Volunteer Biological Assessment Program: Ossipee Watershed and Saco Watershed 2016 Stream Data Collection Report

Students from Sandwich Central School

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I: Acknowledgements

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Volunteers:
Noreen Downs, Madison
Dr. Ned Hatfield, Freedom
Emelyn Albert, Effingham
Dr. Ann Packard, Holderness
Maud Anderson, Tamworth
Carolyn Hemingway, Tamworth
Norm Sizemore, Tamworth

Participating School Groups:
Effingham Elementary School
Freedom Elementary School
Ossipee Central School
Sandwich Central School
Moultonborough Academy
Maine Environmental Science Academy

Dr. Hatfield helping students from Freedom Elementary School identify macros.

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Students from Maine Environmental Science Academy, Fryeburg, Maine.

1. INTRODUCTION

Water Quality Monitoring Program History:
Green Mountain Conservation Group's Water Quality Monitoring (WQM) program was established in 2002 in partnership with the Saco River Corridor Commission (SRCC) in Maine to create a watershed-wide program across 2 states and 26 towns. The WQM program is designed to provide the public with baseline water quality data. Using this information, municipal officials will be able to use scientific data to plan for future growth and also monitor the effects of growth on water quality in each of the watershed towns. Since 2002, in cooperation with town officials and UNH experts, the WQM program has expanded to 45 monitoring sites including 30 tributary sites, five deep water sampling sites in Ossipee Lake and Bays and 10 Volunteer Biological Assessment Program sites with 6 assessed by local youth this year. This baseline data represents another important aspect of maintaining good water quality in our communities.

Since 1997, the New Hampshire Department of Environmental Services (NHDES) conducted stream surveys to determine the health of aquatic systems. As part of these efforts, NHDES developed a preliminary screening protocol, appropriate for volunteers, to evaluate the biological condition of aquatic macroinvertebrate communities. The purpose is to supplement biological data collected by DES, educate the public about water quality issues as interpreted through biological assessments, build a constituency of individuals to practice sound water quality management at the local level, and build public support for water quality protection.

In 2004, the NHDES coordinated efforts with several local organizations to develop the Volunteer Biological Assessment Program (VBAP). In 2006, the DES began working with the Green Mountain Conservation Group (GMCG), a non-profit charitable organization concerned with natural resource conservation in the Ossipee Watershed. The purpose of this partnership was to develop volunteer interest and ability to collect biological data and to initiate and complete biological sampling of macroinvertebrates in streams and rivers within the Ossipee Watershed.

During the fall of 2016, students from Effingham, Ossipee, Freedom, Sandwich, Moultonborough, and Fryeburg, Maine participated in VBAP with Green Mountain Conservation Group. As part of VBAP, students acted as student scientists. They visited local streams and rivers to assess the natural environment, collect and sort macroinvertebrates, and test various components of the water. GMCG relies on youth for the VBAP program. Not only do these students collect valuable data, but they also present their findings at community meetings and are heard differently than adult presenters. Their presentations often have much more impact in getting the message across about water quality protection.

2. METHODS

2.1 Sampling sites and data collection

Prior to any sampling, a training session was held in the classroom. The training consisted of three major components:

1. Macroinvertebrate sampling techniques, including the importance of following protocol.
2. Basic macroinvertebrate identification skills.
3. The collection of supplementary data consisting of basic physical and chemical parameters.

All sites were accessible, 200 feet in length, and contained appropriate sampling habitat (at least one riffle, run, and/or ripple). Sampling was conducted in September and October and required three to four hours per site. Students and volunteers followed the protocol as outlined by NHDES. The protocol was as follows:

- First, sampling locations were identified and students recorded site information on the Habitat Data Sheet.
- Then, macroinvertebrates were collected by placing a 500-micron mesh kick net perpendicular to stream flow and firmly against the streambed with the opening of the net faced upstream to promote macroinvertebrate collection.
- Next, 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).
- Finally, the kick net was carefully lifted out of the water and the same process was repeated four additional times with each sample collected further upstream. Active sampling time approximated five minutes within one square meter area at each sampling station.
- Once the collection process was complete, the contents of the net were transferred into a container of stream water (fitted with 500 micron wire mesh filter). All organisms remaining on the net were carefully removed and added to the sample. The students sorted the entire sample.

Students from Effingham Elementary collecting site information.

