Item 8.3.1

Monitoring efforts

What sediments tell us about lake health

Dr. Josh Kurek
Mount Allison University
jkurek@mta.ca

Modelling

year	start tapping	boiling	last boil	days boiled
1980	Mar. 19 to 21	Mar. 24	Apr. 10	
1981	Feb 19 to 22	Feb. 22	Apr. 04	
1982	Mar.12 to 14	Mar. 18	Apr. 16	
1983	Mar. 06 to 09	Mar. 12	Apr. 16	
1984	Feb. 16 & 17	Feb. 25	Apr. 10	
1985	Mar. 02 to 11	Mar. 12	Apr. 20	
1986	Mar. 13 to 18	Mar. 24	Apr. 12	
1987	Mar. 19 to 21	Mar. 21	Apr. 27	
1988	Mar 08 to 11	Mar. 19	Apr. 17	
1989	Mar. 12 to 15	Mar. 16	Apr. 18	
1990	Mar. 02 to 03	Mar. 11	Apr. 15	
1991	Feb. 09 to 21	Mar. 03	Apr.07	
1992	Feb 27 Mar 07	Mar. 28	Apr. 28	21 of 24 days
1993	Mar. 13 to 21	Mar. 24	Apr.18	18 of 28 days
1994	Mar. 05 to 14	Mar. 15	Apr. 10	20 of 24 days
1995	Feb 20 Mar 06	Mar 09	Apr. 15	24 of 38 days
1996	Feb. 21 to 25	Feb. 28	Apr. 13	20 of 44 days
1997	Feb.27 Mar 02	Mar. 28	Apr.22	17 of 26 days
1998	Feb.24 Mar.03	Mar. 5 &9	Apr.12	17 of 38 days
1999	Feb.16 Mar.03	Mar. 2 &3	Apr 10	21 of 40 days
2000	Feb 22 to 29	Mar.01 02	Mar. 30	20 of 30 days
2001	Mar..05 to 11	Mar.14	Apr. 16	23 of 31 days
2002	Feb.20 to 24	Feb27 Mar 4	Apr. 10	18 of 42 days
2003	Mar.01 to 06	Mar. 21	Apr.21	21 of 30 days
2004	Mar.01 to 05	Mar. 06 Mar.26	Apr. 20	21 of 46 days
2005	Feb 22 Mar.03	Mar.09	Apr.20	20 of 48 days
2006	Feb. 19 to 22	Mar. 10	Apr.02	20 of 24 days
2007	Feb 28 Mar. 05	Mar.13	Apr.16	24 of 34 days
2008	Feb.25Mar. 03	Mar.06	Apr.17	14 of 38 days
2009	Feb. 26 to 28	Mar.09	Apr. 06	10 of 37 days
2010	Feb.21 to 25	Feb. 25	Apr.03	24 of 30 days
2011	Feb.25 Mar.07	Mar.07	Apr. 10	27 of 35 days
2012	Feb.21 to24	Feb28	Apr. 03	24 of 35 days
2013	Feb.22 to 26	Mar.04	Apr. 07	25 of 33 days
2114	Feb.27 Mar.04	Mar.09	Apr.14	25 of35 days
2012	Mar 05 to 07	Mar. 12 Mar.27	May 01	25 of 39 days
2015	Feb.18 to 20	Feb 21	Apr. 16	25 of 40 days
2016	Feb 10 to 20	Feb 23	Apr. 14	24 of 34 days
2017	Feb. 10&11	Feb 14		
2018				

