Volunteer Biological Assessment Program
Stream Data Collection Report
for the Saco Watershed
2019

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ACKNOWLEDGEMENTS

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Indian Mound Golf Course

Participating School Groups:

Effingham Elementary School
Freedom Elementary School
KA Brett School, Tamworth
Madison Elementary School
Ossipee Central School
Pine Tree Elementary School, Conway
Sacopee Middle School S.O.L.E. Program
Sandwich Central School

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Introduction

Since 1997, the New Hampshire Department of Environmental Services (DES) has conducted stream surveys to determine the health of aquatic ecosystems. As part of these efforts, DES developed a preliminary screening protocol for 1st through 4th order streams that is appropriate for volunteers to evaluate the biological condition of aquatic macroinvertebrate communities. The goals of the protocol are as follows:

- To educate the public about water quality issues as interpreted through biological assessments;
- To build a constituency of individuals who will practice sound water quality management at the local level; and
- To build public support for water quality protection.

Since 2006, Green Mountain Conservation Group has collaborated with DES, NH Fish & Game Department and local volunteers and schools for the Volunteer Biological Assessment Program (VBAP). While NH DES no longer oversees the program "due to lack staff support" according to David Neils, Chief Aquatic Pollution Biologist, GMCG continues to offer the VBAP program to schools in the Ossipee Watershed for educational purposes following the recommendation of NH DES and NH Fish & Game Department. In 2018 and 2019, the program expanded to additional schools and sites outside of the Ossipee Watershed, including parts of the Saco River Watershed in Conway, NH and Porter, ME.

In the fall of 2019, GMCG worked with students and teachers from eight local schools across the Saco Watershed in New Hampshire and Maine. They sampled eight sites, collecting, sorting and analyzing macroinvertebrates. This report contains the results of that sampling with additional data analysis to compare sites across the watershed and over time since some of these sites are year-round sampling sites for GMCG's RIVERS program (Regional Interstate Volunteers for the Ecosystems and Rivers of Saco). As monitoring continues, data will continue to be evaluated and analyzed for any trends or water quality issues.

Methods

Prior to any sampling, a VBAP Training was held with NH Fish & Game in August, 2019 to train new teachers and volunteers in the program. A training session was also held at each school for students during a scheduled classroom period and consisted of the following components: macroinvertebrate identification skills; biomonitoring and macroinvertebrate tolerance levels; macroinvertebrate sampling protocols; and an introduction to watersheds; riparian ecosystems; and aquatic food chains. Additionally, student volunteers were trained to collect and record supplementary data for physical and chemical parameters of the rivers/streams, including: habitat assessments; stream measurements; pH; conductivity; temperature; dissolved oxygen and turbidity.

Sampling Sites

Sampling sites were accessible, wadeable, approximately 200 feet in length, 1st through 4th order streams and contained appropriate sampling habitat (at least one riffle, one pool, and one run with mixed cobble substrate). Four of the sites are annual monitoring sites for VBAP and year-round monitoring sites for RIVERS. Additional sites are sampled from spring through fall

for RIVERS, and have been sampled by school groups in the past for VBAP periodically. While some schools sample their adopted VBAP site annually, some are on an every-other-year schedule due to combined classes. An additional site in Conway, NH was added this year based on accessibility to the local school participating in the program. Students were included in sampling and taking measurements as much as possible. Sampling was scheduled throughout September and October and required three to four hours per site.

Data Collection

The data collection at each site and along the stream followed the same protocol. The protocol was as follows:

- A 500-micron mesh kicknet was placed perpendicular to stream flow and held firmly against the streambed with the opening of the net facing upstream to promote macro invertebrate collection.
- A collector would disturb the sample area (1/5 m^2) upstream of the net for a total of 60 seconds (30 second hand-scrub followed by a 30 second kick).
- The kicknet was carefully lifted out of the water and the contents of the net were emptied into a shallow container with a small amount of water. All organisms remaining on the net were carefully removed and added to the sample.
- The same process was repeated four additional times with each sample collected further upstream (spanning 200 feet). Collectively, active sampling time approximated five minutes within one square meter area at each sampling station.

Macroinvertebrate Sorting and Identification

For approximately 60 minutes, student volunteers, teachers and/or staff removed macroinvertebrates from the selected portion of the sample with spoons or pipettes and placed them into separate containers according to common attributes. After sorting, specimens were identified to various coarse taxonomic groups. The number of macroinvertebrates within each taxonomic group was identified, calculated, and recorded, see Table 1. Students were assisted by GMCG staff and/or trained volunteers with the process of identifying the macroinvertebrates in the sample.

Table 1. Total Macros Found Across the Watershed

Order	Common Name	Number of Macro Invertebrate Collected
Ephemerotera	Mayfly nymph	716
Plecoptera	Stonefly nymph	188
Trichoptera	Caddisfly larvae	613
Odonata	Dragonfly larvae Damselfly nymph	9 13
Diptera	Black fly larvae Midge larvae True flies	51 7 34
Megaloptera	Alderfly Hellgrammite	1 16

Coleoptera	Riffle Beetle	41
	Water Penny	19
	Beetle/Beetle like	1
Other	Crayfish	0
	Snails	0
	Aquatic Worms	39
	Scuds	0
	Sowbug	0
	Leech	1
	Water Mites	7

Biotic Index Computation

Biotic scores are based on pollution tolerance values ranging from 0 to 9 and are assigned to individual taxonomic groups. More tolerant groups have higher tolerance values and less tolerant groups have lower values. A standardized computational worksheet was used to compute the biotic scores for each sample site (stream/river). Taxonomic-specific biotic scores for individual samples were computed by multiplying the number of individual organisms by their respective tolerance value; summing the taxonomic-specific biotic scores; and then dividing the sum by the total number of individuals identified in the respective sample. Final biotic scores correspond to three interim narrative categories:

- Excellent (0 to 3.5)
- Good (3.5 to 4.8)
- Fairly Poor (greater than 4.8).

