Lake Champlain Long-Term Water Quality and Biological Monitoring Program

Summary of Program Activities During 2011

March 27, 2012

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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 2011.

Sampling Activities During 2011

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. This year the New York lake and tributary field sampling was conducted by the Lake Champlain Research Institute at SUNY Plattsburgh under an MOU between NYSDEC and SUNY. The frequency of lake sampling exceeded workplan targets at all stations during 2011. The frequency of tributary sampling was below the workplan targets for 13 stations, equaled the target for 1 station, and was above the target for 8 stations. 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. Figure 1 shows that most peak flow events during 2011 were sampled at each tributary.

Impacts of the 2011 Floods on Program Operations

Lake Champlain reached record flood levels during the spring of 2011. This directly impacted lake field activities as many of the boat launches used by the project teams were closed and marinas delayed dock installation. Additionally, Quebec closed the northern portion of Missisquoi Bay to boaters to reduce wake-related wave impacts on the shoreline. While most lake stations were sampled at least once in May, teams did not reach some sites until early June.

Flooding associated with Tropical Storm Irene in late August caused significantly more disruption. The Vermont State Office Complex in Waterbury was flooded and closed, resulting in dislocation of the Vermont project staff and closure of the Vermont DEC Laboratory. A small number of samples were lost when the laboratory sample receiving room was destroyed. The archived historical phytoplankton and zebra mussel veliger samples were also lost. Lake sampling was suspended briefly while damage assessment was undertaken, alternative appropriate sample storage could be located, and the Vermont staff could re-organize. Vermont tributaries were not sampled during the peak flows associated with Tropical Storm Irene, although New York crews managed to do so. Field teams were back on the lake by September 1st, but the full suite of analytes was not collected until the following week when proper preservation and storage were established. The Vermont DEC Laboratory required several weeks to relocate and reestablish analytical capability. As a result, some sample holding times were exceeded and those data were flagged in the database. In general, however, the loss of data during 2011 was minor considering the magnitude of the disruptions.

Table 1. Number of sampling visits during 2011 at each lake and tributary station in comparison with workplan targets.

Table 2. Number of samples collected and analyzed for each

Number of Lake Sampling Visits					Number of Tributary Sampling Visits				
Lake Station	**NY**	**VT**	**Total**	**Workplan Target[1]**	**Tributary Station**	**Crew**	**All Parameters** TP, DP, TSS, Cl, TN	**Total Phosphorus**	**Workplan Target[2]**
2	8	11	19	12	AUSA01	NY	15	23	14/24
4	8	11	19	12	BOUQ01	NY	15	23	14/24
7	7	9	16	12	GCHA01	NY	14	22	14/24
9	7	10	17	12	LAMO01	VT	13	23	14/24
16	7	10	17	12	LAPL01	VT	13	27	14/24
19	7	9	16	12	LAUS01	NY	16	22	14/24
21	7	10	17	12	LCHA01	NY	14	22	14/24
25	7	10	17	12	LEWI01	VT	12	26	14/24
33	7	8	15	12	LOTT01	VT	12	27	14/24
34	7	9	16	12	METT01	VT	10	18	14/24
36	7	8	15	12	MISS01	VT	14	26	14/24
40	7	9	16	12	OTTE01	VT	12	26	14/24
46	7	11	18	12	PIKE01	VT	10	15	14/24
50	6	11	17	12	POUL01[3]	VT	8	13	14/24
51	6	10	16	12	PUTN01	VT	10	18	14/24
					ROCK02	VT	13	24	14/24
					SALM01	NY	15	22	14/24
					SARA01	NY	14	22	14/24
					WINO01	VT	12	23	14/24
					JEWE02[4]	VT	13	25	14/24
					STEV01[4]	VT	13	25	14/24
					MILL01[5]	VT	13	25	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] The road to sampling site at POUL01 was impassible due to high lake levels in May, 2011.