Local observations

& Indigenous knowledge

Historical records

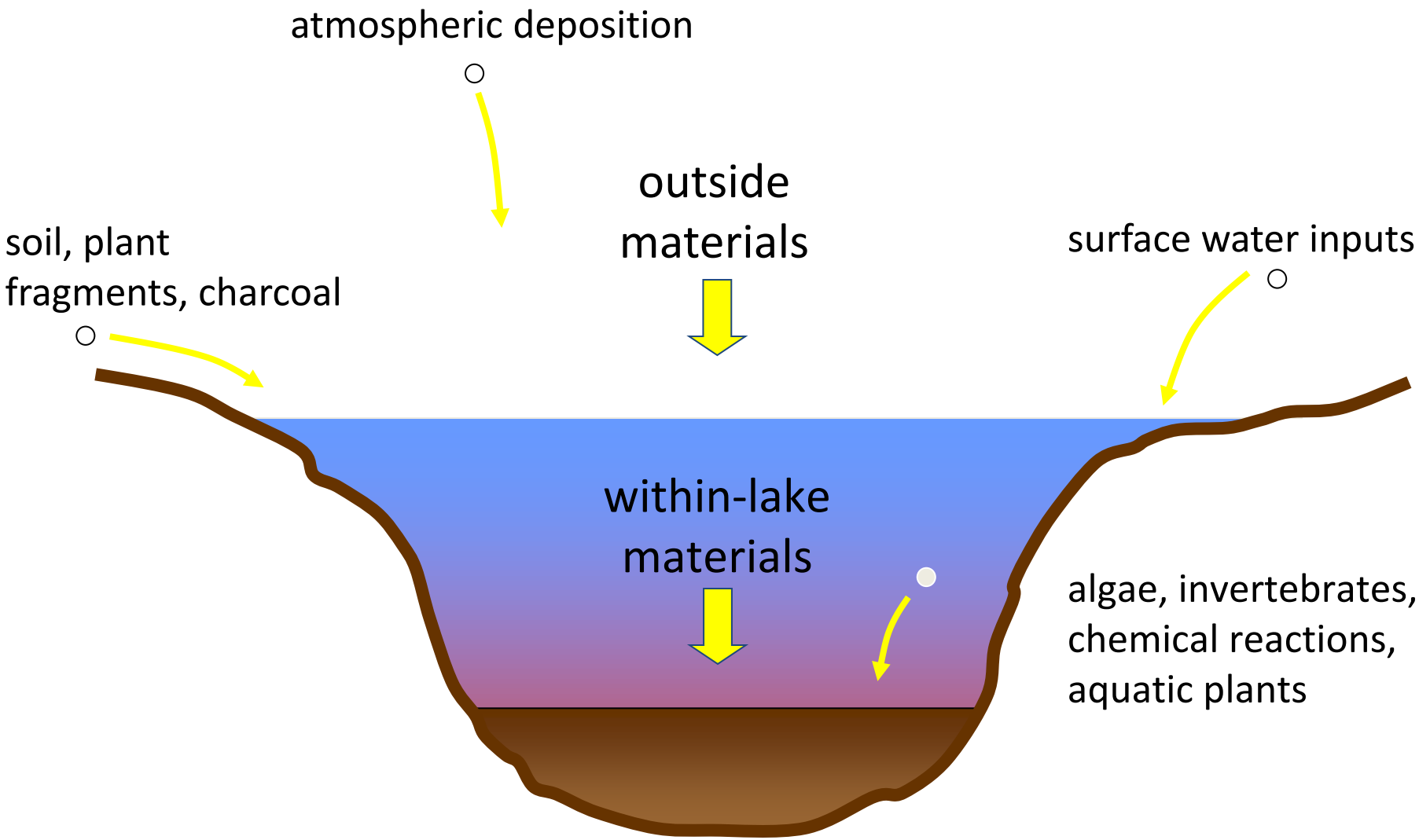
Natural environmental archives

Sediments: help to "reconstruct" past conditions of lakes

We use multiple sedimentary measures:

physical
geochemical
biological

Sediments accumulate in chronological order



In absence of monitoring data sediments can help determine…

What were pre-impact conditions?

What is considered natural?

Have conditions changed?
Importantly…Why?

Key lake sediment studies, lots of great work by others too!

