Volunteer Biological Assessment Program
Stream Data Collection Report
The Ossipee Watershed
2018 (Draft)

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GREEN MOUNTAIN
CONSERVATION GROUP

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Participating School Groups:
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Freedom Elementary School
Ossipee Central School
Sacopee Middle School
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, for thirteen years 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. This program allows students to complete biological sampling of macroinvertebrates in streams within the Ossipee Watershed.

During the fall of 2018, GMCG worked with students and teachers from five local schools across the watershed in New Hampshire and Maine. They sampled five 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 training session was held 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

Most 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. An additional site in Porter, Maine was added this year based on accessibility to the local school participating in the program and landowner consent. 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	230
Plecoptera	Stonefly nymph	51
Trichoptera	Caddisfly larvae	267
Odonata	Dragonfly larvae	9
	Damselfly nymph	13
Diptera	Black fly larvae	9
	Midge larvae	7
	True flies	17
Megaloptera	Alderfly	0
	Hellgrammite	9
Coleoptera	Riffle Beetle	17
	Water Penny	6
	Beetle/Beetle like	2
Other	Crayfish	0
	Snails	0
	Aquatic Worms	18
	Scuds	0
	Sowbug	0
	Leech	1
	Water Mites	4

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).

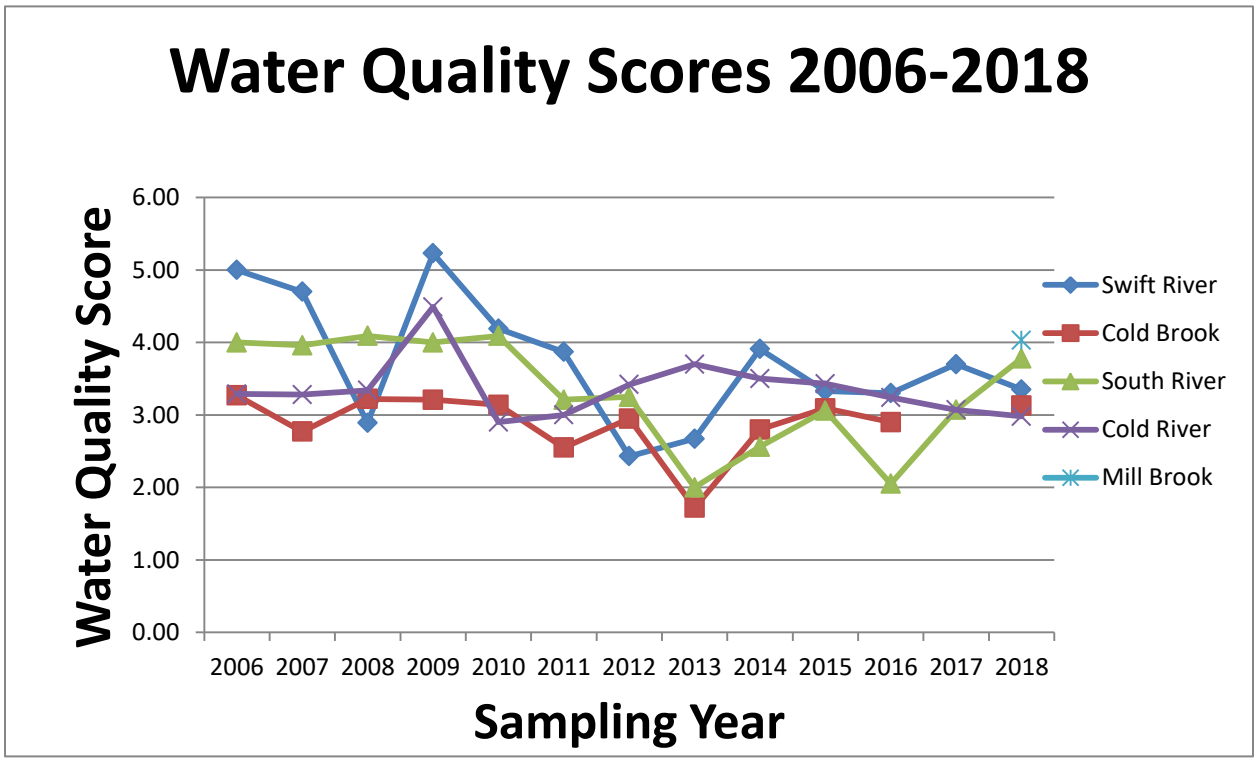
Table 2 highlights the biotic score and the narrative category for each sampling site tested in the Ossipee Watershed. Three of the five scores fell in the "Excellent" category and two fell in the "Good" category, see Table 2.

Table 2. Biotic Scores of Sampling Sites

Location	Biotic Score	Water Quality Score
Cold River	2.98	Excellent
Cold Brook	3.13	Excellent
South River	3.78	Good
Swift River	3.35	Excellent
Mill Brook	4.03	Good

Table 3 shows changes in water quality scores over time at the sites sampled in 2018. 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 have improved at sites tested since 2006.