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

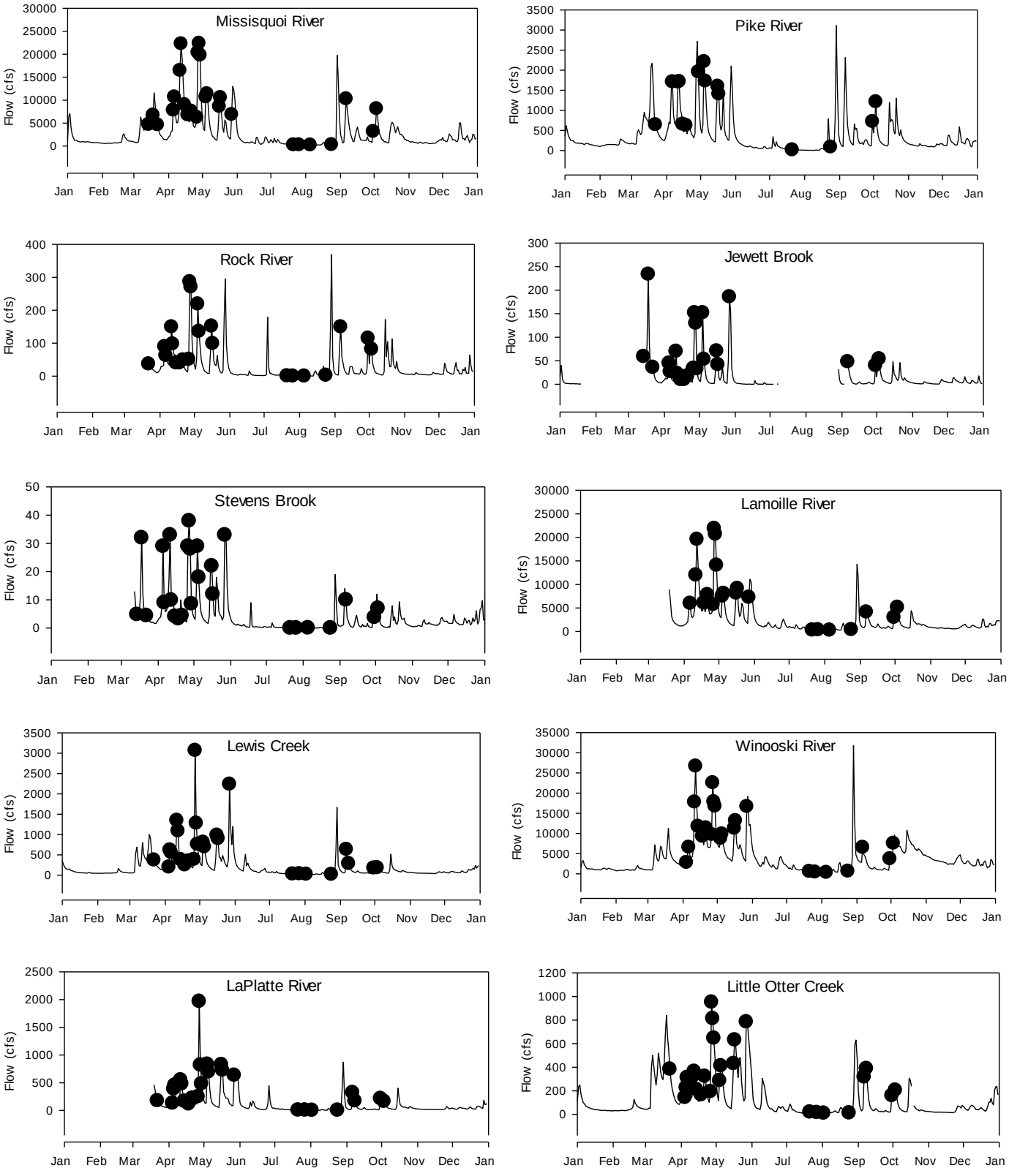
[5] New station on Mill River in the St. Albans Bay watershed was added in November 2010.

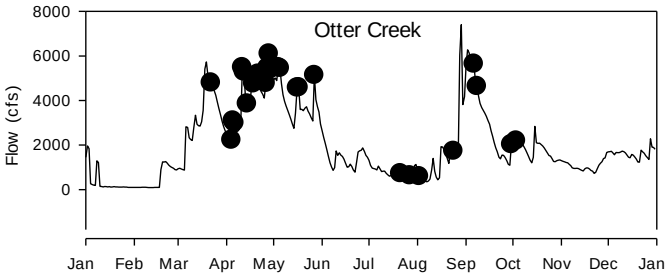
monitoring parameter during 2011.

