Niagara River
Niagara County, New York

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January 2010

Lower Niagara River

The Niagara River carries water from Lake Erie to Lake Ontario and is the major source of Lake Ontario's water volume. Famous for the immense Niagara Falls, the 36-mile river is used by over 1 million people in the United States and Canada for functions including drinking water, recreation, and hydropower (Niagara Parks 2009). The Niagara River drains the entire upper Great Lake system into the final lake, Lake Ontario, and due to this huge volume of water has a large potential to change Lake Ontario's water quality. Nuisance algae, bacterial abundance, and algal mat development along the southern shoreline of Lake Ontario are major causes of beach closings, fouling the nearshore waters and limiting water recreation. This short report provides a synopsis of data collected monthly from May through September (2003 to 2009) on the water quality of the Niagara River and the lakeside (swimmable depth, surface sample at a 1-m depth) of Lake Ontario near the mouth of the river.

Phosphorus is of concern as it stimulates the growth of plants, causing blooms of algae such as *Cladophora*. Phosphorus levels in the lakeside waters (Fig. 1a.) were generally higher than in river water, indicating that the Niagara River itself may not be the largest influence on phosphorus levels of the lakeshore. Average total phosphorus (TP) concentrations in the waters of the Niagara River (16.0±2.3 µg P/L) were lower than other monitored Lake Ontario stream systems (83.8±7.0 µg P/L), lakeside waters (62.0±7.4 µg P/L), embayments (129.7±59.6 µg P/L), and the Niagara lakeside site (92.5±47.6 µg P/L) itself (Table 1). TP concentrations at the lakeside site (62.0±7.4 µg P/L) exceeded the NYSDEC ambient water quality guidance value of 20 µg P/L and were much higher than in offshore waters of Lake Ontario (9.5±0.7 µg P/L). Water samples taken from the Niagara River, as well as from the shore of Lake Ontario near the mouth of the river, suggested that annual lakeside TP and algae levels were quite variable, while river TP was relatively consistent from year to year (Figs. 1a, c). Phycocyanin and soil/sediment levels in lakeside water appeared to have decreased from 2004 to 2009 (Fig. 1d, e). Nitrate and total Kjeldahl nitrogen (TKN) (Figs. 1f, g) showed no trends through the study period of 2003-2009. Seasonally, lakeside TP, chlorophyll, phycocyanin, total suspended solids, and TKN (Figs. 2a, c, d, e, g) were generally higher in the late summer than in May and June. For example, levels of chlorophyll, a general measure of all algae, increased from May to September at the lakeside site (Fig. 2c) reaching an average high of >60 µg/L. Similarly, seasonal lakeside levels of phycocyanin (Fig. 1d), an indicator of the nuisance species of blue-green algae, and soil/sediment increased and reached a peak in late summer (Figs. 2d, e). Dissolved fractions, soluble reactive phosphorus (SRP), and nitrate were lower in late summer than in May and June (Figs. 2b, f). Seasonally in Niagara River, TP, SRP, nitrate, and phycocyanin concentrations had similar concentration peaks in July and September (Fig. 3).

References
Niagara Parks. 2009. Niagara Falls and Great Gorge. Government of Ontario. Available at: http://www.niagaraparks.com/nfgg/geology.php

Table 1. Average concentrations (2003 to 2009, May through September) and standard errors (S.E.) of total phosphorus (TP), soluble reactive phosphorus (SRP), nitrate, Chlorophyll a, phycocyanin, total suspended solids (TSS), total Kjeldahl nitrogen (TKN), sodium, and silica.

	TP (µg P/L)		SRP (µg P/L)		Nitrate (mg/L)		Chlorophyll (µg/L)		Phycocyanin (µg/L)		TSS (mg/L)		TKN (µg/L)		Sodium (mg/L)		Silica (mg/L)	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Lakeside	62.0	7.4	7.0	0.9	0.27	0.01	19.1	4.1	17.8	2.2	33.5	4.8	795	96	13.78	0.19	0.56	0.06
Rivers	83.8	7.0	44.8	5.4	0.57	0.03	6.5	0.8	13.2	3.0	10.5	1.9	559	25	26.65	1.28	1.42	0.15
Embayments	129.7	59.6	15.5	2.0	0.14	0.01	20.0	2.4	237.5	207.6	17.0	5.70	923	70	27.47	1.49	1.29	0.11
Lake Ontario 30m	9.9	0.7	3.1	0.5	0.31	0.02	2.0	0.17	5.5	1.2	0.7	0.14	253.3	21.0	11.46	0.23	0.35	0.05
Lake Ontario 100m	9.5	0.7	5.2	2.1	0.31	0.01	2.6	0.26	6.1	1.3	0.8	0.12	343.4	50.9	11.45	0.24	0.40	0.07

Map of the "North Coast" of New York showing sampling locations for
the Lake Ontario Coastal Initiative. Niagara River watershed is shown in the insert.