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Arsenic and mercury contamination and complex aquatic bioindicator responses to historical gold mining and modern watershed stressors in urban Nova Scotia, Canada

Allison J. Clark [a], Andrew L. Labaj [a], John P. Smol [b], Linda M. Campbell [c], Joshua Kurek [a,*]

[a] Department of Geography and Environment, Mount Allison University, Sackville, New Brunswick, Canada
[b] Paleoecological Environmental Assessment and Research Laboratory, Department of Biology, Queen's University, Kingston, Ontario, Canada
[c] Environmental Sciences Department, Saint Mary's University, Halifax, Nova Scotia, Canada

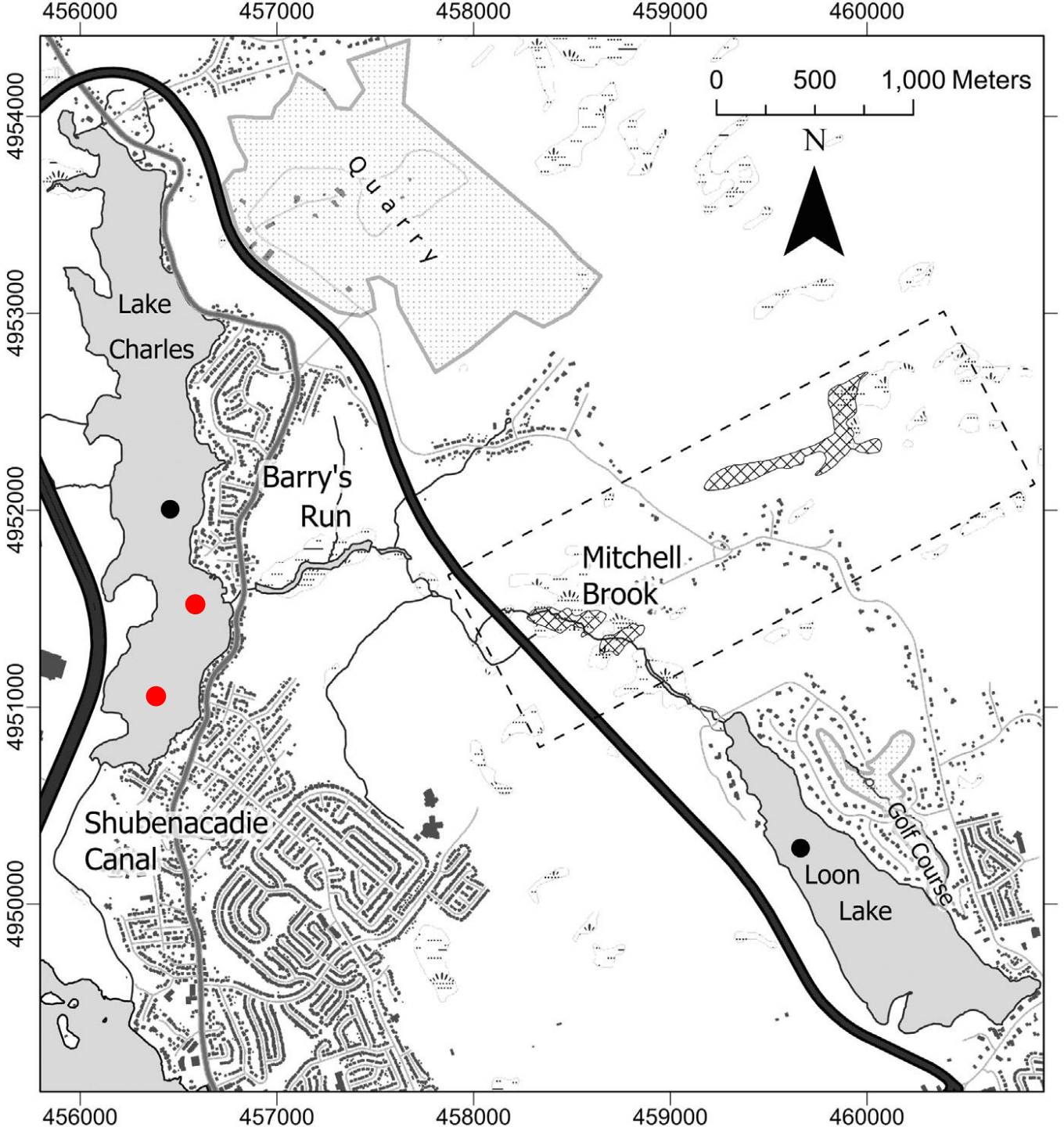
Establishing realistic management objectives for urban lakes using paleolimnological techniques: an example from Halifax Region (Nova Scotia, Canada)

