UNIVERSITY OF OTTAWA DECEMBER 2019

The Record

The 2019 newsletter for the Blais lab; Issue 3

Highlights of 2019

Tracing past human occupation by the Dorset, Thule, and Norse in Canada's High Arctic, seabird population history in Hudson Strait, optimizing decontamination for firefighters, collaborations in China, and wrapping up our experiment to simulate an oil spill at the IISD-Experimental Lakes Area.

June 2019: Our Arctic field team in Pond Inlet making our way to Resolute Bay for two weeks of Arctic field work. From left, David, Mija, Madison, Jules, and Jennifer. Photo: David Eickmeyer

FIELD SITES

High Arctic ponds; Hudson Strait; IISD Experimental Lakes Area; Alberta oilsands

RESEARCH VIGNETTES

Sustainable harvesting of eiders; firefighter decontamination; collaborations in China

MISCELLANEOUS

Conference highlights; helicopter underwater evacuation training;

Eider population histories

Sediments show evidence of eider over-harvesting

Arctic Archeology

New approaches to studying ancient Arctic peoples

Chemicals in firefighters

Finding ways to reduce their exposures

Who we are in 2019:

Jules Blais, Professor

Linda Kimpe, Lab Manager

David Eickmeyer, Lab Analyst

Jose Rodriguez-Gil Postdoctoral Fellow,

Leslie Saunders Postdoctoral Fellow,

Braden Gregory Postdoctoral Fellow,

Philippe Thomas, PhD Candidate

Lauren Gallant, PhD Candidate

Mija Azdajic, PhD Candidate

Cynthia Cheney, PhD Candidate

Jennifer Keir, PhD Candidate

Sawyer Stoyanovich, PhD Candidate

Madison Bell, PhD Candidate

Jennifer Kissinger, PhD Candidate

Jonathan Seguin, MSc Candidate

Kirsten Smythe, MSc Candidate

Alexandre Salat, MSc Candidate

Leah Cundall, MSc Candidate

Claudia Tanamal, MSc Candidate

New developments in tracking historical seabird populations

Kathryn Hargan showed evidence of 20th Century over-harvesting of eiders in the Hudson Strait by analyzing chemical tracers in lake sediment cores. This research shows promising new approaches for conservation biology and wildlife management*.

One of the main challenges in wildlife conservation biology is to understand what factors affect vulnerable populations. Often, wildlife population surveys are limited and only extend back a few decades at most, challenging our ability to understand what factors affect populations over time. These problems are most pronounced in remote areas like the Arctic, where wildlife monitoring is limited. For example, the population of the common eider, a seaduck long sought by Inuit for its meat and down, once numbered in the millions in the Eastern Canadian Arctic-Greenland region, but reports by northerners and some wildlife surveys suggested substantial reductions by the late 20th Century. Although hunting pressures were suspected to be the cause of the population declines, scientists have been trying to better understand factors affecting these populations to estimate how much hunting in a season is sustainable.

A new study published by our group in *Proceedings of the National Academy of Sciences* (April 2019) showed that eider populations likely succumbed to hunting pressures in the mid-20th Century. The researchers used a novel method to track how nesting bird populations changed over time, even before population census data were collected. Our method involved taking lake sediment cores from the bottom of small lakes and ponds in Canada's Eastern Arctic in the main breeding range where the common eiders nest.

Over time, sediments slowly accumulate at the bottom of lakes, archiving a detailed history of biological and chemical changes in those lakes, much like tree rings reveal historical information. When birds colonize a new area, they begin to fertilize the local environment, changing the nutrient levels in the water. In recent years, we have been discovering new and more sensitive ways to detect how birds alter the environment where they nest, allowing more detailed historical interpretations of how and when bird populations increased or collapsed.
By examining a range of chemical compounds recorded in pond sediments, including sterols, stanols, and nitrogen isotopes, we found evidence that common eider populations in Hudson Strait

Kathryn Hargan with a sediment core from a pond near Hudson Strait where eiders nest. These samples showed evidence of eider population collapse in the early 20th Century, likely due to hunting pressures.

near Cape Dorset, Nunavut, declined in the mid to late 20th Century, during a period of intense hunting pressure by Greenlanders and the relocation of nearby Inuit communities.

