Lake Champlain Long-Term Water Quality and Biological Monitoring Program

Summary of Program Activities During 2009

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Purpose of Report

The workplan for the Lake Champlain Long-Term Water Quality and Biological Monitoring Program approved by the Lake Champlain Basin Program specifies the following annual reporting requirements:

An annual report will consist of a summary of the history and purpose of the (program), description of the sampling network, summary of field sampling and analytical methods, parameter listings, and data tables. The purposes of this annual report will be achieved by maintaining an up-to-date Program Description document, graphical presentations of the data, and an interactive database, including statistical summaries, on the project website…… In addition, the quarterly report produced in April each year will provide a summary of program accomplishments for the calendar year just ended, including the number of samples obtained and analyzed at each site by parameter.

The Program Description document, interactive access to the project data, and graphical and statistical summaries of the data are available on the program webpage: http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_longterm.htm

The purpose of this report is to provide a summary of sampling activities and other accomplishments during 2009.

Sampling Activities During 2009

Table 1 lists the number of sampling visits to each lake and tributary station in relation to the target frequencies specified in the project work plan. Table 2 lists the number of samples collected and analyzed for each monitoring parameter.

The frequency of lake sampling exceeded workplan targets at all stations during 2009. The frequency of tributary sampling was below the workplan targets. The number of tributary samples obtained each year depends to some extent on the number and timing of high flow events, since sampling is geared toward capturing the highest flow conditions when loading of phosphorus and other materials is greatest. There is little value in obtaining more samples under low or moderate flow conditions simply to meet workplan targets since low flow data do not contribute significantly to improving the precision of annual loading estimates. However, an effort is made to sample more high flow events each year whenever possible.

A better measure of the effectiveness of the tributary sampling effort is the percent of the total annual flow volume represented by the samples that were obtained each year. In order to assess this measure, the total flow volumes on days that were sampled for total phosphorus during the past three calendar years (2006-2008) at each tributary were obtained from the relevant U.S. Geological Survey flow gage records and compared with the total annual flow volumes recorded at these gages (Table 3). Complete flow data for calendar year 2009 are not yet available from the USGS. The information in Table 3 will be updated to include the 2009 results as soon as the necessary data are available.

Table 3 shows that the percent of the total annual flow volume sampled averaged between 7-18% among the various tributary stations in recent years. The ability to sample a high proportion of the total annual flow volume in these tributaries will depend to some extent on individual watershed hydrology, as well as the sampling effort. While no program targets have been established for this data quality indicator, it is important to maintain and improve to the extent possible the proportion of annual flow volume represented by the samples collected.

Table 1. Number of sampling visits during 2009 at each lake and tributary station in comparison with workplan targets.

Number of Lake Sampling Visits					Number of Tributary Sampling Visits				
Lake Station	**NY**	**VT**	**Total**	**Workplan Target[1]**	**Tributary Station**	**Crew**	**All Parameters**	**Total Phosphorus Only**	**Workplan Target[2]**
2	6	12	18	12	AUSA01	NY	8	19	14/24
4	6	12	18	12	BOUQ01	NY	8	14	14/24
7	3	10	13	12	GCHA01	NY	8	17	14/24
9	3	9	12	12	LAMO01	VT	9	15	14/24
16	4	11	15	12	LAPL01	VT	11	19	14/24
19	4	10	14	12	LAUS01	NY	8	19	14/24
21	4	11	15	12	LCHA01	NY	8	18	14/24
25	4	12	16	12	LEWI01	VT	10	19	14/24
33	3	10	13	12	LOTT01	VT	11	19	14/24
34	3	12	15	12	METT01	VT	11	18	14/24
36	3	10	13	12	MISS01	VT	9	15	14/24
40	3	12	15	12	OTTE01	VT	11	20	14/24
46	7	11	18	12	PIKE01	VT	9	12	14/24
50	7	11	18	12	POUL01	VT	11	18	14/24
51	7	11	18	12	PUTN01	VT	10	16	14/24
					ROCK02	VT	9	15	14/24
					SALM01	NY	8	19	14/24
					SARA01	NY	8	19	14/24
					WINO01	VT	9	15	14/24
					JEWE02[3]	VT	9	15	14/24
					STEV01[3]	VT	9	15	14/24

