

CREATE ABATE – 2019 Year in Review

Graduated Students

Dallosch, Michael A. Optimal algorithms for deriving estimates of phytoplankton biomass in lakes from LANDSAT satellite imagery. MSc, Western University.

Dong, Habin (Rick). Early warning of global change effects on catchment nutrient exports. MSc, Western University.

Nelligan, Clare. Assessing long-term environmental trends in Ontario lakes that support Lake Trout. PhD, Queen's University.

Paltsev, Aleksey. The stability of temperate lakes under the changing climate. PhD, Western University.

Publications

1. Duda, M.P., Hargan K.E., Michelutti, N., Smol, J.P. (2019) Freshwater diatom assemblages from seabird-inhabited ponds in Hudson Strait, sub-Arctic Canada. *Polar Biology*. 42: 1549-1560.
2. Erratt, K.J., Creed, I.F., and Trick C.G. (2019). Differential utilization of ammonium, nitrate and urea by freshwater chlorophytes and cyanobacteria. *Journal of Phycology* (Manuscript ID: JPY-19-100-ART.R1).
3. Favot, E.J., Rühland, K.M., DeSellas, A.M., Ingram, R., Paterson, A.M., and Smol, J.P. (2019) Climate variability promotes unprecedented cyanobacterial blooms in a remote, oligotrophic Ontario lake: Evidence from paleolimnology. *Journal of Paleolimnology* 62: 31-52
4. Mehdizadeh Allaf, M., Trick, C.G., 2018. Multiple-stressor design-of-experiment (DOE) and one-factor-at-a-time (OFAT) observations defining *Heterosigma akashiwo* growth and cell permeability. *J. Appl Phycol.* 1-12. DOI: <https://doi.org/10.1007/s10811-019-01833-6>.
5. Nelligan, C., Jeziorski, A., Rühland, K. M., Paterson, Smol, J. P. 2019. A multi-basin comparison of historical water quality trends in Lake Manitou, Ontario – a provincially significant lake trout lake. *Lake and Reservoir Management*. DOI: 10.1080/10402381.2019.1659889.
6. Nelligan, C., Jeziorski, A., Rühland, K. M., Paterson, Smol, J. P. 2019. Long-term trends in hypolimnetic volumes and dissolved oxygen concentrations in Boreal Shield lakes of south-central Ontario, Canada. *Canadian Journal of Fisheries and Aquatic Sciences*. 76: 2315-2325.
7. Pilon, S., Zastepa, A, Taranu, Z.E., Gregory-Eaves, I., Racine, M., Blais, J.M., Poulain, A., Pick F.R. (2019). Contrasting histories of microcystin-producing cyanobacteria in two

temperate lakes as inferred from quantitative sediment DNA analyses. *Lake Reserv. Manage.* 35: 102-117. **(nominated for Labounty Best Paper Award of journal for 2018-2019).**

8. Sivarajah, B., Korosi, J.B., Blais, J.M., and Smol, J.P. (2019) Multiple environmental variables influence diatom assemblages across an arsenic gradient in 33 subarctic lakes near abandoned gold mines. *Hydrobiologia* 841:133-151.
9. Taranu, ZE, Frances R. Pick, Irena F. Creed, Arthur Zastepa and Sue B. Watson. (2019). Meteorological and nutrient conditions influence microcystin congeners in freshwaters. *Toxins* 2019, 11, 620; doi:10.3390/toxins11110620.
10. Yeung C.Y. A., A. Paltsev, A. Daigle, P. N. Duinker, I. F. Creed (2018) Atmospheric change as a driver of change in the Canadian boreal zone. *Environmental Reviews*. doi: org/10.1139/er-2018-0055

