

**AQUATIC MACROINVERTEBRATE MONITORING  
AT THE  
VERMONT MONITORING COOPERATIVE SITE  
UNDERHILL, VERMONT**  
by the  
Vermont Department of Environmental Conservation

**SUMMARY**

Aquatic macroinvertebrates were sampled at two sites in the upper Brown's River drainage basin using standardized sampling methods. The macroinvertebrate communities were dominated by mayflies, stoneflies, and caddisflies and were fairly typical of high-quality, high-elevation, high-gradient streams in the Green Mountains. Slight differences in community structure suggest potential differences in watershed character. 1992 is the second year of DEC sampling at these sites. Comparison of data between years shows considerable annual variation within certain structural components of the macroinvertebrate community. Overall biological integrity at both sites is excellent.

**INTRODUCTION**

The Vermont Department of Environmental Conservation (DEC) maintains a Statewide monitoring program, the Ambient Biomonitoring Network (ABN), which samples aquatic biological communities in rivers and streams at 50-70 sites annually. There is a core of 30-40 sites that are sampled every year during the late summer/fall period for the purpose of evaluating temporal variability and tracking long-term trends in biological integrity at those sites. Other sites are sampled on a one time basis for the purpose of making site-specific water quality/habitat evaluations related to some specific watershed disturbance. In 1991, DEC added two sites, located in the vicinity of the Vermont Monitoring Cooperative (VMC) research area on the west slope of Mount Mansfield, to the core sites sampled as part of the ABN. These sites have been integrated into the Statewide long-term biological monitoring program and were sampled in October of 1991 and 1992. The results of the 1991 sampling were reported last year. This report will report and discuss the 1992 sampling results.