2.2 Macroinvertebrate sorting and identification

For approximately 60 minutes students and volunteers sorted and identified the macroinvertbrates, using the following protocol:

- The selected portion of the sample was sorted using spoons or pipettes. The macros were then placed into separate containers. Student groups sometimes rotated among the sample portions to examine more completely each sample portion. Students were assisted by GMCG staff and trained volunteers in the process of identifying the macroinvertebrates in the sample.
- After sorting, specimens were identified according to the various coarse taxonomic groups (Table 2). According to protocol, the number of people sorting, cumulative sorting effort (0.5 hour x # people sorting), and approximate fraction of the total sample sorted were recorded.
- The number of macroinvertebrates within each taxonomic group and the total number of individuals sorted was calculated and recorded.

Students from Ossipee Central School sorting macros.

2.3 Biotic index computation

Biotic scores are based on pollution tolerance values ranging from 0 to 8 assigned to individual taxonomic groups. More tolerant groups have higher tolerance values and less tolerant groups have lower values. The Biotic scores were computed for each sample station using a standardized computational worksheet. The procedure was as follows:

1. Multiply the number of individual specimens by their respective tolerance value.
2. Sum the taxonomic-specific biotic scores.
3. Divide the sum by the total number of individuals identified in the respective sample.
4. The final number is the final biotic score.

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).

Dr. Deighan calculated the biotic score of each site and schools had the option of figuring out the score back in the classroom. Both biotic scores could be compared to verify them.

2.4 Supplementary data

The water chemistry and physical parameters of the stream were recorded. Physical parameters recorded included width/depth of the stream, canopy cover, and observations of nearby erosion or human influence. Basic water chemistry data was collected using a multi-parameter submersible water quality probe and included dissolved oxygen, conductivity, and water temperature. Turbidity samples and pH samples were also taken at each site.

Sandwich Central School student calculating the temperature.

3. RESULTS

3.1 Water Quality

The water quality of each site in the Ossipee Watershed was found to be in the excellent range as calculated by the water quality score. Moose Pond Brook in the Greater Saco Watershed in Denmark, Maine received a Good water quality score. Basic water quality measures were collected at each of the sampling locations. All measures were within the range of expectation based on past data collection. For more detailed water quality data on the water bodies in the Ossipee watershed, refer to the annual reports published by GMCG available online at http://www.gmcg.org/research/water-quality-program-data/ or contact GMCG.

Table 1. Water Quality Scores

Stream, Location	Water Quality Score	VBAP Category
Bearcamp River, Tamworth, NH	3.38	Excellent
Cold Brook, Freedom, NH	2.9	Excellent
Cold River, Sandwich, NH	3.24	Excellent
Moose Pond Brook, Denmark, ME	3.91	Good
Swift River, Tamworth, NH	3.3	Excellent
South River, Parsonsfield, ME	2.05	Excellent

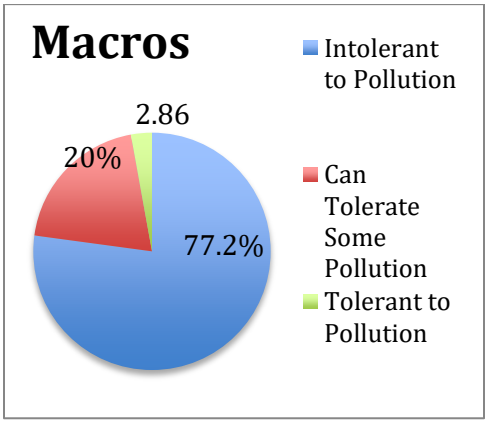
3.2 Biological Assessment

Macroinvertebrate samples from each site were evaluated using the VBAP biotic score index utilizing taxa-specific tolerance values. Individual tables for each site can be found in Appendix. The averages are as follows:

Biotic Score	Value
Mean	3.12
Median	3.27
Mode	3.3
Range	2.58

BEARCAMP RIVER, TAMWORTH

On October 5th ten high school students from Moultonborough Academy tested the water quality of the **Bearcamp River** in Tamworth, NH. This was the last test of the season and although the students found a small amount of macros, the water quality was excellent.

