

Soil & Water Conservation Society of Metro Halifax (SWCSMH)

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Ref.: HWCC_Paleolimnology (5 pages)
To: **Chair & Members, Halifax and West Community Council, 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: May 07, 2013
Subject: "Power of the Past"- Paleolimnology

Please feel free to ask any questions, and I will endeavour my level best to respond either via emails and/or in person at one of your meetings, if invited to do so. Kindly pardon any typos/grammar.

This submission on **paleolimnology** (<http://lakes.chebucto.org/PALEO/paleo.html>) is intended to inform all of you elected reps as well as senior executives of the importance of taking interest in this topic which has generally been ignored in Nova Scotia.

We are not submitting this to the Standing Committee on Environment & Sustainability in order to avoid duplication. Because of the considerable importance of this little known subspecialty in limnology, we feel that all elected representatives should be aware of this, simply stating. We are unaware if any staff of the HRM, Halifax Water, the NSE, local branches of the federal agencies, or the routine local consultants conducting paleo.

Our scientific society, the SWCSMH, is taking 'renewed interest', primarily, as a result of the paleo studies conducted on Pockwock Lake in Hammonds Plains, Russell Lake in Dartmouth, and Lake George in Kings County which were mostly funded by the NSERC (Natural Sciences and the Engineering Research Council of Canada) during the 2000's. We were active collaborators of the Ontario scientists who headed the project in HRM. The lead scientist was Prof. John Smol PhD FRSC whose photograph and brief bio are on the next page. Several lead paleolimnologists around the world have studied under him.

We have inserted select coloured pictures from the powerpoints that we received from the scientists during the 2000's, most of them being self-explanatory. You will be able to appreciate in colour lot better than in black-n-white, hence we are submitting sufficient print copies to the Municipal Clerk rather than emailing in the usual PDF format.

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We had submitted an overview of the paleo results of Russell Lake to the Harbour East-Marine Drive Community (HEMDCC) in February, 2013. It can be viewed via the URL, <http://www.halifax.ca/Commcoun/east/documents/SoilWaterConservationSocietyjanuary1613.pdf>.

Preamble (excerpts from literature):--

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.

ASPECT #1: "Power of the Past":



(A photo from the early 2000's of John gracing my apartment at Maynard Lake, Dartmouth.)

Prof. John Smol PhD FRSC is a recipient of several national and international scientific awards inclusive of the Gerhard Herzberg Gold Medal, in 2004. The Herzberg Gold Medal is awarded by the NSERC (Natural Sciences and Engineering Research Council of Canada) annually for both the sustained excellence and

overall influence of research work conducted in Canada in the natural sciences or engineering. It has been awarded to only one person per year since 1991. He is a Scientific Director/advisor of our international group, the SWCSMH, as well.

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Abstract from "Smol, J.P. 2010. The power of the past: using sediments to track the effects of multiple stressors on lake ecosystems. *Freshwater Biology* (2010), 55 (Suppl. 1), 43-59.":-

"1. One of the greatest challenges faced by limnologists, as well as most ecologists and environmental scientists, is finding data with time scales appropriate to their questions. Because of the general lack of reliable long-term monitoring data, it is often difficult to determine the nature and timing of ecosystem changes. In lieu of direct monitoring data, palaeolimnologists have developed a variety of physical, chemical and biological approaches to track past changes in aquatic ecosystems using proxy data archived in lake and river sediments. This article summarises a few of our recent palaeolimnological programs that have studied the effects of multiple stressors on lake ecosystems and demonstrates how palaeolimnological approaches can circumvent this common problem of data availability.

2. Lakewater calcium concentrations are declining in many softwater lake regions because logging and acid precipitation have lowered calcium levels in soils. In many cases, however, the onset of lakewater calcium decline predates direct observation, and so documenting the effects on freshwater ecosystems may be complex. By combining laboratory, field and palaeolimnological approaches, it is now evident that keystone taxa (e.g. *Daphnia* spp.) have been severely affected by these calcium declines.

3. Some of the most common complaints received by lake managers concern the smell and taste of water. Although the root causes of taste and odour problems vary, compounds released by certain species of algae are often responsible. In nutrient-poor or mesotrophic lakes, colonial chrysophytes are often the culprits, including scaled taxa of the genus *Synura*. Palaeolimnological approaches can be used to assess the various multiple stressors that influence the abundance of these phytoplankton.

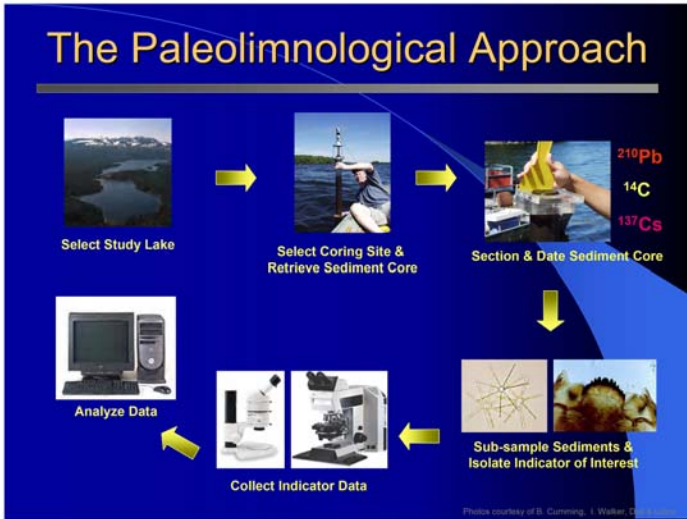
4. Thematic implications: recent climatic warming is affecting a wide range of lake ecosystems in diverse and often complex ways across vast geographical regions, and this has added to the complexities of limnological responses to other stressors. As more palaeolimnological studies are completed, meta-analyses of sedimentary profiles can now be used to help disentangle the effects of climate warming from other environmental variables to determine how various components of lake ecosystems are responding to these multiple stressors."