Brian K. Ginn*†, Thiyake Rajaratnam, Brian F. Cumming, and John P. Smol
Paleoecological Environmental Assessment and Research Laboratory (PEARL), Department of Biology, Queen's University, Kingston, ON, Canada K7L 3N6

Anthropogenic activity in the Halifax region, Nova Scotia, Canada, as recorded by bulk geochemistry of lake sediments

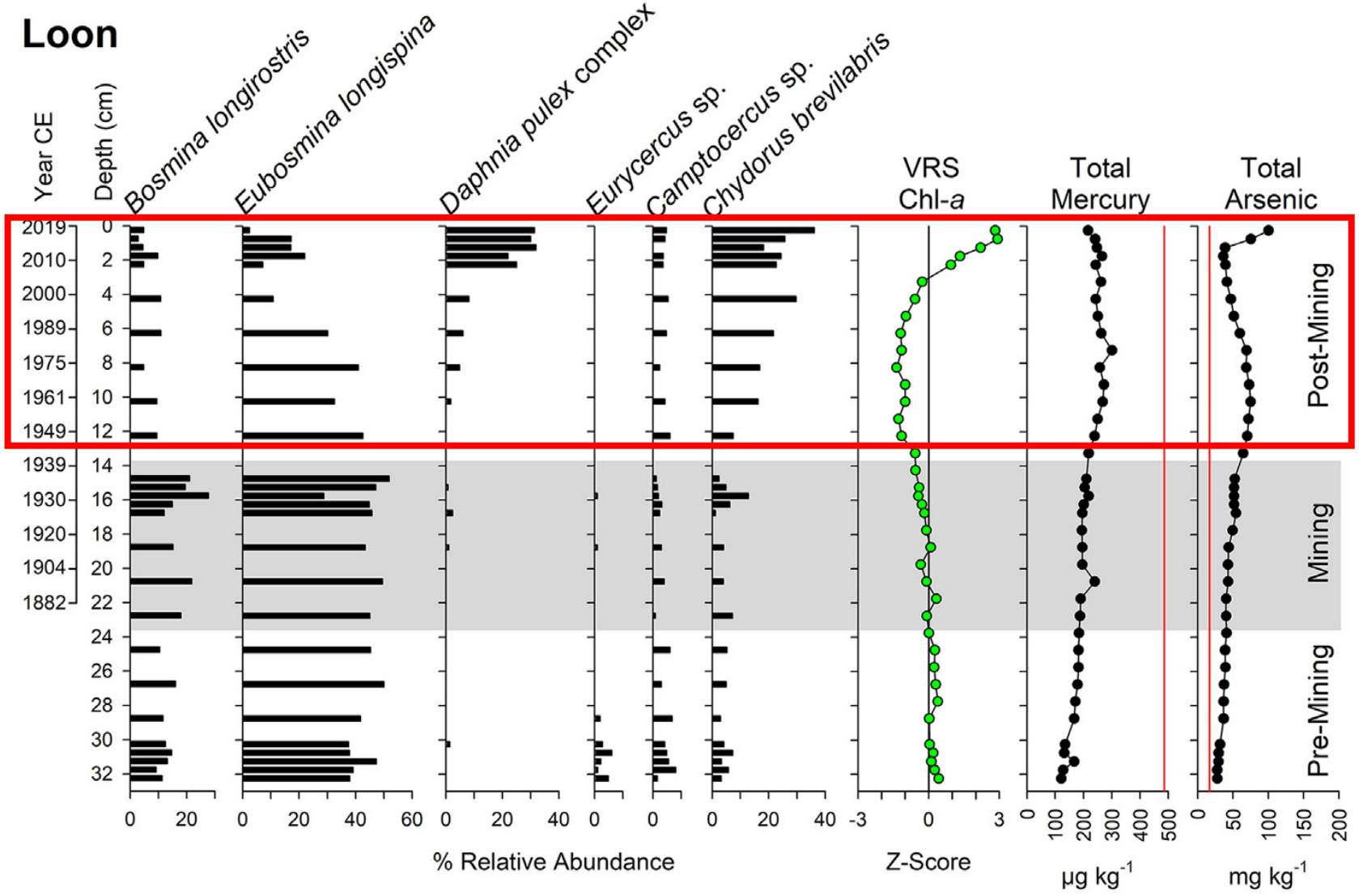
Dewey W. Dunnington [a], Ian S. Spooner[b], Wendy H. Krkošek[c], Graham A. Gagnon [a], R. Jack Cornett[d], Joshua Kurek[e], Chris E. White[f], Ben Misiuk[g], and Drake Tymstra[b]