We also looked for evidence of population decline at more remote eider nesting sites with lower hunting pressure, and found that indicators of eider populations remained stable in places where hunting pressure was low or absent. The eider population decline near Cape Dorset coincided with increased sales in firearms and motorized boats in Greenland in the mid 20th Century, indicating eider harvest at this time was unsustainable.

"Our study shows that hunting restrictions were necessary to prevent the collapse of the eiders in their core breeding area", explained lead author Dr. Kathryn Hargan, a W. Garfield Weston postdoctoral fellow and a L'Oréal-UNESCO postdoctoral fellow at the University of Ottawa where the study was completed.

This study was a partnership between indigenous, academic, and government partners. Other participating organizations in the study were Environment and Climate Change Canada, Carleton University, Acadia University, and Queen's University.

*With excerpts from a uOttawa press release dated April 1, 2019.

Reference:

Hargan KE, Gilchrist HG, Clyde N, Iverson S, Forbes M, Kimpe LE, Mallory M, Michelutti N, Smol JP, Blais JM. 2019. Multi-century perspective assessing the sustainability of the historical harvest of seaducks. *Proceedings of the National Academy of Science* 116 (17) 8425-8430. https://www.pnas.org/content/early/2019/03/26/1814057116

Media on this story:

Phys.org, April 2, 2019: https://phys.org/news/2019-04-how-much-hunting-is-too.html

The Wildlife Society, April 12, 2019: https://wildlife.org/lake-core-samples-reveal-impact-of-overhunting-on-seaducks/

La Presse: June 16, 2019: https://www.lapresse.ca/actualites/sciences/201906/16/01-5230364-comment-le-grand-nord-sadapte-au-rechauffement-climatique.php

Optimizing decontamination procedures for firefighters

Can new information on firefighter exposures to harmful contaminants improve decontamination procedures and reduce risk?

Firefighters experience increased risk of cancers and other serious illnesses. One factor of this increased risk may be due to firefighters' exposures to toxic compounds found in smoke. Jennifer Keir's previous work found significant exposures to polycyclic aromatic hydrocarbons (PAHs), a group of compounds formed during combustion and some of which are mutagenic and carcinogenic. A lack of change in a lung injury biomarker after fire suppression suggested that respiratory exposure may not be the main route of exposure. A link between concentrations of PAHs on skin and metabolites in urine further suggested that skin may be a major route of exposure for firefighters. Our objective now is to investigate possible ways to reduce such exposures.

Using skin cleaning wipes after a fire has become a popular choice in the fire service in an attempt to remove contaminants and reduce exposure to toxic chemicals firefighters are exposed to during fire suppression. Although a valiant effort, no research has been done to suggest that this is an effective method to reduce exposure. Thus, with funding from the Canadian Forces Fire Marshall, International Association of Fire Fighters, Ottawa Professional Fire Fighters Association, Association des Pompiers de Montréal, Institut de Protection Contre les Incendies du Québec, and in-kind funding from the Ottawa Fire Services (OFS), our lab is conducting an intervention study to assess the ability of post-fire dermal cleaning procedures to reduce internal dose of PAHs.

November 2019: Cynthia Cheney, Lauren Gallant, Jen Keir, Mija Azdajic, Kirsten Smythe. Tatiana Kozbenko; Photo: Vic Dillibaugh

November 2019: Jen collecting a skin wipe sample from one of the participants. Photo: Vic Dillibaugh

Samples of air, wipes of skin, and urine were collected before, during, and/or after OFS live fire training. In collaboration with Dr. Rocio Aranda-Rodriguez from Health Canada, silicone wristbands worn during the live fire training were also collected as a side project investigating the use of these passive samplers as tools for exposure studies. 88 sets of samples were collected, including over 800 wipes and 350 urine samples divided into 880 separate analyses for urine alone.

Samples are currently being analyzed and the project is estimated to be finished by December 2020. With the volume of samples being collected, a lot of help was required. Jennifer is very grateful for all of her lab mates and students for their help in the wind, rain, and sometimes, snow!