Table 3. Water Quality Scores 2006-2018



Supplementary Data

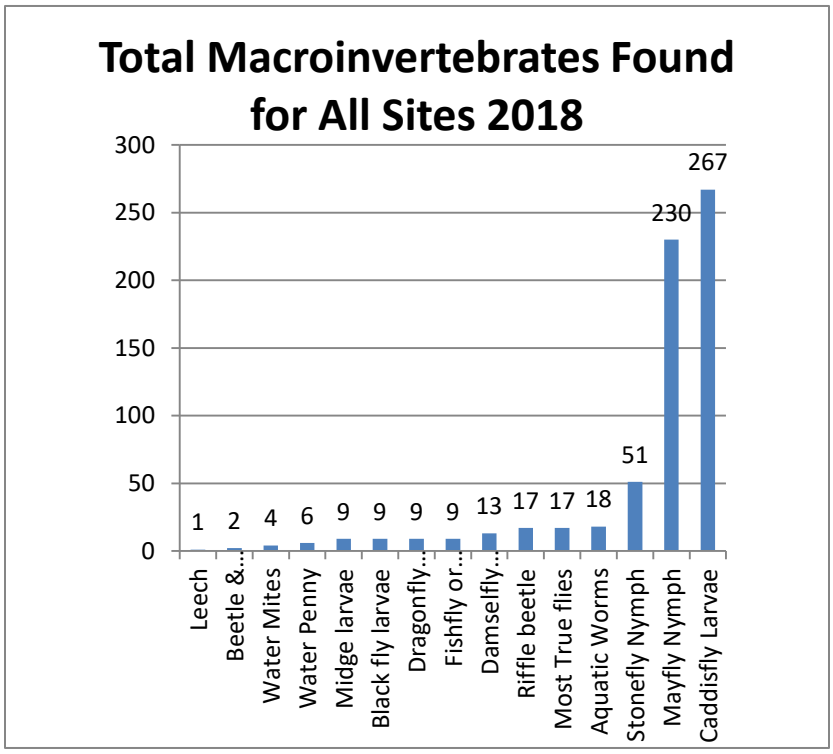
The water chemistry and physical parameters of the stream were recorded. Physical parameters recorded included width/depth of the stream, canopy cover, observations of nearby erosion or human influence, turbidity, pH, conductivity and temperature. A multi-parameter submersible Hach water quality probe 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 3.45 and corresponds to the "excellent" narrative category. See Table 2 for

biotic scores for the individual streams. Overall, caddisfly nymphs were the most dominant taxon 267 (40%), followed by mayfly nymph 230 (35%) and stonefly nymphs 51 (8%). Together, these three taxa comprised 83% of all individuals. In completing the sampling effort, volunteers collected and identified 663 macroinvertebrates (See Figure 1).

Figure 1. Cumulative VBAP Data 2018



All pH, dissolved oxygen, turbidity, and temperature readings were within the normal range to support aquatic life (Table 3). Conductivity levels at Cold Brook in Freedom were slightly elevated above natural background levels, and simple trend line analysis of historical data demonstrates that conductivity levels at this site as well as at Cold River in Sandwich are increasing over time, likely due to road salting activities (see Figures 2 and 3). 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/.

Table 3. Physical & Chemical Parameters of Sampling Sites

Physical & Chemical Parameters	Normal Range/Optimal Value	Cold Brook	Cold River	South River	Swift River	Mill Brook
pH	6.5-8.0	6.94	6.68	6.58	6.88	6.73
Dissolved Oxygen	5 mg/L and above	8.86mg/L	9.84mg/L	7.79mg/L	10.30mg/L	9.81mg/L
Conductivity	Below 100µS/cm²	131.26µS/cm	22.7µS/cm²	64.6µS/cm²	42.6µS/cm²	43.9µS/cm²
Turbidity	Under 10NTUs	1.21NTUs	1.57NTUs	2.38NTUs	1.20NTUs	.55NTUs
Temperature	21°C below for trout/mayfly nymphs	18.5°C	15.1°C	18.5°C	15°C	13.4°C