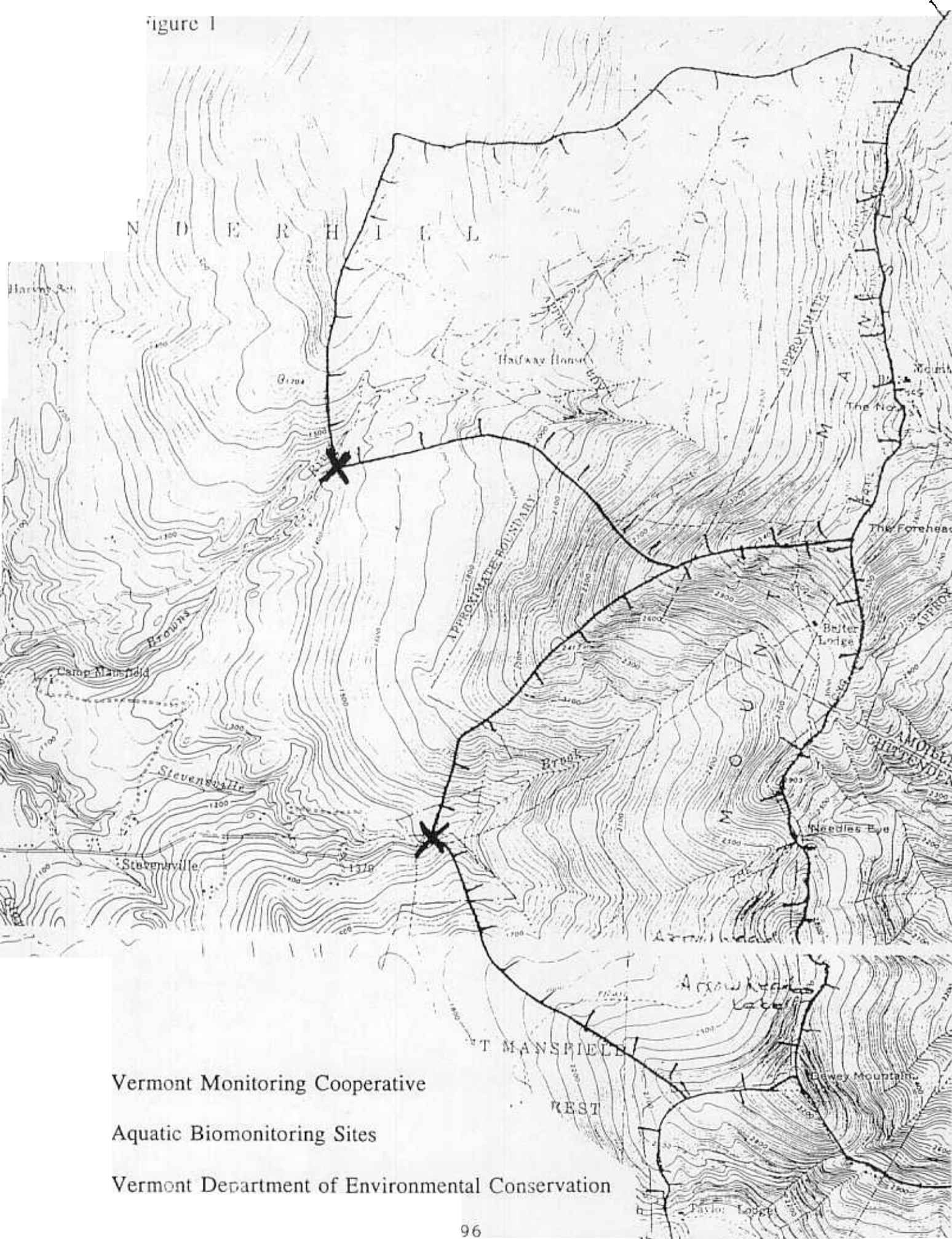
**LOCATION**

The two sampling sites are located in the upper reaches of the Brown's River watershed - one on Stevensville Brook and one on the Brown's River upstream of its confluence with Stevensville Brook (Figure 1). Both sampling sites are located at an elevation of 1400 feet. The Stevensville Brook site is located about 50m above the bridge at the parking lot for the Nebraska Notch trail (lat 44 30 21:long 72 50 45) and drains approximately 5.2 km<sup>2</sup> of forested watershed. The Brown's River site is located about 100m above the last bridge before the State Park gate (lat 44 51 09:long 72 31 28) and drains approximately 6.1 km<sup>2</sup> of forested watershed. Both sites were sampled on October 19, 1992.

**METHODS**

Duplicate samples of aquatic macroinvertebrates were collected from riffle areas using a standardized "kick-net" procedure used by DEC at all ABN sites. The use of standardized sampling methods results in an equal sampling effort applied to all sites sampled, providing a quantitative basis for making comparisons between sites. The sampler

Figure 1



Vermont Monitoring Cooperative  
Aquatic Biomonitoring Sites  
Vermont Department of Environmental Conservation

holds a 500u mesh D-frame net in the stream and vigorously disturbs the substrate immediately above the net, dislodging macroinvertebrates associated with the substrate and allowing them to be carried into the net by the current. A sample consists of all the organisms and detritus that are dislodged from the substrate during two minutes (as timed by a stopwatch) of active substrate disturbance. Organisms are removed from the net, placed in labeled jars, and preserved in alcohol or formalin. A habitat evaluation of the sample site is conducted at the time of sampling. Temperature, pH, alkalinity, and specific conductance of the water column are measured at the time the sample is collected. Samples are returned to the DEC laboratory in Waterbury where organisms are separated from the detritus, sorted into taxonomic groups, and identified to the lowest possible taxonomic levels using appropriate identification keys. Data are tabulated and entered into a computer data management system using Paradox software and IBM-compatible DOS-PC systems. Data can be outloaded in a variety of formats, including ASCII, dBase, and Lotus.

The data are analyzed by calculating various community structural and functional attributes that are indicative of overall biological integrity at the sampling site. Calculated attributes can be affected by habitat and water quality, riparian characteristics in the watershed, as well as the hydro-geo-physical nature of the watershed. Appendix 1 summarizes the potential information obtained from the evaluation of some of the major community attributes which DEC regularly calculates.

## RESULTS

In 1992, 39 and 43 taxa of aquatic invertebrates were identified from Browns River and Stevensville Brook respectively (Tables 1 and 2), compared with 36 and 35 taxa in 1991. In general, the composition of the invertebrate communities was typical of high elevation oligotrophic streams draining steep forested watersheds and were dominated by species of mayflies, stoneflies, and caddisflies. There were some differences between the two streams.

As in 1991, Stevensville Brook had lower pH and alkalinity than Browns River and had fewer organisms per unit sampling effort.

	pH	Conductance (uS)	Alkalinity (mg/l)
Stevensville Brook (1991)	5.94 (6.05)	25.0 (25.0)	1.00 (1.01)
Brown's River (1991)	6.64 (7.05)	42.0 (36.0)	10.0 (6.41)

There were seven and six taxa that made up 4% or more of the community composition at Stevensville Brook and Brown's River respectively, indicating good evenness of taxa distribution within the community. In Stevensville Brook, two mayfly taxa (*Baetis sp.* and *Epeorus sp.*) and a dipteran (*Micropsectra sp.*) were the three dominant taxa (50%), followed by four stonefly taxa. The same three taxa were dominant in the Brown's River (66%) followed by a stonefly, caddisfly and dipteran. Taxa richness and diversity indices indicate excellent diversity at both sites, with slightly greater diversity indicated at Stevensville Brook.