Media on this story:

CBC Montreal, June 26, 2019:

Firefighter study mentioned on CBC Montreal – interview with Chris Ross, VP Firefighter's Association of Montreal:

CBC Montreal (CBMT)

HELICOPTER UNDERWATER EVACUATION TRAINING

As part of our preparations for the GreenLAnd Circumnavigation Expedition (GLACE), we were requested by the Swiss Polar Institute to take Helicopter Underwater Evacuation Training (HUET). Our GLACE team traveled to Dartmouth Nova Scotia in April 2019 for training with 'Rely on Nutec', a company specializing in maritime safety training. We participated in a morning of classroom instruction, followed by an afternoon in the pool working with the HUET simulator that would submerge us into water and flip us upside down so we could practice underwater evacuation techniques.

April 2019: From left, Jennifer, Linda, Madison, David, and Jules in Dartmouth Nova Scotia with the helicopter simulator in background, about to be submerged and flipped upside down as part of their survival training. Photo: Madison Bell

In 2019, we wrapped up our experiment on the effects of oil spills in lakes

The BOREAL Project is successfully wrapped up following our major 2018 experiment.

Our major experiment on the effects of oil spills at the IISD Experimental Lakes Area was successfully wrapped up in 2019. The "Boreal Oil Release Experiment by Additions to Limnocorrals (or BOREAL) project consisted of adding diluted bitumen (dilbit) to a series of large enclosures to simulate a pipeline spill to lake water. These enclosures can be described as large test tubes submerged in a lake, with a floating collar 10 meters in diameter, and a plastic curtain extending to the bottom of the lake to enclose a volume of lake water within. To complete this experiment, we worked with a team of researchers from several universities and government organizations. We examined the physical and chemical properties of the diluted bitumen, as well as its effects on the ecosystem, from bacteria to fish, in the 80 days following an experimental dilbit spill, to assess the impacts of diluted bitumen on lakes in a major experiment.

In 2019, our activities consisted mainly of decommissioning the experiment and bringing the lake back to its former state. A professional oil spill response organization was contracted to oversee the clean up of the oil. This company, along with the assistance of Environment and Climate Change Canada and members of the BOREAL team, removed visible sunken oil from the footprint of the enclosures. Rakes, nets, and

August 2019: Our field team performing site clean-up at Lake 260 of the IISD Experimental Lakes Area in northwestern Ontario following our simulated oil spill experiment that was completed the previous summer. Photo: Sawyer Stoyanovich

a venturi pump system were used to collect and recover the sunken oil. The collected oil was disposed as solid oily waste. After removal of all visible sunken oil from the enclosure footprints, sandbags were removed.

This experiment adds to a growing literature of studies to address the impacts of oil spills.

Media on this story:

Globe and Mail: July 30, 2019:

https://www.theglobeandmail.com/canada/article-slick-science-how-researchers-are-preparing-for-canadas-next-major/

Canadian Geographic, June 17, 2019:

https://www.canadiangeographic.ca/article/why-we-spilled-oil-science

Can lake sediments be used to trace the occupation of ancient Arctic peoples?

We are applying our lake sediment studies to find new ways to track human occupation in the Canadian Arctic.

The Thule were nomadic whalers who arrived in the Canadian Arctic about 800-1,000 years ago. Their legacy lives on in the form of their descendants, the Inuit, who have occupied these lands ever since. The Thule survived by hunting bowhead whales using technology they brought with them from what is now Siberia. With no trees to use for wood, they framed their houses with the bones of the whales they hunted, particularly Bowhead whale. The architecture of the houses was symbolic and honoured the whales they hunted, with the entrance and corridor representative of the whale's mouth and neck, the den made largely of the ribcage representative of the body, and an oil fire made from blubber symbolizing the beating heart. These houses and their impact on the environment are still visible today, leaving a lasting legacy of the people who once called the Arctic their home.

Our research into the Thule occupation of the Arctic continued in 2019 with an expedition to the Polar Continental Shelf Program (PCSP) base near Resolute Bay, followed by trips to Somerset Island and Devon Island. Our objective was to collect sediment cores from ponds adjacent to Thule camps and villages in order to see if we can find traces of Thule occupation recorded in pond sediments. This year, we focused on using our methods to identify new potential markers to reveal human occupation, including sterile collection and sectioning techniques inspired by methods used in forensic investigations to sample sediment cores for ancient sediment DNA, sedaDNA. We are also applying our newly developed methods in un-targeted 'sedimentomics' analysis of lake sediments to identify new potential markers of human occupation in these remote environments. The Arctic is an ideal environment to trace Thule occupation and look for new biomarkers because of sparse human habitation throughout its history, and a climate that favours organic preservation in sediments.