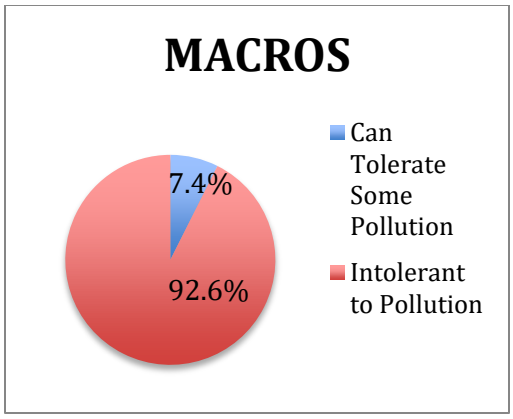


Macros found at Bear Camp River, 2016

Low water levels at Bear Camp River, 10/3/2016

COLD BROOK, FREEDOM

A small group of third graders from Freedom Elementary School tested the water quality of **Cold Brook**. Dr. Ned Hatfield accompanied the group and was instrumental in helping the students identify the collected macroinvertebrates. Although the water level of Cold Brook was extremely low, 92% of the macros that were found are intolerant to pollution.

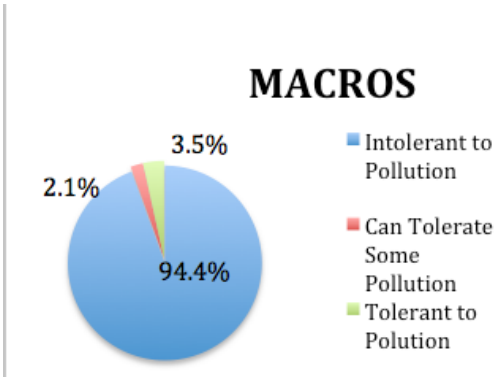


Macros found at Cold Brook, 2016

Low water levels, Cold Brook 9/28/2016

COLD RIVER, SANDWICH

Students in grades fourth, fifth and sixth grade from Sandwich Central School assessed the water quality of the **Cold River** in Sandwich, NH. Although the water levels were consistently low as were the other rivers and streams, the temperature of the water was colder than the other streams. A SCS student said, "They don't call it the Cold River for nothing."

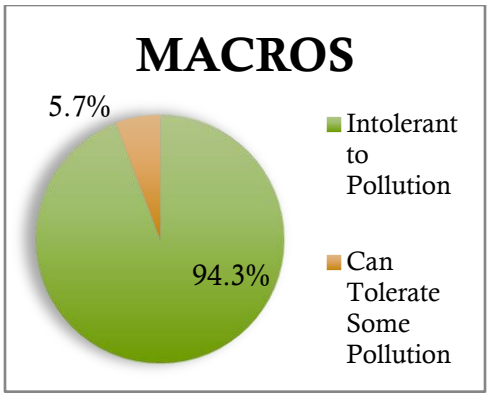


Macros found at Cold River, 2016

Low water levels at Cold River, 9/26/2016

SOUTH RIVER, PARSONSFIELD, ME

Students from Effingham Elementary School tested the water quality at the **South River** in Parsonsfield, Maine. The water levels were extremely low and there was several pieces of disposable trash ie. cans, paper, boxes, etc. found on the banks of the river. The water quality was calculated to be in the excellent range.

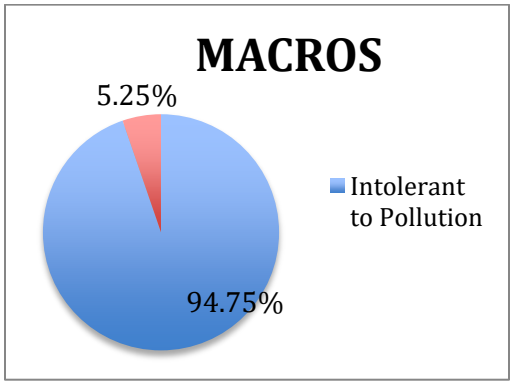


Macros found at South River, 2016

Low water levels at South River, 9/19/2016

SWIFT RIVER, TAMWORTH

Grades five and six from Ossipee Central School assessed the water quality at the **Swift River** in Tamworth. While the group was working, a volunteer from GMCG's tributary monitoring program, Mr. Norm Sizemore, stopped by to lend a helping hand with data collection after he had finished data collection in Madison.

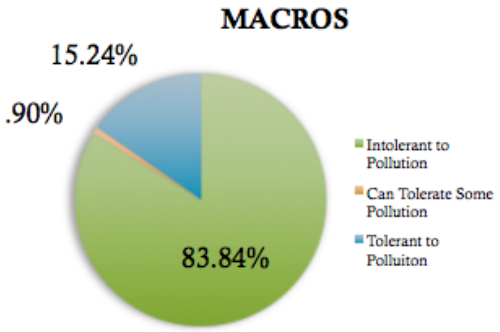


Macros found at the Swift River, 2016

Low water levels at Swift River, 9/23/2016

MOOSE POND BROOK, DENMARK MAINE

Students from Maine Environmental Science Academy tested **Moose Pond Brook.** This site continues to maintain "good" water quality which is also what water quality monitoring data collected by GMCG's downstream partners, the Saco River Corridor Commission (SRCC), has shown since 2002. Contact SRCC at 207-625-8123 for more information about water quality data in the Saco River Watershed.