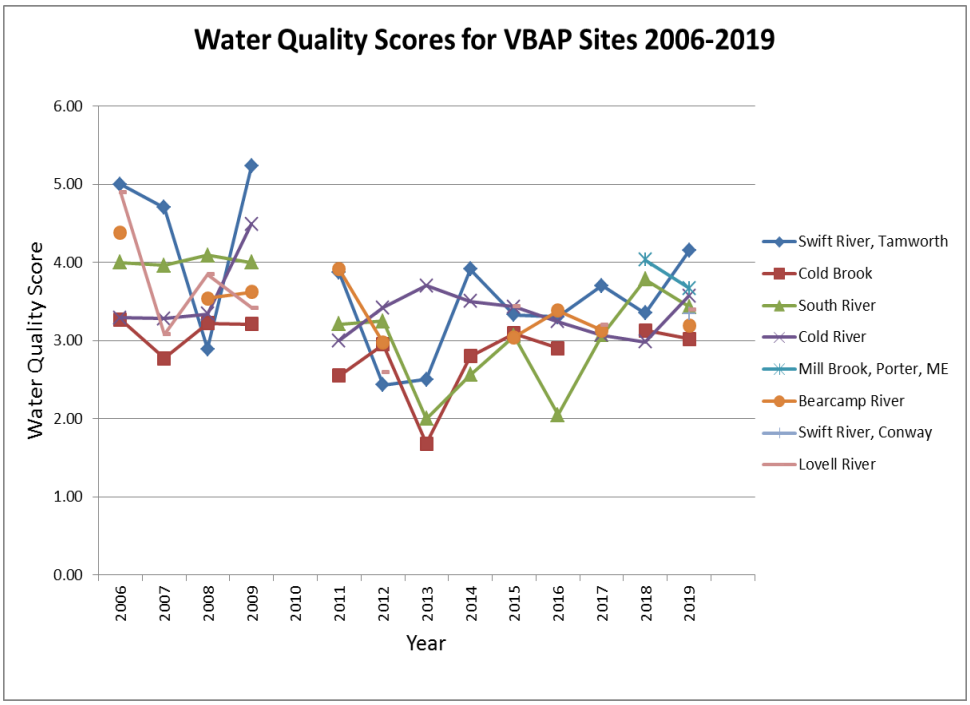
Table 2 highlights the biotic score and the narrative category for each sampling site tested in the Ossipee Watershed. Three of the five scores fell in the "Excellent" category and two fell in the "Good" category, see Table 2.

Table 2. Biotic Scores of Sampling Sites

School Group	Date	Location	Total # Macro's	Biotic Score	Water Quality Score
Sandwich, NH	9/12/2019	Cold River	277	3.57	Good
Freedom, NH	9/23/2019	Cold Brook	184	3.02	Excellent
Effingham, NH	9/13/2019	South River	548	3.43	Excellent
Tamworth, NH	9/25/2019	Swift River	115	4.15	Good
Ossipee, NH	9/26/2019	Lovell River	185	3.4	Excellent
Conway, NH	10/10/2019	Swift River	159	3.34	Excellent
Tamworth, NH	10/9/2019	Bearcamp River	168	3.19	Excellent
Porter, ME	10/7/2019	Mill Brook	120	3.67	Good

Table 3 shows changes in water quality scores over time at the sites sampled in 2019. Scores appear to be variable over time, with some years of more pollution tolerant macroinvertebrates such as black fly larvae affecting the biotic score at sites such as Swift River and Cold River (2006, 2009). Overall, it appears that water quality scores are variable year-to-year.

Table 3. Water Quality Scores 2006-2019



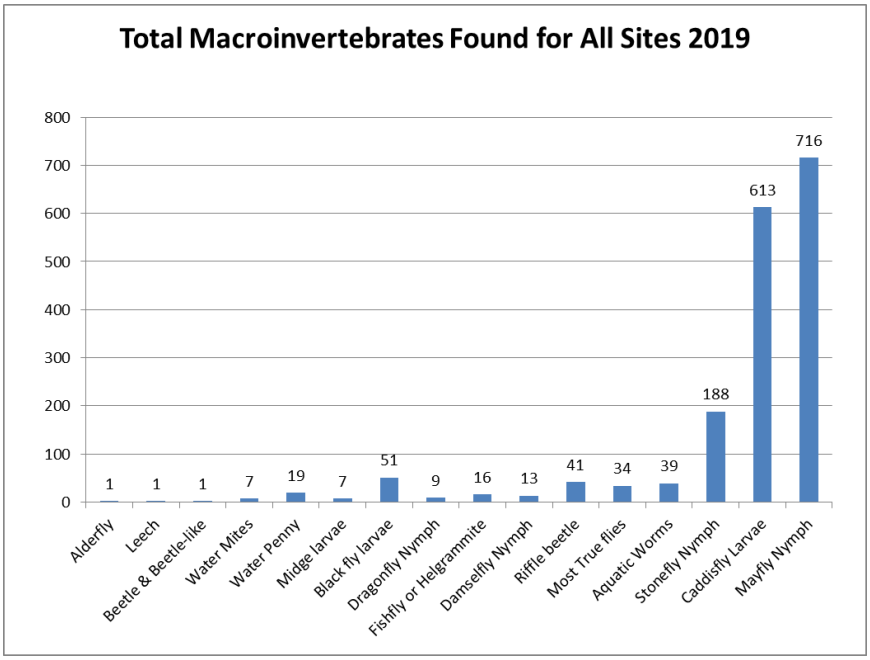
Supplementary Data

The water chemistry and physical parameters of the stream were recorded. Physical parameters recorded included width/depth of the stream, canopy cover, observations of nearby erosion or human influence, turbidity, pH, conductivity and temperature. A multi-parameter submersible Hach water quality probe was used to collect pH, dissolved oxygen, conductivity and temperature data (see Table 3). Turbidity samples and pH samples were also taken at each site with Hach meters and pH strips.

Water Quality Results

Basic water quality data were collected at each of the sampling locations. The data included chemical parameters, physical parameters, and calculating a biotic score for each of the sampling sites. Macroinvertebrate samples from each site were evaluated using the VBAP biotic score index utilizing taxa-specific tolerance values. A cumulative biotic score for all sites and individual site-specific biotic scores were computed. The average biotic score for all sites was 3.47 and corresponds to the "excellent" narrative category. See Table 2 for biotic scores for the individual streams. Overall, mayfly nymphs were the most dominant taxon 716 (41%), followed by caddisfly larvae 613 (35%) and stonefly nymphs 188 (11%). Together, these three taxa comprised nearly 87% of all individuals. In completing the sampling effort, volunteers collected and staff identified 1,756 macroinvertebrates (See Figure 1).