Media on this story:

CBC Quirks and Quarks, September 6, 2019:

July 2019. Our field team sitting at a partially restored Thule whale bone house near Resolute Bay on Cornwallis Island. From left, David, Jules, Madison, Jennifer, and Mija. Photo: Mija Azdajic

Tracing sources of agricultural pollution using sterol biomarkers in lake sediments

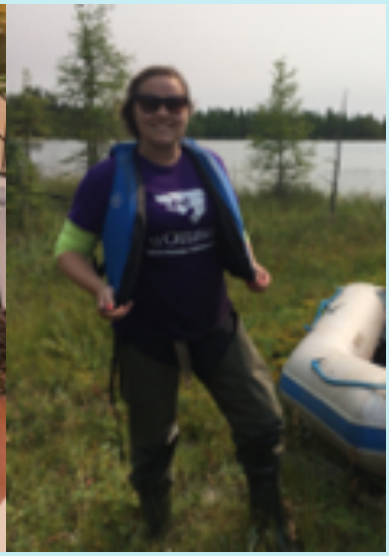
We are expanding our 'forensic toolkit' to track the effects of mink farms on lakes in Nova Scotia.

Mink farming is a big enterprise in Nova Scotia, raising over $125 million annually in the province. Despite the clear economic benefits that mink farms bring to the region, they are also at the centre of controversy because of their suspected impacts on water quality. Mink farms started appearing in the region after the 1950s and more prominently in the 1970s and 1980s. Until amendments were made to the Fur Industry Act in 2013, regulations did not exist to address the management of waste from the mink farms, some of which were directly situated next to lakes. Ongoing public debates between mink farmers, local residents, and public regulators are polarizing in rural communities as the economic benefits of mink farms are being weighed against their environmental costs. Many residents blame mink farms for frequent algal blooms, bad odours, illnesses in pets and livestock, and risks to human health as a result of agricultural runoff from the mink farms.

Our lab is undertaking a 4-year strategic assessment of water quality near mink farms, focusing on lake sediment records as a means to assess whether changes to water quality can be directly attributed to mink farms. Jennifer Kissinger is investigating how sterols may be applied to determine inputs from mink farms into lakes in dated sediment records and exploring how a multi-proxy approach can be integrated into a 'forensic toolkit' to aid regulatory decision making. Preliminary results show elevated δ15N and sterols rising coeval during the presence of mink farms at sites affected by mink farms. Additionally, Braden Gregory, a new postdoc in our lab will work with Madison Bell to examine new sediment biomarkers using non-targeted screening methods, as well as bioaccumulating contaminants like mercury, polychlorinated biphenyls, and other persistent organic pollutants, which may be enriched in lakes adjacent to mink farms. This work will complement projects by Acadia University focusing on gulls as biovectors between the mink farms and nearby breeding areas, and our long standing collaboration with Queen's University who will be looking at the effects of mink farms on algal assemblages in lakes.

Our field team representing three Canadian universities doing field work on a soggy day in Nova Scotia, with the Bay of Fundy in the background. Photo: Jennifer Kissinger

OUR TRADITION OF BRINGING HOME 'BEST STUDENT PRESENTATION' AWARDS CONTINUED IN 2019.

Cynthia Cheney received the Laurentian SETAC 'Best Student Presentation Award' in March, and then the 'Best Presentation by a Doctoral Student' at the Paleolimnology Society (PALS) meeting at St. Catherine's in April. Jennifer Keir won the 'Best Oral Presentation Award' for the NSERC-CREATE REACT symposium in Edmonton in July. Kirsten Smythe received 'Second Best Student Presentation Award' at the Laurentian SETAC AGM meeting in Ottawa in June. Congratulations to all three of you, and thanks for making us proud!

JENNIFER KEIR AND JONATHAN BRUYERE ARE MARRIED!

Congratulations to Jen and Joe for tying the knot in August! We all extend our best wishes to the happy couple.

International collaborations:

DEVELOPING OUR COLLABORATIONS IN CHINA.

Members of our group travelled to China in June to work on an international project funded by the Chinese government to reconstruct past migratory bird populations from lake sediment cores collected on the Tibetan Plateau in Qinghai Province. Our trip took us from Kunming and Hefei in the south, to northern cities like Xi'an and Beijing.