Parameter	Lake	Tributaries	Total
TP	376	622	998
DP	376	345	721
Cl	376	336	712
TN	367	344	711
Ca	60	122	182
SiO_2	316	--	316
K	60	122	182
Na	60	122	182
Mg	60	122	182
Alkalinity	65	62	127
DO (Winkler)	282	--	282
Chl-a	275	--	275
TSS	--	310	310
Temperature	263	359	662
Conductivity	--	292	292
pH	--	304	304
Secchi depth	248	--	248
Multiprobe depth profiles	263	--	263
Zebra mussel veligers	124	1	125
Zebra mussel settled juveniles	7	--	7
Mysids	12	--	12
Zooplankton	132	30[1]	162
Phytoplankton	170	--	170

[1]Canal and Hudson River system monitoring for invasive zooplankton.

Figure 1. Sampling dates during 2011 in relation to daily flows at each tributary station. Daily flows are shown by lines, and sampling dates are shown by dots.

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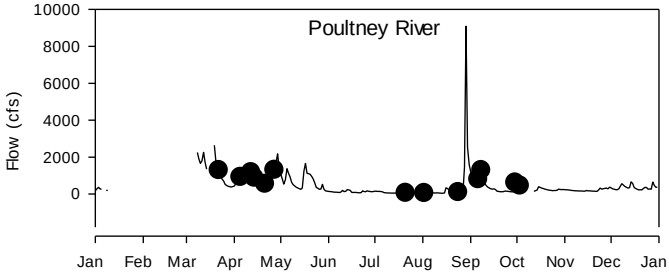
Flow (cfs)
8000
6000
4000
2000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan


Poultney River
Flow (cfs)
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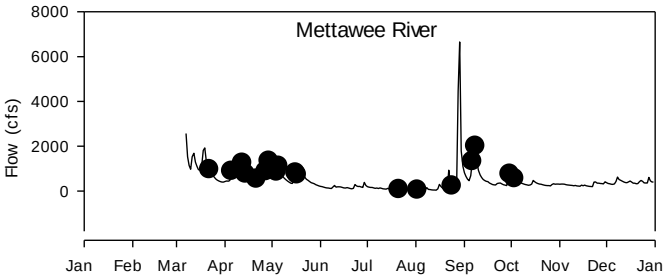
6000
4000
2000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan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Flow (cfs)
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4000
2000
0
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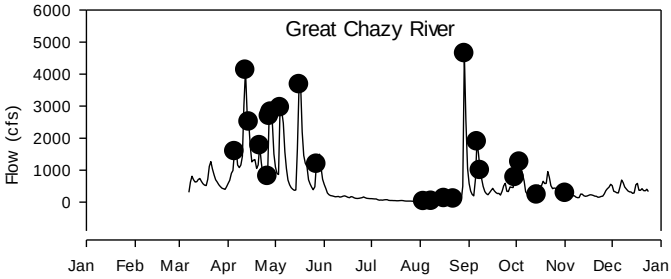
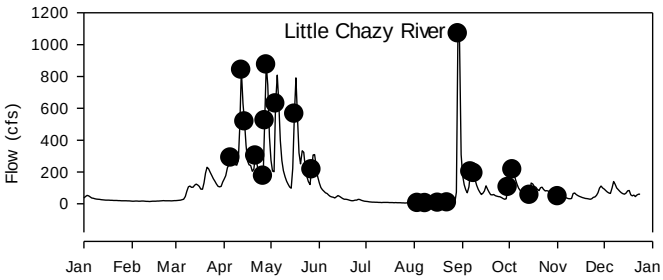
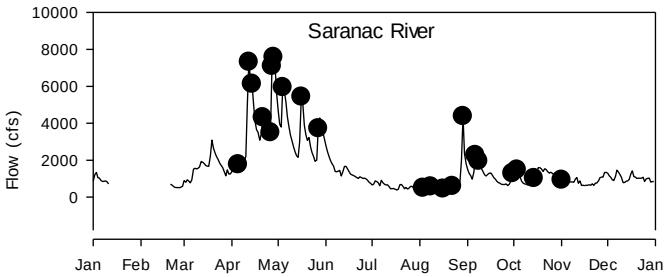