Physical characteristics at the two sampling sites were very similar: stream velocity was 1.3 and 1.5 feet/second at Stevensville and Brown's respectively; substrate composition was similar with 35% boulder, 30% cobble, 20% coarse gravel, 10% gravel, and 5% sand at both sites; canopy cover (shading) was 80% at both sites; sampling depth averaged 0.2 m at both sites.

## DISCUSSION

Two years of data provide a first glimpse into the annual variation at the two sites. Observations from the 1991 sampling were generally true for the 1992 sampling, although the differences between watersheds were less dramatic in 1992. 1991 was apparently a strong stonefly year as evidenced by the overwhelming dominance of stonefly taxa in Stevensville Brook and, to a lesser extent, in the Brown's River. The relative abundance of stoneflies was greatly reduced at both sites in 1992, due primarily to reduced numbers of the Leuctridae Family of stoneflies and increased abundance of mayflies and Chironomid dipterans. The following Table describes the major community structure and function differences observed between the 1991 and 1992 samples by comparing the relative abundance (per-cent composition) of the important taxonomic and functional groups. The major differences are highlighted.

<b>Taxonomic Order</b>	<b>% Comp Stevensville 1991 - 1992</b>	<b>% Comp Brown's 1991 - 1992</b>
Diptera	9.5 - 19	16 - 47
Ephemeroptera	<b>2.0 - 40</b>	26 - 29
Plecoptera	<b>76 - 28</b>	<b>43 - 13</b>
Trichoptera	12 - 13	14 - 10
<b>Functional Group</b>		
Collector/Gatherer	<b>7.8 - 54</b>	<b>39 - 74</b>
Collector/Filterer	5.4 - 5.4	8.0 - 6.3
Predator	18 - 9.8	15 - 12
Detrital Shredder	<b>67 - 28</b>	<b>36 - 6.8</b>

The community structure differences between 1991 and 1992 described above resulted in some differences in the functional composition of the macroinvertebrate communities. In general, functional composition at the two sites showed greater similarity in 1992 than in 1991 with less dominance by detrital/leaf shredders at Stevensville (due to the reduced stonefly numbers) and an increase in fine particulate feeders (primarily Baetid mayflies).

The community attributes found at these two sites can be compared with a Statewide data-base for 23 stream sites with similar watershed characteristics, including watershed area and elevation. The following table compares Statewide ranges of community attributes with those found at these sites.

Attribute <sup>1</sup>	Statewide Range	Stevensville 1991 - 1992	Brown's 1991 - 1992
Mean Richness	25.5 - 51	27.5 - 37.5	29.5 - 29.0
EPT Richness	13 - 29.5	18 - 20.5	19.5 - 17
Biotic Index	.52 - 2.03	<b>.52</b> - .96	.71 - 1.27
% Mayflies	2 - 47	<b>2</b> - 40	26 - 29
% Stoneflies	6 - 76	<b>76</b> - 28	43 - 13
% Diptera	9 - 53	<b>9</b> - 19	16 - 47
% Collector/Gatherer	8 - 74	<b>8</b> - 54	39 - <b>74</b>
% Detrital Shredder	3 - 67	<b>67</b> - 28	36 - 7

1 - see Table 1 for description of attributes

**bold** - extreme of Statewide range for similar stream types

Several of the attributes for the 1991 Stevensville Brook sample represent extremes of the Statewide distribution for streams of similar size and elevation. The 1992 attributes are well within the Statewide range. Overall biological integrity at both sites, as determined from community attribute evaluation, is excellent.

DEC will continue monitoring these sites on an annual basis. Continued monitoring will permit future evaluation of annual variability observed during the first two years of sampling. More intensive sampling could perhaps lead to some clearer definition of the observed differences in community structure between the two watersheds and provide some information relative to the factors causing these differences.

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**Biometric Definitions and Attributes**

Mean Richness - the average number of taxa found at a site. The number of taxa found at a site is a basic measure of community diversity. Taxa richness can increase with moderate ecosystem enrichment and can decrease from toxic stresses or habitat impairment.

EPT Richness - the average number of taxa from the sensitive insect orders Ephemeroptera, Plecoptera, Trichoptera. The taxa from the orders are often the first to decrease due to toxic or habit stresses.

**MEPT/MR**

Mean EPT Value/Mean Richness - the ratio between the average number of EPT taxa and the total taxa at a site. The ratio will generally decrease in areas of environmental stress.