Jennifer and Linda posing for photos at the request of Kunming residents. Westerners are a novelty in many parts of China! Photo: Jules Blais

A tea tasting after seeing the famous Terra Cotta Warriors near Xi'an, China. From left, our former postdoc Wenhan Cheng, Jules, Linda, Jennifer, and student. Photo: Jules Blais

THE GREENLAND CIRCUMPOLAR EXPEDITION (GLACE) IS ON HOLD.

Our planned expedition to circumnavigate Greenland in August and September of 2019 is on hold. This expedition is still on the books, but will not take place before 2021 due to unforeseen circumstances. The expedition is funded by the Swiss Polar Institute, who informed us in June that permitting with the Danish government was the major reason for this delay. The expedition organizers are currently exploring more options, including finding a new vessel for the journey.

Feb 2019. Project leads for GLACE met in Lausanne Switzerland to plan the expedition and coordinate on the 15 research projects. Photo courtesy of the Swiss Polar Institute.

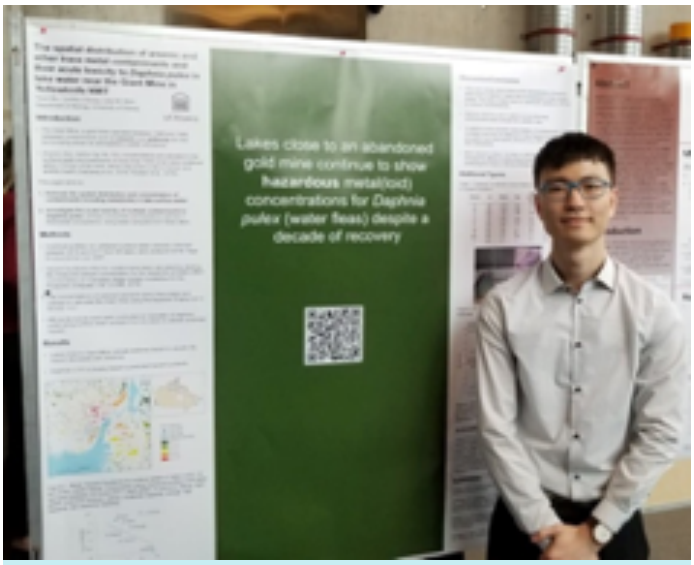
Reconstructing the past to inform the future

Our work on gold mines near Yellowknife is continuing to reveal a legacy of environmental contamination from past mining practices.

The Giant Mine and Con Mine produced gold and prosperity for the Northwest Territories for many decades, but have also left many environmental concerns in their wake. Giant Mine's operation released 20,000 tonnes of arsenic trioxide onto the landscape near Yellowknife between 1949 and 2004. This legacy of environmental contamination from natural resource extraction has been much explored in recent years as concerns about food security, and contaminant exposure have continued to rise. Our studies are being used by the Government of the Northwest Territories to inform residents about precautions to take in areas of elevated exposure risk. Both Mija Azdajic and Cynthia Cheney continue their research exploring the fate and behaviour of mercury and arsenic, and the toxicity of lake sediments in the region. They are using lake sediment cores to trace a history of contamination dating back to the mines' early days when they began their operations. They have been presenting their findings at scientific conferences, including this year's SETAC Europe's Annual Meeting in Helsinki, Finland, and the SETAC North America conference in Toronto.

Claudia Tanamal successfully defended her thesis in 2019, where she explored the transfer of arsenic into freshwater food webs near Yellowknife. Her findings add to the growing body of evidence that arsenic does not transfer effectively into fish tissues, a significant finding for northern residents who rely on fish as country foods. Her work contributed to her appointment to the prestigious United Nations World Health Organization Internship Programme in Geneva this past spring.

Yulun Wu is an undergraduate Honours student who is studying the toxicity of surface water concentrations to small crustacea (called Daphnia) as part of his thesis research. He combined classical toxicity results with advanced global information systems spatial modelling to determine the size of the area around the mines affected by past emissions of arsenic to the region. This research will help regulators assess the past and future extent of environmental contamination from the gold mines.



May 2019: Yulun Wu presenting his findings at the University of Ottawa Undergraduate Research Day. Photo: Cynthia Cheney

Tracking the contaminant history of *in-situ* oil sands activity in the Cold Lake region

Our studies are showing that bitumen extraction near Cold Lake is associated with lower regional contamination than the open pit mines further north.