Great Chazy River
Flow (cfs)
6000
5000
4000
3000
2000
1000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan


Little Chazy River
Flow (cfs)
1200
1000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan


Saranac River
Flow (cfs)
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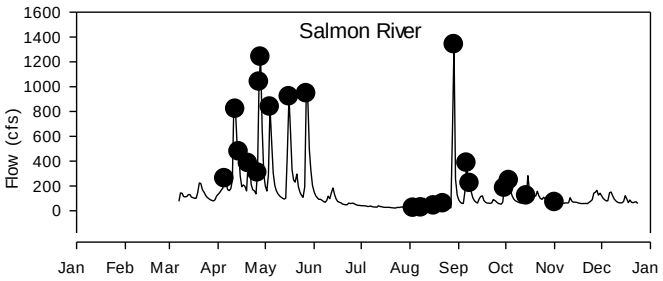
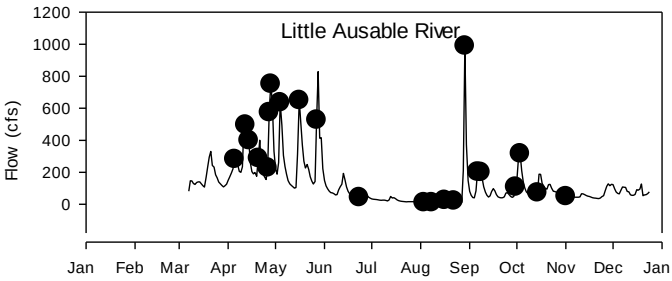
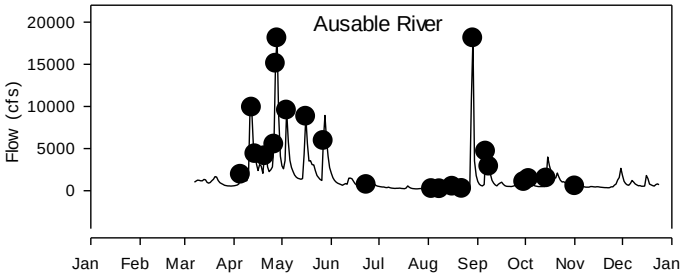
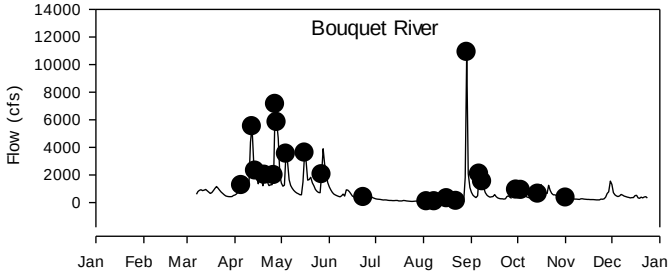
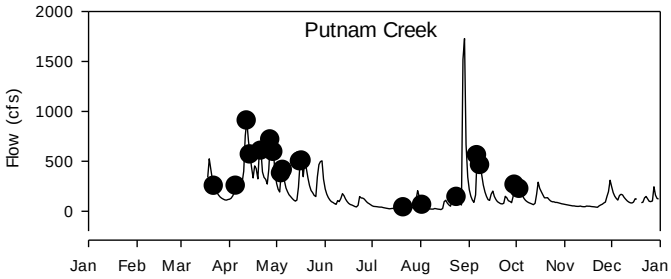
8000
6000
4000
2000
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan


Salmon River
Flow (cfs)
1600
1400
1200
1000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan


Little Ausable River
Flow (cfs)
1200
1000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan







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 3. Thirteen of the 253 blank samples analyzed during 2011 (5%) had concentrations above the analytical detection limits. The results for field duplicate samples are summarized in Table 4 for the chemical analyses. The mean relative percent difference between duplicates obtained during 2011 was 8.1% for all tests. The results from laboratory and field duplicate analyses run on phytoplankton samples obtained during 2006-2010 are shown in Table 5. Mean relative percent differences among field duplicates were in the 31- 35% range during 2010 for cell density and biovolume measurements. Results from 2011 are not yet available.