Macros found at Moose Pond Brook, 2016**.**

Low water levels at Moose Pond Brook, 9/16/2016

Table 3. Comparisons of biotic scores from 2015 and 2016

Stream	Location	2015 Biotic Score	2016 Biotic Score
Bearcamp River	Tamworth, NH	3.04	3.38
Cold Brook	Freedom, NH	3.09	2.9
Cold River	Tamworth, NH	3.43	3.24
South River	Parsonsfield, ME	3.06	2.05
Swift River	Tamworth, NH	3.11	3.3
Moose Pond Brook	Denmark, ME	4.0	3.91

Table 4. Comparisons of number of macros collect from 2015 and 2016

Stream	Location	2015 Number of Macros	2016 Number of Macros
Bearcamp River	Tamworth, NH	127	35
Cold Brook	Freedom, NH	118	27
Cold River	Tamworth, NH	88	143
South River	Parsonsfield, ME	115	88
Swift River	Tamworth, NH	118	76
Moose Pond Brook	Denmark, ME	123	328

3.3 Parameters

Multiple chemical parameters taken at each site. The students used measurement devices to take the following measurements: pH, Dissolved Oxygen, Temperature, Conductivity, and Turbidity. A GMCG volunteer showed the students how to use the devices. For each measurement, two readings were taken and averaged. The results were as follows:

Table 5. Basic water quality parameter results

River/Stream	pH (units)	Dissolved Oxygen (mg/L), (%)	Temperature (°C)	Conductivity (µS/cm)	Turbidity (NTU)
Bearcamp River	6.69	101.5%	14.6°C	46.8	.56
Cold Brook	6.64	92.7%	13.5°C	141	2.05
Cold River	6.62	97.6%	8.7°C	38.2	.41
South River	6.47	83.6%	11.4°C	72.4	1.82
Swift River	6.54	95.65%	15.3°C	42.0	.23
Moose Pond Brook	6.68	95.8%	15.7°C	54.4	.77

4. SUMMARY AND FUTURE RECOMMENDATIONS

The documentation by volunteers of the macroinvertebrate communities using the VBAP protocol during fall 2016 in the Ossipee watershed represented the eleventh consecutive year of 'screening' efforts to evaluate the status of aquatic communities. The sampling efforts included five sites in the Ossipee Watershed and one site in the greater Saco River Watershed. The VBAP protocol was designed by NHDES to provide volunteers and water quality professionals without formal training in biological sampling an avenue to complete "coarse" level investigations of the types and quantities of macroinvertebrates living in streams and rivers. 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.

The VBAP protocol provided volunteers with an opportunity to become familiar with aquatic fauna in the streams and rivers in the Ossipee watershed and beyond. The collection of macroinvertebrates using the VBAP protocol, in addition to the usual chemical parameters collected by GMCG, proved to be a fairly simple and informative way to assess the health of a river or stream. With adequate training, volunteers became familiar with the most common macroinvertebrate types and their respective tolerance to pollution.