Figure 2. Conductivity Levels Increasing at Cold Brook, Freedom

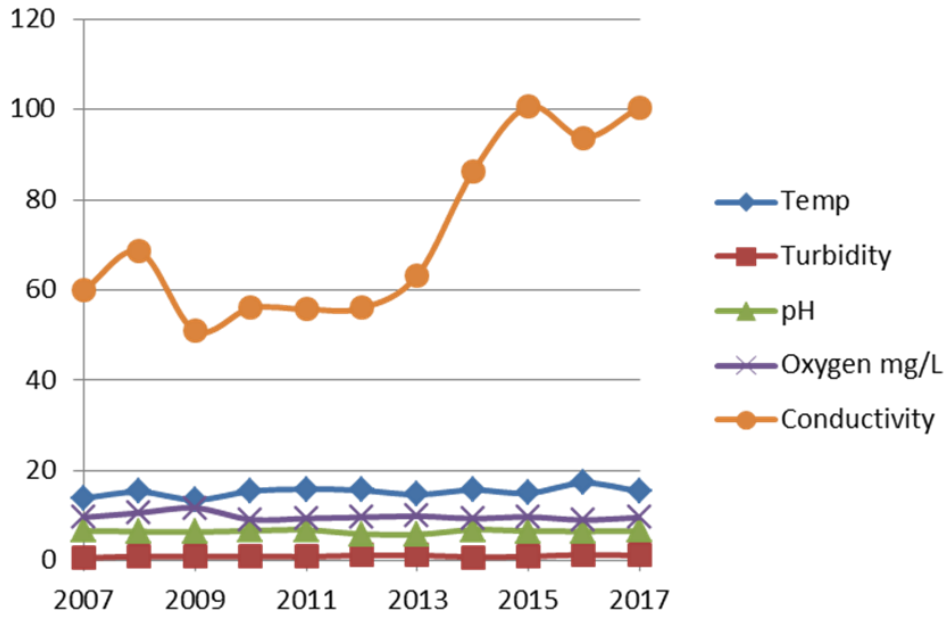
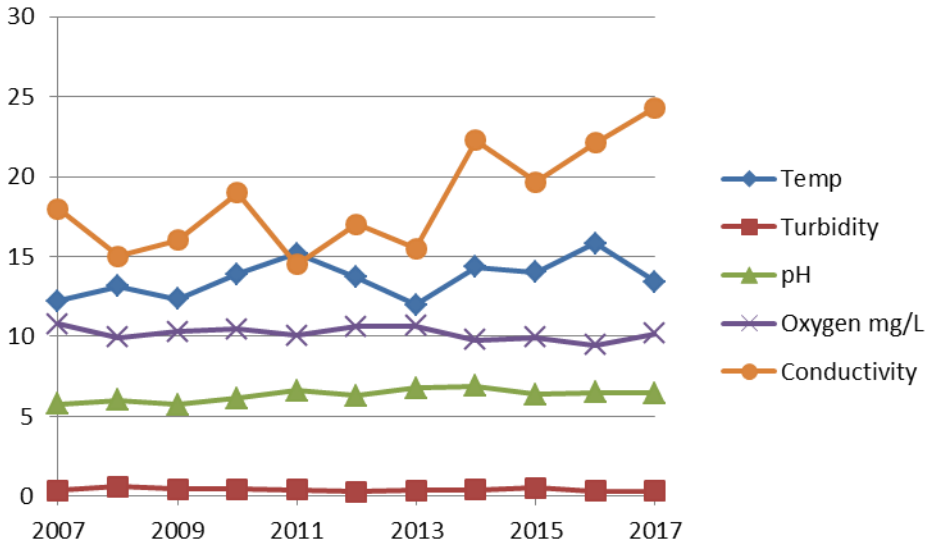


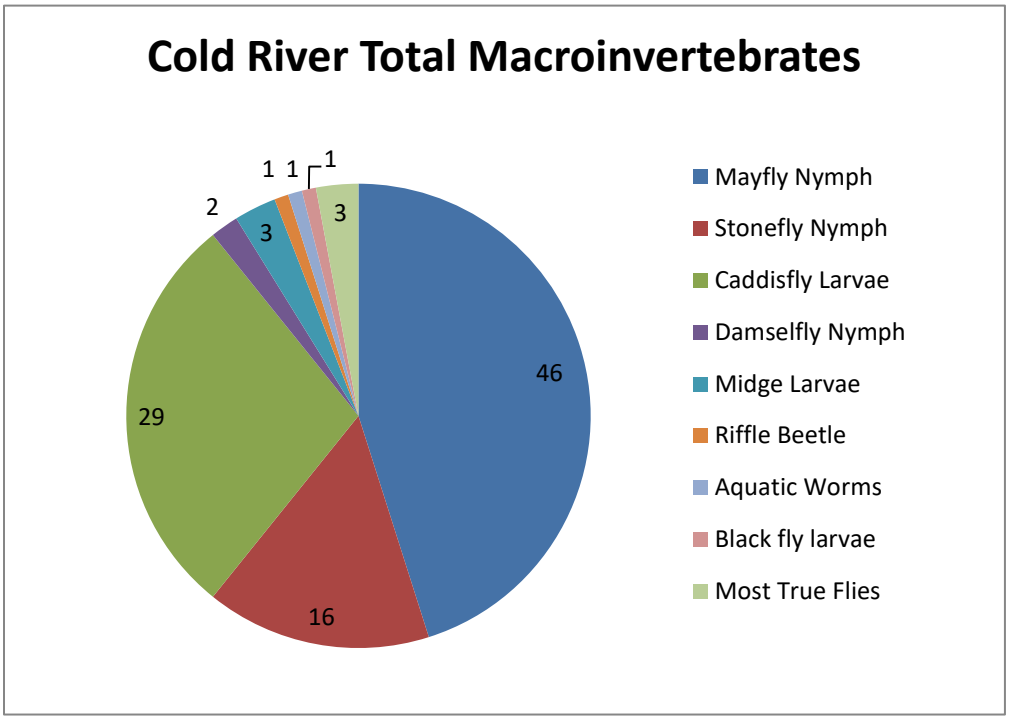
Figure 3. Conductivity Levels Increasing at Cold River, Sandwich

