

**Soil & Water Conservation Society of Metro Halifax (SWCSMH)**

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Ref.: ECC2013january16 (6 pages)  
To: **Chair & Members, East Community Council (ECC), HRM**  
Cc'd Mayor Mike Savage  
Cc'd CAO, Richard Butts  
From: S. M. Mandaville Post-Grad Dip., Professional Lake Manage.  
Chairman and Scientific Director  
Date: January 16, 2013  
Subject: Russell Lake, Dartmouth-Paleolimnology results from an NSERC funded  
research project, 2000's-archives from our files

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This is being formulated on an informal basis, hence, may have typos/grammar. Please feel free to ask me any questions, and I will endeavour my level best to respond either via emails and/or in person, if invited to do so.

Since several parts of this submission are jpeg scan-inserts, they may not be wholly legible; in such a case, kindly contact me so that I can provide copies from my printer.

**In summary, simply stating**, there has been remarkable improvement in the water quality of Russell Lake (Dartmouth) ever since the pre-industrial times (1850's) based on historical diatoms. Unfortunately though, the subfossil chironomids have not reflected the same improvement, primarily as a result of hypolimnetic anoxia, per the university theses.

**Preamble:--**

“Effective management of aquatic resources requires long-term environmental data. The job of the paleolimnologist is to analyze and interpret the diverse information contained in the sedimentary records of lakes, wetlands, reservoirs, and some parts of rivers. This history is archived in a surprisingly complete repository beneath their deep waters. Every second of every day, sediments are accumulating. Incorporated in these sediments is a record of the organisms that lived in and around the lake, as well as proxy data related to processes occurring in the lake, the composition of the lake's water, the conditions in its watershed, and the air above it” (excerpts from literature).

The following is a summary of two paleolimnology university theses (April 2005) with field sampling carried out during the early 2000's under the sponsorship of a world class paleolimnologist, Prof. John Smol PhD FRSC of Ontario. He is also a Scientific Director of our group, the SWCSMH.

The scanned inserts below are on the historical diatoms and chironomids, both of which being biological species used extensively in reconstructing past history and in ascertaining the progression through time. Here, the comparisons have been made on the inferred data from the pre-industrial times (1850's) to the early 2000's.

**Scan-inserts from the thesis on historical diatoms:-**

(<http://lakes.chebucto.org/WATERSHEDS/COWBAYR/RUSSELL/PALEO/paleodiatoms.html>)

**ABSTRACT**

Two lakes in metro Halifax, Nova Scotia, were selected in a paleolimnological investigation of water quality issues. Pockwock Lake, a municipal drinking reservoir, showed a distinct acidification trend consistent with atmospheric sulphur deposition. Although a slightly naturally acidic lake (diatom-inferred pH~ 6.2), there was an increase in acidophilous diatoms (e.g., *Fragilaria acidobiontica*) and a corresponding decrease in the diatom-inferred pH and dissolved organic carbon concentration. Russell Lake, located in area commercial and residential area, has experienced dramatic changes in productivity. The lake has experienced increases and, more recently decreases, in the relative percent abundance of eutrophic diatoms which corresponds to the operation and closure of a pig farm which discharged waste directly into the lake.

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Summary:-

**Russell Lake**

- 1) Mesotrophic, alkaliphilous species, such as *Asterionella formosa* and *Aulacoseira ambigua* were the dominant diatom species prior to watershed development which suggests that Russell Lake was a naturally productive aquatic system.
- 2) Development of the pig farm during the 1960's on a hill overlooking Russell Lake may have led to elevated nutrient concentrations, namely phosphorus, entering the lake. There is corresponding shift in the diatom assemblage toward those taxa which thrive in more productive systems. The timing of this signal, along with an increase in the diatom-inferred total phosphorus levels, suggests that Russell

Lake became more eutrophic as a result of increased nutrients being supplied by run-off from the pig farm.

