Interim Data Report

Conesus Lake Limnology

Including Lake Chemistry, Phytoplankton

and Estimates of Internal Loading in 2004

Prepared for the Livingston County Planning Department

by

Joseph C. Makarewicz, Isidro Bosch[1], and Theodore W. Lewis

Center for Applied Aquatic Science and Aquaculture

Environmental Science Program

Department of Biological Sciences

SUNY College at Brockport

[1]Department of Biology

SUNY College at Geneseo

Introduction

During the spring, summer, fall and winter of 2004 and 2005, various limnological data were collected from Conesus Lake to assist in the implementation of the Conesus Lake Watershed Management Plan. In general, monitoring and analysis are designed to meet the following objectives: (1) Refine the estimates of external loading of sediments and nutrients from the watershed, (2) Refine the estimates of internal loading of phosphorus (that is, phosphorus released from lake sediments), (3) Characterize the lake's community of algae (phytoplankton and metaphyton) and zooplankton to provide a benchmark against which the effectiveness of future management actions can be measured. Specific objectives of the sampling program are outlined below.

a. Measure the concentration of phosphorus at one-meter depth intervals in Conesus Lake on two events: early in the season (May 2004, prior to the onset of thermal stratification) and again in the early fall (late September 2004) prior to fall mixing. It is estimated that a total of 20 depths will be sampled during each of the two events. Samples will be collected by trained field personnel and delivered to the certified water quality laboratory at SUNY Brockport for analysis. Phosphorus profiles taken during these two periods provide an estimate of the magnitude of internal phosphorus load to Conesus Lake. This information will be used to support a decision regarding efficacy of an alum application.

b. Characterize the phytoplankton and zooplankton communities of Conesus Lake. This effort will provide important information regarding the status of the lake's ecosystem, particularly with regards to phosphorus levels, phytoplankton (algal) abundance, and the zooplankton community. It is one of the recommendations of the long-term monitoring program for Conesus Lake developed as part of the Characterization Report and Management Plan.

c. Refine the loading estimate of nutrients and sediment entering Conesus Lake through its tributary streams. Four streams will be added to the on-going USDA research project: No Name, Wilkens, Densmore, and the Inlet. Weekly samples and analysis of these four streams will be conducted for one year (52 events). Samples will be analyzed for the following parameters: Total Phosphorus, Soluble Reactive Phosphorus, Nitrate-Nitrogen, Total Kjeldahl Nitrogen, Total Suspended Solids, and Sodium.
d. Estimate the abundance of metaphyton (large filamentous algae) in the lake's littoral areas. Sampling will be conducted on two occasions during the summer of 2004 at five sites. The five sites are as follows:
    - Harston Point on the South Basin, East Shore

- Old Orchard Cove on the North Basin, East Shore
- Sand Point, North where metaphyton tends to accumulate
- Pebble Beach Cove North Basin, West Shore
- Booher Hill Area, South Basin West Shore

Reports

This report is not an interpretative report. It is a data report. That is, data summaries are provided that tabulate all results of the sampling and describe the sampling and analytical methods. In this report, information on lake chemistry, phytoplankton and phosphorus release are provided. The final report will contain metaphyton distribution, zooplankton abundance and determinations of nutrient losses from selected watersheds.

Sampling and Analytical Methods

Limnological sampling and analysis was performed on thirteen dates from May to October 2004 at the deepest portion of the southern basin of Conesus Lake. A pre-calibrated Hydrolab sonde measured temperature, dissolved oxygen and pH, while a secchi disk enabled transparency measurement. For each sampling date, a water sample was collected from the epilimnion (1m) using a horizontal Van Dorn bottle and analyzed for total phosphorus, soluble reactive phosphorus, nitrate, sodium, chlorophyll *a* and turbidity. On two dates (10 May 2004 and 14 September 2004), water samples were collected from each meter of depth and analyzed for total phosphorus, soluble reactive phosphorus and nitrate.

All sampling bottles were pre-coded so as to ensure exact identification of the particular sample. All sample bottles were routinely cleaned with phosphate free RBS between sampling dates. Containers were rinsed prior to sample collection with the water being collected. In general, all procedures followed Standard Methods for the Analysis of Water and Wastewater. Sample water for dissolved nutrient analyses (SRP, nitrate + nitrite) was filtered immediately with 0.45-µm MCI Magna Nylon 66 membrane and either frozen or analyzed within 24 hours of collection.

Nitrate+Nitrite: Dissolved nitrate+nitrite nitrogen were performed by the automated (Technicon autoanalyser) cadmium reduction method (APHA 1999).