Figure 1. Cumulative VBAP Data 2019



All pH, dissolved oxygen, turbidity, and temperature readings were within the normal range to support aquatic life (Table 4).

Table 4. Physical & Chemical Parameters of Sampling Sites

Physical & Chemical Parameters	Normal Range/Optimal Value	Cold Brook	Cold River	South River	Swift River, Tamworth	Mill Brook	Bearcamp River	Lovell River	Swift River, Conway
pH	6.5-8.0	6.63	6.37	6.3	6.36	6.44	7.05	5.94	6.28
Dissolved Oxygen	5 mg/L and above	9.08mg/L	9.71mg/L	9.19mg/L	10.68mg/L	9.64mg/L	10.47mg/L	10.24mg/L	11.17mg/L
Conductivity	Below 100µS/cm²	128.1µS/cm	27.9µS/cm²	72.3µS/cm²	44.2µS/cm²	46.2µS/cm²	34.5µS/cm²	26.2µS/cm²	41.8µS/cm²
Turbidity	Under 10NTUs	1.03NTUs		1.25NTUs	.64NTUs	.55NTUs	1.09NTUs	.54NTUs	.48NTUs
Temperature	21°C below for trout/mayfly nymphs	17.3°C	15.5°C	11.5°C	12°C	12.3°C	12°C	14°C	10.6°C

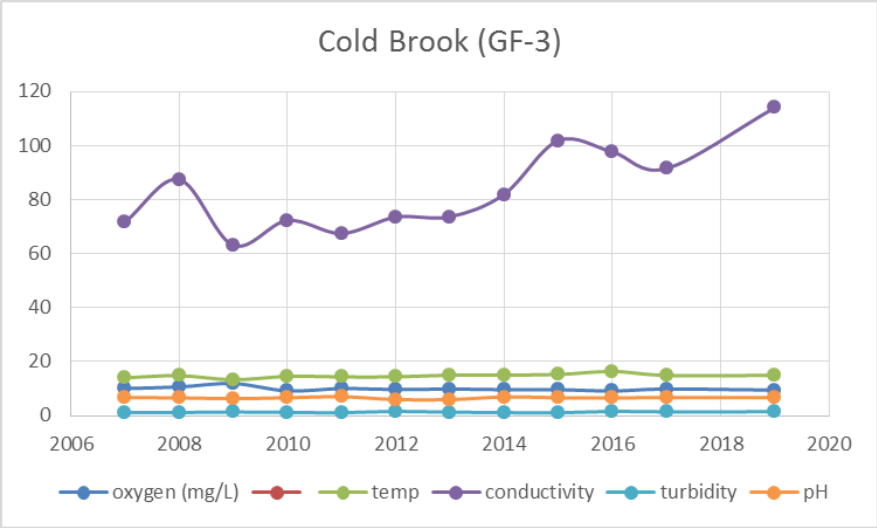
While conductivity levels across all sites remain low, conductivity levels at Cold Brook in Freedom continue to be slightly elevated above natural background levels (>100 µS/cm²), and simple trend line analysis of historical data demonstrates that conductivity levels at this site are slightly increasing over time, likely due to road salting activities (see Figure 2).

Conductivity is a measure of the concentration of dissolved salts in water, for reference, seawater has a Specific Conductance of 55,000 µS. Conductivity levels are not a concern to the EPA (Environmental Protection Agency) unless they rise above 500 µS/cm² for rural areas or 1500 µS/cm² for urban areas, according to Jill Emerson, GMCG's Water Quality Coordinator. NH DES states that conductivity levels in fresh water bodies across the state are rising, in general, mostly due to road salting, faulty septic systems and urban/agricultural runoff. (https://www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/2004_speci

al_topic_conductivity.pdf).

In the past, to bring this issue of slowly rising conductivity levels to the attention of Ossipee Watershed towns, GMCG has co-hosted workshops with UNH T2 Center, NH DES and NH DOT to help train area road agents and plow drivers on efficient use/spreading of salt to help educate those on the front lines about the importance of not over-salting our fresh water ecosystems. For more detailed water quality analyses on the water bodies in the Ossipee Watershed, please see the 10 Year Water Quality Report released in March, 2015: http://www.gmcg.org/research/10-year-water-quality-report/.

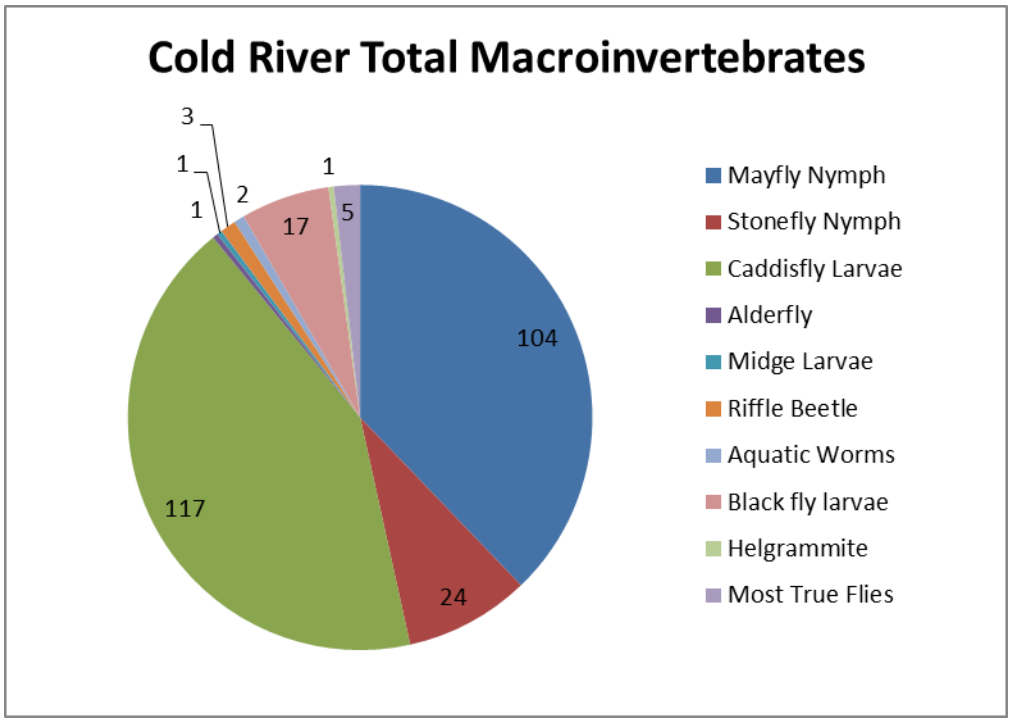
Figure 2. Conductivity Levels Slightly Increasing at Cold Brook, Freedom