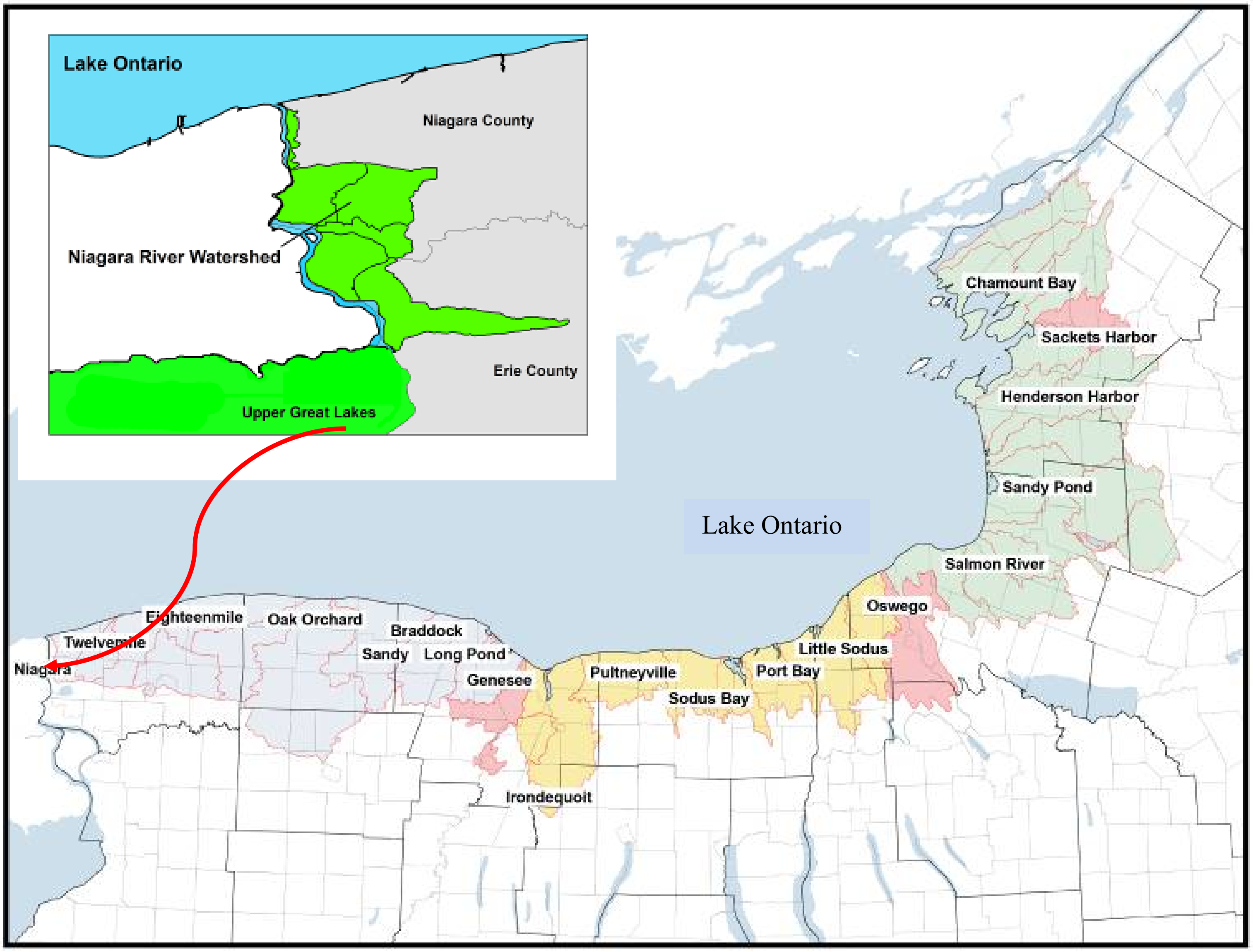

Figure 1. Average summer (±SE) total phosphorus, soluble reactive phosphorus, chlorophyll a, phycocyanin, total suspended solids, nitrate, and total Kjeldahl nitrogen concentrations in the Niagara River and at the lakeside of Lake Ontario east of the river. Surface water samples were taken monthly (May-September) at a 1-meter depth.

