerant Percent	4.01%
Hilsenhoff Biotic Index	7.297
Intolerant Percent	1.34%
Supertolerant Percent	69.23%
CTQa	98.909

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	7	23.33%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	8	44.44%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	0	0.00%	Severe



Metrics Report

Project ID: BWTF12GR2
RAI No.: BWTF12GR2004
Sta. Name: Community: Middle Fork of West Fork of Gallatin
Client ID: Community
STORET ID
Coll. Date: 9/13/2012

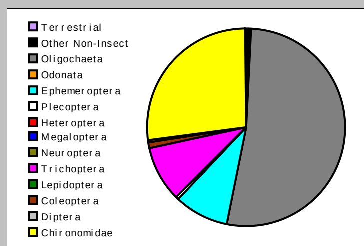
Abundance Measures

Sample Count: 338
Sample Abundance: 5,070.00 6.67% of sample used

Coll. Procedure: KICK
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Terrestrial			
Other Non-Insect	3	3	0.89%
Oligochaeta	2	175	51.78%
Odonata			
Ephemeroptera	5	30	8.88%
Plecoptera	1	2	0.59%
Heteroptera			
Megaloptera			
Neuroptera			
Trichoptera	7	31	9.17%
Lepidoptera			
Coleoptera	2	4	1.18%
Diptera	1	1	0.30%
Chironomidae	6	92	27.22%

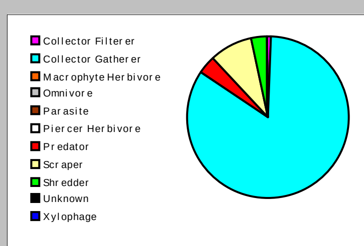


Dominant Taxa

Category	A	PRA
Nais	174	51.48%
Eukiefferiella Gracei Gr.	33	9.76%
Orthocladius	26	7.69%
Glossosoma	18	5.33%
Baetis	16	4.73%
Eukiefferiella Devonica Gr.	12	3.55%
Cricotopus trifascia	9	2.66%
Eukiefferiella	7	2.07%
Arctopsyche grandis	5	1.48%
Drunella doddsii	4	1.18%
Baetis tricaudatus	4	1.18%
Pagastia	3	0.89%
Ephemerella	3	0.89%
Optioservus	2	0.59%
Micrasema	2	0.59%

Functional Composition

Category	R	A	PRA
Predator	7	13	3.85%
Parasite			
Collector Gatherer	11	282	83.43%
Collector Filterer	2	3	0.89%
Macrophyte Herbivore			
Piercer Herbivore			
Xylophage			
Scraper	5	29	8.58%
Shredder	2	11	3.25%
Omnivore			
Unknown			

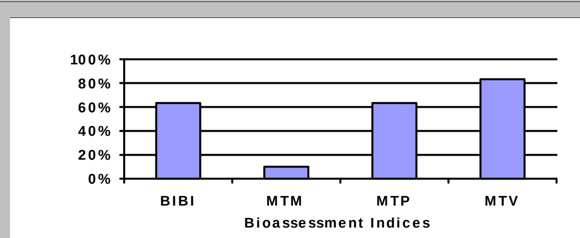


Metric Values and Scores

Metric	Value
Composition	
Taxa Richness	27
E Richness	5
P Richness	1
T Richness	7
EPT Richness	13
EPT Percent	18.64%
All Non-Insect Abundance	178
All Non-Insect Richness	5
All Non-Insect Percent	52.66%
Oligochaeta+Hirudinea Percent	51.78%
Baetidae/Ephemeroptera	0.667
Hydropsychidae/Trichoptera	0.161
Dominance	
Dominant Taxon Percent	51.48%
Dominant Taxa (2) Percent	61.24%
Dominant Taxa (3) Percent	68.93%
Dominant Taxa (10) Percent	89.94%
Diversity	
Shannon H (loge)	1.803
Shannon H (log2)	2.602
Margalef D	4.527
Simpson D	0.333
Evenness	0.074
Function	
Predator Richness	7
Predator Percent	3.85%
Filterer Richness	2
Filterer Percent	0.89%
Collector Percent	84.32%
Scraper+Shredder Percent	11.83%
Scraper/Filterer	9.667
Scraper/Scraper+Filterer	0.906
Habit	
Burrower Richness	0
Burrower Percent	0.00%
Swimmer Richness	1
Swimmer Percent	5.92%
Clinger Richness	15
Clinger Percent	16.27%
Characteristics	
Cold Stenotherm Richness	3
Cold Stenotherm Percent	2.37%
Hemoglobin Bearer Richness	
Hemoglobin Bearer Percent	
Air Breather Richness	1
Air Breather Percent	0.30%
Voltinism	
Univoltine Richness	11
Semivoltine Richness	5
Multivoltine Percent	34.02%
Tolerance	
Sediment Tolerant Richness	1
Sediment Tolerant Percent	0.30%
Sediment Sensitive Richness	2
Sediment Sensitive Percent	6.80%
Metals Tolerance Index	4.277
Pollution Sensitive Richness	4
Pollution Tolerant Percent	0.59%
Hilsenhoff Biotic Index	6.539
Intolerant Percent	13.31%
Supertolerant Percent	67.46%
CTQa	58.571

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	32	64.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	19	63.33%	Slight
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	15	83.33%	None
MTM	Montana DEQ Mountains (Bukantis 1998)	2	9.52%	Severe



Monday, January 28, 2013