Final Report: Phytoplankton Community Composition, Development and Health in a Fluvial Lake: Lake St. Lawrence (St. Lawrence River)

To: Professor Glenn Johnson, Department of Biology, SUNY College at Potsdam
44 Pierrepont Ave, Potsdam, NY 13676-2294, Tel.: 315-267-2710, Email: johnsong@potsdam.edu

cc.: Maria Toirac, New York Power Authority; email: Maria.Toirac@nypa.gov

cc.: Constance Ferguson, Division of Research, Clarkson University, email: cmferguson@clarkson.edu

From: Michael R. Twiss, Ph.D., Great Rivers Center, Clarkson University, 8 Clarkson Avenue, Potsdam, New York, 13699-5805 Telephone: (315) 268-2359, Email: mtwiss@clarkson.edu

Background: A transect from the Moses-Saunders dam out into Lake Ontario revealed that phytoplankton concentrations decrease upon entry into the river from the headwaters in Lake Ontario. The 2007 transect provided ancillary information that suggests that decreases in phytoplankton are not due to changes in nutrient concentrations or phytoplankton health but instead appear to be linked to an increase in current velocity. Upon entering into Lake St. Lawrence current velocity decreases due to water impoundment at Moses-Saunders and not only does phytoplankton abundance increase but a shift in the type of phytoplankton occurs, with cyanobacteria (blue green algae) concentrations increasing. Nutrient levels in the river indicate a low nutrient regime (oligotrophic), which reflects the stringent controls over phosphorus levels in the offshore headwaters of Lake Ontario.

The objective of this SLRREF project was to conduct detailed sampling surveys of the International Section of the St. Lawrence River including Lake St. Lawrence to measure nutrients (P, N, Si), size fractionated chlorophyll-*a*, phytoplankton community (using a FluoroProbe), photosynthetic efficiency (using a Fast Repetition Rate Fluorimeter; FRRF), current velocity, zooplankton (net tow), and underwater light regime at 20 stations (spaced at 5 mile intervals from the Moses-Saunders Dam to coastal Lake Ontario). Three 180 km investigative surveys from the power dam to 5 miles offshore in Lake Ontario were conducted in 2008. The results of this research provides a detailed data base of phytoplankton zooplankton and nutrient chemistry in the International Section of the St. Lawrence River from which the importance of benthic grazing organisms can be inferred to be import factors influencing plankton dynamics along this stretch of regulated river water.

An additional opportunity arose to participate in the evaluation of water quality in fluvial Lake St. Francis. The summer students participated in this project using techniques developed on fluvial lake St. Lawrence and the St. Lawrence River. As a result of this additional project, funds have been secured to expand this investigative survey in Lake St. Francis in 2009.

Personnel involved:
1. Michael Twiss (PI)
2. Summer students:
   - Carmen Ulrich (University of Texas-Austin; NSF REU student intern)
   - Stefanie Kring (Clarkson University; McNair Scholar)
   - Timothy Kohanski (Clarkson University; research assistant)
   - Hilary Lockwood (Clarkson University; summer research assistant)

Work completed:
The main components of this research project have been investigative surveys up the St. Lawrence River from the Moses-Saunders power dam to 8 km offshore of Lake Ontario. Each transect comprised 20 hydrographic stations located approximately 8 km apart from one another. Transects were conducted on the following dates:
1. June 2-3, 2008
2. July 8- 9, 2008
3. July 15, 2008

An additional sampling of stations in the headwaters of the St. Lawrence River was conducted on July 25 from the RV *Lake Guardian* on a July 19-26, 2008 research cruise on Lake Ontario that was participated on by Twiss, Ulrich and Lockwood.
The Lake St. Francis nearshore (2 m isopleth) was surveyed on June 27, 2008 along the Canadian shoreline (Pointe Beaudette to Hamilton Island) and along the Quebec and US shoreline (from Ponte au Cedres to the Snell Lock).

Research products:

A peer-reviewed publication was submitted (October 2008) to a special issue of the journal *Hydrobiologia*. Twiss is one of guest editors of this special issue that will be published to commemorate the fiftieth anniversary of the damming of the International Section of the St. Lawrence River; other manuscripts will reflect presentations made at the 2008 River Conference (Twiss, as Director of Clarkson University's Great Rivers Center, co-hosted on May 5-7, 2008, with the St. Lawrence River Institute of Environmental Science, Cornwall, Ontario the first of a two conference series entitled: *Managing Ecosystems of Regulated Rivers and Watersheds: A conference series highlighting 50 years of hydroelectric power development and the construction of the St. Lawrence Seaway on the International Section of the St. Lawrence River*).

Peer-reviewed manuscript:

Twiss, M.R. Ulrich, C., Kring, S., Harold, J. and Williams, M.R. Plankton dynamics along a 180 km water level-regulated reach of the Saint Lawrence River. *Hydrobiologia* (accepted with minor revision; anticipated publication date 2010).

Abstract: Changes in phytoplankton and crustacean zooplankton concentrations were examined during four 180 km transects along the International Section of the St. Lawrence River, from 8 km offshore in Lake Ontario to the hydroelectric power dam at Massena, New York and Cornwall, ON during spring and summer. Both phytoplankton biomass, measured as chlorophyll-*a*, and zooplankton decreased markedly upon entry of lake water into the river. Phytoplankton community composition changed little over the river reach and tended to reflect Lake Ontario phytoplankton community and size structure, measured as size fractionated Chl-*a* concentrations. Total phosphorus increased with transit of river water downstream despite low tributary inputs of water into this reach of river. Light availability was high, photosynthetic efficiency suggested that phytoplankton were not physiologically stressed during transit in turbulent waters, and there was no direct evidence of flocculation causing sedimentation of phytoplankton. Grazing by the benthic community (filtering insect larvae and dreissenid mussels) is inferred to be a dominant biological factor as is the geomorphology in this reach of the river, which includes large littoral areas, shoals, and high water velocity reaches that can increase particle contact in the water column with benthic grazers. The findings of this study have a bearing on understanding how changing water levels in a regulated river might alter areas of benthic grazing.

(A copy of the full manuscript is appended to this report.)

Contribution to technical report:

Twiss, M.R., Kring, S., Kohanksi, T. and Ulrich, C. 2008. Lac Saint François and Saint Lawrence River Water Quality Survey: June 27, 2008. Report to the Raisin River Conservation Authority, Cornwall, Ontario.

Conference presentations (conducted after the end of the funded period) stemming from this work:

1. Twiss, M.R. Nearshore Surveys using Fluorimetry; Assessing Tributary and Land Use Influences along the Entire Coastline of Lake Ontario (20 m isopleth) and Lake St. François (2 m isopleth) in the Saint Lawrence River. 16th Annual International Conference on the Great Lakes /St. Lawrence River, Cornwall, Ontario, May 5-6, 2009.
2. Twiss, M.R. Ulrich, C., Kring, S., Harold, J. and Williams, M.R. Plankton dynamics along a 180 km water level-regulated reach of the Saint Lawrence River. International Society for River Science Symposium, St. Petersburg, Florida, July 13-17, 2009.

Michael Twiss
Great Rivers Center
Clarkson University
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