In-situ oil sands operations is the dominant method of bitumen extraction in Canada, overtaking open pit mining ever since 2012. We have been working on a project in collaboration with Alberta Environment and Parks to identify the environmental contamination attributed to in-situ oil sands activities by providing analyses of environmental contaminants within the Cold Lake oil sands deposit. The Cold Lake oil sands this region operates using exclusively *in-situ* thermal extraction techniques and is ~150 km upwind of all refineries, upgraders, tailings ponds and, open-pit operations making it the ideal location to conduct a study on the effect of *in-situ* thermal extraction of bitumen.

Specifically, Kirsten Smythe is examining polycyclic aromatic compound (PAC) profiles in dated sediment cores from 11 lakes throughout the Cold Lake oil field to track how contaminants have changed over time since oil sands activity began in the region in 1985. She is focusing on alkylated PACs, because they derive primarily from petroleum bitumen, and other petroleum biomarkers like steranes, hopanes, and terpanes, to evaluate *in-situ* operations as potential contamination sources. Like open-pit regions, alkylated PACs in Cold Lake sediments are elevated compared to unsubstituted parent PACs. These concentrations are higher in lakes densely surrounded by in-situ extraction areas; however, overall, we observe no consistent increase in PAC enrichment following the start of in-situ development in the region. Diagnostic ratios indicate that the dominant origins of PACs in the area are pyrogenic, suggesting that in-situ operations are a potential source of PAC contamination to lakes densely surrounded by *in-situ* activity. Our results are showing that in-situ operations near Cold Lake are not associated with the kinds of environmental contamination typically associated with the open pit mining, upgrading, and refining that is seen in northern Alberta near Fort MacMurray.

Well pads near Cold Lake where bitumen is extracted form the ground using *in-situ cyclic* steam stimulation. Photo: Kirsten Smythe

Movember 'staches

November 2019: Showing solidarity for men's health. From left, Jonathan, Sawyer, Tatiana, David, Jennifer, and Raphael. Photo: Linda Kimpe

Safety training

May 2019: Spending a Saturday afternoon to learn firearms safety for Arctic field work at the Stittsville Shooting Range. From left, Alexandre, Lauren, Mija, Madison, and Jennifer. Photo: Linda Kimpe

Arctic field work

July 2019: David Eickmeyer and Jennifer Kissinger removing a sediment core from PaJs-3 South pond on Somerset Island, near an ancient Thule settlement. Photo: Jules Blais

July 2019: Our Arctic field team on Tern Island in Nunavut with terns flying overhead. Photo: Jules Blais

Publications in 2019:

Stoyanovich S, Yang Z, Hanson M, Hollebone BP, Orihel DM, Palace V, Rodriguez-Gil JR, Faragher R, Mirnaghi FS, Shah K, Blais JM. 2019. Simulating spills of diluted bitumen: Environmental weathering and submergence in model freshwater system. *Environmental Toxicology and Chemistry* 38: 2621-2628. https://doi.org/10.1002/etc.4600

Sarma S, Kimpe LE, Doyon V, Blais JM, Chan HM. 2019. A metabolomics study on effects of polyaromatic compounds in oil sand extracts on the respiratory, hepatic, and nervous systems using three human cell lines. *Environmental Research* 178: 108680. https://doi.org/10.1016/j.envres.2019.108680

Gutierrez-Villagomez JM, Matyniuk CJ, Xing L, Langlois V, Pauli BD, Blais JM, Trudeau VL. 2019. Transcriptome Analysis Reveals that Naphthenic Acids Perturb Gene Networks Related to Metabolic Processes, Membrane Integrity, and Gut Function in *Silurana* (Xenopus) *Tropicalis* Embryos. *Frontiers in Marine Science* 6: Article 533; https://doi.org/10.3389/fmars.2019.00533

Wang L, Chen G, Liu Y, Li R, Kong L, Huang L, Wang J, Kimpe LE, Blais JM. 2019. Environmental legacy and catchment erosion modulate sediment records of trace metals in alpine lakes of southwest China. *Environmental Pollution*, accepted August 21, 2019 (ENVPOL_2019_2438_R1)