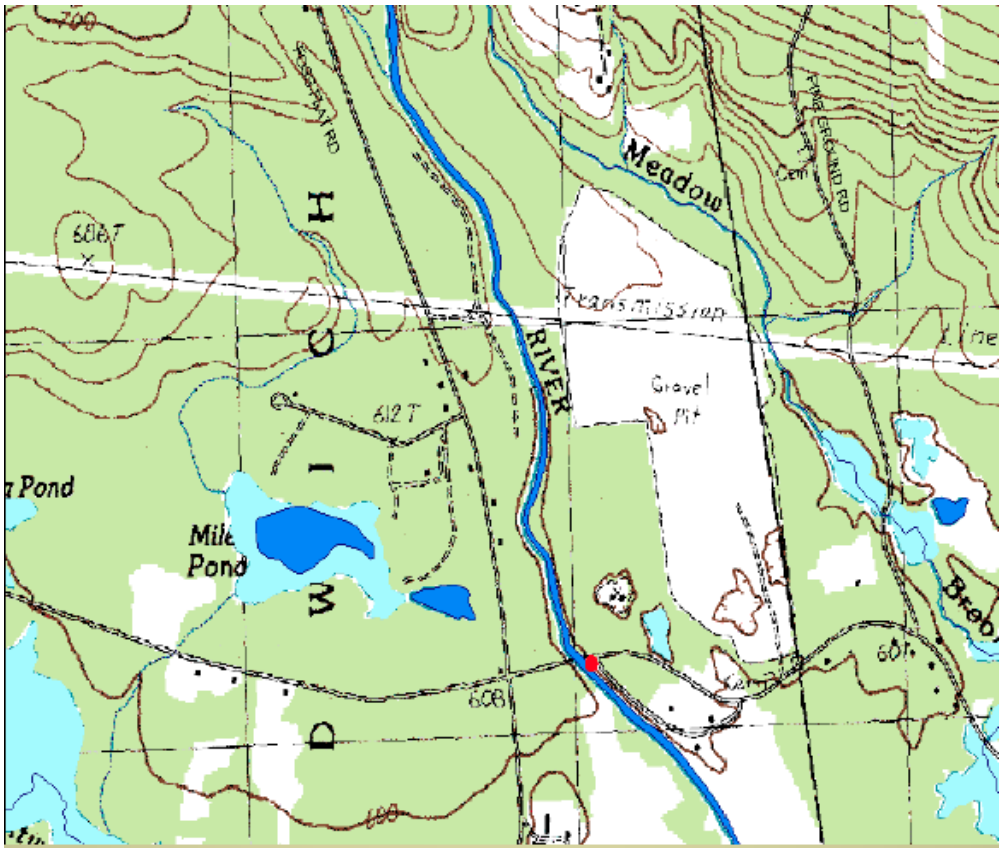


Summary and Future Recommendations

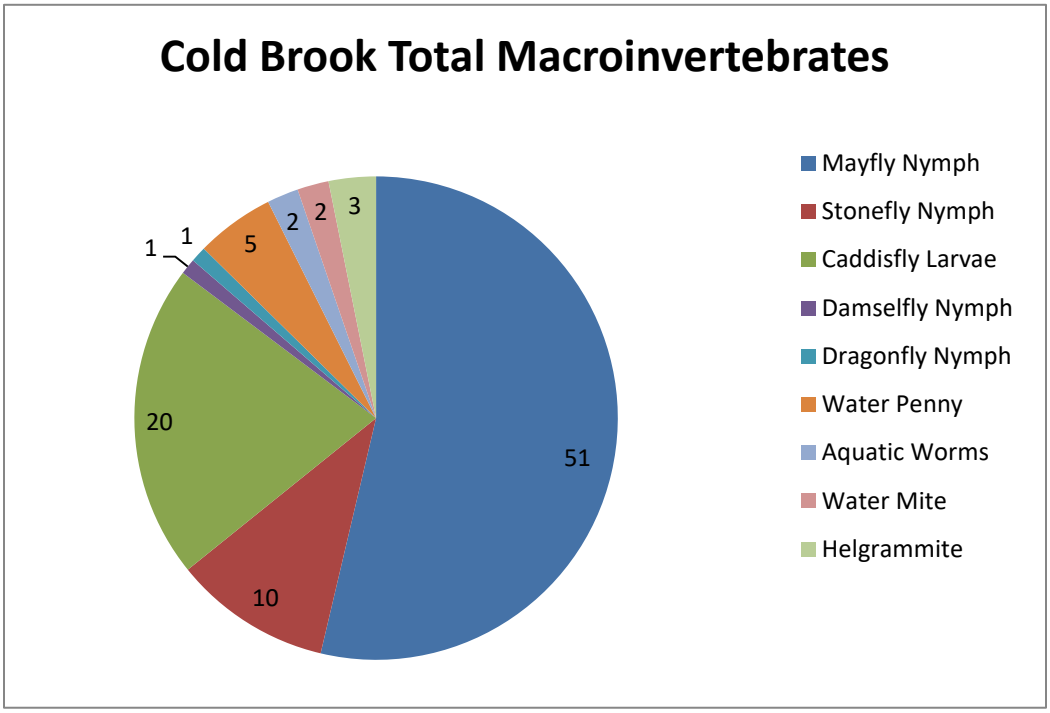
The documentation by volunteers of the invertebrate communities using the VBAP protocol during fall 2018 in the Ossipee Watershed marked the thirteenth year of 'screening' efforts to evaluate the status of aquatic communities. The sampling efforts included five sites in the Ossipee Watershed. Macroinvertebrates 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 2018 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 Ossipee 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