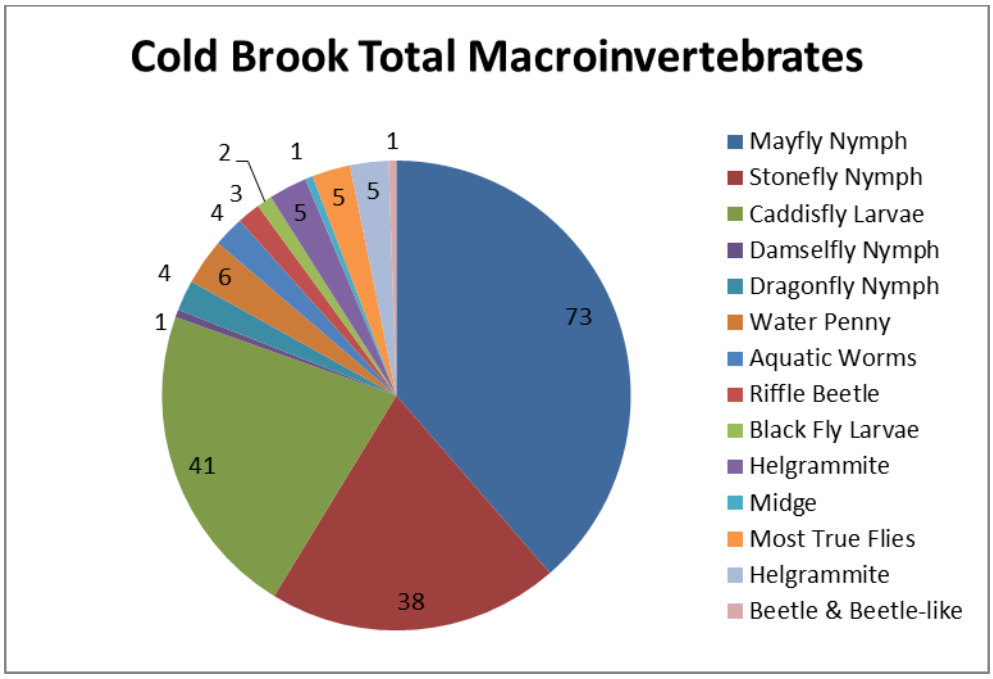
Summary and Future Recommendations

The documentation by volunteers of the invertebrate communities using the VBAP protocol during fall 2019 in the Ossipee Watershed marked the fourteenth year of 'screening' efforts to evaluate the status of aquatic communities. Sampling efforts included eight sites in the Saco River Watershed. Macroinvertebrates are widely used as indicators of water quality that can show the effects of multiple pollutants over time. It is important to recognize that the results obtained from the VBAP protocol are not intended to represent formal water quality assessments, but rather, a basic indicator of aquatic community condition. Ultimately, the results from the Volunteer Biological Assessment Program for 2019 build upon the efforts conducted by GMCG, NH DES and NH Fish & Game to establish reference sites in the state, compare sites across the state, and provide watershed education to youth. The results of the program serve as a basis for further monitoring and management practices to be put into use throughout the watershed. The Ossipee Watershed has a reputation for having great water quality overall and the VBAP results validate this statement. It is recommended that Green Mountain Conservation Group continue to work with schools in the Saco River Watershed and continue to monitor the water quality of the local streams and rivers. Sites where human activities appear to be impacting water quality should be monitored closely for potential sources of contamination, and road salting alternatives should be sought.