**Bio Index (BI)**

Hilsenhoff - 1982 - A measure of the community's tolerance of organic enrichment, based on the indicator organism concept where tolerant species are given a higher value (from 0-5) and sensitive species a lower value. The relative abundance of the different species in the stream community determine the overall BI value for the site. Index values less than 1.75 indicate a clean undisturbed site.

**Indicator Taxa**

The percent composition of those taxa that seem to typify the stream ecosystem type of a site. If as a group they become less dominant then the stream's ecosystem has been altered in some way to the benefit of other taxa.

**Percent Plecoptera**

The percent composition of the insect order Plecoptera (stonefly) at a site. The relatively high proportion of Plecoptera in these small streams is typical and ecologically significant. The Plecoptera will generally decrease in proportion to the other insect orders when stream temperatures increase or food supplies shift.

**Percent Oligocheata**

The percent composition of the order Oligocheata at a site. The Oligocheata are not often found in these high gradient mountain streams. They become a significant

component of these communities only when sedimentation and sand are deposited in the substrate from erosion impacts.

**Percent Shredders**

The percent composition of the functional group known as leaf shredders. Leaf shredders are a significant component of undisturbed forest canopied high mountain brooks. Their decrease in dominance would indicate either a shift toward other food sources by the community or an impact to the riparian habitat of the stream.

**Percent Collectors**

The percent composition of the functional group Collectors (filters and gatherers). The collector functional group is known as generalists. The group is typically one of the more dominant functional feeding groups in all streams averaging around 50 percent in minimally disturbed drainages. They generally become proportionally more dominant in disturbed streams either when other functional groups are eliminated due to environmental stresses or the stream is carrying increased amounts of organic silt/matter.

Location: Browns River # 20.8 Town: Underhill Site Id: 461100000208  
 Device: Kick Net Composites/Rep: 1  
 Lab Id: 92.097 Date: 10/19/92 Area: 1.00 m2 Number of Reps:

Order	Genera	Species	Density	% Comp	Std Err	Minimum	Maximum
COLEOPTERA			18.0	.80	6.00	12.0	24.0
	OPTIOSERVUS	fastiditus	4.0	.18			
	OULIMNIUS	latiusculus	14.0	.62			
DIPTERA			1064.0	47.04	216.00	848.0	1280.0
	ATHERIX	sp	2.0	.09			
	BRILLIA	sp	18.0	.80			
	EUKIEFFERIELLA	brehmi	16.0	.71			
	PARACHAETOCLADIUS	sp	6.0	.27			
	PARAMETRIOCNEMUS	sp	10.0	.44			
	POLYPEDILUM	aviceps	106.0	4.69	2.00	104.0	108.0
	TVETENIA	bavarica	28.0	1.24			
	MICROPSECTRA	sp	860.0	38.02	220.00	640.0	1080.0
	ANTOCHA	sp	2.0	.09			
	DICRANOTA	sp	14.0	.62			
	HEXATOMA	sp	2.0	.09			
EPHEMEROPTERA			656.0	29.00	12.00	644.0	668.0
	BAETIS	tricaudatus	332.0	14.68	0.00	332.0	332.0
	EPHEMERELLA	sp	2.0	.09			
	HEPTAGENIIDAE	unid	8.0	.35			
	EPEORUS	sp	306.0	13.53	26.00	280.0	332.0
PARALEPTOPHLEBIA	sp	8.0	.35				
TRICHOPTERA			232.0	10.26	24.00	208.0	256.0
	PARAPSYCHE	apicalis	0.0	0.00			
	SYMPHITOPSYCHE	slossonae	28.0	1.24			
	SYMPHITOPSYCHE	sparna	2.0	.09			
	LEPIDOSTOMA	sp	38.0	1.68			
	APATANIA	sp	2.0	.09			
	HYDATOPHYLAX	sp	0.0	0.00			
	NEOPHYLAX	sp	0.0	0.00			
	DOLOPHILODES	sp	112.0	4.95	16.00	96.0	128.0
	RHYACOPHILA	fuscula	18.0	.80			
	RHYACOPHILA	carolina	30.0	1.33			
	RHYACOPHILA	fenestra	2.0	.09			
PLECOPTERA			290.0	12.82	82.00	208.0	372.0
	CAPNIIDAE	unid	2.0	.09			
	CHLOROPERLIDAE	unid	174.0	7.69	66.00	108.0	240.0
	LEUCTRIDAE	unid	22.0	.97			
	PELTOPERLA	sp	30.0	1.33			
	AGNETINA	capitata	0.0	0.00			
	ISOPERLA	sp	2.0	.09			
	MALIREKUS	hastatus	16.0	.71			
	PTERONARCYS	sp	6.0	.27			
	PTERONARCYS	dorsata	0.0	0.00			
	TAENIONEMA	sp	38.0	1.68			
LEPIDOPTERA			2.0	.09	2.00	0.0	4.0
	ARCHIPS	sp	2.0	.09			