Publications – submitted, in revision, or in preparation

1. Duda, M.P., Glew, J.R., Michelutti, N., Robertson, G.J., Montevecchi, W.A., Kissinger, J., Eickmeyer, D.C., Blais, J.M., Smol, J.P. Long-term changes in terrestrial vegetation driven by shifts in a colonial seabird population. (Submitted 14-Oct 2019; 27 pages). *Ecosystems* (ID: ECO-19-0345).
2. Duda, M.P., Robertson, G.J., Lim, J.E., Kissinger, J., Eickmeyer, D.C., Grooms, C., Kimpe, L.E., Montevecchi, W.A., Michelutti, N., Blais, J.M., Smol, J.P. (Revisions submitted 24-Sept 2019; 24 pages). Striking centennial-scale changes in the population size of a threatened seabird. *Proceedings of the Royal Society: Biological Sciences* (ID: RSPB-2019-2234).
3. Racine, M., Saleem, A., Pick, F.R. 2019. Metabolome variation between strains of *Microcystis aeruginosa* by untargeted mass spectrometry. *Toxins*. in revision.
4. Simmatis B, Baud A, Francus P, Gregory-Eaves I, Smol JP (submitted) Using subfossil Simuliidae to track past river flow into an industrially-contaminated lake.
5. Simmatis B, Nelligan C, Rühland K, Jeziorski A, Paterson AM, Smol JP (submitted) Tracking ~200 years of water quality in Muskrat Lake, a eutrophic lake trout lake in Ontario (Canada) with algal blooms.
6. Sivarajah, B., Cheney, C., Perrett, M., Kimpe, L.E., Blais, J.M., and Smol, J.P. (In Revision) Regional gold mining activities and recent climate warming alter diatom assemblages in deep sub-Arctic lakes. (Submitted to *Polar Biology*, August 2, 2019; POBI-D-19-00200)
7. Valleau, R.E, Paterson, A.M. (in prep). Effects of road salt on long-term changes in Cladocera assemblages from shallow Precambrian Shield lakes in south-central, Ontario, Canada.

Reports

1. Sivarajah, B., Simmatis B., Smol, J.P. (2019) Using paleolimnology to provide a long-term environmental context to recent algal blooms in Jackfish Lake, Yellowknife, Northwest Territories. Report to Northwest Territories Power Corporation, 14pp.

Presentations

1. Dodsworth, W.P., Pick, F.R. (2019) Temporal trends in cyanobacteria in Central Ontario lakes through paleo-DNA analyses. Canadian Conference For Fisheries Research (CCFFR) & Society for Canadian Limnologists (SCL). 72nd Annual Meeting. Jan 3-6, 2019 London, Ontario. (poster)
2. Duda, M.P., Robertson, G.J., Lim, J.E., Kissinger, J., Eickmeyer, D., Montevecchi, W.A., Kimpe, L.E., Michelutti, N., Blais, J.M., and Smol, J.P. (2019). Millennial-scale dynamics of a threatened seabird reveal striking population changes. Presented at the Ontario-Quebec Paleolimnology Symposium (PALS); University of Waterloo, Waterloo, Ontario; May 1-3.
3. Duda, M.P., Michelutti, N., and Smol, J.P. (2019) Seabirds alter the environment via the introduction of nutrients and metals. Presented at the Interdisciplinary Freshwater Harmful Algal Blooms Workshop (IFHAB); Toronto, Ontario; April 24-26.
4. Duda, M.P., Robertson, G.J., Blais, J.M., Kimpe, L.E., and Smol, J.P. (2019) A novel approach to conservation biology: Using paleolimnology to reconstruct the long-term population trends of a vulnerable seabird. Presented at the Association for the Sciences of Limnology and Oceanography (ASLO); San Juan, Puerto Rico; February 23-March 2.
5. Erratt, K.J.*, Creed, I.F., and Trick, C.G. (2019). Danger lurks in warm, murky water: microcystin production modulated by temperature and browning. Third Interdisciplinary Freshwater Harmful Algal Blooms Workshop, Toronto, Ontario, Apr 24 - 26 2019 (oral presentation).
6. Erratt, K.J., Creed, I.F., and Trick, C.G *. (2019). Contemporary urea-based agricultural fertilizers are the preferred nitrogen source for cyanobacteria in freshwaters. Association for the Sciences of Limnology and Oceanography, San Juan, Puerto Rico, Feb 23 - Mar 2 2019 (oral presentation).
7. Erratt, K.J.*, Creed, I.F., and Trick, C.G. (2019). Do cyanobacteria like it hot and dirty: The synergetic effect of increased temperature and browning on cellular performance and toxicity. Association for the Sciences of Limnology and Oceanography, San Juan, Puerto Rico, Feb 23 - Mar 2 2019 (oral presentation).
8. Favot, E.J., Rühland, K.M., Paterson, A.M., and Smol, J.P. (2019) Diatom and chironomid assemblage shifts over several centuries and their relation to recent cyanobacterial blooms in Callander Bay, Lake Nipissing, Ontario. 39th North American Lake Management Symposium. International conference (Burlington, VT), oral presentation.