[1] Workplan target for lake sampling (12) applies to most chemical parameters and to phytoplankton, zooplankton, and zebra mussel veligers (at a subset of lake stations only). Sampling for Mysids was not done in 2009. Sampling for zebra mussel juveniles in Lake Champlain and for veligers in tributaries and inland lakes is done once annually.

[2] The project workplan calls for 14 samples per year for most chemical parameters, including 10 samples at high flow and four samples at low flow. Additional sampling for total phosphorus only should occur on 10 other dates under high flow conditions, for a target of 24 samples per year for total phosphorus.

[3] New stations on Jewett Brook and Stevens Brook in the St. Albans Bay watershed were added in October 2008.

Table 2. Number of samples collected and analyzed for each monitoring parameter during 2009.

Parameter	Lake	Tributaries	Total
TP	314	356	670
DP	314	195	509
Cl	314	195	509
TN	313	195	508
Alkalinity	61	55	106
DO (Winkler)	542	--	542
Chl-a	232	--	232
TSS	--	195	195
Temperature	204	257	461
Conductivity	--	250	250
pH	--	250	250
Secchi depth	232	--	232
Multiprobe depth profiles	211	--	211
Zebra mussel veligers	101	--	101
Zebra mussel settled juveniles	8	--	8
Mysids	0	--	0
Zooplankton	79	--	79
Phytoplankton	174	--	174

Table 3. Proportion of total annual flow volume sampled in each tributary. Data for 2009 are not yet available.

Tributary	2006	2007	2008	2009	Average
Ausable	0.08	0.13	0.11		0.11
Bouquet	0.08	0.12	0.14		0.11
Great Chazy	0.08	0.10	0.11		0.10
Lamoille	0.12	0.14	0.18		0.15
LaPlatte	0.15	0.24	0.16		0.18
Lewis	0.13	0.19	0.12		0.15
Little Ausable	0.07	0.10	0.09		0.08
Little Chazy	0.09	0.11	0.08		0.09
Little Otter	0.13	0.19	0.11		0.14
Mettawee	0.06	0.15	0.06		0.09
Missisquoi	0.12	0.16	0.15		0.14
Otter	0.07	0.08	0.07		0.07
Poultney	0.08	0.13	0.09		0.10
Putnam	0.11	0.14	0.11		0.12
Salmon	0.07	0.09	0.12		0.10
Saranac	0.06	0.07	0.07		0.07
Winooski	0.11	0.14	0.14		0.13

Data Quality Assurance Results

As described in the program's Quality Assurance Project Plan, field equipment blanks and field duplicate samples are obtained on each sampling run. The results for the blank samples are summarized in Table 4. Only three of the 210 blank samples analyzed during 2009 had concentrations above the analytical detection limits, and the concentrations measured in these cases were only slightly above the detection limits. The results for field duplicate samples are summarized in Table 5 for the chemical analyses. The mean relative percent difference between duplicates obtained during 2009 was less than 15% for all tests. The results from laboratory and field duplicate analyses run on phytoplankton samples obtained during 2006-2009 are shown in Table 6. Mean relative percent differences among field duplicates were in the 37-41% range during 2009 for cell density and biovolume measurements.

Table 4. Field equipment blank results during 2009 for lake and tributary samples.

Test	Detection Limit	Units	Number of Blanks Obtained	Number of Blanks Above Limit	High Blank Values
Alk	1.0	mg/l	8	1	1.4
Cl	2.0	mg/l	38	0	
TN	0.1	mg/l	38	1	0.11
TP	5.0	µg/l	52	0	
DP	5.0	µg/l	38	0	
Chl-a	0.5	µg/l	19	1	2.03
TSS	1.0	mg/l	17	0	
Total			**210**	**3**	

Table 5. Field duplicate results for chemical tests during 2009, showing the number of duplicates obtained (N) and the mean relative percent difference (RPD) between duplicate pairs.