Location: Browns River  
Device: Kick Net

# 20.

own Underhill

Site Id  
Composites/Rep

Lab Id:                      Date:

Area                      m2

Number of Reqs

Order	Genera	Species	Density	% Comp	Std Err	Minimum	Maximum
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TOTAL			2262.0	100.00	318.00	1944.0	2580.0

Location: Stevensville Brook # 2.1  
 Device: Kick Net

Town: Underhill

Site Id: 461143000021  
 Composites/Rep: 1

Lab Id: 92.098

Date: 10/19/92

Area: 1.00 m2

Number of Reps: 2

Order	Genera	Species	Density	% Comp	Std Err	Minimum	Maximum	
COLEOPTERA	OPTIOSERVUS	fastiditus	1.0	.11	1.00	0.0	2.0	
			1.0	.11				
				176.8	18.70	20.77	156.0	197.5
		BEZZIA	sp	1.9	.20			
		BRILLIA	sp	10.5	1.11			
		CRICOTOPUS	sp	11.3	1.20			
		EUKIEFFERIELLA	brevicalar	4.8	.50			
		PAGASTIA	sp	.9	.10			
		PARACHAETOCLEIDIUS	sp	7.5	.79			
		PARAMETRIOCNEMUS	sp	6.7	.71			
		POLYPEDILUM	aviceps	6.8	.72			
		RHEOCRICOTOPUS	sp	16.3	1.73			
		THIENEMANNEMYIA	sp	6.0	.63			
		TVETENIA	bavarica	1.0	.11			
		MICROPSECTRA	sp	91.6	9.69	13.62	78.0	105.2
		PROSIMULIUM	mixtum	1.9	.20			
		SIMULIUM	tubersom	3.8	.41			
		DICRANOTA	sp	1.9	.20			
		HEXATOMA	sp	1.9	.20			
		TIPULA	sp	.9	.10			
		MOLOPHILUS	sp	.9	.10			
	HEMEROPTERA	BAETIS	tricaudatus	379.5	40.15	6.54	372.9	386.0
				271.7	28.75	.31	271.4	272.0
7.7				.81				
		EURYLOPHELLA	funeralis	100.1	10.59	5.92	94.2	106.0
		EPEORUS	sp					
				118.2	12.50	1.85	116.3	120.0
		PARAPSYCHE	apicalis	12.3	1.30			
		SYMPHITOPSYCHE	slossonae	4.8	.50			
		SYMPHITOPSYCHE	ventura	5.7	.60			
		LEPIDOSTOMA	sp	33.8	3.57	4.23	29.5	38.0
		NEOPHYLAX	sp	2.9	.31			
		DOLOPHILODES	sp	22.9	2.43			
		POLYCENTROPUS	sp	2.9	.31			
		RHYACOPHILA	fuscula	19.1	2.02			
		RHYACOPHILA	carolina	2.0	.21			
		RHYACOPHILA	fenestra	7.8	.82			
		RHYACOPHILA	minora	4.0	.42			
				267.8	28.34	23.85	244.0	291.7
		CAPNIIDAE	unid	25.1	2.65			
		CHLOROPERLIDAE	unid	43.8	4.63	9.77	34.0	53.5
		LEUCTRIDAE	unid	69.2	7.32	2.77	66.5	72.0
		NEMOURIDAE	unid	10.9	1.16			
		AMPHINEMURA	sp	23.2	2.46			
	PELTOPERLA	sp	42.7	4.52	12.69	30.0	55.4	
	ACRONEURIA	carolinesis	.9	.10				
	TAENIONEMA	sp	52.0	5.50	20.00	32.0	72.0	
JAPODA			.9	.10	.92	0.0	1.8	

Location: Stevensville Brook # 2.1  
Device: Kick Net

Town: Underhill

Site Id: 461143000021  
Composites/Rep: 1

Lab Id: 92.098

Date: 10/19/92

Area: 1.00 m2

Number of Reps: 2

Order	Genera	Species	Density	% Comp	Std Err	Minimum	Maximum
DECAPODA	CAMBARUS	sp	.9	.10			
OLIGOCHAETA	ENCHYTRAEIDAE	uid	1.0	.11	1.00	0.0	2.0
			1.0	.11			
TOTAL			945.2	100.00	35.15	910.0	980.3