Saleem A, Bell M, Kimpe LE, Korosi JB, Arnason JT, Blais JM. 2019. Identifying novel treeline biomarkers in lake sediments using an untargeted screening approach. *Science of the Total Environment* 694: 133684. https://doi.org/10.1016/j.scitotenv.2019.133684

Sivarajah B, Korosi JB, Blais JM, Smol JP. 2019. Multiple environmental variables influence diatom assemblages across an arsenic gradient in 33 subarctic lakes near abandoned gold mines. *Hydrobiologia*, 841: 133-151. https://doi.org/10.1007/s10750-019-04014-1

Bell M, Blais JM. 2019. "-Omics" workflow for paleolimnological and geological archives: A review. *Science of the Total Environment* 672: 438-455. https://doi.org/10.1016/j.scitotenv.2019.03.477

Thienpont JR, Perreault JT, Korosi JB, Pisaric MFJ, Blais JM. 2019. Have natural lake expansion and landscape inundation resulted in mercury increases in flooded lakes of the Great Slave Lowlands (Northwest Territories, Canada)? *Journal of Paleolimnology* 61: 345-354. https://doi.org/10.1007/s10933-018-0063-7

Hargan KE, Gilchrist HG, Clyde N, Iverson S, Forbes M, Kimpe LE, Mallory M, Michelutti N, Smol JP, Blais JM. 2019. Multi-century perspective assessing the sustainability of the historical harvest of seaducks. *Proceedings of the National Academy of Science* 116 (17) 8425-8430. https://www.pnas.org/content/early/2019/03/26/1814057116

Coleman KA, Palmer MJ, Korosi JB, Thienpont JR, Blais JM, Smol JP. 2019. Assessing long-term changes in aquatic ecosystems near a small conventional oil and gas operation in the Cameron Hills, southern Northwest Territories, Canada. *Fundamental and Applied Limnology* 192: 181-197 https://doi.org/10.1127/fal/2019/1191

Pilon S, Zastepa A, Taranu Z, Gregory-Eaves I, Racine M, Blais JM, Poulain A, Pick FR. 2019. Contrasting histories of microcystin-producing cyanobacteria in two temperate lakes as inferred from quantitative sediment DNA analyses. *Lake and Reservoir Management* 35 : 102-117; https://doi.org/10.1080/10402381.2018.1549625

Bilodeau JC, Gutierrez Villagomez JM, Kimpe LE, Thomas PJ, Pauli BD, Trudeau VL, Blais JM. 2019. Toxicokinetics and bioaccumulation of polycyclic aromatic compounds in wood frog tadpoles (*Lithobates sylvaticus*) exposed to Athabasca oil sands sediment. *Aquatic Toxicology,* 207: 217-225 https://doi.org/10.1016/j.aquatox.2018.11.006

Schuh CE, Jamieson HE, Palmer MJ, Martin AJ, Blais JM. 2019. Controls governing the spatial distribution of sediment arsenic concentrations and solid-phase speciation in a lake impacted by legacy mining pollution. *Science of the Total Environment* 654: 563-575. https://doi.org/10.1016/j.scitotenv.2018.11.065

Stewart EM, Michelutti N, Vu M, Hargan K, Grooms C, Kimpe LE, Blais JM, Smol JP. 2019. Pond sediments on nesting islands in eastern Lake Ontario provide insights into the population dynamics and impacts of waterbird colonies, *Journal of Great Lakes Research* 45: 350-359. https://doi.org/10.1016/j.jglr.2019.01.009

Kang W, Chen G, Wang J, Huang L, Li R, Hu Y, Tao J, Blais JM, Smol JP. 2019. Assessing the impact of long-term changes in climate and atmospheric deposition on a shallow alpine lake from southeast Tibet. *Science of the Total Environment,* 650: 713-724. https://doi.org/10.1016/j.scitotenv.2018.09.066

Mundy LJ, Bilodeau JC, Schock DM, Thomas PJ, Blais JM, Pauli BD. 2019. Utilizing wood frog (*Lithobates sylvaticus*) tadpoles and semipermeable membrane devices to monitor polycyclic aromatic compounds in boreal wetlands in the oil sands region of northern Alberta, Canada. *Chemosphere,* 214: 148-157. https://doi.org/10.1016/j.chemosphere.2018.09.034

Conference presentations in 2019:

Rodríguez-Gil JL, Cundall L, Hanson M, Hollebone B, Orihel D, Palace V, Ahad JM, Blais JM. Tracking the fate and biodegradation of oil-derived carbon in simulated oil spills in lake limnocorrals. Presented at the SETAC North America 40th Annual Meeting in Toronto ON, November 3-7, 2019.