	Lake		Tributaries	
Test	N	Mean RPD	N	Mean RPD
Chl-a	21	14.3	--	--
Cond	--	--	28	1.3
Cl	22	0.7	19	1.4
DP	22	7.5	19	6.1
pH	--	--	28	0.4
Alk	5	2.5	5	1.9
TN	22	4.3	19	4.9
TP	22	5.8	37	5.8
TSS	--	--	19	11.5

Table 6. Phytoplankton duplicate results for 2006–2009, showing the number of pairs (N) and the mean relative percent difference (RPD) between pairs.

Test	Year	N	Sample Type	Mean RPD
Field duplication	2006	8	Biovolume	38.1
			Cell Density	43.7
	2007	9	Biovolume	42.2
			Cell Density	23.6
	2008	17	Biovolume	47.8
			Cell Density	29.3
	2009	19	Biovolume	37.6
			Cell Density	40.9
Lab duplication	2006	17	Biovolume	14.4
			Cell Density	28.2
	2007	13	Biovolume	37.5
			Cell Density	38.6
	2008	18	Biovolume	50.7
			Cell Density	32.5
	2009	16	Biovolume	30.7
			Cell Density	33.7

Phytoplankton and Zooplankton Database

All phytoplankton data from 2006-2009 have been incorporated into the main Lake Champlain Monitoring Program database. Zooplankton data are currently available for the project period of 1993-2008. The data available for download from the web interface include phytoplankton cell densities and biovolumes, and zooplankton densities grouped by major taxonomic category. Counts by individual taxa will eventually be added to the web page, but are currently available only by request.

Webpage Use

Tracking of the number of web hits between 2/4/09 and 12/31/09 indicated that the program webpage received a total of 776 data queries from 129 different external users representing an average of over 16 external data queries per week during 2009.

Invasive Species Tabulation

The project workplan requires an annual compilation of new invasive species arrivals in Lake Champlain. There were no new documented invasive species in Lake Champlain during 2009. However, two new species were documented on the borders of Lake Champlain in 2008. The Asian clam (*Corbicula fluminea*) was confirmed to be present in the Champlain Canal within the Hudson River drainage in the vicinity of Fort Edward, NY. The spiny waterflea (*Bythotrephes longimanus*) was confirmed to be present in Great Sacandaga Lake, NY. Although Great Sacandaga Lake is located within the Hudson River drainage, there is a hydrologic connection to the Lake Champlain Basin via the Glens Falls Feeder Canal connecting the Hudson River and the Champlain Canal. Additional biological sampling was conducted in the Canal system to check for presence/absence of invasive zooplankton. None were detected. Both Asian clam and spiny water flea are considered to be significant threats to the Lake Champlain Basin.

Wastewater Phosphorus Discharge Data

The project workplan requires an annual compilation of wastewater phosphorus discharge data for all treatment facilities in the Vermont and New York portions of the Lake Champlain Basin. Data on annual mean flow, total phosphorus concentration, and phosphorus load at each facility have been compiled for 2009 along with data from previous years, and are available electronically in spreadsheet form on request. The total loads and flows from Vermont and New York wastewater treatment facilities during 2007-2009 are summarized in Table 7.

Table 7. Total phosphorus load to Lake Champlain from wastewater treatment facilities in Vermont and New York from 2007-2009.

State	Number of Facilities	Year	Total Phosphorus Load (mt/yr)	Total Flow (mgd)
Vermont	60	2007	20.9	43.5
	60	2008	21.1	45.1
	60	2009	20.3	40.5
New York	29	2007	28.5	33.2
	29	2008	26.5	34.3
	29	2009	20.9	31.5