9. Favot, E.J., Rühland, K.M., Paterson, A.M., and Smol, J.P. (2019) Using sedimentary diatom and chironomid assemblages to determine the environmental triggers for recent cyanobacterial blooms in Callander Bay, Lake Nipissing, Ontario. 10th US HAB Symposium. National conference (Orange Beach, AL), oral presentation.
10. Favot, E.J., Hadley, K.R., Michelutti, N., Paterson, A.M., Watson, S.B., Zastepa, A., Hutchinson, N.J., Vinebrooke R.D., and Smol, J.P. (2019) Inferring historical changes in cyanobacterial production from lake sediments using Visible Near-infrared Reflectance Spectroscopy (VNIRS). Interdisciplinary Freshwater Harmful Algal Blooms Workshop. International conference (Toronto, ON), oral presentation.
11. Favot, E.J. (2019) Historical context for recent cyanobacterial blooms in minimally impacted Ontario Lakes. Mount Allison University (Sackville, NB), visiting scholar lecture.
12. Favot, E.J. and Smol, J.P. (2019) Paleolimnology. IGnite: Inspiring Generations through Research. Arthur B. McDonald Canadian Astroparticle Physics Research Institute and Queen's University. Kingston Ontario, oral presentation.
13. Favot, E.J., Hadley, K.R., Michelutti, N., Paterson, A.M., and Smol, J.P. (2019) Estimating historical changes in cyanobacterial production from lake sediments using Visible Near-infrared Reflectance Spectroscopy (VNIRS). Canadian Conference for Fisheries Research and Society for Canadian Limnology Joint Meeting. National conference (London, ON), oral presentation.
14. Favot, E.J. (2019) Current research at the Paleoecological Environmental Assessment and Research Lab (PEARL). Beaty Water Research Forum. Regional conference (Kingston, ON), poster presentation.
15. Jeziorski, A., Corrigan, A., Nelligan, C., Paterson, A.M., and Smol, J.P. Using chironomid sedimentary assemblages to infer long-term changes in the deepwater oxygen conditions of Peninsula Lake, ON. (Presented at the 12th Ontario-Québec Paleolimnology Symposium; University of Waterloo, Waterloo, Ontario; May 2, 2019).
16. Libera N, Kurek J, Smol JP. Is the mink fur farming industry causing eutrophication of Nova Scotian lakes? Preliminary results from a multi-proxy paleolimnological study. (Poster presented at the 3rd Interdisciplinary Freshwater Harmful Algal Blooms (IFHAB) Workshop; Toronto, Ontario; April 25, 2019 and the 12th Ontario-Quebec Paleolimnological Symposium (PALS); Waterloo, Ontario; May 2, 2019).
17. Libera N, Kurek J, Smol JP. Using paleolimnology to assess whether nutrient enrichment from Nova Scotia mink farms are affecting eutrophication patterns of local lakes. (Oral presentation at the 39th North American Lake Management Symposium (NALMS); Burlington, Vermont, USA, November 13 2019).
18. MacKeigan, P., B. Beisner, D. Walsh, R. Garner, F. Pick, I. Gregory-Eaves (2019). Cyanobacteria Community Composition: Comparative Analyses using Microscopy and

Metabarcoding. 3rd Interdisciplinary Freshwater Algal Blooms Workshop (IFHAB). U. of Toronto, Toronto, Ontario. April 24-25, 2019 (oral).