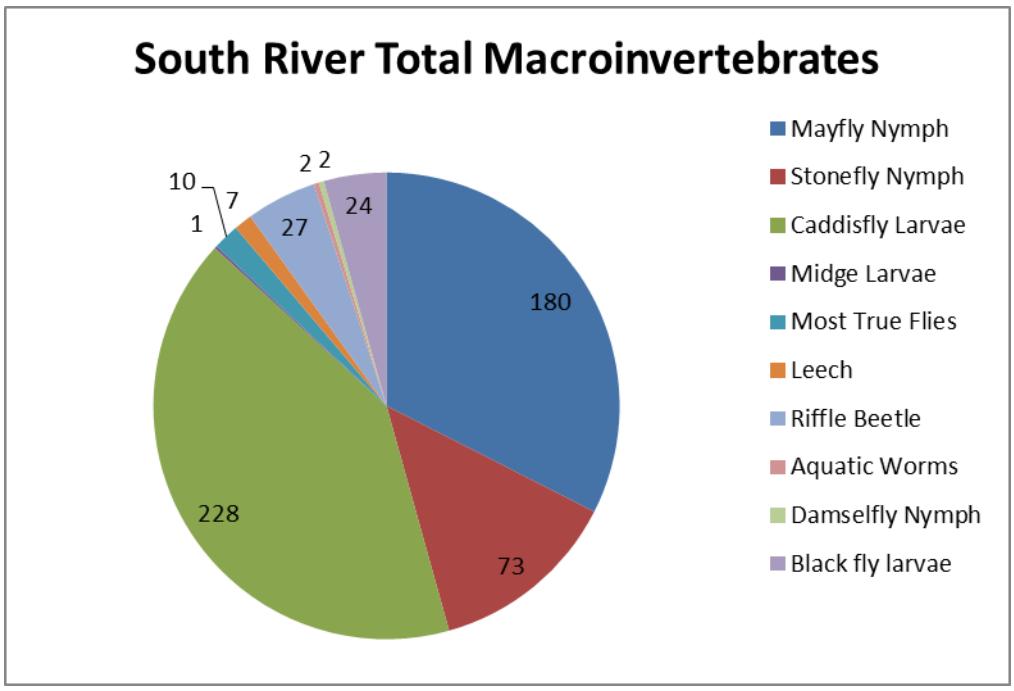
Appendix A



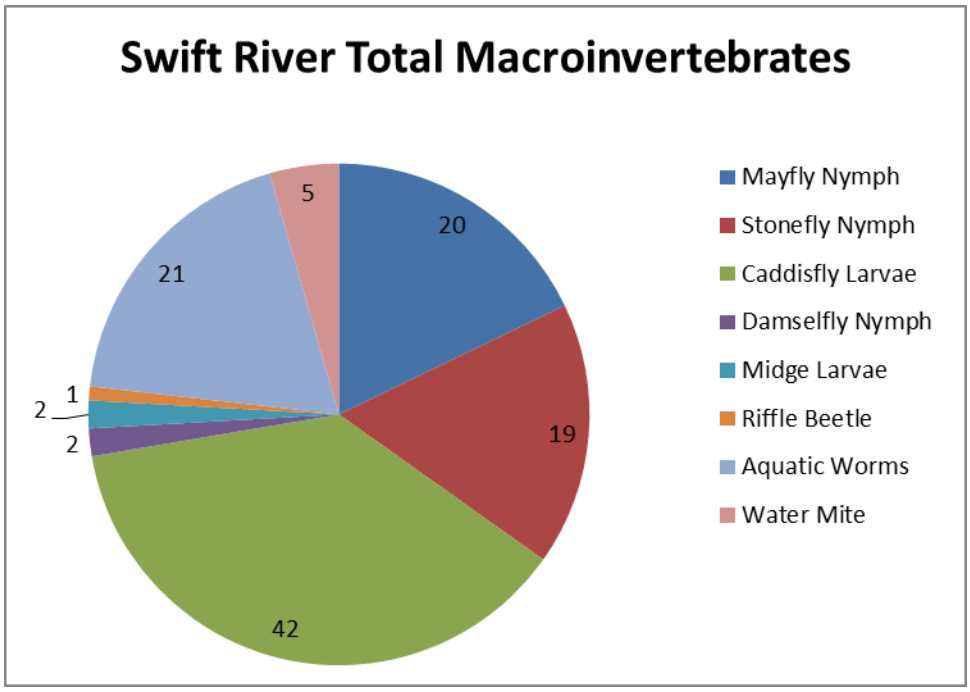
Cold River, Sandwich, NH. Sampled by Sandwich Central School.



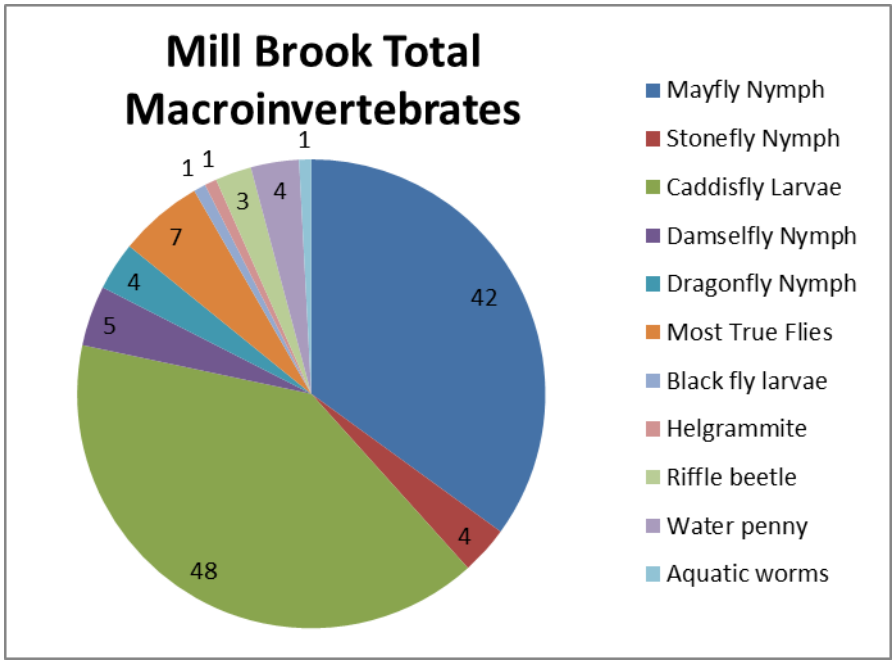
Cold Brook, Freedom, NH. Sampled by Freedom Elementary School



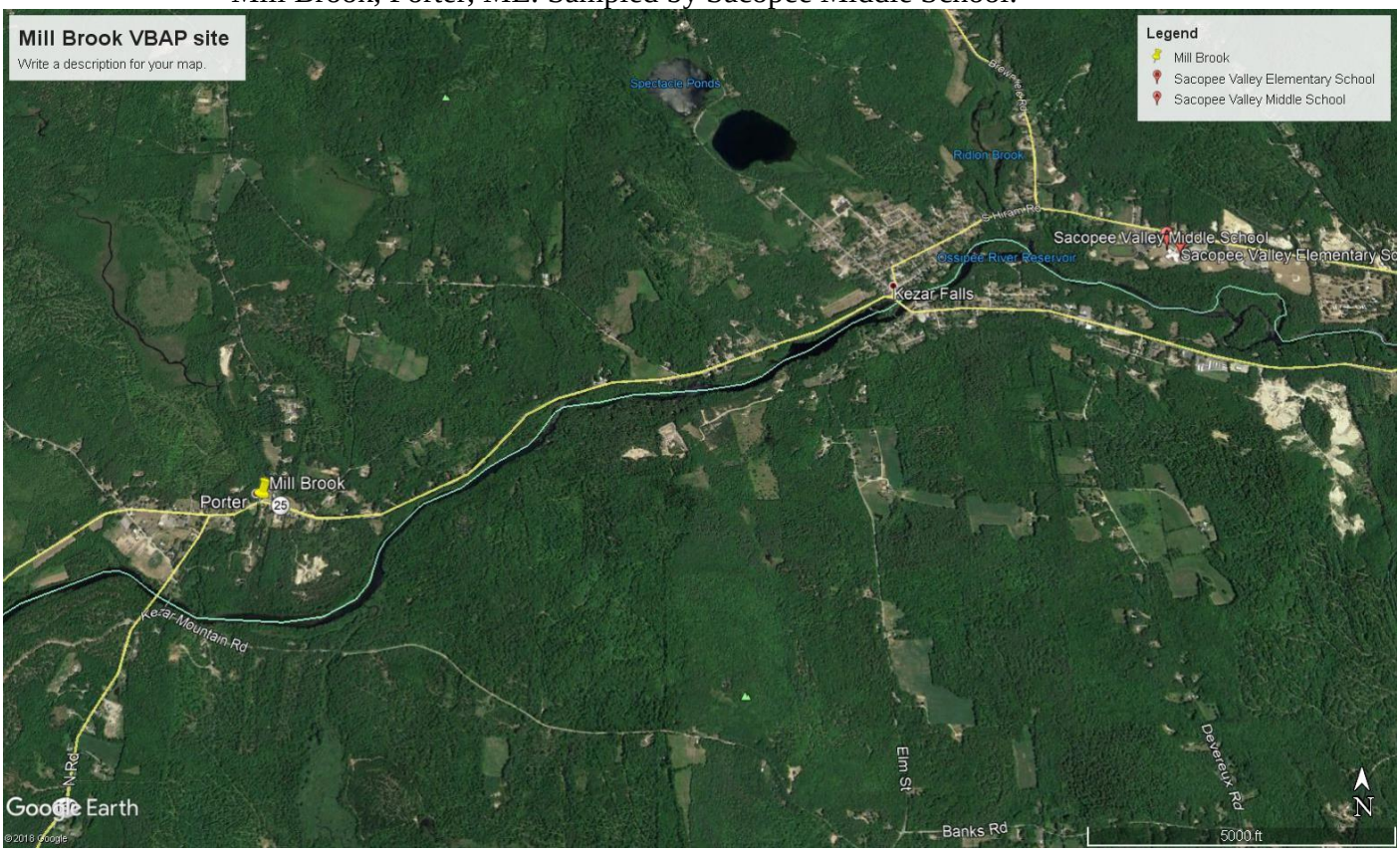
South River, Parsonsfield, ME. Sampled by Effingham Elementary School.

