Soil & Water Conservation Society of Metro Halifax (SWCSMH)
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Master Homepage: http://lakes.chebucto.org

Ref.:	ESSC_phytoplankton	(6 pages)
To:	**Environment & Sustainability Standing Committee, 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	
Note:	Kindly see page-6 for a graceful admission by a former Premier, the Rt. Hon. Dr. John Hamm MD	
Subject:	Characteristics of common major algal associations of the phytoplankton in relation to increasing lake fertility: Limnology: Part-4	

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.

(Access the web pages, http://lakes.chebucto.org/phyto.html and http://lakes.chebucto.org/quotes.html).

Detailed Preamble

Unlike the routine chemical sampling carried out at times by the HRM, by its paid consultants, by select local academia, and by our own scientific society (the SWCSMH) which may require sizeable funds, the phytoplankton analyses are dependant upon the prevalence of personnel with the appropriate scientific capabilities. Any expense, over and above personnel time, is the access to suitable microscopes and the `reference keys', other costs being minimal.

We were able to detect `early warning indicators' in this way and to list select examples, to various degrees, in no particular order over time (and in cases, parts of a lake) are, Papermill Lake (Bedford), Fish Lake (Oakfield), Cranberry Lake (Dartmouth), Five Island Lake (Hubley), Sheldrake Lake (Hubley), Hubley Big Lake (Hubley), parts of Porters Lake, parts of Lake Echo, Bissett Lake (Cole Harbour), Settle Lake (Dartmouth), Russell Lake (Dartmouth), Morris Lake (Dartmouth), Kearney Lake (Halifax), Lake Fletcher (Shubie w/shed), Lake William (Shubie w/shed), Lake Thomas (Shubie w/shed), Winder Lake (North Preston), Shubie Grand Lake (Shubie w/shed), Williams Lake (Jollimore), Drain Lake (Hammonds Plains), Tucker Lake (Beaverbank), Sandy Lake (Bedford), Fenerty Lake? (Beaverbank), and others.

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As needed, we send `reference collections' to experts elsewhere in Canada, the USA, and on occasions, in Western Europe for independent scientific peer reviews. A typical depiction of phytoplankton from literature is inserted on page-5 here.

We have numerous other lakes to monitor yet and it is a never ending process. We repeat the monitoring as necessary when significant events take place in the watersheds.

Phosphorus is not the only stressor, there are other stressors as well. And these are indeed interlinked with regional stressors as a result of climate change, acid deposition, and UVB radiation, among other potential causes.

No study or consultant report of the HRM to date has ever addressed these aspects but they seem to point to phosphorus for everything. More often than not, there are other `cumulative impacts of numerous stressors' which could potentially aggravate a given situation than what phosphorus alone indicates.

Our North American based scientific group (the SWCSMH) has `zero' hired employees, and we don't even have an office. We are volunteers although approximately half of our members are scientists/academia in related professions (limnology, various biological specialties, and microbiology), and the other half are either professors (present/retired) in varied engineering disciplines and/or some in the medical professions. We do collaborate with national researchers, subject to time availability. We do have access to advanced microscopes including scanning electron microscopes in Canada and the USA.

Re the NSE:- When Dr. John Underwood, a resident of HRM, was the sole limnologist at the Nova Scotia Environment (NSE) Dept., he used to carry out such basic phytoplankton identification in a few lakes whenever he had extra time. After he resigned in early 1990, such necessary monitoring came to an abrupt end.

Kindly read the honest admission made in 1999 by a former Premier who was quite interested in lake management, the Rt. Hon. Dr. John Hamm MD (see page-6). There has been no progress in the scientific capabilities of the NSE as far as we can fathom. We have been in regular correspondence with their ministers over the last 25+ years.

In order to keep this submission brief, only a handful of world renown references have been cited below. While they are quite dated, they are being applied worldwide with local modifications, as needed. Published and peer reviewed literature is literally awash with similar case histories.

We found that in most cases, results from literature are applicable here in Nova Scotia as well with modifications as needed. Some of our formal reports are available for public use although they can be appreciated only by those with formal scientific background(s).

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Characteristics of common major algal associations of the phytoplankton in relation to increasing lake fertility (Wetzel, R.G. 1983. Limnology. Second Edition. Saunders College Publishing. 860 pp.)