- 3) During the mid 1990's there was a rapid decline in the relative percent abundance of eutrophic taxa *A. granulata* and a recovery toward the pre-disturbance taxa such as *A. ambigua* and *A. formosa* which corresponds directly with the closure of the pig farm which occurred in 1995. The diatom-inferred total phosphorus levels indicate that Russell Lake has begun to recover toward pre-disturbance conditions.

Wright

(pig farm closed in June 1980. pers comm.  
Gerrie Wamboldt, d/o Thorast, owners)

Critique/info on the historical land uses by Shalom Mandaville:

There were some errors relating to land uses in the aforesaid thesis, most probably because erroneous info was given by various local stakeholders to the researchers. Following are the significant ones; also included are possible land uses dating back to the early 1800's:-

- (1) The pig farm was not operational to 1995 contrary to statements in the thesis. The farm ceased operations in June of 1980 per Geraldine Wamboldt, daughter of Norman Earle Morash, the owner of the pig farm who had passed away in 1964 at the age of 55.
  - a. Whether this fact had some impact in the identification of the paleo diatoms is not clear since the thesis clearly stated that the diatoms revealed the operation of the pig farm until 1995.
  - b. The thesis also states that the pig farm commenced operations during the 1960s; this was also an error since Norman Earle Morash commenced working for his father, Norman Morash, at the pig farm back during the 1930s (*pers. comm.* Wamboldt, October, 2005).
- (2) The pig farm commenced operations in/around the early 1900s by Norman Morash, grandfather of Geraldine Wamboldt.
- (3) There was another farm in addition to the pig farm owned by Norman Morash. There were cattle, sheep, and a part of the farm was used as a garden. It is understood this was the case even during the 1900s. The grandfather, Norman Morash, passed away in at the age of 92.
- (4) Based on a published historical book, there were other farms around Russell Lake. It appears that the first settler there, a Nathaniel Russell, Loyalist from Boston, owned a large farm on the south side of the Cole Harbour Road opposite Colin Grove during the late 1700s. The area would fall within the watershed of Russell Lake.

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**Scan-inserts from the thesis on historical chironomids:-**

(<http://lakes.chebucto.org/WATERSHEDS/COWBAYR/RUSSELL/PALEO/paleochironomids.html>)

**ABSTRACT**

Subfossil chironomid head capsules from a sediment core of Russell Lake, Nova Scotia, were studied to determine if assemblages have changed in response to increased development in the watershed of the lake. Chironomid analysis suggests that Russell Lake was historically mesotrophic with moderate to low deepwater oxygen concentrations. Changes in chironomid assemblages over the last 25 years indicate that there has been a further reduction in deepwater oxygen concentrations reflective of nutrient enrichment. The changes are characterized by increases in the relative abundance of littoral taxa and taxa tolerant of anoxic conditions (e.g. *Chironomus*). These results correspond with shifts in diatom assemblages that also reflect eutrophication trends in Russell Lake following the establishment of a pig farm and the intensification of commercial and residential development. While diatom analysis indicates the system is beginning to recover to pre-disturbance conditions, this is not yet reflected in chironomid assemblages as a result of continued hypolimnetic anoxia.

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## SUMMARY

### **1. Analysis of chironomid assemblages reveals changes in response to increased commercial and residential development in the watershed of Russell Lake.**

- Changes in chironomid assemblages following development are characterized by the increase in taxa tolerant of anoxic conditions (e.g. *Chironomus*), and indicate a depletion of hypolimnetic dissolved oxygen as a result of eutrophication.
- Manure from a pig farm was likely the major source of limiting nutrients contributing to eutrophication. Since the closure of the farm improvements in water quality have been observed and are reflected in diatom assemblages.
- Improvements in surface water quality, as indicated by diatoms, do not appear to be accompanied by the recovery of hypolimnetic oxygen levels, and thus are not reflected in chironomid assemblages.

### **2. Implications of this study for the management of Russell Lake.**

- The water quality of Russell Lake has been negatively impacted by commercial and residential development in the catchment. It appears as though the recent closing of the pig farm has contributed to improvements in water quality observed by local residents and reflected in the recovery of diatom communities.
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