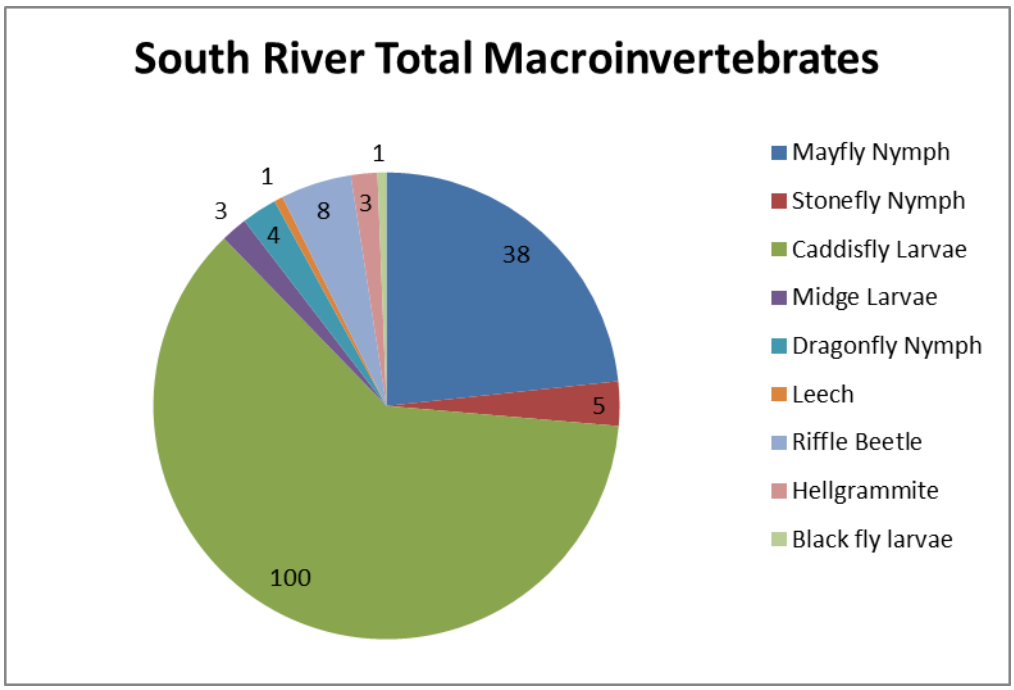


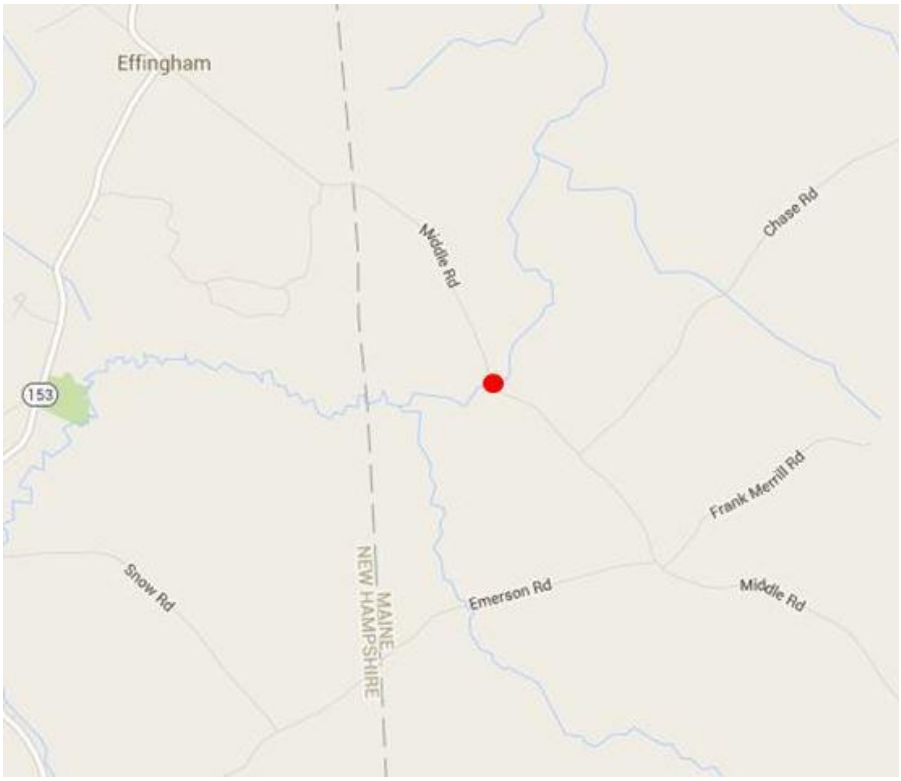


Cold River, Sandwich, NH. Sampled by Sandwich Central School