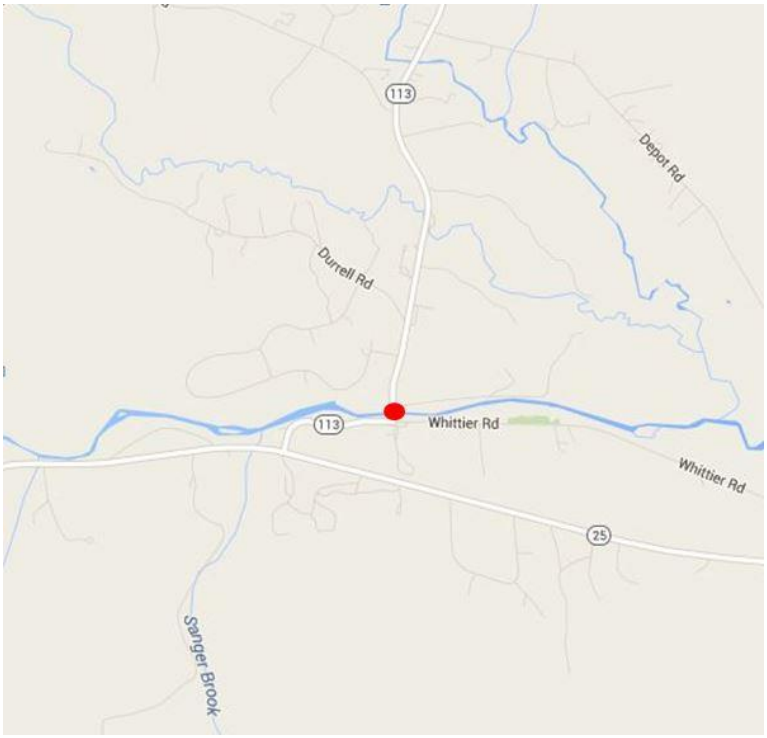
The results obtained by student volunteers using the VBAP protocol indicated that the majority of sites sampled appeared to be in excellent condition. Five of the streams fell into the "excellent" narrative category and one was in the "good" category. Most of the communities were dominated by less tolerant macroinvertebrates, such as the mayflies and stoneflies. The water levels of all of the sites were lower than normal due to the drought conditions in the area this year. On average, students did not collect as many macroinvertebrates as they did in years past. This could have been due to the lower water levels. Although they did not collect as many macros, those that they did collect indicated that the water quality was excellent at all sites in the Ossipee Watershed and Moose Pond Brook maintained a rating of good.

While the biotic index provided a method for relative comparisons of the sites sampled, the tolerance values and narrative categories are still under development and must be calibrated to a set of reference sites before statewide application is possible. The data collected builds upon a baseline against which to compare future VBAP sampling efforts and highlights the general lack of major impacts to the macroinvertebrate communities at the points where samples were collected.

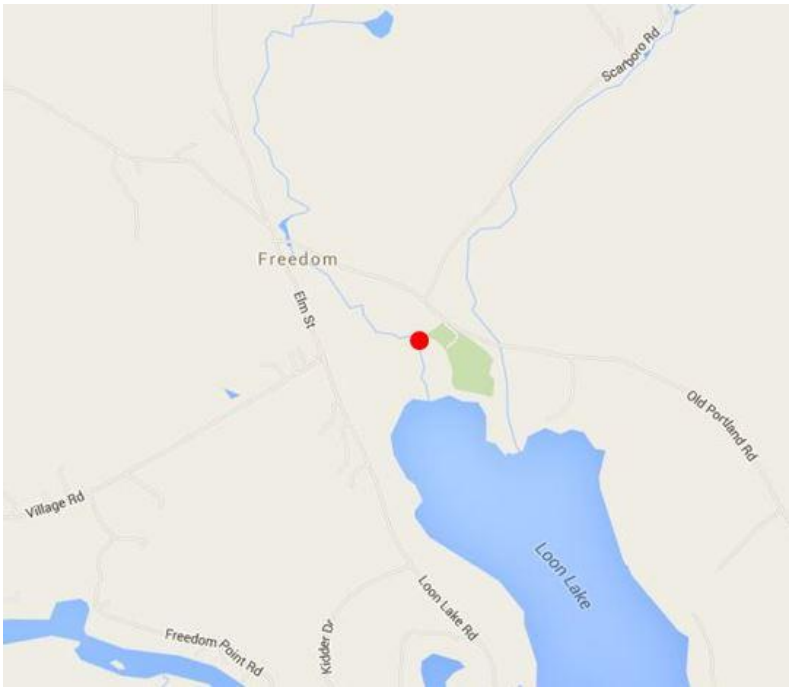
While the sampling efforts were effective at documenting the status of the macroinvertebrate communities at a coarse level, it is important to recognize that the project represented the effort by GMCG to refine and build upon the VBAP protocol. The DES Biomonitoring program developed the VBAP protocol and is continually refining the training provided to volunteers, field sampling techniques, and biotic index applicability. Therefore, more detailed investigations will need to be made in order to make a formal determination of biological community condition.

Ultimately, the results from the Volunteer Biological Assessment Program for 2016 build upon the efforts conducted by GMCG over the past several years. 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 further that reputation. The VBAP results provide objective information to the public so that informed citizens have the ability to make good decisions regarding the Ossipee Watershed's unique water resources.