Soluble Reactive Phosphorus: Sample water was filtered through a 0.45-µm membrane filter. The filtrate was analyzed for orthophosphate using the automated (Technicon) colorimetric ascorbic acid method (APHA 1999). The formation of the phosphomolybdeum blue complex was read colorimetrically at 880nm.

Total Phosphorus: The persulfate digestion procedure was used prior to analysis by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (APHA 1999).

Sodium: Sodium analysis was performed by Atomic Absorption Spectrophotometry (APHA 1999).

Turbidity: Turbidity was measured using nephelometric method 2130B (APHA 1999)

Chlorophyll *a*: Chlorophyll was extracted in 90% alkaline acetone and measured by fluorometry following Wetzel and Likens (1979).

Phytoplankton: Methodology for phytoplankton and zooplankton were similar to previous work of Makarewicz (2000) on Conesus Lake. Phytoplankton were identified and enumerated following the settling chamber procedure (Utermohl 1958) using an inverted microscope. A second identification and enumeration of diatoms was performed after the organic portion was oxidized with 30% hydrogen peroxide and nitric acid. The cell volume of each species was calculated by applying average dimensions for each sampling date to the geometric shape that most closely resembled the species form (Makarewicz et al). At least ten specimens of each species for each sample was measured for the cell volume calculation. When fewer that ten specimens were present, those present were measured as they occurred. Individual cells of colonial and filamentous forms were measured. For comparative purposes, biovolume ($\mu m^3/mL$) was converted to biomass (mg/m^3) assuming the specific gravity of phytoplankton to be 1.0 ($mm^3/L = mg/m^3$) (Willen 1959, Nauwerk 1963).

Zooplankton, metaphyton and nutrient loading methodology will be provided in the final data report.

Quality Control

The Water Chemistry Laboratory at SUNY Brockport is certified through the New York

State Department of Health's Environmental Laboratory Approval Program (ELAP - # 11439). This program includes bi-annual proficiency audits, annual inspections and good laboratory practices documentation of all samples, reagents and equipment (Table 1).

Literature Cited

APHA 1999. Standard Methods for the Examination of Waste and Wastewater. American Public Health Association, 20th ed. New York, NY. 1134p.

Nauwerk. A. 1963. The relation between zooplankton and phytoplankton in Lake Erken. Symb. Bot. Ups. 17: 163.

Makarewicz, J. C., Lewis, T. and Bertram, P. 1999. Phytoplankton composition and biomass in the offshore waters of Lake Erie: Pre- and post-Dreissena introduction. J. Great Lakes Res. 25(1):135-148.

Makarewicz, J.C. 2001. Trophic interactions: Changes in phytoplankton community structure coinciding with alewife introduction. Verh. Internat. Verein Limnol. 27: 1780-1786.

Utermohl, H. 1958. Zur vervollkommung der quantitativen phytoplankton-methodik. M.H. Int. Ver. Limnol. 9. 38pp.

Wetzel, R. and G.E. Likens. 1979. Limnological Analysis. W.B. Saunders Company. 357 pp.

Willen, T. 1959. The phytoplankton of Gorwalm, a bay of Lake Malaren. Oikos. 10:241-274.

Results

Tables and figures are also provided as Excel files on the attached CD.

Table 1. Results of proficiency audit samples of the Water Quality Laboratory at SUNY Brockport

WADSWORTH CENTER
NEW YORK STATE DEPARTMENT OF HEALTH
ENVIRONMENTAL LABORATORY APPROVAL PROGRAM
Proficiency Test Report

Lab 11439 SUNY BROCKPORT EPA Lab Code NY01449
WATER LAB LENNON HALL
BROCKPORT, NY 14420
USA

Shipment 275 Non Potable Water Chemistry
Shipment Date: 19-Jul-2004

Analyte	Sample ID	Result	Mean/Target	Warning Limits	Method	Score
Sample: **Water Residue**						
Solids, Total Suspended 260 passed out of 268 reported results. EPA Code: 0072	7502	82.9	89.0	73.6-91.6	SM 18-20 2540D	Satisfactory
Sample: **Organic Nutrients**						
Kjeldahl Nitrogen, Total 89 passed out of 98 reported results. EPA Code: 0034	7504	30.41	30.5	25.0-35.0	EPA 351.3	Satisfactory
Phosphorus, Total 115 passed out of 123 reported results. EPA Code: 0035	7504	4.37	4.38	3.63-4.84	SM18-20 4500-P E	Satisfactory
Sample: **Inorganic Nutrients**						
Nitrate (as N) 113 passed out of 121 reported results. EPA Code: 0032	7507	36.1	35.4	30.4-39.7	SM18-20 4500-NO3 F	Satisfactory
Orthophosphate (as P) 97 passed out of 101 reported results. EPA Code: 0033	7507	2.49	2.57	2.32-2.84	SM18-20 4500-P F	Satisfactory
Sample: **Minerals II**						
Sodium, Total 88 passed out of 102 reported results. EPA Code: NA	7537	67.32	63.9	59.7-68.1	SM 18-20 2450D	Satisfactory

Table 2. Calculation of volume at depth. In the second column area at depth in square kilometers was read directly off of the above hypsographic curve. In the third column the basin was divided into horizontal section with regards to depth. The fourth column is the calculated volume of each horizontal section expressed in million cubic meters, derived by multiplying the horizontal section width by the corresponding area.