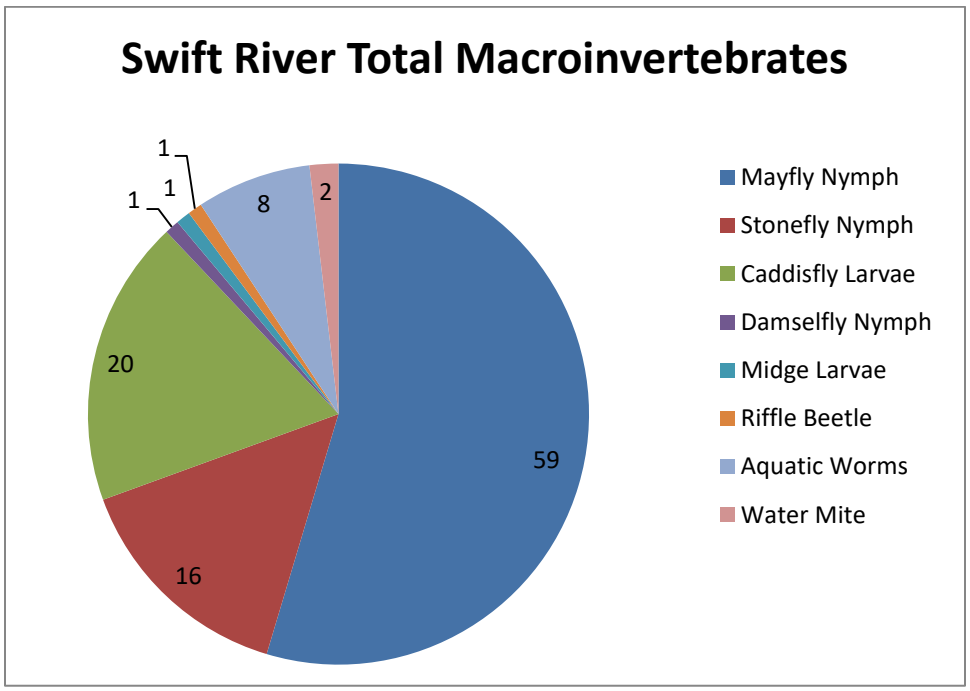


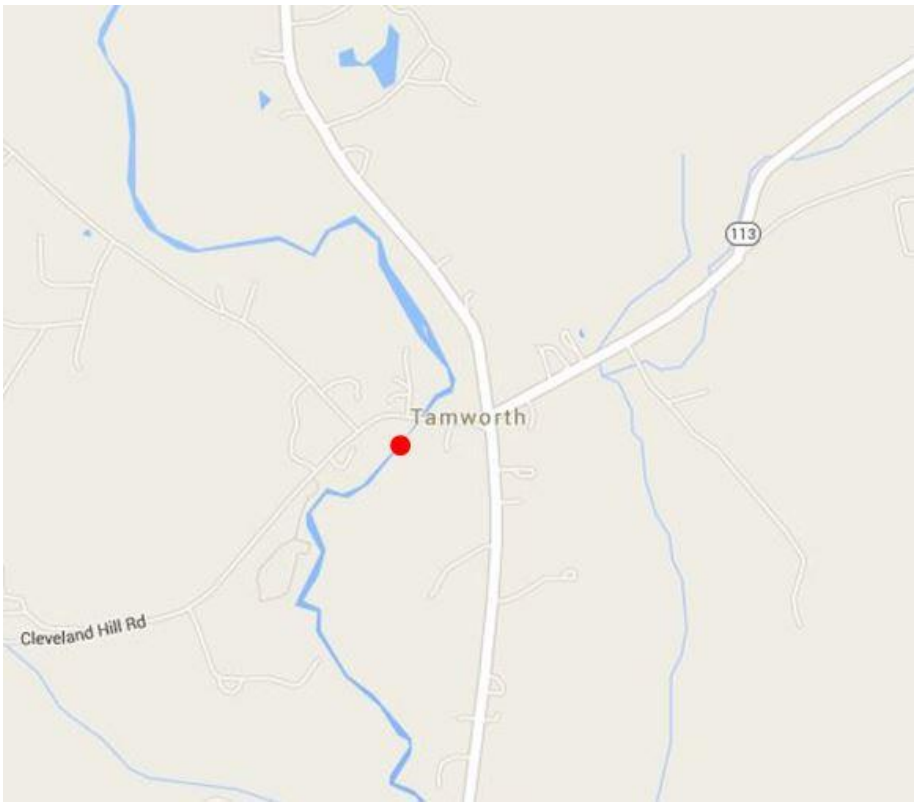
Cold Brook, Freedom, NH. Sampled by Freedom Elementary School