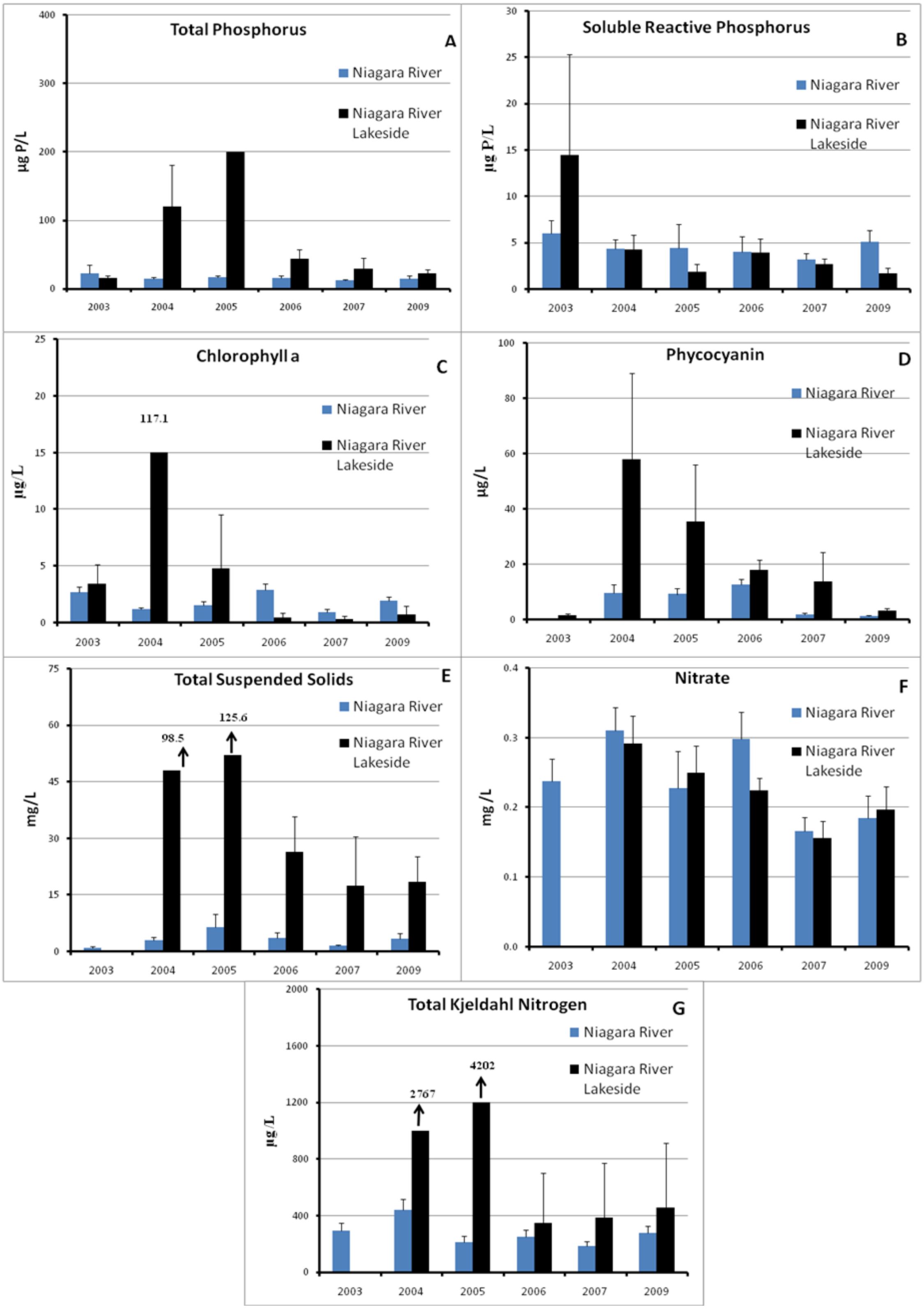

Figure 2. Average summer concentrations of total phosphorus, soluble reactive phosphorus, chlorophyll a, phycocyanin, total suspended solids, nitrate, and total Kjeldahl nitrogen at the lakeside of Lake Ontario near the Niagara River.