Table 3. Field equipment blank results during 2011 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	6	0	
Cl	2.0	mg/l	41	0	
TN	0.1	mg/l	41	2	0.14, 0.12
TP	5.0	µg/l	58	2	7.12, 9.39
DP	5.0	µg/l	43	2	5.68, 6.96
Chl-a	0.5	µg/l	16	0	
TSS	1.0	mg/l	22	4	4.3, 3.03, 6.3, 1.24
SiO2	0.2	mg/l	14	3	3.43, 5.62, 6.75
Ca	0.25	mg/l	3	0	
Na	0.25	mg/l	3	0	
K	0.25	mg/l	3	0	
Mg	0.01	mg/l	3	0	
Total			253	13	

Table 4. Field duplicate results for chemical tests during 2011 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	17	13	--	--
Cond	--	--	28	1.9
Cl	20	1.7	28	2.2
DP	27	17.7	28	13.1
pH	--	--	29	1.8
Alk	3	1.1	5	5.1
TN	18	9.2	26	5.6
TP	21	13.1	45	2.3
TSS	--	--	24	18.6
SiO2	15	2.3	--	--
Ca	1	0.9	2	2.5
Na	1	0.2	2	2.1
K	1	1.3	2	4.3
Mg	1	0	2	2

Table 5. Phytoplankton duplicate results for 2006–2011 showing the number of pairs (N) and the mean relative percent difference (RPD) between pairs. 2011 data are not available at this time.

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
	2010	14	Biovolume	35.7
			Cell Density	31.4
	2011		Biovolume	
			Cell Density	
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
	2010	16	Biovolume	36.7
			Cell Density	35.7
	2011		Biovolume	
			Cell Density	

Phytoplankton and Zooplankton Database

All phytoplankton data from 2006-2010 have been incorporated into the main Lake Champlain Monitoring Program database. Zooplankton data are currently available for the project period of 1993-2008. The 2009 and 2010 data will be ready for upload to the main database by May 2011. The data available for download from the web interface include phytoplankton cell densities or 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 1/1/11 and 12/31/11 indicated that the program webpage received a total of 1,034 data queries from 162 different external users representing an average of 20 data queries per week during 2011.

Invasive Species Tabulation

Routine monitoring for spiny water flea (SPW) continued in the Champlain Canal. SPW were documented in the Stewart's Bridge Reservoir, the last ponded waterbody in the Sacandaga River before its confluence with the Hudson River. Additional biological sampling was conducted in the Champlain Canal and the Glens Falls Feeder Canal to check for presence/absence of invasive zooplankton. None were detected. No species of concern were noted in 19 inland lake plankton samples analyzed by monitoring program staff in 2011.

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 2011 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 2007-2011 are summarized in Table 6.

Table 6. Total phosphorus load to Lake Champlain from wastewater treatment facilities in Vermont and New York from 2007-2011.

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
	60	2010	18.4	39.7
	59	2011	19.2	45.5
New York	29	2007	28.5	33.2
	29	2008	26.5	34.3
	29	2009	20.9	31.5
	29	2010	22.0	32.8
	29	2011	23.0	34.4

Method Changes

Azide comparison

In 2011, the Vermont DEC Laboratory requested that azide used in the Winkler DO reagent #2 be eliminated from their procedure because of its hazards and high cost for proper disposal. The Laboratory had investigated whether azide could be eliminated from the reagent without significantly affecting the results, but it was found that there has been no research done on this by EPA. The potential concern is for low-DO samples where nitrite might be present and cause a negative bias. The azide prevents this. The Laboratory eliminated azide from the preparation of DO reagent #2. During mid-summer when hypolimnetic depletion developed in the lake, VTDEC staff was to obtain a number (~30) split samples of low-DO hypolimnetic water from various stations in the lake on a few dates, so that the two methods can be compared (with and without azide). Unfortunately, the flooding of the VTDEC Laboratory on August 28, 2011, made it impossible to collect DO samples and have them analyzed during the 8 hour hold-time.