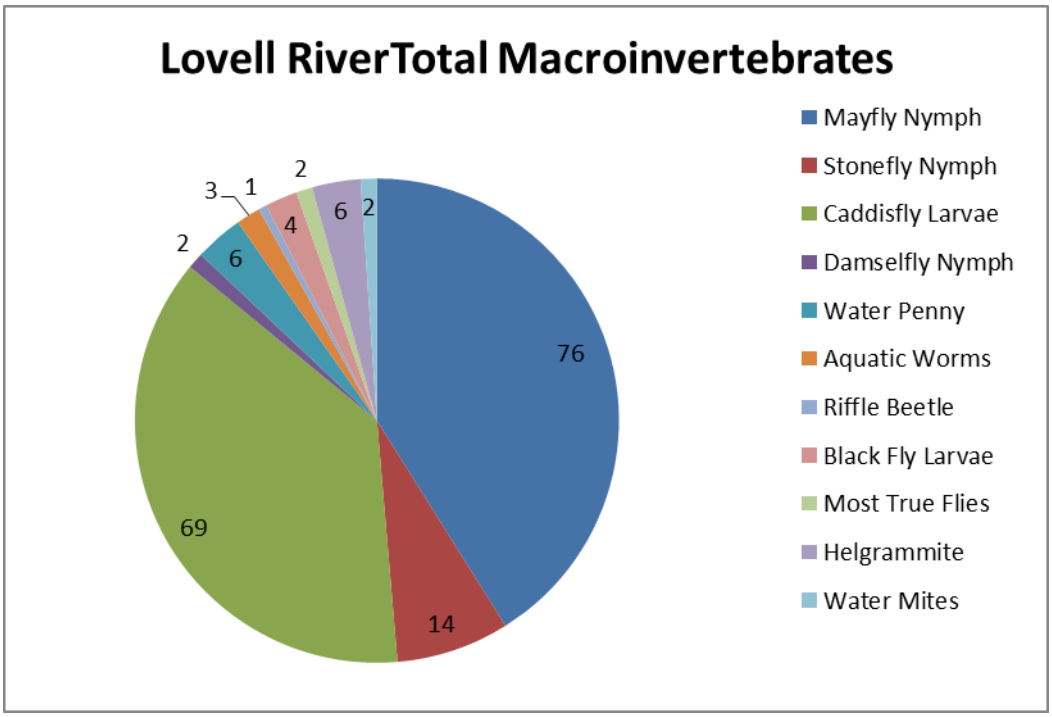


Swift River (downstream), Tamworth, NH. Sampled by Ossipee Central School

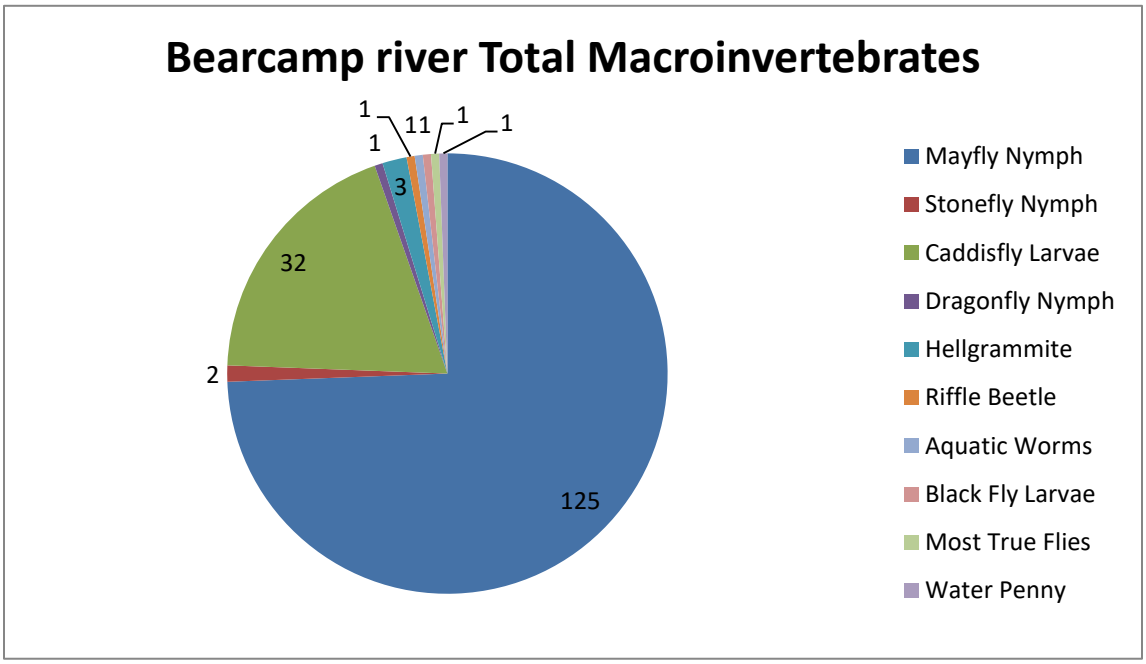


Mill Brook, Porter, ME. Sampled by Sacopee Middle School.