General Lake Trophy	Water characteristics	Dominant algae	Other commonly occurring algae
Oligotrophic	Slightly acidic; very low salinity	Desmids *Staurodesmus*, *Staurastrum*	*Sphaerocystis*, *Gloeocystis*, *Rhizosolenia*, *Tabellaria*
Oligotrophic	Neutral to slightly alkaline; nutrient-poor lakes	Diatoms, especially *Cyclotella* and *Tabellaria*	Some *Asterionella* spp., some *Melosira* spp., *Dinobryon*
Oligotrophic	Neutral to slightly alkaline; nutrient-poor lakes or more productive lakes at seasons of nutrient reduction	Chrysophycean algae, especially *Dinobryon*, some *Mallomonas*	Other chrysophyceans, e.g., *Synura*, *Uroglena*; diatom *Tabellaria*
Oligotrophic	Neutral to slightly alkaline; nutrient-poor lakes	Chlorococcal *Oocystis* or chrysophycean *Botryoccocus*	Oligotrophic diatoms
Oligotrophic	Neutral to slightly alkaline; generally nutrient poor; common in shallow Arctic lakes	Dinoflagellates, especially some *Peridinium* and *Ceratium* spp.	Small chrysophytes, cryptophytes, and diatoms
Mesotrophic or Eutrophic	Neutral to slightly alkaline; annual dominants or in eutrophic lakes at certain seasons	Dinoflagellates, some *Peridinium* and *Ceratium* spp.	*Glenodinium* and many other algae
Eutrophic	Usually alkaline lakes with nutrient enrichment	Diatoms much of year, especially *Asterionella* spp., *Fragilaria crotonensis*, *Synedra*, *Stephanodiscus*, and *Melosira granulata*	Many other algae, especially greens and blue-greens during warmer periods of year; desmids if dissolved organic matter is fairly high
Eutrophic	Usually alkaline; nutrient enriched; common in warmer periods of temperate lakes or perennially in enriched tropical lakes	Blue-green algae, especially *Anacystis* (= *Microcystis*), *Aphanizomenon*, *Anabaena*	Other blue-green algae; euglenophytes if organically enriched or polluted

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Phytoplankton Indices (Hutchinson, G.E. 1967. A treatise on Limnology v.2. Introduction to Lake biology and the limnoplankton. John Wiley & Sons. 1048 pp.)

Several phytoplankton indices have been reported and related with transparency, and so the total mass of seston, and to some extent with productivity. The use of these indices, however, requires discretion; they are certainly inapplicable in some regions.

Myxophycean index= (# of Myxophyceae species) / (# of Desmideae species)

Chlorophycean index= (# of Chlorococcales species) / (# Desmideae species)

Diatom index= (# of centric diatom species) / (# of pennate diatom species)

Euglenophyte index= (# of Euglenophyta species) / (# of Myxophyceae and Chlorophyceae species)

Compound index= (# of Myxophyceae, Chlorococcales, centric diatoms, and Euglenophyta species) / (# of Desmideae species)

Since there is a tendency for green and blue-green algae to be summer forms, although the diatoms may flourish at any time of year, the indices other than the diatom quotient refer only to summer collections, preferably made in June, July, and August. The diatom quotient is supposedly applicable at any time of year.

Nygaard regarded lakes containing associations giving a compound index of less than 1.0 as unproductive and those giving an index of more than 3.0 as definitely eutrophic; the intermediate values implied mesotrophy or weak eutrophy.

Phytoplankton indices for less productive and more productive groups of lakes (Nygaard's data for several Danish lakes)

Lake characteristics	Myxophycean	Chlorophycean	Diatom	Euglophyte	Compound
Less productive, more transparent (pH<7.0, Ca<10 mg/l)	0.0-0.4	0.0-0.7	0.0-0.3	0.0-0.2	0-1
More productive, less transparent (pH>7.0, Ca>10 mg/l)	0.1-3.0	0.2-9.0	0.0-1.75	0.0-1.0	1.2-25

Applicability to lakes in HRM

It is also possible to make for any region a list of organisms of more frequent occurrence in unproductive waters and another list of species of more frequent occurrence in more productive waters. The ratio, in the plankton of any lake, of the number of species on one list to the number on the other can be used to assess the position of the lake in a scale of productivities.