19. Mejbél, H.S., Pick, F.R. (2019) Validating the use of sedimentary DNA as a proxy for cyanobacterial dynamics in lakes. Paleolimnological Symposium (PALS annual meeting). U. of Waterloo, Waterloo, Ontario. May 1-3, 2019 (poster)
20. Mejbél, H.S., Pick, F.R. (2019) Analyzing sedimentary DNA as a proxy for cyanobacterial dynamics. 3rd Interdisciplinary Freshwater Algal Blooms Workshop (IFHAB). U. of Toronto, Toronto, Ontario. April 24-25, 2019. (poster)
21. Nelligan, C., Jeziorski, A., Rühland, K.M., Paterson, A.M., and Smol, J.P. Lake Trout (*Salvelinus namaycush*) habitat trends in south-central Ontario lakes: Insights from ~40 years of end-of-summer hypolimnetic oxygen data. (Presented at the 2019 joint meeting of the Canadian Conference for Fisheries Research and the Society of Canadian Limnology; Western University, London, Ontario; January 5, 2019).
22. Pick, FR (2019). Toxic algae - a growing threat to Canadians. Invited talk to parliamentarians as part of Bacon & Eggheads series hosted by the Partnership Group for Science and Engineering. Ottawa, Ontario. March 21, 2019. (oral).
23. Sivarajah, B., Perrett, M., Stewart, E.M., Korosi, J.B., Cheney, C.L., Thienpont, J.R., Kimpe, L.E., Blais, J.M., and Smol, J.P. Examining the long-term algal responses to metal contamination within the context of multiple environmental stressors: case studies of lakes around Yellowknife, NT. (Oral presentation at the joint 2019 Canadian Conference for Fisheries Research (CCFFR) and Society of Canadian Limnologists (SCL) annual conference, London, Ontario; January 5, 2019).
24. Sivarajah, B., Perrett, M., Stewart, E.M., Korosi, J.B., Cheney, C.L., Thienpont, J.R., Kimpe, L.E., Blais, J.M., and Smol, J.P. Using landscape paleolimnological techniques to examine the effects of gold mining activities, land-use changes, and climate warming in lakes near Yellowknife, Northwest Territories. (Oral presentation at the 7th annual Queen's Northern Research Symposium; Queen's University, Kingston, Ontario; April 17, 2019).
25. Sivarajah, B., Perrett, M., Stewart, E.M., Korosi, J.B., Cheney, C.L., Thienpont, J.R., Kimpe, L.E., Blais, J.M., and Smol, J.P. A diatom-based regional assessment of lakes near Yellowknife, NT to track the long-term algal responses to local land-use and climatic changes. (Oral presentation at the 12th Ontario- Québec Paleolimnology Symposium; University of Waterloo, Waterloo, Ontario; May 2, 2019)
26. Sivarajah, B., Perrett M., Korosi J.B., Thienpont J.R., Blais J.M., and Smol J.P. Diatom assemblages track the impacts of gold mining and land-use changes in climatically sensitive sub-Arctic lakes around Yellowknife, Northwest Territories, Canada (Oral Presentation at The Micropaleontological Society (TMS) Annual Conference; British Geological Survey, Nottingham, United Kingdom; November 14, 2019)