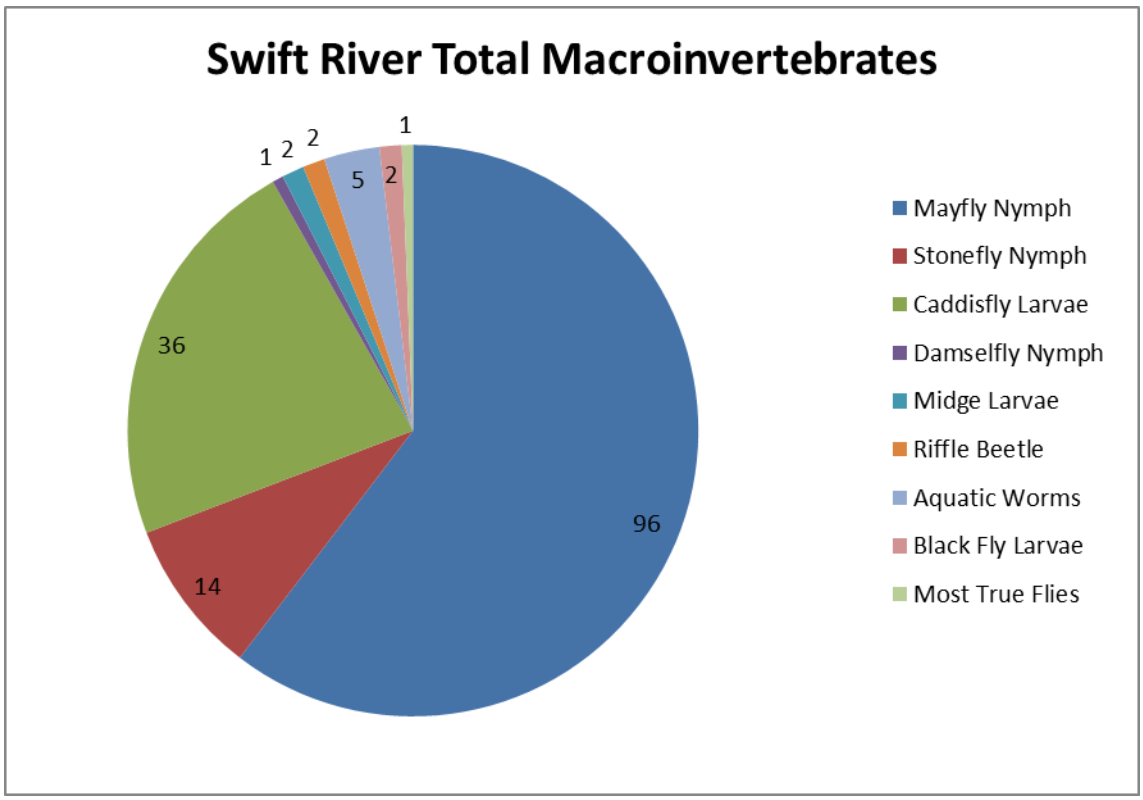




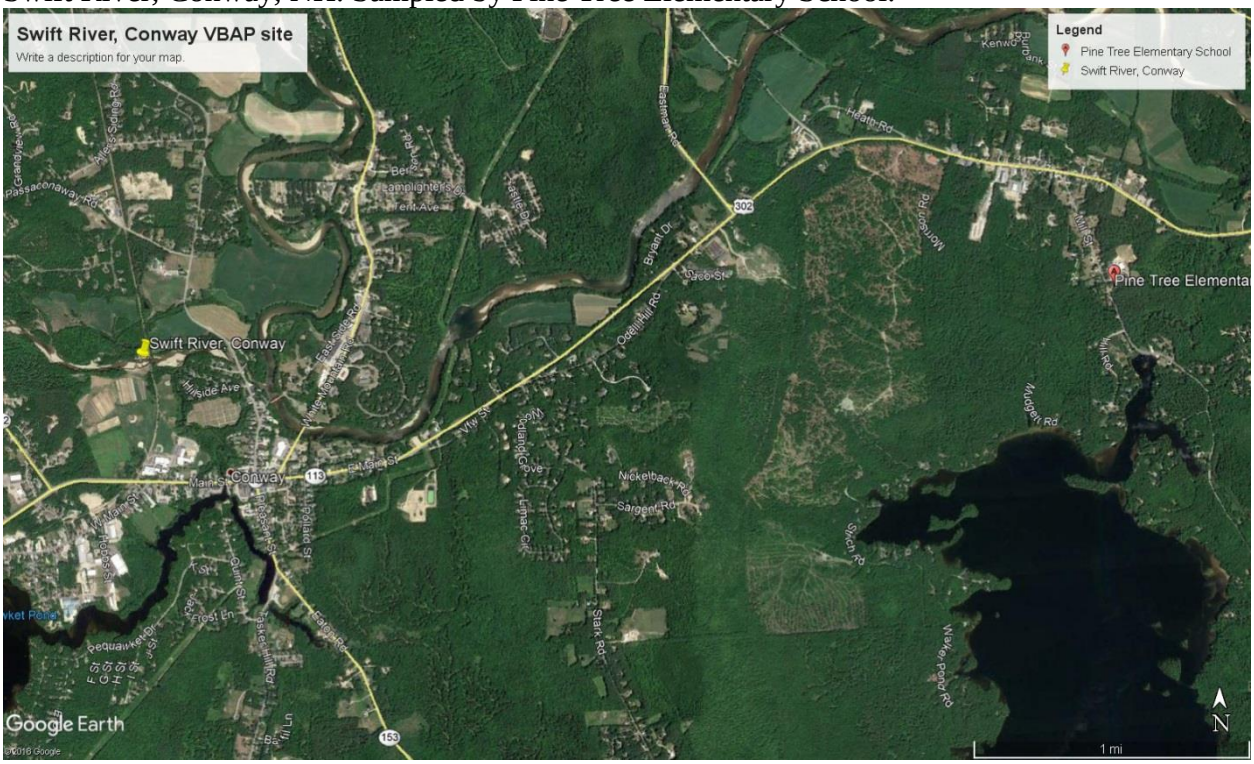
Lovell River, Ossipee, NH. Sampled by Madison Elementary School.