Depth (m)	Area (km^2)	Section Depth (m)	Volume (m^3 X 10^6)
0	12.72	0 - 0.5	6.36
1	11.91	0.5 - 1.5	11.91
2	11.18	1.5 - 2.5	11.18
3	10.57	2.5 - 3.5	10.57
4	10.15	3.5 - 4.5	10.15
5	9.91	4.5 - 5.5	9.91
6	9.80	5.5 - 6.5	9.80
7	9.79	6.5 - 7.5	9.79
8	9.69	7.5 - 8.5	9.69
9	9.31	8.5 - 9.5	9.31
10	8.44	9.5 - 10.5	8.44
11	7.30	10.5 - 11.5	7.30
12	6.21	11.5 - 12.5	6.21
13	5.52	12.5 - 13.5	5.52
14	5.02	13.5 - 14.5	5.02
15	4.46	14.5 - 15.5	4.46
16	3.59	15.5 - 16.5	3.59
17	2.49	16.5 - 17.5	2.49
18	1.30	17.5 - 18.5	1.30
19	0.45	18.5 - 19.5	0.45
20	0.02	19.5 - 20	0.01
		Total	143.46

Table 3. Concentration and amount of total phosphorus (TP), nitrate-nitrite (Nitrate), and soluble reactive phosphorus (SRP) in various depth strata of Conesus Lake on 10 May 2004.

Depth (m)	TP (µg P/L)	Nitrate (mg N/L)	SRP (µg P/L)	Section Depth (m)	Volume (m^3 X 10^6)	TP (kg P)	Nitrate (kg N)	SRP (kg P)
0	17.4	0.28	4.3	0 - 0.5	6.36	110.7	1780.8	27.3
1	20.3	0.28	2.9	0.5 - 1.5	11.91	241.8	3334.8	34.5
2	14.4	0.27	2.5	1.5 - 2.5	11.18	161.0	3018.6	28.0
3	47.3	0.28	4.3	2.5 - 3.5	10.57	500.0	2959.6	45.5
4	16.2	0.28	6.5	3.5 - 4.5	10.15	164.4	2842.0	66.0
5	18.2	0.29	11.6	4.5 - 5.5	9.91	180.4	2873.9	115.0
6	13.8	0.24	6.1	5.5 - 6.5	9.80	135.2	2352.0	59.8
7	14.4	0.28	9	6.5 - 7.5	9.79	141.0	2741.2	88.1
8	13.2	0.28	12.2	7.5 - 8.5	9.69	127.9	2713.2	118.2
9	16.8	0.29	11.9	8.5 - 9.5	9.31	156.4	2699.9	110.8
10	17.9	0.29	9.9	9.5 - 10.5	8.44	151.1	2447.6	83.6
11	15	0.29	11.8	10.5 - 11.5	7.30	109.5	2117.0	86.1
12	21.5	0.29	9	11.5 - 12.5	6.21	133.5	1800.9	55.9
13	12.7	0.29	7	12.5 - 13.5	5.52	70.1	1600.8	38.6
14	28.8	0.31	16.1	13.5 - 14.5	5.02	144.6	1556.2	80.8
15	30.3	0.31	2.4	14.5 - 15.5	4.46	135.1	1382.6	10.7
16	15.6	0.31	9.5	15.5 - 16.5	3.59	56.0	1112.9	34.1
17	18.8	0.31	5	16.5 - 17.5	2.49	46.8	771.9	12.5
18	16.8	0.31	9.7	17.5 - 18.5	1.30	21.8	403.0	12.6
19	20.9	0.3	2.7	18.5 - 19.5	0.45	9.4	135.0	1.22
20	33.2	0.3	2.9	19.5 - 20	0.01	0.33	3.0	0.03
					Total	2797.0	40646.9	1109.3

Table 4. Concentration and amount of total phosphorus (TP), nitrate-nitrite (Nitrate), and soluble reactive phosphorus (SRP) in various depth strata of Conesus Lake on 14 September 2004.