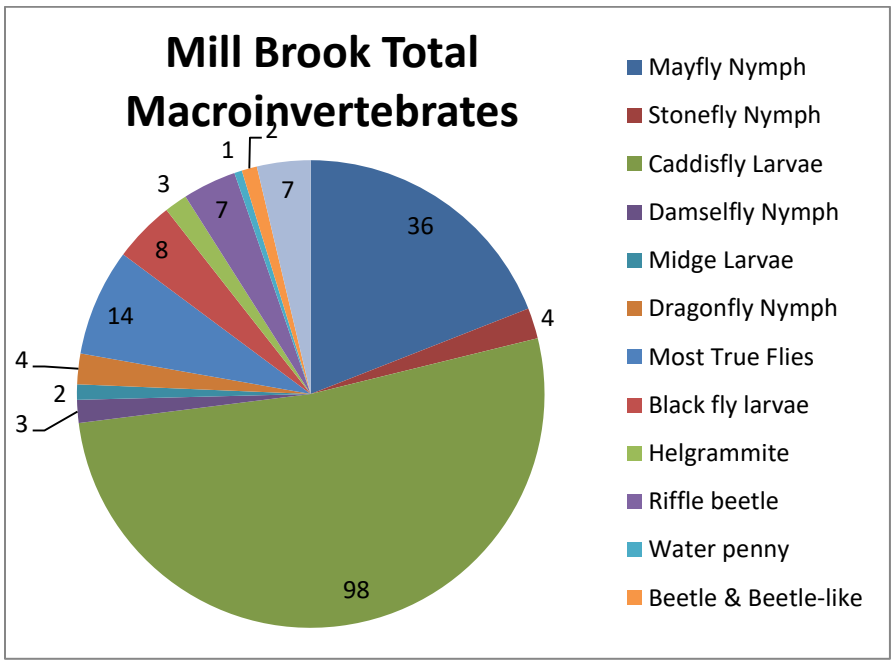


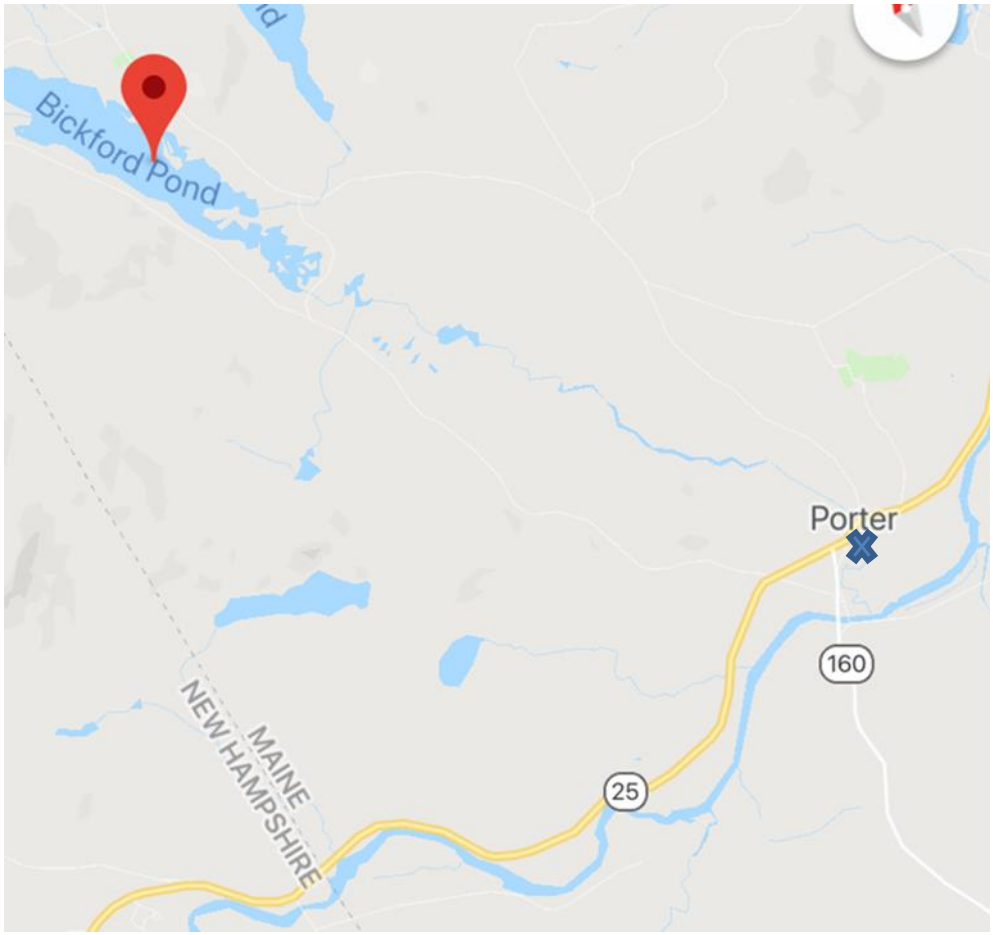
South River, Parsonsfield, ME. Sampled by Effingham Elementary School