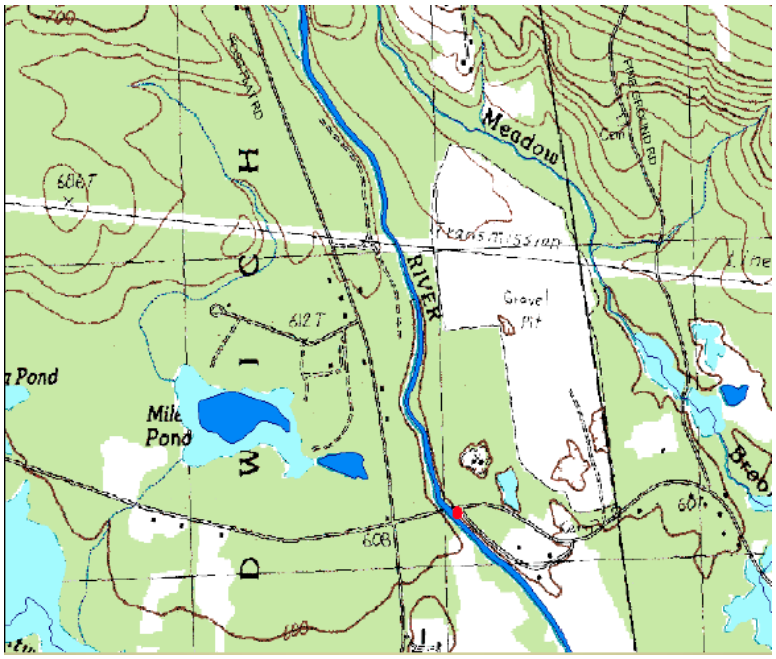
APPENDIX A



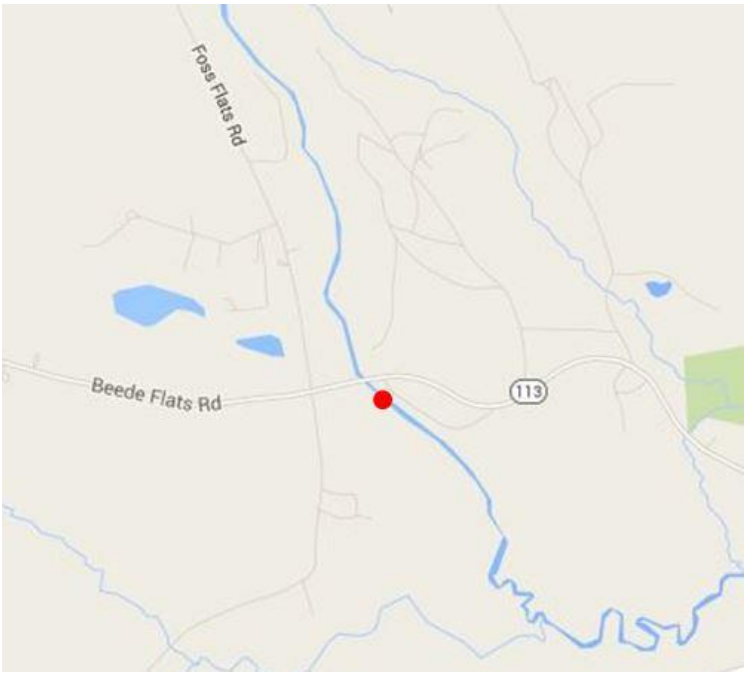
Bearcamp River, Tamworth, NH. Sampled by Moultonborough Academy



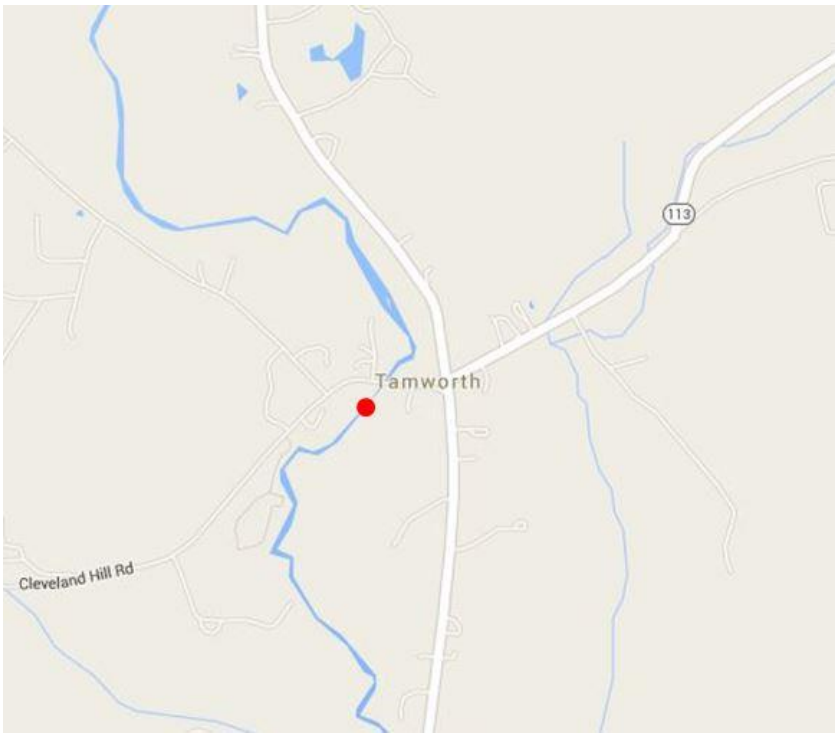
Cold Brook, Freedom, NH. Sampled by Freedom Elementary School