Depth (m)	Strata	TP (µg P/L)	Nitrate* (mg N/L)	SRP (µg P/L)	Section Depth (m)	Volume (m^3 X 10^6)	TP (kg P)	Nitrate (kg N)	SRP (kg P)
0	epilimnion	24.3	0	1.7	0 - 0.5	6.36	154.5	0.0	10.8
1	epilimnion	21.6	0	2.6	0.5 - 1.5	11.91	257.3	0.0	31.0
2	epilimnion	23.8	0	1.6	1.5 - 2.5	11.18	266.1	0.0	17.9
3	epilimnion	26.5	0	2.2	2.5 - 3.5	10.57	280.1	0.0	23.3
4	epilimnion	21.6	0	1.7	3.5 - 4.5	10.15	219.2	0.0	17.3
5	epilimnion	24.1	0	2.4	4.5 - 5.5	9.91	238.8	0.0	23.8
6	epilimnion	23.2	0	1.7	5.5 - 6.5	9.80	227.4	0.0	16.7
7	epilimnion	22.7	0	1.7	6.5 - 7.5	9.79	222.2	0.0	16.6
8	epilimnion	20.2	0	1.6	7.5 - 8.5	9.69	195.7	0.0	15.5
9	epilimnion	20.5	0	1.4	8.5 - 9.5	9.31	190.9	0.0	13.0
10	metalimnion	21.6	0	1.4	9.5 - 10.5	8.44	182.3	0.0	11.8
11	metalimnion	20.0	0	1.9	10.5 - 11.5	7.30	146.0	0.0	13.9
12	hypolimnion	25.2	0.05	9.9	11.5 - 12.5	6.21	156.5	310.5	61.5
13	hypolimnion	46.2	0.02	36.0	12.5 - 13.5	5.52	255.0	110.4	198.7
14	hypolimnion	84.5	0	71.8	13.5 - 14.5	5.02	424.2	0.0	360.4
15	hypolimnion	101.6	0	100.4	14.5 - 15.5	4.46	453.1	0.0	447.8
16	hypolimnion	102.2	0	87.6	15.5 - 16.5	3.59	366.9	0.0	314.5
17	hypolimnion	138.0	0	134.8	16.5 - 17.5	2.49	343.6	0.0	335.7
18	hypolimnion	305.9	0	278.0	17.5 - 18.5	1.30	397.7	0.0	361.4
19	hypolimnion	344.1	0	305.0	18.5 - 19.5	0.45	154.8	0.0	137.25
						Total	5132.4	420.9	2428.7

* Non-dectable samples treated as 0 values

Table 5. Phosphorus release rates and Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP) content of the hypolimnion for Conesus Lake. The hypolimnion was defined by the temperature vs. depth curve as being below 11 meters of depth (see Figure 2). The first and second rows are the calculated amounts of TP and SRP found in the hypolimnion on 10 May 2004 and 14 September 2004. The first and second rows were calculated by summing the SRP and TP contents of the horizontal sections described in Tables 2 and Table 3 from 12 meters to the bottom of the basin. The third row is the change in the amount of SRP and TP in the hypolimnion between 10 May 2004 and 14 September 2004. The third row is calculated by subtracting the first row from the second. The fourth row is the number of days between 10 May 2004 and 14 September 2004. The fifth row is the amount of phosphorus in kilograms released from the sediment into the overlying waters of the hypolimnion per day. The fifth row is derived by dividing the third row by the fourth row. The area of the basin at 12 meters, as read off of Figure 1, is entered into the sixth row as the area of the hypolimnion. The seventh row is the amount of phosphorus released from the sediment in milligrams per meter squared of hypolimnion area per day.

	SRP	TP
Hypolimnion P 5/10/2004 (kg P)	246.5	617.73
Hypolimnion P 9/14/2004 (kg P)	2217.2	2551.88
Hypolimnion P increase (kg P)	1970.7	1934.1
Time period (days)	127	127
Phosphorus Release Rate (kg P/day)	15.52	15.23
$Area_{Hypolimnion}$ (km^2)	6.21	6.21
Areal Phosphorus Release Rate (mg P/m^2/day)	2.50	2.45

Figure 1. Hypsographic curve of Conesus Lake basin comparing depth vs. area. Measurements by P.G. Savard recomputed to metric scale from 1 : 4800 scale map (1939-1940). Depth is expressed as the distance in meters from the lake surface. Area is square kilometers of surface area of the basin at depth.

Depth (m)	Area (km^2)
0	12.72
3.05	10.54
6.1	9.79
9.15	9.22
12.2	6.03
15.25	4.30
18.3	0.98
20.13	0.02

Hypsographic Curve of Conesus Lake
Measurements by P.G.Savard
Depth vs. Area
data taken from:
Bloomfield, Jay A. 1978. Lakes of New York State, volume I, Ecology of the Finger lakes. Academic Press, Inc. New York, NY p. 156