ASPECT #2: Info on Appendix A (8 coloured photos inserted in pages 4 to 5).

The inserts are mostly self-explanatory. The last photo on page-5 is that I took of students of Dr. Smol at Russell Lake, Dartmouth. The students were sectioning the cores at 0.25 cm intervals at the lake for later high-resolution analyses at their lab in Ontario.

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Appendix-A: (see Aspect #2 on page-3 for explanation)



Part II: Eutrophication

A photograph of a lake with green, turbid water and a log floating in the foreground, illustrating eutrophication.

- World's most widespread water quality issue
- Increased lake productivity due to inputs of limiting nutrients:
 - Nitrogen
 - Phosphorus
- Algal blooms (algae + cyanophytes)
 - Decreased water quality, taste and odour issues, hypolimnetic anoxia (fish kills)

Surface-water Acidification

So:

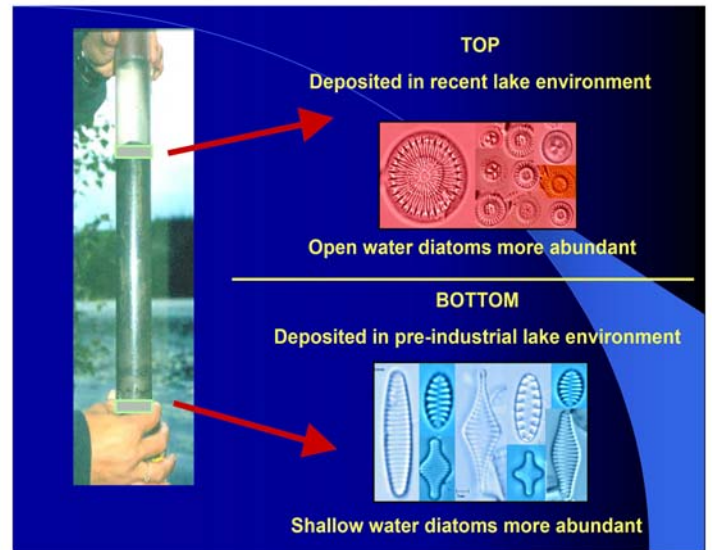
- Lowers pH in soils and surface waters
- Mobilizes metals in soils
 - e.g. Hg, Cd, etc.
 - Monomeric Al
 - Binds to gills (e.g., trout)

Additionally:

- Coastal Areas: $\text{Cl}^- + \text{H}_2\text{O} \rightarrow \text{HCl}$

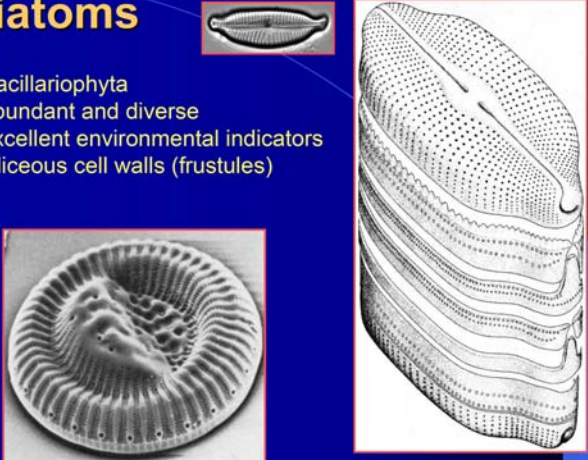
A photograph of an industrial facility with smokestacks emitting plumes of smoke into the sky.

Photo: CBC News

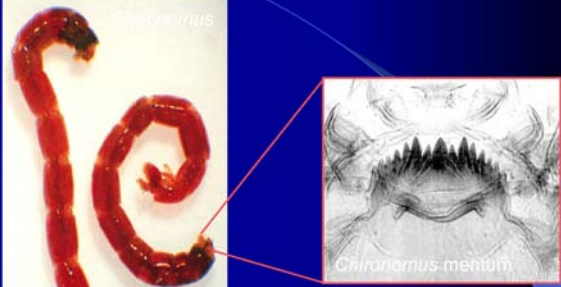


Diatoms

- Bacillariophyta
- abundant and diverse
- excellent environmental indicators
- siliceous cell walls (frustules)



Chironomid head capsules as indicators



Chrysophyte Scales

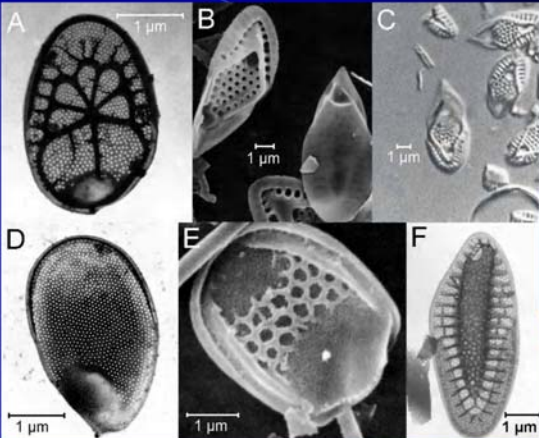


Figure 5.5 in Smol (2002)

Students of Prof. Dr. Smol were sectioning the cores at 0.25 cm intervals at Russell Lake, Dartmouth for later high-resolution analyses at their lab in Ontario