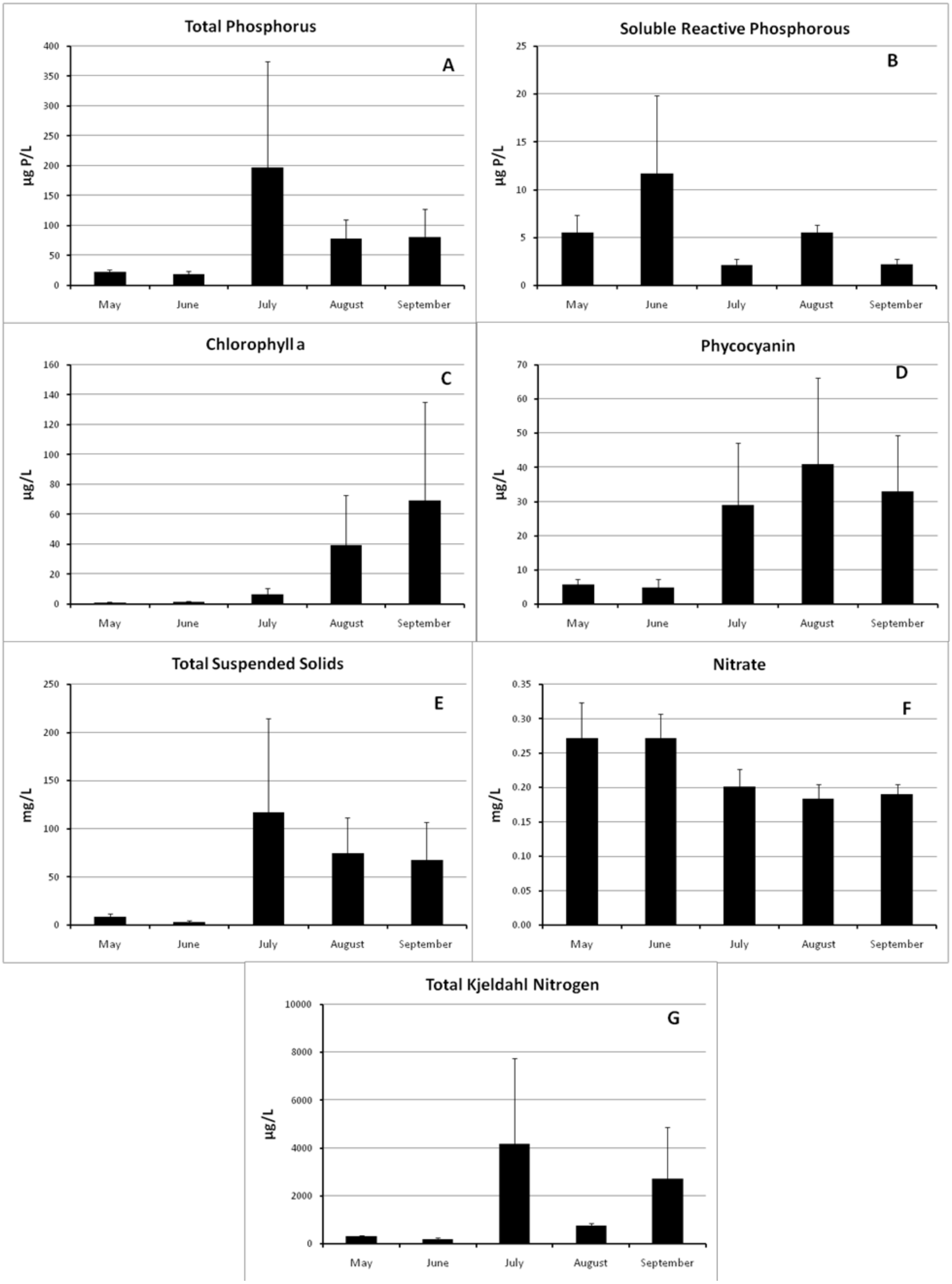

Figure 3. Average (+S.E) seasonal concentrations of total phosphorus, soluble reactive phosphorus, chlorophyll a, phycocyanin, total suspended solids, nitrate, and total Kjeldahl nitrogen in the Niagara River.