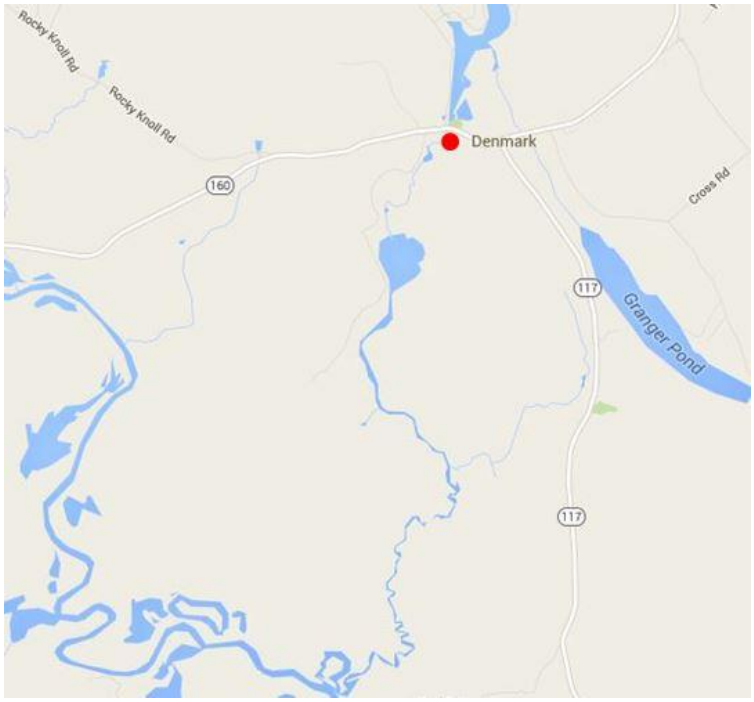
Cold River, Sandwich, NH. Sampled by Sandwich Central School



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



Swift River, Tamworth, NH. Sampled by Ossipee Central School



Moose Pond Brook, Denmark, ME. Sampled by the Maine Environmental Science Academy

APPENDIX B

Macroinvertebrate sampling results from individual sites sampled during fall 2016.

Bearcamp River, Tamworth, NH. Tested by Moultonborough Academy

Order	Common Name	Tolerance Value	Totals Found	=	Biotic Score	Final Biotic Score	VBAP Narrative Category
Ephemeroptera	Mayfly Nymph	3	2	=	6		
Plecoptera	Stonefly Nymph	1	7	=	7		
Trichoptera	Caddisfly Larvae	4	17	=	68		
Odonata	Dragonfly Nymph	3	3	=	9		
	Damselfly Nymph	7		=			
Diptera	Black fly larvae	7		=			
	Midge larvae	6	4	=	24		
	Most True flies	4		=			
Megaloptera	Alderfly	4		=			
	Fishfly or Hellgrammite	0	1	=	0		
Coleoptera	Riffle beetle	4		=			
	Water Penny	4	1	=	4		
	Beetle & Beetle-like	7		=			
Others	Crayfish	6		=			
	Snails	7		=			
	Aquatic Worms	8		=			
	Scuds	8		=			
	Sowbugs	7		=			
	Clams and Mussels	7		=			
Totals			**35**		**118**	**3.38**	**Excellent**