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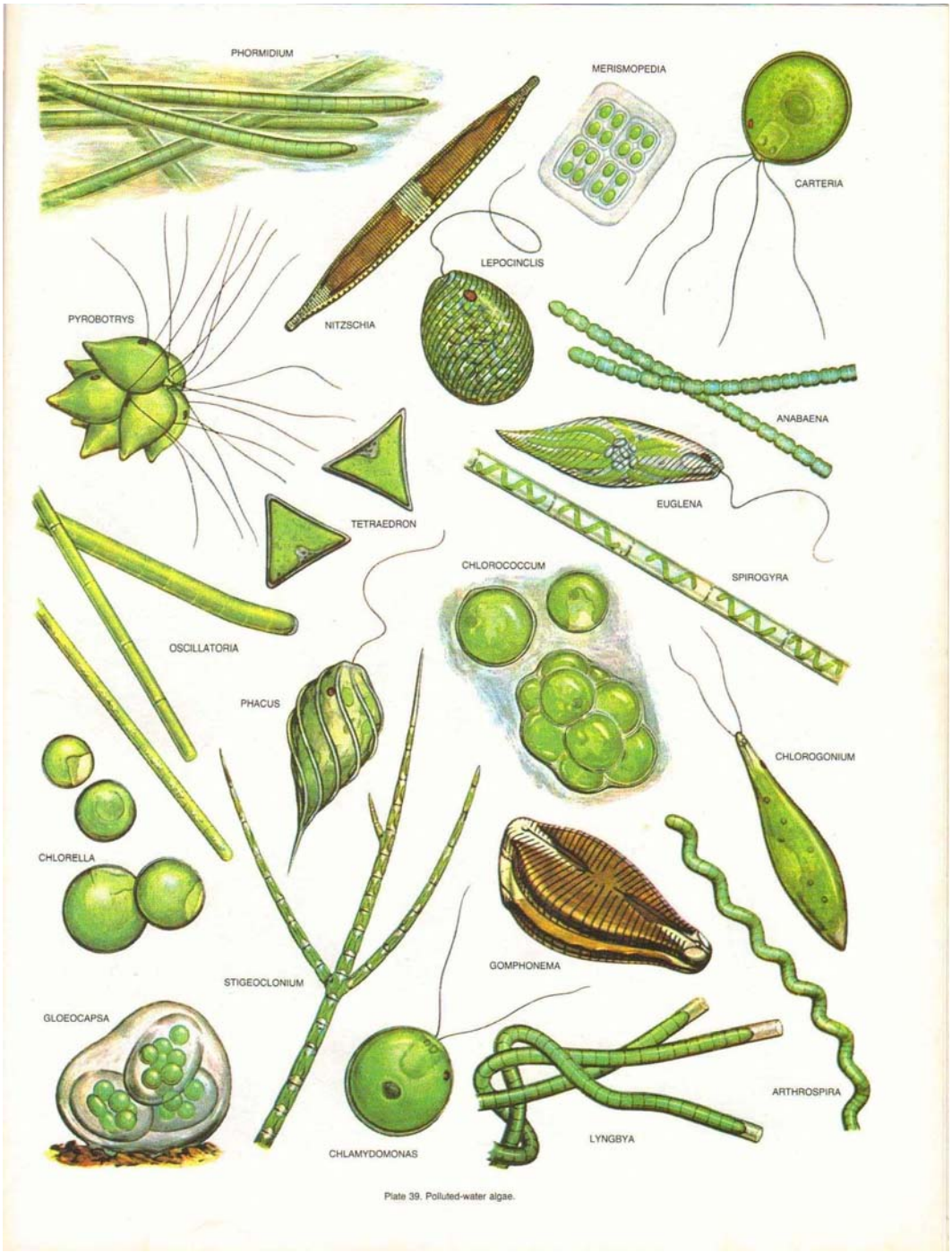
An example of phytoplankton species, from Standard Methods, 1992
(Note: This is included here for educational and representative examples only. Consult published literature for further understanding and numerous other examples.)



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Shalom M. Mandaville
Chairman & Exec. Director
Soil & Water Conservation Society of Metro Halifax
310-4 Lakefront Road, Dartmouth, NS
B2Y 3C4

Dear Mr. Mandaville:

Thank you for your electronic correspondence of August 3, 1999 and July 30, 1999, on the subject of Nova Scotia Department of the Environment's (NSDOE) capacity to properly manage the province's numerous lakes.

As far as the professional composition of NSDOE staff is concerned, this reflects the range of environmental management issues and problems that the department addresses. This includes everything from acid rain and particulate monitoring, to contaminated sites and agricultural practices. Lake water quality is an ongoing concern for the department, not just as it is affected by urban development, but in every way.

With respect to your request that a limnologist be added to the Environment staff, the department will undergo a full program re-assessment as part of the required legislative review. Following that review, there will be better direction on staffing priorities, and the need for a limnologist will be evaluated at this time.

Your personal interest in lake water quality management is indeed evidenced in your website, which I understand to be comprehensive. I very much appreciate the continuing interest of voluntary groups such as your own, and their contribution to our environment. In this regard, I would ask that you maintain contact with NSDOE through Mr. Darrell Taylor (424-2570). I would support collaborative efforts to improve our approaches to environmental management that incorporates the experience of organization's like yours. I have requested that Mr. Taylor follow up with you to discuss this further.

Sincerely,

John Hamm

John F. Hamm

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