Keir JLA, Akhtar U, Matschke DM, White PA, Kirkham T, Chan HM, Blais JM. Firefighters' exposures to polycyclic aromatic hydrocarbons and other environmental mutagens during emergency fire suppression. Platform presentation at the SETAC North America 40th Annual Meeting in Toronto ON, November 3-7, 2019.

Smythe K, Cooke C, Drevnick P, Thienpont J, Korosi J, Cornett RJ, Blais JM. Polycyclic Aromatic Compound (PAC) Characterization within In-Situ Oil Sands Operations, Cold Lake, Alberta, Canada. Platform presentation at the SETAC North America 40th Annual Meeting in Toronto ON, November 3-7, 2019.

Stoyanovich S, Rodriguez-Gil JL, Hanson M, Hollebone B, Orihel D, Palace V, Faragher R, Mirnaghi F, Shah K, Yang Z, Blais JM. Petroleum hydrocarbons in the water column and

sediments following experimental additions of diluted bitumen to freshwater limnocorrals. Poster presentation at the SETAC North America 40th Annual Meeting in Toronto ON, November 3-7, 2019

Gallant LR, Kimpe LE, Blais JM. A Multi-proxy approach to tracking human occupation in the High Arctic. Poster presentation at the SETAC North America 40th Annual Meeting in Toronto ON, November 3-7, 2019.

Seguin JY, Mason J, Hanson M, Hollebone BP, Orihel DM, Palace VP, Rodriguez-Gil JL, Blais JM. Bioaccumulating compounds in freshwater giant floater mussels exposed to a simulated diluted bitumen spill. Poster presentation at the SETAC North America 40th Annual Meeting in Toronto ON, November 3-7, 2019.

Rodriguez-Gil JL, Stoyanovich S, Hanson M, Hollebone BP, Orihel DM, Palace V, Blais JM. Simulating diluted bitumen spills: Environmental weathering and submergence in model freshwater systems. Poster presented at the 46th Canadian Ecotoxicity Workshop, Québec, QC, Oct. 6-9, 2019.

Bell MA, Saleem A, Kimpe L, Korosi J, Arnason J, and Blais J. Sedimentomics: A systematic paleolimnological biomarker discovery method. Presented at the American Geophysical Union Conference in San Francisco, CA, December 9-13, 2019.

Smythe K, Cooke C, Drevnick P, Thienpont J, Korosi J, Cornett RJ , Blais JM. Source Determination of Polycyclic Aromatic Compounds for *In-Situ* Oil Sands Operations in Cold Lake, Alberta. Platform presentation for the Laurentian Chapter of the Society of Environmental Toxicology and Chemistry 24th Annual General Meeting & Conference (LSETAC AGM), Ottawa, ON, Canada. June 6-7, 2019 (This presentation was awarded second place in the student platform competition).

Rodríguez-Gil JL, Hanson M, Hollebone B, Orihel D, Palace V, Blais JM. The BOREAL Project: Study design and objectives of a simulated addition of diluted bitumen into limnocorrals in an outdoor aquatic environment. Presented at the 42nd AMOP Technical Seminar on Environmental Contamination and Response in Halifax NS, June 4-6, 2019.

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Cheney CL, Pothier MP, Poulain AJ, Thienpont JR, Korosi JB, Kimpe LE, Blais JM. Paleoecotoxicology: The application of novel tools to assess the toxicity of historically contaminated lake sediments. Presented to the Laurentian Chapter of the Society of Environmental Toxicology and Chemistry (SETAC) Student Pub Night; Ottawa, Ontario; March 28th, 2019. (This presentation received the Best Student Oral Presentation Award by the SETAC Laurentian committee).

Bell M, Saleem S, Korosi J, Kimpe L, Arnason J, Blais JM. Sedimentomics: What is it? And how can it be applied to the Canadian Arctic treeline? Ottawa-Carleton Student Northern Research Symposium 2019 at Carleton University, Ottawa, ON, March 15th, 2019.

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