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

Order	Common Name	Value	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	9	=	27		
Plecoptera	Stonefly Nymph	1	3	=	3		
Trichoptera	Caddisfly Larvae	4	5	=	20		
Odonata	Dragonfly Nymph	3	1	=	3		
	Damselfly Nymph	7		=			
Diptera	Black fly larvae	7		=			
	Midge larvae	6		=			
	Most True flies	4		=			
Megaloptera	Alderfly	4		=			
	Fishfly or Hellgrammite	0	3	=	0		
Coleoptera	Riffle beetle	4		=			
	Water Penny	4	4	=	16		
	Beetle & Beetle-like	7		=			
Others	Crayfish	6		=			
	Snails	7	1	=	7		
	Aquatic Worms	8		=			
	Scuds	8		=			
	Sowbugs	7		=			
	Clams and Mussels	7		=			
Totals			**26**		**76**	**2.9**	**Excellent**

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

Order	Common Name	Value	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	28	=	84		
Plecoptera	Stonefly Nymph	1	26	=	26		
Trichoptera	Caddisfly Larvae	4	40	=	160		
Odonata	Dragonfly Nymph	3	3	=	9		
	Damselfly Nymph	7		=			
Diptera	Black fly larvae	7		=			
	Midge larvae	6	4	=	24		
	Most True flies	4	36	=	144		
Megaloptera	Alderfly	4	2	=	8		
	Fishfly or Hellgrammite	0	3	=	0		
Coleoptera	Riffle beetle	4		=			
	Water Penny	4		=			
	Beetle & Beetle-like	7		=			
Others	Crayfish	6		=			
	Snails	7		=			
	Aquatic Worms	8	1	=	8		
	Scuds	8		=			
	Sowbugs	7		=			
	Clams and Mussels	7		=			
Totals			**143**	**3.24**	**463**		**Excellent**

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

Order	Common Name	Value	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	6	=	18		
Plecoptera	Stonefly Nymph	1	55	=	55		
Trichoptera	Caddisfly Larvae	4	19	=	76		
Odonata	Dragonfly Nymph	3	2	=	6		
	Damselfly Nymph	7		=			
Diptera	Black fly larvae	7	2	=	14		
	Midge larvae	6		=			
	Most True flies	4		=			
Megaloptera	Alderfly	4	2	=	8		
	Fishfly or Hellgrammite	0		=			
Coleoptera	Riffle beetle	4		=			
	Water Penny	4	1	=	4		
	Beetle & Beetle-like	7		=			
Others	Crayfish	6		=			
	Snails	7		=			
	Aquatic Worms	8		=			
	Scuds	8		=			
	Sowbugs	7		=			
	Clams and Mussels	7		=			
Totals			**88**		**181**	**2.05**	**Excellent!**

Swift River, Tamworth Tested by Ossipee Central School.

Order	Common Name	Value	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	14	=	42		
Plecoptera	Stonefly Nymph	1	16	=	16		
Trichoptera	Caddisfly Larvae	4	40	=	160		
Odonata	Dragonfly Nymph	3		=			
	Damselfly Nymph	7	1	=	7		
Diptera	Black fly larvae	7		=			
	Midge larvae	6	3	=	18		
	Most True flies	4	2	=	8		
Megaloptera	Alderfly	4		=			
	Fishfly or Hellgrammite	0		=			
Coleoptera	Riffle beetle	4		=			
	Water Penny	4		=			
	Beetle & Beetle-like	7		=			
Others	Crayfish	6		=			
	Snails	7		=			
	Aquatic Worms	8		=			
	Scuds	8		=			
	Sowbugs	7		=			
	Clams and Mussels	7		=			
Totals			**76**		**251**	**3.3**	**Excellent!**

Moose Pond Brook, Denmark, ME. Tested by the Maine Environmental Science Academy.

Order	Common Name	Value	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	39	=	117		
Plecoptera	Stonefly Nymph	1	37	=	37		
Trichoptera	Caddisfly Larvae	4	209	=	836		
Odonata	Dragonfly Nymph	3	1	=	3		
	Damselfly Nymph	7	1	=	7		
Diptera	Black fly larvae	7	6	=	42		
	Midge larvae	6	11	=	66		
	Most True flies	4		=			
Megaloptera	Alderfly	4		=			
	Fishfly or Hellgrammite	0	2	=	0		
Coleoptera	Riffle beetle	4		=			
	Water Penny	4		=			
	Beetle & Beetle-like	7		=			
Others	Crayfish	6		=			
	Snails	7		=			
	Aquatic Worms	8	21	=	168		
	Scuds	8	1	=	8		
	Sowbugs	7		=			
	Clams and Mussels	7		=			
Totals			**328**		**1284**	**3.91**	**Good**