[a]Centre for Water Resources Studies, Department of Civil & Resource Engineering, Dalhousie University, 1360 Barrington St., Halifax, NS, Canada; [b]Department of Earth & Environmental Science, Acadia University, 12 University Ave., Wolfville, NS, Canada; [c]Halifax Water, 450 Cowie Hill Road, Halifax, Nova Scotia, Canada; [d]Andreé E. Lalonde Accelerator Mass Spectrometry Lab, Department of Earth Science, University of Ottawa, Ottawa, ON, Canada; [e]Department of Geography and Environment, Mount Allison University, Sackville, NB, Canada; [f]Nova Scotia Department of Natural Resources, Halifax, NS, Canada; [g]Department of Geography, Memorial University of Newfoundland, St. John's, NL, Canada

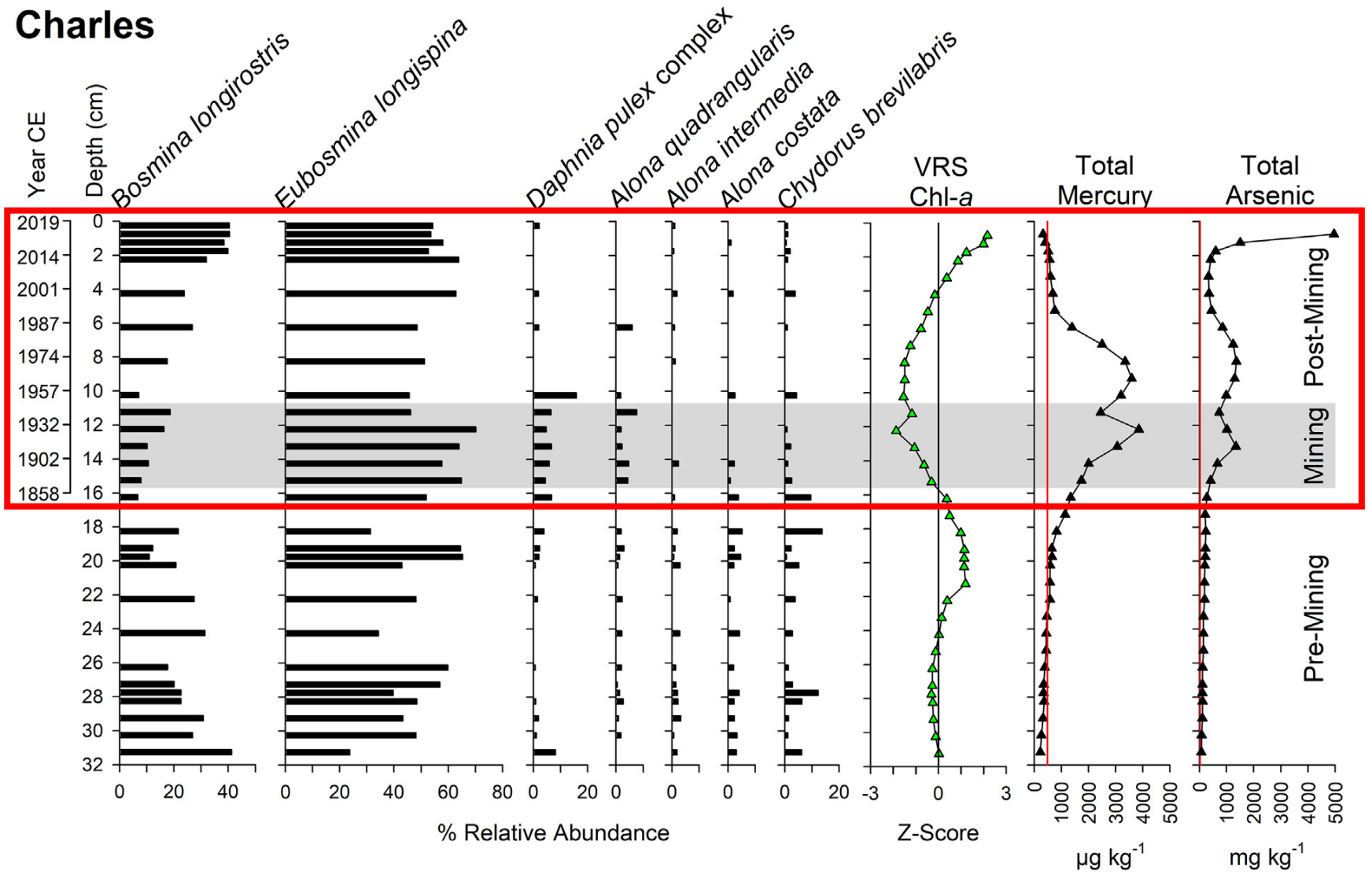


- Clark et al. cores
  (Excellent dates, ICP-MS, pXRF, Chl-*a*, zooplankton, midges)
- Acadia Uni. Cores
  (Undated and no ICP-MS)

After 1950, urbanization and climate change caused bioindicator shifts at reference lake