Bearcamp River, Tamworth, NH. Sampled by KA Brett School.



Swift River, Conway, NH. Sampled by Pine Tree Elementary School.



Appendix B

Cold River, Sandwich, NH. Tested by Sandwich Central School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	104	=	312		
Plecoptera	Stonefly Nymph	1	*	24	=	24		
Trichoptera	Caddisfly Larvae	4	*	117	=	468		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	0	=	0		
Diptera	Black fly larvae	7	*	17	=	119		
	Midge larvae	6	*	1	=	6		
	Most True flies	4	*	5	=	20		
Megaloptera	Alderfly	4	*	1	=	4		
	Hellgrammite	0	*	1	=	0		
Coleoptera	Riffle beetle	4	*	3	=	12		
	Water Penny	4	*	2	=	8		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	2	=	16		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
Totals				**277**		**989**	**3.57**	**Good**

Cold Brook, Freedom, NH. Tested by Freedom Elementary School

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	73	=	219		
Plecoptera	Stonefly Nymph	1	*	38	=	38		
Trichoptera	Caddisfly Larvae	4	*	41	=	164		
Odonata	Dragonfly Nymph	3	*	4	=	12		
	Damselfly Nymph	7	*	1	=	7		
Diptera	Black fly larvae	7	*	2	=	14		
	Midge larvae	6	*	1	=	6		
	Most True flies	4	*	5	=	20		
Megaloptera	Alderfly	4	*	0	=	4		
	Hellgrammite	0	*	5	=	0		
Coleoptera	Riffle beetle	4	*	3	=	12		
	Water Penny	4	*	6	=	24		
	Beetle & Beetle-like	7	*	1	=	7		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0 0	=	0		
	Aquatic Worms	8	*	4	=	32		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels							
	Water Mites	4	*	0	=	0		
Totals				**184**		**555**	**3.02**	**Excellent**

South River, Parsonsfield, ME. Tested by Effingham Elementary School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	180	=	114		
Plecoptera	Stonefly Nymph	1	*	73	=	5		
Trichoptera	Caddisfly Larvae	4	*	228	=	400		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	2	=	14		
Diptera	Black fly larvae	7	*	24	=	168		
	Midge larvae	6	*	1	=	6		
	Most True flies	4	*	10	=	40		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	0	=	0		
Coleoptera	Riffle beetle	4	*	27	=	108		
	Water Penny	4	*	0	=	0		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	2	=	16		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels Leeches	9	*	1	=	9		
Totals				**548**		**1884**	**3.43**	**Excellent**

Swift River (downstream), Tamworth, NH. Tested by Ossipee Central School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	20	=	60		
Plecoptera	Stonefly Nymph	1	*	19	=	19		
Trichoptera	Caddisfly Larvae	4	*	42	=	168		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	2	=	14		
Diptera	Black fly larvae	7	*	0	=	0		
	Midge larvae	6	*	2	=	12		
	Most True flies	4	*	3	=	12		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	0	=	0		
Coleoptera	Riffle beetle	4	*	1	=	4		
	Water Penny	4	*	0	=	0		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	21	=	168		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels Water Mites	4	*	5	=	20		
Totals				**115**		**477**	**4.15**	**Good**

Mill Brook, Porter, ME. Tested by Sacopee Middle School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	42	=	126		
Plecoptera	Stonefly Nymph	1	*	4	=	4		
Trichoptera	Caddisfly Larvae	4	*	48	=	192		
Odonata	Dragonfly Nymph	3	*	4	=	12		
	Damselfly Nymph	7	*	5	=	35		
Diptera	Black fly larvae	7	*	1	=	7		
	Midge larvae	6	*	0	=	0		
	Most True flies	4	*	7	=	28		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	1	=	0		
Coleoptera	Riffle beetle	4	*	3	=	12		
	Water Penny	4	*	4	=	16		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	1	=	8		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
Totals				**120**		**440**	**3.67**	**Good**

Bearcamp River, Tamworth, NH. Tested by KA Brett School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	125	=	375		
Plecoptera	Stonefly Nymph	1	*	2	=	2		
Trichoptera	Caddisfly Larvae	4	*	32	=	128		
Odonata	Dragonfly Nymph	3	*	1	=	3		
	Damselfly Nymph	7	*	0	=	0		
Diptera	Black fly larvae	7	*	1	=	7		
	Midge larvae	6	*	0	=	0		
	Most True flies	4	*	1	=	4		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	3	=	0		
Coleoptera	Riffle beetle	4	*	1	=	4		
	Water Penny	4	*	1	=	4		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	1	=	8		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
Totals				**168**		**535**	**3.19**	**Excellent**

Lovell River, Ossipee, NH. Tested by Madison Elementary School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	76	=	228		
Plecoptera	Stonefly Nymph	1	*	14	=	14		
Trichoptera	Caddisfly Larvae	4	*	69	=	276		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	2	=	14		
Diptera	Black fly larvae	7	*	4	=	28		
	Midge larvae	6	*	0	=	0		
	Most True flies	4	*	2	=	8		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	6	=	0		
Coleoptera	Riffle beetle	4	*	1	=	4		
	Water Penny	4	*	6	=	24		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	3	=	24		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels							
	Water Mites	4	*	2	=	8		
Totals				**185**		**628**	**3.40**	**Excellent**

Swift River, Conway, NH. Tested by Pine Tree Elementary School.

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	96	=	288		
Plecoptera	Stonefly Nymph	1	*	14	=	14		
Trichoptera	Caddisfly Larvae	4	*	36	=	144		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	1	=	7		
Diptera	Black fly larvae	7	*	2	=	14		
	Midge larvae	6	*	2	=	12		
	Most True flies	4	*	1	=	4		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	2	=	0		
Coleoptera	Riffle beetle	4	*	2	=	8		
	Water Penny	4	*	0	=	0		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	5	=	40		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
Totals				**159**		**531**	**3.34**	**Excellent**