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





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

Appendix B

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

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	46	=	138		
Plecoptera	Stonefly Nymph	1	*	16	=	16		
Trichoptera	Caddisfly Larvae	4	*	29	=	87		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	2	=	14		
Diptera	Black fly larvae	7	*	1	=	7		
	Midge larvae	6	*	3	=	18		
	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	*	1	=	8		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
Totals				**102**		**304**	**2.98**	**Excellent**

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

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	51	=	152		
Plecoptera	Stonefly Nymph	1	*	10	=	10		
Trichoptera	Caddisfly Larvae	4	*	20	=	80		
Odonata	Dragonfly Nymph	3	*	1	=	3		
	Damselfly Nymph	7	*	1	=	7		
Diptera	Black fly larvae	7	*	0	=	0		
	Midge larvae	6	*	0	=	0		
	Most True flies	4	*	0	=	0		
Megaloptera	Alderfly	4	*	0	=	4		
	Hellgrammite	0	*	3	=	0		
Coleoptera	Riffle beetle	4	*	0	=	0		
	Water Penny	4	*	5	=	20		
	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							
	Water Mites	4	*	2	=	8		
Totals				**95**		**297**	**3.13**	**Excellent**

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

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	38	=	114		
Plecoptera	Stonefly Nymph	1	*	5	=	5		
Trichoptera	Caddisfly Larvae	4	*	100	=	400		
Odonata	Dragonfly Nymph	3	*	4	=	12		
	Damselfly Nymph	7	*	6	=	42		
Diptera	Black fly larvae	7	*	1	=	7		
	Midge larvae	6	*	3	=	18		
	Most True flies	4	*		=	0		
Megaloptera	Alderfly	4	*		=	0		
	Hellgrammite	0	*	3	=	0		
Coleoptera	Riffle beetle	4	*	8	=	32		
	Water Penny	4	*		=	0		
	Beetle & Beetle-like	7	*		=	0		
Others	Crayfish	6	*		=	0		
	Snails	7	*		=	0		
	Aquatic Worms	8	*		=	0		
	Scuds	8	*		=	0		
	Sowbugs	7	*		=	0		
	Clams and Mussels Leeches	9	*	1	=	9		
Totals				**169**		**639**	**3.78**	**Good**

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

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	59	=	177		
Plecoptera	Stonefly Nymph	1	*	16	=	16		
Trichoptera	Caddisfly Larvae	4	*	20	=	80		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	1	=	7		
Diptera	Black fly larvae	7	*	0	=	0		
	Midge larvae	6	*	1	=	6		
	Most True flies	4	*	0	=	0		
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	*	8	=	64		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels Water Mites	4	*	2	=	8		
Totals				**108**		**362**	**3.35**	**Excellent**

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

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	36	=	108		
Plecoptera	Stonefly Nymph	1	*	4	=	4		
Trichoptera	Caddisfly Larvae	4	*	98	=	392		
Odonata	Dragonfly Nymph	3	*	4	=	12		
	Damselfly Nymph	7	*	3	=	21		
Diptera	Black fly larvae	7	*	8	=	56		
	Midge larvae	6	*	2	=	16		
	Most True flies	4	*	14	=	56		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	3	=	0		
Coleoptera	Riffle beetle	4	*	7	=	28		
	Water Penny	4	*	1	=	4		
	Beetle & Beetle-like	7	*	2	=	14		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	7	=	56		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
Totals				**189**		**763**	**4.03**	**Good**