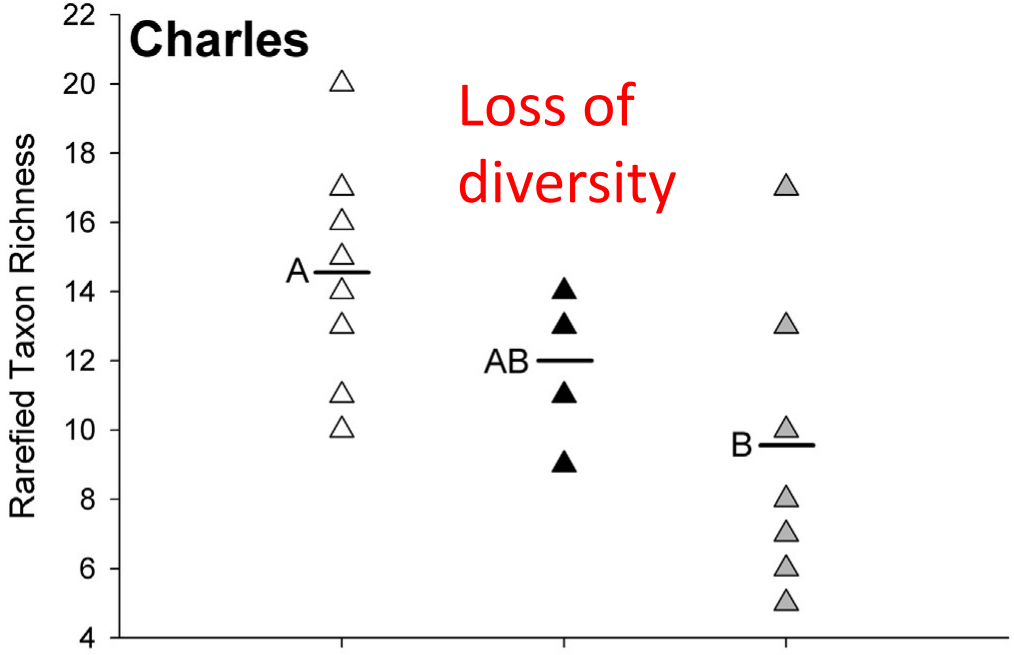


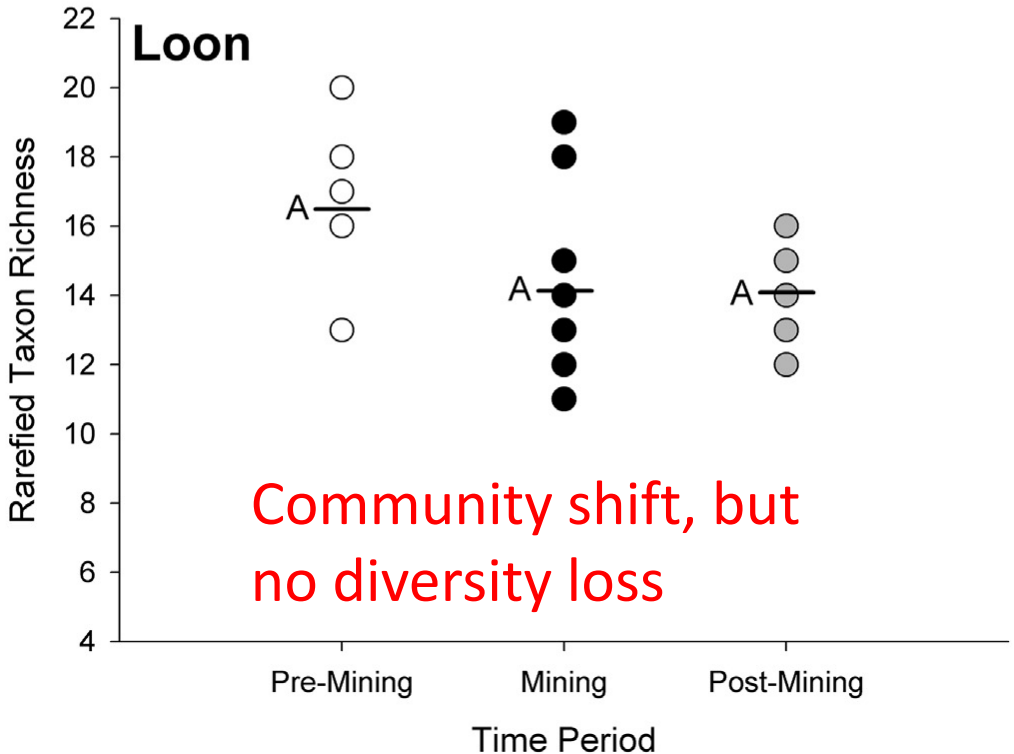
Mining and other env changes resulted in bioindicator shifts



Arsenic:
300X above CCME guidelines

Mercury:
Recovers to pre-mining levels





Recovery has not occurred despite mine closure ~80 years ago

Less diversity at impact lake

Urbanization and climate change alter recovery trajectory

Loss of deep-water O_2 a concern, further study ongoing

Mount Allison University

Saint Mary's University

Mitacs Accelerate