27. Taranu, Z, Heathcote, A., Pick F.R (2019) Identifying major producers of microcystin across multiple lakes using paleo-records. 3rd Interdisciplinary Freshwater Algal Blooms Workshop (IFHAB). U. of Toronto, Toronto, Ontario. April 24-25, 2019 (oral).
28. Valleau, R.E., Grecco, D., McClymont, A. Getting Salty about Road Salt. (Presented at IGnite Science event; Kingston, Ontario; January 31, 2019)
29. Valleau, R.E., Paterson, A.M., Smol, J.P. Keeping our lakes 'fresh': Effects of road salt application on sedimentary Cladocera assemblages in shallow softwater lakes in the Muskoka River Watershed, Ontario. (Presented at Interdisciplinary Freshwater Harmful Algal Blooms; Toronto, Ontario; April 25, 2019).
30. Valleau, R.E., Paterson, A.M., Smol, J.P. Sedimentary cladoceran assemblages and zooplankton communities of shallow lakes in south-central Ontario (Canada): Relationships to road salt runoff and other measured environmental variables. (Presented at the 39th North American Lake Management Society (NALMS) International Symposium; Burlington, Vermont; November 13, 2019).
31. Valleau, R.E., Celis-Salgado, M.P., Arnott, S.E., Paterson, A.M., Smol J.P. Assessing the impact of chloride from road salt on the survival and reproduction of two littoral Cladocera species (*E. longispina* and *C. brevilabris*). (Presented at the SETAC North America 40th Annual Meeting; Toronto, Ontario; November 3, 2019).
32. Wittmaier, K. (2019). Watershed Management in Ontario under different contexts and circumstances: a case study approach. i. Eagle Lake Conservation Association Workshop on Blue-Green Algae, South River, Canada (paper presentation)
33. Wittmaier, K. (2019). Watershed Management in Ontario under different contexts and circumstances: a case study approach. CAGONT 2019, Guelph, Canada (paper presentation).
34. Wittmaier, K. (2019). How applicable is the Lake Simcoe watershed planning framework within other contexts in Ontario? A case study approach. IFHAB, Toronto, Canada (paper presentation)

Internship Highlights

Will Dodsworth, University of Ottawa:

Internship with Environment and Climate Change Canada – One month internship with Andrew Paterson at Dorset Environmental Center – where I was taught the basics of sample collection for paleolimnological research (coring, lake chemistry, sample collection, grab samples, etc.)

Hebah Mejbil, University of Ottawa:

Internship at McGill University (May-June 2018). I didn't really have a position title, but me and two other McGill students were involved in developing the methods in sub-sectioning freeze-cores in a lab setting. Four ELA cores (L227, L223, L224, L442), were sub-sectioned over the course of 10 days in a sterile cold room. Because the cores were frozen, we developed a system

where one person was in charge of using the rotary tool to cut the core, one person had to split the core piece into different vials (since we were sharing the cores between labs), and one person had to record everything (mass, interval level, etc) in an Excel file. We had to work extremely fast as the core was melting while we were cutting it!

Field Schools

Uganda (5 to 28 May, 2019)

Eight ABATE students and postdocs traveled to Uganda for three weeks in May to learn about the ways that humans are challenging the planet in ways that place some of the most vulnerable people at risk. The field school started in Kampala, Uganda's capital and largest city. Students then traveled to Fort Portal and Kibale National Park, which is home to the world's largest biomass of primates per unit area. This is where three community engagement projects took place. Next, students visited the African Great Lakes and ended their time in the city of Jinja on the shores of Lake Victoria, near the source of the Nile River.

Some highlights from ABATE students:

Branaavan Sivarajah: The field school in Uganda was an incredible opportunity to learn about the African Great Lakes! Specifically, our trip to the National Fisheries Resource Research Institute in Jinja was an informative learning experience.

Kevin Erratt: Highlights included venturing onto Lake Victoria and learning about the evolution of the fishery and current threats. Also, contributing to the design and implementation of the Miranga Community Well Project, providing clean water to more than 3000 people.

Queen's University and University of Ottawa (12 to 16 August, 2019)

A total of 17 ABATE graduate students participated in the final CREATE ABATE field school, which took place at Queen's University and the University of Ottawa in August 2019. The first part of this course took place at Queen's and provided a general introduction to paleolimnology, such as bioindicators, zoological proxies, and the use of chironomids to reconstruct oxygen in deep water environments. This was followed by discussions of isotope analysis and carbon concentrations in paleolimnology. The final section at Queen's examined the management of cyanobacterial blooms, and societal, policy, and management concerns. Students then traveled to Ottawa for the second half of the course, which consisted of lectures and labs on both coccoid and filamentous cyanobacteria taxonomy. While in Ottawa, the students also went on a tour of the Canadian Museum of Nature for a tour led by guest lecturer Dr. Paul Hamilton.

Some highlights from ABATE students:

Branaavan Sivarajah: This field school was a good opportunity to learn about how paleolimnology can be used to track past changes in algal production (& blooms). The session

with Dr. Pick provided an excellent first-hand experience on cyanobacterial species identification.

Will Dodsworth: I participated in the UOttawa half of [the field course]. The highlights were definitely the microscopy portion - the sharing of expertise from fellow students in an area that was really not a strength of mine. The second highlight was the trip to the Museum of Nature research division and archived warehouse. The amount of samples, research and expertise all located in one building was staggering. A definite highlight of my degree was seeing the collections, and a special thanks to Dr. Paul Hamilton who acted as tour guide for the day. It was fantastic to see all the collections and research being put in!

Hebah Mejbal: In regards to the Queen's/uOttawa field school, one of my highlights at Queen's was the tour we had of the Isotope Lab in the Department of Geology. I've never seen anything like the machines in those labs, and it was incredibly fascinating learning how they work. At uOttawa, while I already work on cyanobacteria, I still had trouble identifying certain taxa under the microscope--the lectures and labs given during this portion of the field course helped me gain valuable skills in identifying coccoidal and filamentous species. I also really enjoyed the field trip we had to the Canadian Museum of Nature.

Kyle Wittmaier: The intersect between policy and science, hearing from professors/professionals and being in the room with students who are experts on both sides generated interesting and necessary discussion about how to make science and policy work together as well as possible. Hearing Dr. John Smol speak about paleolimnology was fascinating given my extremely limited understanding of the concept before attending the field school.

And some notes from an ABATE instructor:

Dr. Frances Pick: The workshop in August allowed students to get hands on experience in identifying cyanobacteria in cultures and in environmental samples including blooms. Use of microscope and imaging software using phase contrast oil immersion etc. Dr. Paul Hamilton, an expert in algal taxonomy from the Canadian Museum of Nature, gave a presentation on systematics in the Chroococcales and in particular *Microcystis* species. A highlight for students was the behind the scenes, in depth tour of the Research Division of the Canadian Museum of Nature in Aylmer, Quebec. Five scientists involved in research and curatorial work on a range of taxa gave individual talks on methods and current challenges (plants, insects, as well as paleontology).

Other media, coverage, and outreach:

From Dr. Frances Pick:

My talk in March 2019 on Toxic algae for parliamentarians was highlighted in the SCL [Society of Canadian Limnologists] newsletter and made its way on the Twitter feed of a few MPs. Was a huge honour to be invited. I explained how our CREATE grant provided interdisciplinary research and applied experiences, as well as community outreach opportunities, in order to provide students with the tools to manage the growing problem of algal blooms.

In terms of media, and outreach. I received a request from the National Capital Commission to examine samples from Harrington Lake for blooms early summer 2019. This is the summer residence of the Prime Minister, and there was some immediacy to the request because of visiting dignitaries.

Radio Canada recently interviewed and filmed me regarding the effects of climate change on water, particularly drinking water. Algal toxins are a particular threat for some water supplies across Canada, and this was explained with reference to the Toledo incident on Lake Erie. (Not sure when this is coming out as it is part of a longer expose.)